Economics Bulletin

Volume 32, Issue 3

Regional allocation of public investment with transfer policy and agglomeration

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Abstract

This paper analyses the allocation of public investment across heterogeneous regions when the government can use a regional transfer policy and individuals can migrate across regions. The government should choose the same amount of public investment regardless of the taxation policy. The government should use taxation to concentrate individuals in the region in order to utilize scale economies. To control regional agglomeration, the government should use taxation, not the public investment.

I thank the anonymous referee, Hideaki Murase, Yukie Sakuragawa, Masaya Sakuragawa, Keiko Shimono, Hiroyuki Hashimoto, Masaya Yasuoka, Hideki Toya, Akira Yakita, Koichiro Sawano, and Ryo Itoh for their helpful comments.
Citation: Akiyoshi Furukawa, (2012) "Regional allocation of public investment with transfer policy and agglomeration", *Economics Bulletin*, Vol. 32 No. 3 pp. 1865-1872.
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Submitted: April 09, 2012. **Published:** July 04, 2012.

1. Introduction

Regional differences exist for a variety of reasons. For example, Fujita et al. (1999) have shown that economic agglomeration yields regional disparities. This paper presents the government's regional policy when these disparities are present.

To solve the problem of regional inequality, what policy should the government use? One effective instrument is public investment. However, public investment is not the only instrument. Taxation and transfer can also be used to solve that problem. For example, Martin (1999) has examined public policy that contains both public investment and transfer from the viewpoint of its effect on regional income distribution, growth and economic geography. In this paper, regional policy contains both public investment and transfer.

This paper analyses the allocation of public investment across heterogeneous regions when the government is free to use taxation and transfer policy. When taxation and transfer can be used to solve regional inequality, should the government change the allocation of public investment? Some studies have examined regional policy in terms of public investment and transfer. For example, Caminal (2004) showed that the government should allocate public investment efficiently in most cases when it can redistribute income through taxation. Although such studies have concluded that the government should use taxation and transfer to reduce regional inequality, they assume that individuals cannot migrate across regions. But, in regional economics and public economics, factor mobility is an important issue. In regional economics, the new economic geography (NEG) model analyses factor mobility and agglomeration economies. In public economics, factor mobility affects the analysis of tax competition and the efficiency of provision of public goods. Ihara (2008) showed that many studies have examined the effect of factor mobility on the regional policy of providing local public good. In recent years, the condition that individuals can migrate across regions is reasonable. As individuals are mobile, the regional policy that contains public investment and transfer should consider migration behaviour. This paper examines the optimal regional policy by using

a model in which regional differences exist because of scale economies, and individuals are allowed to migrate across regions without cost.

The remainder of the paper is as follows. Section 2 introduces the model. Section 3 analyses the government policy. Section 4 summarizes the results.

2. The model

The economy is composed of regions 1 and 2, with each region differing with respect to the production of consumption goods. Because of that production, one region has scale economies, while the other does not. I assume that region 1 has scale economies. In region 1, the consumption good Z is produced from intermediate goods. Each intermediate good is produced by labour and the public infrastructure. In region 2, the consumption good X is produced using labour and the public infrastructure.

The consumption good X is tradable across regions without cost, and I assume that it is produced only in region 2 from the public infrastructure and labour. The production function is as follows:

$$X = G_2^{\beta} L_{dm}$$

where G_2 is the public infrastructure supplied in region 2, and L_{dm} is the manufacturer's labour input. The consumption good X is provided under perfect competition. The producer of this good maximizes the profit as if the public infrastructure were given.

The consumption good Z is produced from intermediate goods and is tradable across regions, whereas intermediate goods are not. I assume that intermediate goods are produced only in region 1. The production function of the good Z is defined by

$$Z = \left[\int_0^N (z^n)^{\rho} dn \right]^{\frac{1}{\rho}}, \quad 0 < \rho < 1$$

where z^n is the intermediate good n, and N is the number of intermediate goods endogenously determined. ρ is the parameter of substitution. The consumption good Z is produced under perfect competition.

