Equalization Transfers, Fiscal Decentralization, and Economic Growth*

Hikaru Ogawa†
School of Economics, Nagoya University.

Sayaka Yakita
School of Economics, Nagoya University.

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Abstract

This paper analyses the fiscal decentralization and equalization transfers in a two-region model of endogenous growth. In our model, two levels of government with different objectives are considered; the local governments maximize the utility of the residents of the region; and the central government makes the equalization transfers to close the gaps in fiscal capacity among the regions and pays attention to the economic growth rate. Our first result demonstrates that the preferred tax rate chosen by the local government is positively affected by the magnitude of fiscal decentralization. The second result shows that the fiscal equalization policies of the central government have no influence on the speed of interregional growth-convergence. Furthermore, the normative implication is obtained from our final results that there exists an optimal degree of fiscal decentralization to reach the central government's goal of growth maximization, but the magnitude of fiscal decentralization chosen by the central government is excessive to entail the highest regional welfare.

Key words: Equalization Transfers, Fiscal Decentralization, Economic Growth, Convergence

JEL Classification: E6, H5, H7, R5

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†Correspondence to: Hikaru Ogawa, School of Economics, Nagoya University, Furocho Chikusaku, Nagoya 464-8601, Japan, Tel.:+81-52-789-2379, Fax:+81-52-789-4924, email: ogawa@soec.nagoya-u.ac.jp.

1 Introduction

A series of empirical studies have sought to examine the relationship between fiscal decentralization and economic growth. On the one hand, the initial contributions derive the zero or negative relationship between the fiscal decentralization and economic growth [Davoodi and Zou (1998), Zhang and Zou (1998), Woller and Phillips (1998), and Xie et al. (1999)]. On the other hand, recent studies derive a positive relationship between the decentralization and economic growth and underscore the significance of decentralization from the macroeconomic perspectives [Lin and Liu (2000), Akai and Sakata (2002), Thieβen (2003), Stansel (2005), and Iimi (2005)]. It would be fair to say at this moment that a direct relationship between fiscal decentralization and economic growth remains an open question. However, it might be also true, as summarized in Thieβen (2003), that there exists an optimal degree of fiscal decentralization to maximize economic growth[1]: The growth-decentralization relationship is positive when fiscal decentralization is increasing from low levels, but then reaches a peak and turns negative[2].

Although intense empirical investigations have been conducted, an adequate theoretical explanation of growth-decentralization relationship is still wanting. This is quite strange since it is often the case that the changes in fiscal structure affect economic growth. The lack of an intensive effort to present a formal theoretical model has apparently undermined the validity of the empirical work. The main purpose of this paper is to supplement the existing works and to develop a simple multi-region model of endogenous growth. By this complementary study, we analyze the characteristics of the growth-decentralization relationship and demonstrate a theoretically optimal degree of fiscal decentralization for growth-maximization.

Two studies so far provide a theoretical model that can explain the existence of an optimal degree of fiscal decentralization. Davoodi and Zou (1998)

[1] Using the 1973-1998 data of cross-countries, Thieβen (2003) analyses the long-run empirical relationship between economic growth and the fiscal decentralization for the high-income OECD countries.

[2] A recent paper of Akai et al. (2007) reveals a hump-shaped relationship between fiscal decentralization and economic growth.

and Xie et al. (1999) extend the canonical growth model of Barro (1990) to consider three tiers of government system and derive the growth-maximizing budget shares of each level of government. Although they do not derive the optimal magnitude of fiscal decentralization, three recent papers develop models to illustrate the impact of fiscal decentralization on the long-run economic growth. Madies and Ventelou (2005) study the effects of tax base sharing on the growth path when two tiers of government both seek to maximize the net tax revenues. They clarify the effects that play critical roles in discussing whether decentralization or centralization maximizes the growth rate. In a very recent paper, Brueckner (2006) presents the OLG model with endogenous growth to show that the decentralization, which allows public goods levels to be tailored to suit the preferences of a heterogeneous population, increases the incentive to save, the investment in human capital, and thereby assures faster economic growth. Nishimura (2006) presents a bureaucrat model with endogenous growth to show that there is a critical degree of complementarity between regions below which fiscal decentralization is more desirable than the centralization for the economic growth.

