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Abstract

The purpose of this paper is to investigate the central government's redistribution policies across local governments that affect regional agglomeration. The local government provides the local public good that has the centripetal force in the distribution of population. In this regional economy, only one region produces the manufactured goods. For the production of the good, it is desirable that all workers concentrate in that region. In this case, this paper analyzed whether or not the central government should adjust the distribution of populations through local governments.

The result is as follows: If individuals are relatively immobile, i.e., the migration cost is large, the central government should transfer from the non-production region to the productive region because it should adjust the smaller agglomeration in the productive region. On the other hand, if the migration cost is small, the central government should transfer from the productive region to non-production region because it should adjust the excess agglomeration and income distribution. For deciding the central government's adjustment policy, it is important to consider the migration cost.

JEL classification: R12; H41; H50; H72

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1 Introduction

Economic agglomeration is caused by a variety of reasons. For example, Fujita, Krugman and Venables (1999) and Fujita and Thisse (2002) have pointed out that increasing returns in the private sector promotes agglomeration. Beenstock and Feldstein (2010) have analyzed the Marshallian theory of regional agglomeration to explain regional wage disparity. As shown by Glazer and Kondo (2007), previous literature have explained that geographical features, economics of agglomeration, network effects and the public sector cause agglomeration. This paper analyzes the public sector that relates to the agglomeration of economic activity.

Many studies have shown the relationship between agglomeration and the public sector. Burbidge and Myers (1994) have analyzed the local government's transfer policy to control agglomeration. Glazer and Kondo (2007) have analyzed the voter's decision where the local government influences agglomeration. Roos (2004) has shown that the local government has a centripetal force and may cause agglomeration without depending on increasing returns to scale in private production. Mark, McGuire and Papke (2000) have estimated that local government's tax schemes and public expenditures serve to increase population in regions.

When the existence of a local government affects agglomeration, should a central government redistribute across local governments? Roos (2004) has shown that local government's competition for a mobile population causes less agglomeration so that fewer workers live in the more highly productive region. Moreover, Lee and Choe (2012) have obtained that same result in the model of two asymmetric regions where all firms are located in one region. These studies indicate that the central government should adjust this inefficiency. Concerning the central government's policy for the local government, Riou (2006) has analyzed the central government's transfer across local governments when the local government causes agglomeration. This paper analyzes whether the central government should use a redistribution policy to adjust the local government and the agglomeration.

The redistribution policy relates to migration behavior across regions. Furukawa (2012) has found that when individuals can migrate across regions without cost, the government should use a transfer policy to control regional agglomeration. On the other hand, Caminal (2004) has shown that when individuals cannot migrate across regions, the government should use a transfer policy to reduce regional inequality. However, in most cases, individuals migrate across regions with the cost. This migration cost affects migration behavior and the spatial distribution of the population. Sorek (2009) has analyzed the relationship between migration cost and the equilibrium population distribution. This paper analyzes the relationship between public policy and the migration cost.

The purpose of this paper is to investigate the central government's redistribution policies across local governments that affect regional agglomeration. As shown by Roos (2004), the local government provides the local public good that has the centripetal force in the distribution of population. Different from Roos (2004) and Lee and Choe (2012), this paper assumes that local governments do not behave strategically. This means that in local governments, competition does not occur. In this case, previous studies have indicated that the central government does not need to adjust the regional distribution. This paper analyzes whether or not this is true. Moreover, it analyzes the relationship between redistribution policy and the migration cost.

This paper is organized as follows: Section 2 introduces the model of this paper. Section 3 analyzes the market equilibrium and the local government's behavior. Section 4 analyzes the central government's policy. Section 5 concludes this paper.

2 The model

Consider an economy composed of two regions, region 1 and region 2. Each region differs with respect to production technology of the manufactured good. Concerning the private good, there are two sectors (a manufacture sector and agriculture sector). For the production, each sector requires workers. Moreover, the local public good exists in each region.