Each intermediate good is produced by one firm using labour and the public infrastructure. The labour requirement for the intermediate good n is as follows:

$$L_n = \frac{f + bz^{ns}}{G_1^{\gamma}} \quad (n \in [0, N])$$

where f/G_1^{γ} is the fixed labour requirement, b/G_1^{γ} is the marginal labour requirement, and G_1 is the public infrastructure in region 1. z^{ns} is the intermediate good output. Each firm is under monopolistic competition and maximizes the profit as if the public infrastructure were given.

The labour force is comprised of individuals, each of whom supplies one unit of labour. In region i $(i = 1, 2)$, the population of individuals is L_i , while the total population in the economy is $\bar{L} = L_1 + L_2$. In the model, since individuals can migrate among regions without cost, L_i is determined endogenously. Individuals migrate to the region where the utility is higher. In region i, they have the same utility function U^i :

$$U^i = (z_i x_i)^{\frac{1}{2}}$$

where z_i is the amount of the consumption good Z, and x_i is the amount of the consumption good X . The budget constraint of individuals in region i is

$$P_Z z_i + P_X x_i = (1 - t_i) w_i$$

where P_Z and P_X are the prices of consumption goods. w_i is region i's labour wage, and t_i is the region i's income tax rate.

The public infrastructure in each region is provided by the central government, and is not traded across regions. The central government maximizes welfare, that is the utility of individuals, by allocating the public infrastructure between regions. In the following, public investment denotes the product of this public infrastructure. Moreover, if possible, the government utilizes a transfer policy through taxation. The public infrastructure in region i is produced by labour in that region. The production function is as follows:

$$G_i = L_{G_i} \quad (i = 1, 2)$$

where L_{G_i} $(i = 1, 2)$ is the labour input.

To finance the production of the infrastructure, the government imposes an income tax on each region's workers. When the government is unable to adopt the regional transfer or redistribution policy, the tax is uniform across regions. This uniform income tax rate is t. The government's budget constraint is

$$w_1 L_{G_1} + w_2 L_{G_2} = t(w_1 L_1 + w_2 L_2)$$

Because individuals are free to migrate across regions, they prefer regions where the utility is higher. In the equilibrium, $w_1 = w_2$ holds because of the migration behaviour. From market clearing conditions and the migration behaviour, equilibrium populations of each region are

$$\begin{aligned} L_1 &= \frac{\bar{L} + G_1 - G_2}{2} \\ L_2 &= \frac{\bar{L} - G_1 + G_2}{2} \end{aligned}$$

The objective function of the government is the indirect utility function of individuals. This function is as follows:

$$V^i = (1-t)^{\frac{1}{2}\left(\frac{1}{\rho}+1\right)} G_1^{\frac{\gamma}{2\rho}} G_2^{\frac{\beta}{2}} \left[\left(\frac{1}{2}\right)^{\frac{1}{\rho}+1} \frac{\rho}{b} \left(\bar{L} \frac{1-\rho}{f} \right)^{\frac{1}{\rho}-1} \right]^{\frac{1}{2}}$$

Next, I consider the case in which the government adopts the regional transfer or redistribution policy. In this case, the government applies different income tax rates in each region. The income tax rate in region i is written as t_i . The government's budget constraint is then

$$w_1 L_{G_1} + w_2 L_{G_2} = t_1 w_1 L_1 + t_2 w_2 L_2$$

In the equilibrium, $(1 - t_1)w_1 = (1 - t_2)w_2$ holds because of the migration behaviour and different tax rates. From market clearing conditions and this migration behaviour, equilibrium populations of each region are

$$\begin{aligned} L_1 &= \frac{1-t_2}{(1-t_1)+(1-t_2)} \left[\frac{1-t_1}{1-t_2} \bar{L} + G_1 - \frac{1-t_1}{1-t_2} G_2 \right] \\ L_2 &= \frac{1-t_2}{(1-t_1)+(1-t_2)} \left[\bar{L} - G_1 + \frac{1-t_1}{1-t_2} G_2 \right] \end{aligned}$$

The government's objective function is as follows:

$$V^i = (1-t_1)^{\frac{1}{2\rho}}(1-t_2)^{\frac{1}{2}}G_1^{\frac{\gamma}{2\rho}}G_2^{\frac{\beta}{2}}\left[\left(\frac{1}{2}\right)^{\frac{1}{\rho}+1}\frac{\rho}{b}\left(\bar{L}\frac{1-\rho}{f}\right)^{\frac{1}{\rho}-1}\right]^{\frac{1}{2}}$$

The next section analyses the behaviour of the government in detail. For analysing the effect of the regional redistribution policy, I compare the case when the redistribution policy is adopted to the case when it is not.