The present study is also concerned with the direct relationship between fiscal decentralization and economic growth. Specifically, our attention is focused on the derivation and the examination of properties of the optimal degree of fiscal decentralization. Our focus, however, differs in some aspects from the previous studies cited above. First, Madies and Ventelou (2005), Brueckner (2006), and Nishimura (2006) only consider the case of full decentralization/centralization. Our paper provides a much stronger result in the sense that it allows both full and partial decentralization. Second, we establish the equalization transfer system in the two-region model of endogenous growth. The regional human or public capital, which is accumulated through public involvement, is often considered as the growth engine, and the interregional differentials in the fiscal condition make for a difference in economic growth between regions. In such a case, there is concern that the equalization transfer made by the central government has accelerated the growth convergence among the regions and affected the long-run economic growth rate. All studies cited above ignored the

equalization transfers, which has one of the most important roles in the modern public sector. The aim of this paper is thus to incorporate a fiscal equalization transfer into the model in developing a simple two-region model of endogenous growth to demonstrate a theoretically optimal degree of fiscal decentralization for growth-maximization. We further examine how the system of equalization transfer affects the speed of convergence and the long-run economic growth.

To perform our analysis, we use the model of de la Croix and Monfort (2000), where the speed of convergence and the economic growth properties are examined under an alternative system for education funding[3]. In our model, two levels of government with different objectives are assumed; the local governments maximize the utility of the residents in the region; and the central government makes the equalization transfers to close the gaps in fiscal capacity among the regions and pays attention to the economic growth rate. Under this setup, our first finding demonstrates that the preferred tax rate chosen by the local government is positively affected by the magnitude of fiscal decentralization. The second result shows that the fiscal equalization policies conducted by the central government have no influence on the speed of interregional growth-convergence. Furthermore, the normative implication is obtained from our final results that there exists an optimal degree of fiscal decentralization to reach the central government's goal, but the magnitude of fiscal decentralization set by the growth-maximizing central government is excess to give the highest regional welfare.

The paper is organized as follows. Section 2 presents the model, and Section 3 is devoted to examining the speed of convergence and the long-run economic growth rate. The limitations and extensions of the model are discussed in the final section.

[3]de la Croix and Monfort (2000) consider three systems for education funding (decentralization, centralization and privatization) to compare the performance in terms of growth and the speed of convergence. They conclude that while the different funding system results in a different speed of convergence, the equilibrium growth with central funding system shows no difference in the growth rate with the decentralized funding. The major difference of our paper with de la Croix and Monfort (2000) is that we consider equalization transfers and take the autonomy indicator, which represents the fiscal dependency on local governments to the central government, as the proxy of fiscal decentralization.

2 Model

The model is based on the model of regional funding for public education provided in de la Croix and Monfort (2000), modified to include interregional fiscal transfers made by the central government. Throughout this paper we use the two regions and the three-period overlapping-generations model. The subscripts $i(=1,2)$ and $t(=1,2,..)$ denote the region and the time period, respectively.

2.1 Production

There is only one good, which is produced in each region i at period t according to the constant-returns to scale production function $Y_{i,t} = F(K_{i,t}, L_{i,t})$, where $K_{i,t}$ and $L_{i,t}$ denote the capital and the effective labor, respectively. In the following analysis the production function is specified by the Cobb-Douglus technology as follows:

$$Y_{i,t} = K_{i,t}^{\alpha} L_{i,t}^{1-\alpha}, \qquad 0 < \alpha < 1. \tag{1}$$

Note that $L_{i,t}$, represents the quantity of regional human capital and is not the simple number of regional workers. In this paper, we assume the population in each region is immobile, constant over time, and is normalized to one, while the capital is completely mobile across the regions. Thus, denoting the per capita human capital in region i at period t as $h_{i,t}$, we have $L_{i,t} = h_{i,t}$.

Since we assume the constant returns to scale technology, we can replace $F(K_{i,t}, L_{i,t})$ function by the per effective-labor function $f(k_{i,t})$, where

$$k_{i,t} \equiv \frac{K_{i,t}}{L_{i,t}} = \frac{K_{i,t}}{h_{i,t}}. \tag{2}$$

Then, perfect competition in the factor markets ensures that in equilibrium the interest factor, R_t, and the wage income per worker, $w_{i,t}$, are equal to the respective marginal products, i.e.

$$R_t = \alpha k_{i,t}^{\alpha-1}, v \tag{3}$$

$$w_{i,t} = (1-\alpha) k_{i,t}^{\alpha}. \tag{4}$$

Since the capital is free to move, the regional capital-labor ratios are equalized across the regions, implying that the wages per unit of human capital are also equalized, $k_{i,t} = k_t$ and $w_{i,t} = w_t$ for all i.

2.2 Individuals

Each individual lives for exactly three periods (education, working, and retirement ages). In the first period, they are educated in the region of residence to accumulate human capital. They work in the second period and then retire for one period. The preferences of the representative individual living in region i in generation t are given by the utility function of the form

$$U_{i,t} = \ln c_{i,t} + \beta \ln d_{i,t+1} + \gamma \ln e_{i,t}, \tag{5}$$

where $c_{i,t}$ ($d_{i,t+1}$) is the consumption in the second (third) period of individuals' life at region i of a member of the generation born at period $t-1$, and $e_{i,t}$ is the level of public education service provided in region i at period t. The term $e_{i,t}$ is included in the basis of warm glow altruism that is often considered in the literature [Glomm and Ravikumar (1992) etc.]. Public education contributes to increase the human capital of the next-generation, as discussed later. In (5), β is the private discount factor and γ the utility weight of altruism factor representing the fact that parents have an ad-hoc taste for giving.