The manufacture sector produces one manufactured good. The two regions are asymmetric in terms of production technology of the good. Following Lee and Choe (2012), this paper assumes that only region 1 produces the good. In region 1, for producing per unit of the manufactured good, β units of region 1's workers are required. The manufactured good is produced under perfect competition. On the other hand, the agriculture sector produces two agricultural goods. In each region, one agricultural good is produced that is different from the other. These goods are produced under perfect competition and constant returns. The two regions are symmetric in terms of production technology. In region i $(i = 1, 2)$, one unit of region i's workers is required to produce one unit of the agricultural good. These manufactured and agricultural goods are traded between regions without cost.

In each region, a local government exists. The local government produces the local public good. The production of the good requires the agricultural good and the manufactured good. The local public good in region i can be consumed by region i's residents.

There are $\bar{L}$ individuals in the economy. Region i's population is L_i and $\bar{L} = L_1 + L_2$. Each individual supplies one unit of labor and has the same preference. For an individual in region i, the utility function is:

$$U_l = x^{\mu} \{z_1 z_2\}^{\frac{1-\mu}{2}} g_i{}^{\gamma} \tag{1}$$

where x is the consumption of the manufactured good, z_j is the consumption of the agricultural good j $(j = 1, 2)$ and g_i is the local public good in region i.

Individuals can move across regions with the mobile cost. Thus, they migrate to the other region when the utility, including the migration cost, is larger.

The budget constraint of the individual in region i is

$$(1 - t_i)w_i = p_x x + p_1 z_1 + p_2 z_2 \tag{2}$$

where p_x, p_1, p_2 are prices of the manufactured and agricultural goods 1 and 2 and w_i is the wage in region i. t_i is the tax rate the local government imposes.

In region i, the agricultural good i $(i = 1, 2)$ is produced. Because of the perfect competition, marginal cost pricing holds:

$$p_1 = w_1 \qquad p_2 = w_2 \tag{3}$$

In the following, this paper assumes that the agricultural good 2 is numeraire: $p_2 = w_2 = 1$.

In the manufacture sector, profit maximization leads to:

$$p_x \beta = w_1 \tag{4}$$

Each local government collects income tax to supply the local public good. Following models of Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003), and Riou (2006), the public good is produced using the manufactured and the agricultural good. A fraction μ of the tax revenue is spent on the manufactured good x and a fraction $(1-\mu)/2$ of the tax revenue is spent on the agricultural good i. Because of this production, private goods markets are unaffected by the local government. The production function of the local public good is as follows:

$$g_i = {x_{g_i}}^{\mu} \left\{ z_{1_{g_i}} z_{2_{g_i}} \right\}^{\frac{1-\mu}{2}} \tag{5}$$

and the budget constraint is:

$$t_i w_i L_i = p_x x_{g_i} + p_1 z_{1_{g_i}} + p_2 z_{2_{g_i}}$$

where t_i is the tax rate and $x_{g_i}, z_{1_{g_i}}, z_{2_{g_i}}$ are the amounts of the manufactured and agricultural goods 1 and 2 input to produce the local public good i.

The market clearing condition is as follows: Because the manufactured good productivity of region 1 is superior to that of region 2, only region 1 produces the manufactured good. In this case, the market clearing conditions are as follows:

$$\frac{\mu \left(w_1 L_1 + w_2 L_2 \right)}{2 p_x} = \beta L_x \tag{6}$$

$$\frac{(1-\mu) \left(w_1 L_1 + w_2 L_2 \right)}{2 p_1} = L_{z_1} \quad \frac{(1-\mu) \left(w_1 L_1 + w_2 L_2 \right)}{2 p_2} = L_{z_2} \tag{7}$$

$$L_1 = L_x + L_{z_1} \qquad L_2 = L_{z_2} \tag{8}$$

where L_x, L_{z_1}, L_{z_2} are the amounts of labor input to produce manufactured and agricultural goods 1 and 2 .