3. Effect of Taxation Policy

This section shows the optimal policy. First, I analyse the optimal policy of the public infrastructure allocation in which the government is constrained from choosing the regional transfer policy through taxation. Next, I examine the case where the government is free to utilize that policy through taxation. To evaluate the effect of the regional policy on the public infrastructure policy, I compare those two cases.

When the government is unable to use the regional transfer policy through taxation, the optimal public infrastructure and the tax rate are as follows:

$$G_1 = \frac{\frac{\gamma}{\rho}}{\frac{\gamma+1}{\rho}+\beta+1}\bar{L}, \quad G_2 = \frac{\beta}{\frac{\gamma+1}{\rho}+\beta+1}\bar{L} \tag{1}$$

$$t = \frac{\frac{\gamma}{\rho}+\beta}{\frac{\gamma+1}{\rho}+\beta+1} \tag{2}$$

and populations in each region are

$$L_1 = \frac{\frac{2\gamma+1}{\rho}+1}{\frac{\gamma+1}{\rho}+\beta+1}\frac{1}{2}\bar{L}, \quad L_2 = \frac{\frac{1}{\rho}+2\beta+1}{\frac{\gamma+1}{\rho}+\beta+1}\frac{1}{2}\bar{L} \tag{3}$$

When the government can use the regional transfer policy through taxation, the optimal public infrastructure and the tax rate are derived as

$$G_1 = \frac{\frac{\gamma}{\rho}}{\frac{\gamma+1}{\rho}+\beta+1}\bar{L}, \quad G_2 = \frac{\beta}{\frac{\gamma+1}{\rho}+\beta+1}\bar{L} \tag{4}$$

$$t_1 = \frac{-\frac{1}{\rho}+1+\frac{\gamma}{\rho}+\beta}{\frac{\gamma+1}{\rho}+\beta+1}, \quad t_2 = \frac{\frac{1}{\rho}-1+\frac{\gamma}{\rho}+\beta}{\frac{\gamma+1}{\rho}+\beta+1} \tag{5}$$

and populations in each region are derived as follows:

$$L_1 = \frac{\frac{\gamma+1}{\rho}}{\frac{\gamma+1}{\rho}+\beta+1}\bar{L}, \quad L_2 = \frac{\beta+1}{\frac{\gamma+1}{\rho}+\beta+1}\bar{L} \tag{6}$$

From these results, I obtain the following proposition.

Proposition Suppose that the government can adopt different income tax rates in each region. The government should choose the same amount of public infrastructure regardless of the taxation policy. The tax rate in region 1 is lower than that in region 2 for the purpose of managing regional agglomeration.

The amount of public infrastructure should not be changed when the government can use taxation as the regional redistribution device. This is the same result discussed by Caminal (2004). In Caminal's analysis, when the government has the utilitarian social welfare function, the amount of public infrastructure should be efficiently allocated across regions. In this paper's analysis, the government has that welfare function. But, individuals can migrate across regions, whereas they cannot in Caminal's model. The above proposition shows that public infrastructure should always be efficiently allocated across regions.

The tax rate in region 1 is lower than that in region 2. Intuitively, the government should reduce the tax rate in a poor region for the purpose of redistribution. But the proposition suggests that the government should increase the tax rate in a poor region. This policy increases the population of a rich region through migration behaviour. Then, the welfare is maximized because of scale economies in the rich region. Ottaviano et al. (2002) have reported that regional policy is required to control undesired regional agglomeration. To control regional agglomeration, the government should use the taxation, not the public investment.

4. Conclusion

This paper has examined the optimal allocation of public investment across two heterogeneous regions when the government is able to use the regional transfer policy through taxation. Moreover, individuals can migrate across regions without cost.

The government should choose the same amount of public infrastructure regardless of the taxation policy. The tax rate in the region that has scale economies is lower

than in other regions. The government should use taxation to concentrate individuals in that region in order to utilize scale economies. To control regional agglomeration, the government should use the taxation, not the public investment.

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