Since individuals are immobile, they consume, save and work at the location of their residence, in accord with the literature. The budget constraints of an individual born in period $t-1$ in region i are

$$c_{i,t} + s_{i,t} = w_{i,t} h_{i,t} (1 - \tau_{i,t}), \tag{6}$$

$$R_{t+1} s_{i,t} = d_{i,t+1}, \tag{7}$$

where $s_{i,t}$ is the saving and $\tau_{i,t}$ is the income tax rate. Human capital is accumulated according to the following function:

$$h_{i,t+1} = \psi e_{i,t}^{\theta} (h_{i,t} + \delta h_{j,t})^{1-\theta}, \quad \psi > 1, \quad 0 \leq \delta \leq 1. \tag{8}$$

In (8), it is assumed that the stock of human capital depends on the level of public education provided in region i and the two types of spill-over resulting from the intergenerational externalities. First, the individuals born in period t inherit part of the human capital of the region's adults, $h_{i,t}$. Second, regional human capital accumulation hinges on the adult's human capital stock of the other region, $h_{j,t}$. When $\delta = 0$, the stock of human capital in any one region depends only on the regional economic environments, $e_{i,t}$ and $h_{i,t}$. In this case, the model has no convergence forces. If δ is positive, the human capital stock in region i positively affects not only the human capital of the younger generation in i but in the other region j as well[4]; a low value of δ means that these cross-regional spillovers are small. The upper limit of $\delta = 1$ corresponds to complete or perfect spillovers, where a unit of human capital in region i spreads as much elsewhere as it does locally[5].

The optimization problem of the individual in region i at period t is to maximize (5) with respect to $c_{i,t}$, $s_{i,t}$ and $d_{i,t+1}$, subject to (6) and (7). Then, we have

$$c_{i,t} = \frac{w_{i,t}h_{i,t}(1-\tau_{i,t})}{1+\beta}, \tag{9}$$

$$s_{i,t} = \frac{\beta w_{i,t}h_{i,t}(1-\tau_{i,t})}{1+\beta}, \tag{10}$$

$$d_{i,t+1} = \frac{\beta R_{t+1}w_{i,t}h_{i,t}(1-\tau_{i,t})}{1+\beta}. \tag{11}$$

Using (9)-(11), we have the regional indirect utility function as follows:

$$V_{i,t} = (1+\beta)\ln\{w_{i,t}h_{i,t}(1-\tau_{i,t})\} + \gamma \ln e_{i,t} + const, \tag{12}$$

where $const \equiv -(1+\beta)\ln(1+\beta) + \beta \ln \beta R_{t+1}$.

[4]Though the residents are not mobile among the regions, δ carries out a function for interregional convergence and is tantamount to the degree of residential mobility in our model setting; a low value of δ stands for the low mobility and the high value of δ the high mobility.

[5]Note that we can easily define the alternative formula of human capital accumulation to capture the spillover effect. For instance, considering that public educations has some spillover effects as usually suggested by the empirical research, the human capital function can be defined as $h_{i,t+1} = \psi(e_{i,t} + \delta e_{j,t})^{\theta} h_{i,t}^{1-\theta}$. Even if we employ this formulation, the main result of this paper does not change, however.

2.3 Governments

In each region, there exists a single regional/local government. Local governments provide regional public education, $e_{i,t}$, which is mainly financed by income taxation[6]. Assuming that one unit of the private good can be transformed into a unit of the public education service, the local government budget constraint is given by

$$e_{i,t} = \tau_{i,t} w_{i,t} h_{i,t} + T_{i,t}, \tag{13}$$

where $T_{i,t}$ is the equalization transfers made by the central government. As discussed below in detail, the regions participate in an interregional fiscal transfer system that is conditioned on the region's economic characteristics. While government i receives grants when $T_{i,t} > 0$, it transfers the income to the other region when $T_{i,t} < 0$.