3 Local government behavior and population distribution

This section analyzes the local government's behavior and the equilibrium of regional populations. Each local government maximizes individual utility in its own region, and it is assumed that each local government behaves as if the population and tax rates of the other region are given. From the previous section, the local government maximizes the following objective function:

$$\max_{t_i} \qquad (1-t_i)w_i\left[t_i w_i L_i\right]^{\gamma}\left[\frac{\mu^{\mu}\left(\frac{1-\mu}{2}\right)^{1-\mu}}{{p_x}^{\mu}{p_1}^{\frac{1-\mu}{2}}}\right]^{1+\gamma}$$

where the tax rate does not influence the wage and prices from the model. This maximization yields the tax rate.

$$t_i = \frac{\gamma}{1+\gamma}$$

Individuals can migrate between regions with migration cost. Then, individuals migrate to the other region when the utility, including the mobile cost, is larger. Individuals in region 2 do not migrate to region 1 when the following condition holds:

$$(1-t_2)w_2\left[t_2 w_2 L_2\right]^{\gamma}\left[\frac{\mu^{\mu}\left(\frac{1-\mu}{2}\right)^{1-\mu}}{{p_x}^{\mu}{p_1}^{\frac{1-\mu}{2}}}\right]^{1+\gamma} \geq (1-t_1)(1-c)w_1\left[t_1 w_1 L_1\right]^{\gamma}\left[\frac{\mu^{\mu}\left(\frac{1-\mu}{2}\right)^{1-\mu}}{{p_x}^{\mu}{p_1}^{\frac{1-\mu}{2}}}\right]^{1+\gamma} \qquad (9)$$

When individuals migrate to the other region, a part of the wage is lost as the migration cost. c represents that rate. From the market clearing condition, the following equation holds:

$$p_x = \frac{1}{\beta}\frac{1+\mu}{1-\mu}\frac{L_2}{L_1} \qquad p_1 = w_1 = \frac{1+\mu}{1-\mu}\frac{L_2}{L_1}$$

Substituting these equations into (9),

$$\frac{L_1}{L_2} \geq \left(\frac{1+\mu}{1-\mu}\right)^{1+\gamma}(1-c) \qquad (10)$$

On the other hand, individuals in region 1 do not migrate to region 2 when the following condition holds:

$$(1-t_1)w_1\left[t_1w_1L_1\right]^{\gamma}\left[\frac{\mu^{\mu}\left(\frac{1-\mu}{2}\right)^{1-\mu}}{p_x{}^{\mu}p_1{}^{\frac{1-\mu}{2}}}\right]^{1+\gamma} \geq (1-t_2)(1-c)w_2\left[t_2w_2L_2\right]^{\gamma}\left[\frac{\mu^{\mu}\left(\frac{1-\mu}{2}\right)^{1-\mu}}{p_x{}^{\mu}p_1{}^{\frac{1-\mu}{2}}}\right]^{1+\gamma} \quad (11)$$

Similarly, (11) is rearranged as follows:

$$\frac{L_1}{L_2} \leq \left(\frac{1+\mu}{1-\mu}\right)^{1+\gamma}\frac{1}{1-c} \quad (12)$$

It is assumed that the initial population in each region is identical: $L_1 = L_2 = \bar{L}/2$. Because $0 < c < 1$, the following condition holds:

$$1 < \left(\frac{1+\mu}{1-\mu}\right)^{1+\gamma}\frac{1}{1-c}$$

From (12), having this condition means that individuals in region 1 do not migrate to region 2 during the initial population distribution. When migration occurs, only migration from region 2 to region 1 is plausible. From (10), individuals in region 2 migrate to region 1 when the following condition holds:

$$c < \frac{\left(\frac{1+\mu}{1-\mu}\right)^{1+\gamma}-1}{\left(\frac{1+\mu}{1-\mu}\right)^{1+\gamma}} = c^{*} \quad (13)$$

When $c < c^{*}$, migration from region 2 to region 1 occurs. Therefore, $L_1 = L_2 = \bar{L}/2$ is not the equilibrium population distribution. Individuals concentrate in region 1 and the population of region 1 is larger than that of region 2. In the equilibrium, about (10), equality holds. Then, equilibrium populations are as follows:

$$L_1 = \frac{\left(\frac{1+\mu}{1-\mu}\right)^{1+\gamma}(1-c)}{\left(\frac{1+\mu}{1-\mu}\right)^{1+\gamma}(1-c)+1}\bar{L} \qquad L_2 = \frac{1}{\left(\frac{1+\mu}{1-\mu}\right)^{1+\gamma}(1-c)+1}\bar{L}$$

On the other hand, when $c > c^*$, the migration does not occur. Then, $L_1 = L_2 = \bar{L}/2$ is the equilibriuim population. To sum up, the following lemma is obtained:

> **Lemma** Assume that initially the population distribution in each region is identical. If the rate of the migration cost is larger than c^*, the migration does not occur and the initial distribution is the equilibrium. If the migration cost is smaller than c^*, migration occurs and region 1's population is larger in the equilibrium.

When the migration cost is larger in the equilibrium, the population distribution does not change from the initial population and the government does not affect the population distribution. On the contrary, when the migration cost is smaller, individuals concentrate in region 1. Because of the manufacture sector, the wage of region 1 is larger than that of region 2 in the initial population distribution, and individuals in region 2 want to migrate to region 1. The manufacture sector causes agglomeration. Similar to Roos (2004), the local government by itself does not cause agglomeration. But when migration occurs, the local government reinforces the agglomeration. The increment of population increases the taxbase, and that results in larger local public goods. Therefore, migration causes further utility differences between regions, reinforcing agglomeration.

4 Central government intervention

The previous section showed that the local government stimulates regional agglomeration. In the previous section, however, the central government did not exist. This section analyzes the role of the central government.

The central government intervenes in the economy through the transfer across local governments. It maximizes the weighted average of the utility of individuals in each region and it is assumed that it knows the behavior of the private sector and the local government.

The central governments budget constraint is as follows:

$$\alpha_1 t_1 w_1 L_1 = \alpha_2 t_2 w_2 L_2 \tag{14}$$

where α_i is the tax rate levied on the revenue of local government. When $\alpha_i < 0$, $\alpha_i t_i w_i L_i$ is the transfer received from the central government to the region i.

The objective function of central government becomes

$$\delta V_1 + (1-\delta) V_2 \tag{15}$$

where $\delta \in [0, 1]$ is a weight on the utility in region 1.

For analyzing the behavior of the central government, it is necessary to examine equilibrium prices, populations and local government behavior. First, consider the local government. The budget constraint of local government i is

$$(1-\alpha_i)t_i w_i L_i = p_x x_{g_i} + p_1 z_{1g_i} + p_2 z_{2g_i}$$

Similar to the previous section, the behavior of the local government yields

$$t_i = \frac{\gamma}{1+\gamma}$$

Compared to Section 3, the tax rate does not change. That is, the behavior of the local government does not change regardless of the central government.

Next, consider the market prices. The previous sections model yields

$$p_x = \frac{1}{\beta}\frac{1+\mu}{1-\mu}\frac{L_2}{L_1} \qquad p_1 = w_1 = \frac{1+\mu}{1-\mu}\frac{L_2}{L_1}$$

Similar to the previous section, it is assumed that the population is initially equally distributed among regions. The following analysis examines the marginal effect when the central government does not behave: $\alpha_1 = \alpha_2 = 0$. Therefore, it can be considered that $1-\alpha_1 = 1-\alpha_2 = 1$. Similar to the previous section, when $c > c^*$, $L_1 = L_2 = \bar{L}/2$ is the equilibrium population. Otherwise, when $c < c^*$, the equilibrium populations are

$$L_1 = \frac{\left(\frac{1+\mu}{1-\mu}\right)^{1+\gamma}\left(\frac{1-\alpha_1}{1-\alpha_2}\right)^{\gamma}(1-c)}{\left(\frac{1+\mu}{1-\mu}\right)^{1+\gamma}\left(\frac{1-\alpha_1}{1-\alpha_2}\right)^{\gamma}(1-c)+1}\bar{L} \qquad L_2 = \frac{1}{\left(\frac{1+\mu}{1-\mu}\right)^{1+\gamma}\left(\frac{1-\alpha_1}{1-\alpha_2}\right)^{\gamma}(1-c)+1}\bar{L}$$