Much consensus was achieved with respect to basing the equalization transfers on fiscal capacity, but the appropriate measure of fiscal capacity is open to dispute[7]. One approach would be to take the regional *tax base* as a measure of fiscal capacity to be equalized. A second approach is to measure fiscal capacity by *tax revenues* that should be equalized. Though various formulations could be defined in describing the actual fiscal equalization schemes, in this paper, we take the second approach to derive clear-cut results and assume that the equalization transfer is made under the following formulation:

$$T_{i,t} = f(\bar{\tau}_t w_{i,t} h_{i,t} - \tau_{i,t} w_{i,t} h_{i,t}), \tag{14}$$

where $\bar{\tau}_t$ is the standard (target) income tax rate set by the central government. In (14), $\bar{\tau}_t w_{i,t} h_{i,t}$ represents the virtual tax revenue targeted by the central

[6]Taxation of corporate profits may be one of the main sources of public funds in the actual circumstances. However, we ignore it in our model, since by the linear homogeneity of production function in its factors and the familiar profit maximizing conditions, profits of the firms are zero. Taxation on mobile capital may also be the source of public funds. However, there is no incentive for local governments to tax on mobile capital in our model since it generates so-called *horizontal fiscal externality*.

[7]Boadway and Shah (2007) provide a comprehensive review of the conceptual and empirical literature of intergovernmental fiscal transfers. Especially, see chapter 1 of this book by Shah (2007) for a review of international practices. It suggests that there is no single set of equalization transfers that suits all circumstances, and that transfer systems are tailored to each case depending on the objective, initial conditions, and resource constraints.

government. That is, if the local government sets the standard income tax rate, it would raise the tax revenue of $\bar{\tau}_t w_{i,t} h_{i,t}$. The second term in (14) represents the actual tax revenues. Hence, if the actual tax revenue of region i is less (more) than the standard (targeted) tax revenue, local government i receives (transfers) the fiscal resources. f corresponds to the autonomy indicator used in Akai and Sakata (2002) that represents the fiscal dependency of local governments on the central government. We assume $0 \leq f \leq 1$, implying that the smaller f is, the more local governments finance their budgets by themselves. By contrast, the larger f is, the more they depend on the fiscal assistance of the central government. In this paper, we use f as the indicator of decentralization[8]. Specifically, $f = 0$ represents complete fiscal decentralization.

The national transfer system is a net equalization scheme. Transfers to one region are financed by negative transfers to another region. The budget constraint of the central government is thus given by

$$\sum_i T_{i,t} = 0. \tag{15}$$

As is always the case, assumptions on the governments' objectives must be chosen carefully. In the classic *The Theory of Public Finance*, Musgrave (1959) proposes three roles for the public sector, including (i) ensuring economic stability and growth, (ii) adjusting for undesired income distribution, and (iii) correcting for inefficient market results. It is natural to consider that the central government takes responsibility for (i) and (ii), and that the local governments play their roles for (iii) in the actual government activities. In this sense, governments in different tiers often have objectives that do not coincide in general. Following the argument of Musgrave, we have assumed in this paper that the central government makes equalization transfers to reallocate regional fiscal resources and seeks to maximize the rate of economic growth, while the local government maximizes the resident's utility. This setting gives a well description of the relationship between fiscal decentralization and economic growth that is the main focus of this paper[9].

[8]See Murakami (2005), who also uses the degree of financial dependency of the local government on the central government as decentralization indicator.

[9]We follow Ogawa and Omori (2003) in this approach to government objectives. The

3 Growth, Convergence, and Welfare

To derive the growth rate, the speed of convergence, and the welfare in the equilibrium, we first define the clearing conditions of the factor market. The equilibrium condition on the labor market is given by $L_{i,t} = h_{i,t}$, and the capital market is cleared by $\sum_i K_{i,t+1} = \sum_i s_{i,t}$. Note that the initial conditions $\{K_{i,o}, h_{i,o}\}$ are also given.

We now examine the optimal policy choice of the local governments. Formally, the local government maximizes the residents' utility represented by (12), subject to (14). The first-order condition of this maximization problem gives the income tax rate in region i as

$$\tau_{i,t} = \frac{\gamma(1-f) - (1+\beta)f\bar{\tau}_t}{(1-f)(1+\beta+\gamma)} \tag{16}$$

The budget balance condition of the central government, (15), requires that $\tau_{i,t} = \bar{\tau}_t$ holds in the equilibrium. Thus, the equilibrium tax rate on regional income is given by

$$\tau_{i,t} = \frac{\gamma(1-f)}{1+\beta+\gamma(1-f)}, \tag{17}$$

indicating that $d\tau_t/df < 0$. Summarizing this comparative static result, we obtain the following result.

Proposition 1. Fiscal decentralization induces the local government to raise the income tax rate.