Now, consider the behavior of the central government. From the above analysis, the objective function of the central government is

$$\delta \quad (1-t_1)t_1{}^{\gamma}\left[\frac{\mu^{\mu}\left(\frac{1-\mu}{2}\right)^{1-\mu}}{\beta^{-\mu}\left(\frac{1+\mu}{1-\mu}\right)^{\frac{1+\mu}{2}}}\frac{1+\mu}{1-\mu}\right]^{1+\gamma}\left\{\frac{L_1}{L_2}\right\}^{\frac{(1+\gamma)(\mu-1)}{2}} L_1{}^{\gamma}(1-\alpha_1)^{\gamma}$$

$$+ \quad (1-\delta)(1-t_2)t_2{}^{\gamma}\left[\frac{\mu^{\mu}\left(\frac{1-\mu}{2}\right)^{1-\mu}}{\beta^{-\mu}\left(\frac{1+\mu}{1-\mu}\right)^{\frac{1+\mu}{2}}}\right]^{1+\gamma}\left\{\frac{L_1}{L_2}\right\}^{\frac{(1+\gamma)(1+\mu)}{2}} L_2{}^{\gamma}(1-\alpha_2)^{\gamma} \quad (16)$$

For evaluating the transfer policy, consider the case where the burden of the local government in region 1 increases. That is, the effect on the welfare caused by the increment of α_1 is

$$\begin{aligned}\frac{\partial W}{\partial \alpha_1} &= -\delta V_1\frac{\gamma}{1-\alpha_1} - (1-\delta)V_2\frac{\gamma}{1-\alpha_2}\frac{\partial \alpha_2}{\partial \alpha_1} + \delta V_1\frac{\gamma}{L_1}\frac{\partial L_1}{\partial \alpha_1} + (1-\delta)V_2\frac{\gamma}{L_2}\frac{\partial L_2}{\partial \alpha_1} \\ &\quad +\delta V_1\frac{(1+\gamma)(\mu-1)}{2}\frac{L_2}{L_1}\frac{\partial\left(\frac{L_1}{L_2}\right)}{\partial \alpha_1} + (1-\delta)V_2\frac{(1+\gamma)(1+\mu)}{2}\frac{L_2}{L_1}\frac{\partial\left(\frac{L_1}{L_2}\right)}{\partial \alpha_1} \quad (17)\end{aligned}$$

In the case of $\alpha_1 = \alpha_2 = 0$, if $\frac{\partial W}{\partial \alpha_1} > 0$, the central government should transfer the revenue from region 1 to region 2.

First, following Furukawa (2012), we analyze a case where the central government does not consider the political influences on the population. In this case, the central government behaves as $\frac{\partial L_1}{\partial \alpha_1} = \frac{\partial L_2}{\partial \alpha_1} = 0$. Then, $\frac{\partial W}{\partial \alpha_1}$ is

$$-\delta V_1\frac{\gamma}{1-\alpha_1} + (1-\delta)V_2\frac{\gamma}{1-\alpha_2}\frac{1+\mu}{1-\mu} \quad (18)$$

Concerning the utility, the following condition holds:

$$V_1 = V_2\left\{\frac{1+\mu}{1-\mu}\right\}^{1+\gamma}\frac{L_2}{L_1}\left(\frac{1-\alpha_1}{1-\alpha_2}\right)^{\gamma}$$

Substituting the equation into (18),

$$\frac{\partial W}{\partial \alpha_1} = \gamma V_2\frac{1+\mu}{1-\mu}\left[-\delta\left(\frac{1+\mu}{1-\mu}\right)^{\gamma}\frac{L_2}{L_1}\frac{1}{1-\alpha_1}\left(\frac{1-\alpha_1}{1-\alpha_2}\right)^{\gamma} + (1-\delta)\frac{1}{1-\alpha_2}\right]$$

When $\alpha_1 = \alpha_2 = 0$,

$$\left.\frac{\partial W}{\partial \alpha_1}\right|_{\alpha_1=\alpha_2=0} = \gamma V_2 \frac{1+\mu}{1-\mu}\left[-\delta\left(\frac{1+\mu}{1-\mu}\right)^\gamma \frac{L_2}{L_1} + (1-\delta)\right] \tag{19}$$

When $\delta = \frac{1}{\left(\frac{1+\mu}{1-\mu}\right)^\gamma \frac{L_2}{L_1}+1}$, (19) $= 0$ and $\alpha_1 = \alpha_2 = 0$ is the optimal policy. But if $\delta < \frac{1}{\left(\frac{1+\mu}{1-\mu}\right)^\gamma \frac{L_2}{L_1}+1}$, (19) > 0 and $\alpha_1 > 0$ is the desirable policy. Because the weight on the utility in region 1 is small, the central government should transfer to region 2. On the other hand, if $\delta > \frac{1}{\left(\frac{1+\mu}{1-\mu}\right)^\gamma \frac{L_2}{L_1}+1}$, $\alpha_1 < 0$ that the central government should transfer to region 1. In the following analysis, it is assumed that $\delta = \frac{1}{\left(\frac{1+\mu}{1-\mu}\right)^\gamma \frac{L_2}{L_1}+1}$: when the central government does not consider political effects on the population, it should not intervene in the local government.

Second, analyze a case where the central government considers political effects on the population. If $\alpha_1 = \alpha_2 = 0$, $\frac{\partial L_1}{\partial \alpha_1}$ and $\frac{\partial L_2}{\partial \alpha_1}$ are as follows:

$$\frac{\partial L_1}{\partial \alpha_1} = -\frac{\partial L_2}{\partial \alpha_2} = -\frac{L_1 L_2}{\bar{L}}\frac{2\gamma}{1-\mu} \tag{20}$$

From above equations and $\delta = \frac{1}{\left(\frac{1+\mu}{1-\mu}\right)^\gamma \frac{L_2}{L_1}+1}$, (17) is as follows:

$$\left.\frac{\partial W}{\partial \alpha_1}\right|_{\alpha_1=\alpha_2=0} = (1-\delta) V_2 \frac{1+\mu}{1-\mu}\frac{2\gamma^2}{(1-\mu)\bar{L}}\left[\frac{1-\mu}{1+\mu}L_1 - L_2\right] \tag{21}$$

When $\frac{L_1}{L_2} > \frac{1+\mu}{1-\mu}$, (21) is always positive. From equilibrium populations, if $c < 1 - \left(\frac{1-\mu}{1+\mu}\right)^\gamma = c^{**}$, this condition holds. When the migration cost is small, the central government should transfer to region 2. On the other hand, when $c > c^{**}$, (21) is always negative. If the migration cost is large, the central government should transfer to region

1. In this case, the mobility of individuals is not sufficient and the population in the more productive region is less agglomerated. The central government should attract individuals in that region through the local government. However, when $c > c^*$, the equilibrium populations do not change from the initial distribution, and the government cannot affect the population. In this case, the central government should not transfer to each region.

To sum up, the following proposition holds:

> **Proposition** Assume that if the central government does not consider political effects on the population, it should not intervene in the local government. If the central government considers the population distribution and $c^* > c > c^{**}$ ($c < c^{**}$), it should foster (restrain) agglomeration through the transfer to region 1 (region 2).

Assume that the central government should not intervene in the local government's behavior when it does not consider the population. When the central government considers the migration behavior, it should behave as follows: Only if the migration cost is moderately large, should the central government transfer from region 2 to region 1. In this case, the population is less agglomerated in the more productive region. The central government can improve the welfare through redistribution to the local government in the more productive region. On the other hand, if migration cost is small, the central government should transfer to the less productive region. Because individuals are mobile, the distribution of population is efficiently adjusted for production, and each region produces private goods efficiently. In this case, the central government should prevent excess agglomeration to adjust income distribution.

5 Conclusion

This paper has examined the central government's redistribution policies across local governments that affect the regional distribution of population. In this regional economy, only one region produces the manufactured good. For the production of the good, it is desirable that all workers concentrate in that region. This paper analyzed whether or not the central government should adjust the distribution of populations through local governments.

The result is as follows: If individuals are relatively immobile, i.e., the migration cost is large, the central government should transfer from the non-productive region to the productive region because that should adjust the smaller agglomeration in the productive region. On the other hand, if the migration cost is small, the central government should transfer from the productive region to non-productive region because that should adjust the excess agglomeration and income distribution. For deciding the central government's adjustment policy, it is important to consider the migration cost.

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