Viewed from the opposite side, Proposition 1 states that a massive (larger f) equalization transfer system can thus create poor incentives for local governments to raise their own revenues and captures a disincentive effect of equaliza-

objective functions can be changed if the study is undertaken within the framework of the benevolent or Leviathan model. In the former framework, the central government may maximize the total welfare in the economy, and we may assume in the latter framework that the objectives of governments are maximization of tax revenue as in Madies and Ventelou (2005) and Rauscher (2005).

tion transfers that is most obvious in the actual public finance system in many countries. Under the equalization transfer system, the central government makes up for the difference between the standard tax revenue and the actual tax revenue. The local government perceives that if its actual tax revenue is smaller than the standard tax revenue, it would obtain additional fiscal revenues from the equalization scheme. This makes the local governments choose a lower tax rate when the equalization transfers are made.

The dynamics of this economy is now analyzed in terms of three variables: The capital-effective labor ratio, k_t, the ratio of worker's consumption in region 2 to that in region 1, $z_t = c_{2,t}/c_{1,t}$, and the growth factor in region i, $g_{i,t} = h_{i,t}/h_{i,t-1}$. Since $k_{i,t} = k_t$ and $w_{i,t} = w_t$, from (3) and (4), and making use of (9) and (17), the interregional differential in private consumption is given by

$$z_t = \frac{c_{2,t}}{c_{1,t}} = \frac{w_t h_{2,t}(1-\tau_t)}{w_t h_{1,t}(1-\tau_t)} = \frac{h_{2,t}}{h_{1,t}}. \tag{18}$$

That is, the ratio of workers' consumption in region 2 to that in region 1 also measures the ratio of regional human capital. We substitute (4), (13), and (17) into (8) to obtain

$$\begin{aligned} h_{1,t+1} &= \psi e_{1,t}^{\theta}(h_{1,t} + \delta h_{2,t})^{1-\theta} = \psi \left[\frac{\gamma(1-f)w_t h_{1,t}}{1+\beta+\gamma(1-f)}\right]^{\theta} [h_{1,t}(1+\delta z_t)]^{1-\theta} \\ &= \psi \left[\frac{\gamma(1-f)(1-\alpha)k_t^{\alpha}}{1+\beta+\gamma(1-f)}\right]^{\theta} h_{1,t}(1+\delta z_t)^{1-\theta}, \qquad (19) \\ h_{2,t+1} &= \psi e_{2,t}^{\theta}(h_{2,t} + \delta h_{1,t})^{1-\theta} \\ &= \psi \left[\frac{\gamma(1-f)(1-\alpha)k_t^{\alpha}}{1+\beta+\gamma(1-f)}\right]^{\theta} h_{2,t}(1+\delta z_t^{-1})^{1-\theta}. \qquad (20) \end{aligned}$$

Using (19), (20) with (18), the index of interregional differential and its dynamics is obtained as

$$\begin{aligned} z_{t+1} &= \frac{h_{2,t+1}}{h_{1,t+1}} = \frac{\psi e_{2,t}^{\theta}(h_{2,t} + \delta h_{1,t})^{1-\theta}}{\psi e_{1,t}^{\theta}(h_{1,t} + \delta h_{2,t})^{1-\theta}} = \frac{h_{2,t}(1+\delta z_t^{-1})^{1-\theta}}{h_{1,t}(1+\delta z_t)^{1-\theta}} \\ &= z_t \left(\frac{1+\delta z_t^{-1}}{1+\delta z_t}\right)^{1-\theta}. \qquad (21) \end{aligned}$$

In addition, dividing both sides of (19) with respect to $h_{1,t}$, we have the growth factor in region 1 as

$$g_{1,t+1} = \frac{h_{1,t+1}}{h_{1,t}} = \psi \left[\frac{\gamma(1-f)(1-\alpha)k_t^{\alpha}}{1+\beta+\gamma(1-f)} \right]^{\theta} (1+\delta z_t)^{1-\theta}. \tag{22}$$

Similarly, from (20), we have the growth factor in region 2 as

$$g_{2,t+1} = \frac{h_{2,t+1}}{h_{2,t}} = \psi \left[\frac{\gamma(1-f)(1-\alpha)k_t^{\alpha}}{1+\beta+\gamma(1-f)} \right]^{\theta} (1+\delta z_t^{-1})^{1-\theta}. \tag{23}$$

To derive the capital-effective labor ratio, we divide the capital clearing condition, $K_{t+1} = s_{1,t} + s_{2,t}$, with $h_{1,t+1} + h_{2,t+1}$ to obtain

$$\begin{aligned} k_{t+1} &\equiv \frac{K_{t+1}}{h_{1,t+1} + h_{2,t+1}} \\ &= \frac{\beta(1-\alpha)}{1+\beta+\gamma(1-f)} \times \frac{k_t^{\alpha} h_{1,t}(1+z_t)}{h_{1,t+1} + h_{2,t+1}}. \end{aligned}$$

Substituting (19) into above equation, we have

$$k_{t+1} = \frac{\beta}{\psi[\gamma(1-f)]^{\theta}} \left[\frac{1-\alpha}{1+\beta+\gamma(1-f)} \right]^{1-\theta} \frac{(1+z_t)k_t^{\alpha(1-\theta)}}{(1+\delta z_t)^{1-\theta} + z_t(1+\delta z_t^{-1})^{1-\theta}}. \tag{24}$$

In the steady state we have $z = z_{t+1} = z_t$, and from (21), the interregional differential converges to $z = 1$. To derive the speed of convergence in our model, (21) is linearized around steady state $z = 1$ to give

$$\hat{z_{t+1}} = \lambda \hat{z}_t = \lambda^t \hat{z}_0, \tag{25}$$

where

$$\lambda \equiv \frac{1-\delta+2\theta\delta}{1+\delta} < 1.$$

To ensure the positive convergence speed, we define the speed of convergence as $v \equiv \lambda^{-1} - 1$. As λ is small, the speed of convergence becomes fast. The speed of convergence is formally approximated by

$$v = \frac{2(1-\theta)\delta}{1-\delta+2\theta\delta}. \tag{26}$$

From (26), we have our second result.

Proposition 2. The policy variables of central government, f and $\bar{\tau}_t$, have no effects on the speed of convergence, v.

Intuitively, we might assume that the equalization transfer made by the central government accelerates the interregional convergence. However, Proposition 2 shows that the equalization transfer system has no influence on the speed of convergence.

To explain why the equalization transfer system does not have an effect on the acceleration of convergence speed, let us define $h_{2,t}/h_{1,t} \equiv \phi > 1$ without loss of generality. To gain speed of convergence by closing the gap of human capital in period $t+1$, we must have $e_{2,t}/e_{1,t} < \phi$. That is, the speed of convergence will be accelerated when the central government induces governments to choose $e_{2,t}/e_{1,t} < h_{2,t}/h_{1,t}$. On the other hand, the convergence speed will be decelerated when $e_{2,t}/e_{1,t} > \phi$, and it will not change when $e_{2,t}/e_{1,t} = \phi$. In the equilibrium of our model, $k_{1,t} = k_{2,t}$, $\tau_{1t} = \tau_{2t}$ and $T_{i,t} = 0$. Hence, we have

$$\frac{e_{2,t}}{e_{1,t}} = \frac{\tau_{2,t} w_t h_{2,t} + T_{2t}}{\tau_{1,t} w_t h_{1,t} + T_{1t}} = \frac{h_{2,t}}{h_{1,t}} = \phi,$$

indicating that the speed of convergence does not change as the policy variables of central government change.

Now, we examine the behavior of a growth-maximizing central government. In the steady state, we have $z_{t+1} = z_t = 1$ and $k_{t+1} = k_t = k$. Substituting these equations into (24), the dynamics in k_t converges to

$$k = \left\{ \left[\frac{1-\alpha}{1+\beta+\gamma(1-f)} \right]^{1-\theta} \frac{\beta}{\psi[\gamma(1-f)]^{\theta}(1+\delta)^{1-\theta}} \right\}^{\frac{1}{1-\alpha(1-\theta)}}. \tag{27}$$

Then, the long-run economic growth rate, g, can be obtained as

$$g = \Gamma \left(\frac{1-\alpha}{1+\beta+\gamma(1-f)} \right)^{\frac{\theta}{1-\alpha(1-\theta)}} (1-f)^{\frac{\theta(1-\alpha)}{1-\alpha(1-\theta)}}, \tag{28}$$

where

$$\Gamma \equiv (\psi\gamma^{\theta})^{\frac{1-\alpha}{1-\alpha(1-\theta)}} \beta^{\frac{\alpha\theta}{1-\alpha(1-\theta)}} (1+\delta)^{\frac{(1-\theta)(1-\alpha)}{1-\alpha(1-\theta)}}.$$

As the objective of central government is to maximize the economic growth rate as has been already assumed, we take the first-order derivative of (28) with f to obtain

$$\text{Sign}\left[\frac{\partial g}{\partial f}\right] = \text{Sign}\left[\frac{\gamma}{1+\beta+\gamma(1-f)} - \frac{1-\alpha}{1-f}\right],$$

which gives the optimal degree of fiscal decentralization for growth maximization, f^*, as[10]

$$f^* = 1 - \frac{(1-\alpha)(1+\beta)}{\alpha\gamma}. \tag{29}$$

(29) leads us to obtain the following result.

Proposition 3. There exists an optimal degree of fiscal decentralization, given by (29). The promotion of decentralization enhances the economic growth if $f < f^*$, and it curbs the growth if $f \geq f^*$.

This result is straightforward extension of fairly standard results in simple endogenous growth models (see, e.g., Barro (1990)). Substituting (29) into (17), the local government is induced by the central government's choice of the magnitude of fiscal decentralization to set its tax rate at $\tau_{i,t} = 1 - \alpha$, indicating that the tax rate is chosen to be identical to the production share of the factor that is the source of economic growth.

A growth-maximizing central government chooses the level of fiscal decentralization at $f^* = 1 - (1-\alpha)(1+\beta)(\alpha\gamma)^{-1}$. However, this choice in fiscal decentralization must be inappropriate from the local welfare point of view, since the governments in different tiers have objectives that do not coincide. Our concern is now as to whether the central government's choice of the magnitude of fiscal decentralization is excessive or insufficient from the viewpoint of local welfare. To consider this problem, we derive the steady-state equilibrium level of regional utility as[11]

$$V = \ln c^* + \beta \ln d^* + \gamma \ln e^*$$

[10]The second-order condition is satisfied, $\partial^2 g/\partial f^2 < 0$.
[11]See Appendix.

$$= -\frac{[\alpha(1+\beta+\gamma)+\beta(\alpha-1)][(1-\theta)\ln[1+\beta+\gamma(1-f)]+\theta\ln(1-f)]}{1-\alpha(1-\theta)}$$
$$-(1+\beta+\gamma)\ln[1+\beta+\gamma(1-f)]+\gamma\ln(1-f)+t(1+\beta+\gamma)\ln g. \quad (30)$$

Differentiating (30) with f, we have

$$\frac{\partial V}{\partial f} = \frac{\alpha(1+\beta+\gamma)+\beta(\alpha-1)}{1-\alpha(1-\theta)}\left[\frac{\gamma(1-\theta)}{1+\beta+\gamma(1-f)}+\frac{\theta}{1-f}\right]$$
$$+\frac{(1+\beta+\gamma)\gamma}{1+\beta+\gamma(1-f)}-\frac{\gamma}{1-f}+t(1+\beta+\gamma)\frac{1}{g}\frac{\partial g}{\partial f} \quad (31)$$

The first and second term of the RHS in (31) are the welfare effects originating from the changes in consumption and education level. The third term represents the growth effect. Now, we evaluate (31) at $f = f^*$, so that $\partial g/\partial f = 0$. Then, we have

$$\text{Sign}\left[\frac{\partial V}{\partial f}|_{f=f^*}\right] = \text{Sign}\left[\frac{\alpha\gamma(1+\alpha\beta)}{(1-\alpha)(1+\beta)}\right] > 0. \quad (32)$$

(32) shows that if f increases marginally from f^*, it raises the regional welfare, implying that the degree of fiscal decentralization chosen by the central government, $f = f^*$, turns out to be excessive for the local welfare-maximization. Summarizing this result, we have the following:

Proposition 4. The degree of fiscal decentralization chosen by the growth-maximizing central government is excessive from the viewpoint of a welfare-maximizing local government.

This proposition also suggests that if the fiscal decentralization is substantially accomplished, i.e., $0 \leq f < f^*$, a decrease in f leads to a lower growth rate. At the same time, this decrease reduces the welfare level. Thus, in this case, the government can achieve both a higher growth rate and a higher level of welfare by promoting fiscal centralization. In contrast, the government faces a trade-off between growth rate and residents' welfare when the fiscal decentralization is inadequate, i.e., $f \geq f^*$. Fiscal decentralization increases the growth rate, but it reduces regional welfare.

Although it might be counterintuitive that the magnitude of decentralization determined by the central government is excessive from the viewpoint of a welfare-maximizing local government, there is an intuitive mechanism. Since the welfare-maximizing local government prefers to secure a source of revenue by receiving the transfer from other region, which enables to keep local tax at lower level, it prefers lower tax rate than the central government does. From Proposition 1, this is tantamount to that local governments prefer higher f than the central government does. This can be considered to be sort of addiction to equalization transfer system. This can be easily confirmed from (31) that preferred level of decentralization by the local government, f^{**}, can be obtained by

$$f^{**} = \frac{(\theta+\gamma+\theta\beta)(\alpha-\beta+2\alpha\beta+\alpha\gamma)+t\theta(\beta+\gamma+1)[\alpha\gamma-(1-\alpha)(1+\beta)]}{\gamma[1+\theta\alpha+\alpha\beta+\alpha\gamma+\theta\alpha\beta+t\theta\alpha(\beta+\gamma+1)]}, \tag{33}$$

which satisfies $f^* \leq f^{**}$. To shake local governments' addiction, the central government chooses lower level of f that stimulate local governments' incentive to raise the tax rate. The dissociation between f^* and f^{**} will be rolled back as time advances, however. This is because, from (33), we have

$$\frac{\partial f^{**}}{\partial t} = -\frac{\theta[(1-\alpha(1-\theta)](1+\beta)(\alpha\beta+1)(1+\beta+\gamma)}{\gamma(\theta\alpha+\alpha\beta+\alpha\gamma+t\theta\alpha+\theta\alpha\beta+t\theta\alpha\beta+t\theta\alpha\gamma+1)^2} < 0 \tag{34}$$

with $\lim_{t\to\infty} f^{**} = f^*$, indicating the deviance dissipates over time.

4 Conclusion

In this paper we have formulated a simple equalization transfer system in the framework of a two-region economy with endogenous growth. The model contains two levels of government with different objectives; the local governments maximize the utility of the residents of the region; and the central government makes the equalization transfers to close the gaps in fiscal capacity among regions and pays attention to the economic growth rate.

The first result obtained in this paper is that the preferred tax rate chosen by the local government is positively affected by the magnitude of fiscal de-

centralization. That is, fiscal decentralization induces the local government to raise the income tax rate. If we view this result from the opposite standpoint, it states that a massive equalization transfer system creates poor incentives for local governments to raise their own revenues, which captures the disincentive effects of equalization transfers that are most obvious in the actual public finance system of many countries. The second result shows that the fiscal equalization policies conducted by the central government have no influence on the speed of interregional growth-convergence. This result might be counterintuitive, since we might reason that the equalization transfer made by the central government speeds up the interregional convergence. Furthermore, the normative implication is obtained from our final results that there exists an optimal degree of fiscal decentralization to achieve central government's goal, but the choice of central government turns out to be over-decentralization from the viewpoint of regional welfare.

In one sense, the results are derived within the context of a model that is general in some respects, but of course it depends on other assumptions that are less general. For example, one could imagine an alternative equalization system: instead of tax revenue-based equalization system, we can formulate an equalization transfer system based on the tax base differentials among regions. Our approach is justified as the transfer system is conducted to correct the tax revenue differentials. In addition, to obtain the analytical solutions, the two regions are assumed to be symmetric except initial level of human capital. Introducing the regional asymmetry will not change the main result of this paper that there exists the optimal level of fiscal decentralization, but it may change the result on the effect of equalization transfers on the speed of convergence. Finally, the objective function of central and local government might be changed by incorporating the aspects of political economy and/or bureaucratic behavior.

We admit of remaining issues suggested above, but we believe that our analysis would at least succeed in presenting a basic model to show a growth-maximizing degree of fiscal decentralization. That is, the model shows that the growth-decentralization relationship is positive when fiscal decentralization is increasing from low levels, but then reaches a peak and turns negative within

the context of a multiple-region economy with an equalization transfer system. Exploration of the optimal fiscal decentralization is admittedly in its infancy and, in particular, there is a pressing need for further systematic empirical study of the characteristics of the optimal degree of fiscal decentralization.

Appendix

In this Appendix, we derive (30). The indirect utility at the steady state equilibrium can be given as

$$\begin{aligned} V &= \ln \frac{w^* h^* (1-\tau^*)}{1+\beta} + \beta \ln \frac{\beta R^* w^* h^* (1-\tau^*)}{1+\beta} + \gamma \ln \tau^* w^* h^* \\ &= (1+\beta+\gamma) \ln w^* + (1+\beta+\gamma) h^* + (1+\beta) \ln(1-\tau^*) \\ &\quad + \beta \ln R^* + \gamma \ln \tau^* - (1+\beta) \ln(1+\beta) + \beta \ln \beta \end{aligned}$$

The human capital level in the steady state equilibrium is now given by $h^* = h_0 g^t$. Using this equation with other steady state equilibrium values, we have

$$\begin{aligned} V &= [\alpha(1+\beta+\gamma) + \beta(\alpha-1)] \ln k + t(1+\beta+\gamma) \ln g \\ &\quad -(1+\beta+\gamma) \ln[1+\beta+\gamma(1-f)] + \gamma \ln(1-f) + const(1), \end{aligned} \tag{35}$$

where $const(1) \equiv \beta \ln \beta + (1+\beta+\gamma) \ln(1-\alpha) + (1+\beta+\gamma) \ln h_0 + \beta \ln \alpha + \gamma \ln \gamma$. Now steady state capital level is obtained as

$$\ln k = -\frac{(1-\theta) \ln[1+\beta+\gamma(1-f)]}{1-\alpha(1-\theta)} - \frac{\theta \ln(1-f)}{1-\alpha(1-\theta)} + const(2), \tag{36}$$

where

$$const(2) \equiv [1-\alpha(1-\theta)]^{-1} \left[(1-\theta) \ln(1-\alpha) + \ln \frac{\beta}{\psi \gamma^\theta (1+\delta)^{1-\theta}} \right].$$

Substituting (36) into (35), we have (30), in which the terms $const(1)$ and $const(2)$ are omitted.

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