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Abstract

This paper analyzes the joint provision of local public goods and industrial distribution. Often, when local public goods are offered in a city, the local government in nearby regions seek to obtain a "free ride" and make use of the public goods in their region. If the local public goods of a city can be consumed in a nearby region, it may be possible to provide them jointly and share the administration and cost. It is expected of industrial dispersion to increase revenue and of local governments to participate in joint provision voluntarily. Then, there would be no need for policy centralization or local government consolidation.

The results depend on the population in the periphery. When the population is large, the local government in the periphery accepts the joint provision of local public goods regardless of the industrial location. Conversely, if the periphery population is small, the manufacturing sector agglomerates in the city and the local government does not want joint provision. Only when the manufacturing sector disperses and the wages in the periphery increase sufficiently does the local government accept joint provision.

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1 Introduction

This paper analyzes the joint provision of local public goods. Some local public goods, such as the registration of addresses, the collection and disposal of garbage, and fire prevention, have a scale effect making it efficient for adjacent regions to provide these goods jointly. If local public goods of a city can be consumed in a nearby region, it may be possible to provide them jointly, sharing the cost and administration. Often, however, when the local public goods in the city can be consumed by a nearby region, the local government of the nearby region seeks a "free ride," hoping to share in the benefit without having to supply the local public good itself. Following Braid (2010), that region seems to be viewed as free rider, though residents in that region pay the commuting cost for consuming it. In order to sharing the cost, interlocal cooperation is necessary.

In the provision of purely local public goods, when and how does cooperation among local governments arise? Often, residents of neighboring regions can. In this analysis, these local public goods are considered to be pure local public goods. Because they are non-excludable, the local government cannot charge a user fee to exclude the residents of another region that does not pay the cost. Moreover, because they are non-rival goods, congestion does not occur in their use and the local government does not want to exclude the residents of the other region. Intuitively, the other region's local government does not pay the cost voluntarily in the provision of the goods. However, in sharing the cost of local

public goods, cooperation among local governments is expected to arise. If cooperation does not arise, policy centralization may be desirable. If the cost of providing local public goods is large, subsidy by the central government may be necessary.

To maintain fiscal decentralization, the joint provision of local public goods is desirable. One solution for sharing the costs of joint provision is to consolidate nearby governments as studied by Furukawa (2014). However, it may not be realistic to do so because consolidation extinguishes independent control over policy matters for local governments. To maintain independent control, an alternative solution should be provided. Joint provision is the efficient policy alternative to the consolidation of local governments. Miceli (1993) and Brasington (1999) analyzed school districts to investigate joint provision. Feiock et al. (2009) studied whether joint ventures arise, and Brueckner (2015) analyzed the provision of road investment across regions when user fees can be levied.

In fiscal decentralization, the problem is whether a local government participates in the joint provision of local public goods voluntarily. This paper analyzes the relationship between joint provision and industrial distribution. On this topic, Roos (2004) analyzes the relationship between industrial agglomeration and the public sector. When considering two regions, such as a city and a suburb, normally, the suburb seeks a "free ride" on the city's local public goods because of the suburb's low revenue. However, if industrial dispersion increases the suburb's revenue, it should influence the decision for joint pro-

vision. If this is true, local governments participate in joint provision voluntarily, thus obviating policy centralization and local government consolidation.

This paper is organized as follows. Section 2 presents and examines the model. Section 3 analyzes local government behavior without the joint provision of local public good. Section 4 shows the effect of industrial distribution on joint provision. Section 5 concludes the paper.

2 The Model

2.1 Setting

This model considers an economy with two regions (Region 1 and Region 2), where each individual in this economy consumes three goods: a manufactured good, an agricultural good, and a local public good.

The manufactured good is produced under constant returns and is provided in the national market. Following Anas and Xiong (2003, 2005), the model assumes that the equilibrium of the national market is exogenous. Each region can produce intermediate goods that can be traded between regions with transportation costs. These goods are intermediate inputs in the production of the manufactured good and are produced under increasing returns, with local labor as the input. In the market for intermediate goods, monopolistic competition occurs.

The manufacturers are located in Region 1. Moreover, the firms making the interme-

diate goods are initially located in Region 1. This means that the manufacturing sector (firms making the manufactured good and the intermediate goods) agglomerates in Region 1. The intermediate goods producer may relocate to Region 2. In the equilibrium, when it is efficient for some of the intermediate producers to relocate, they disperse in each region. In this case, the manufacturer in Region 1 uses all of the intermediate goods that are produced in each region.

The agricultural goods are produced under constant returns and are provided in the national market. The producer of agricultural goods uses local labor. In each region, the labor market is competitive. When intermediate goods producers pay a higher wage than the agricultural producers do, labor is shifted from the production of agricultural goods. Then, the region does not produce agricultural goods and import them from the national market. Conversely, when intermediate goods producers are not located in a region (offering higher wages), the agricultural producer can use local labor and the region produces agricultural goods.

Following Takatsuka (2014) and Tsubuku (2016), in the model, each individual in each region supplies one unit of labor and cannot migrate across regions. In this economy, the total population is represented by $\bar{L} = L_1 + L_2$, where $L_i (i = 1, 2)$ is Region i's population. This paper assumes that $L_1 > L_2$. That is, Region 1 is larger (has a greater population) than the other region. Intuitively, this assumption means that Region 1

represents the city and Region 2 is the periphery.

Initially, the local public good is provided only in Region 1. In this region, the local public good is always provided. Individuals in Region 2 can consume it with a commuting cost. Each region has a local government that can provide the local public good. To produce the good, the manufactured good is utilized. The local government imposes an income tax on individuals in its own region to finance the production of the local public good. The objective of each local government is to maximize individual utility in its own region. In Region 2, the local government begins to provide the local public good when the utility is large enough.

2.2 Model specification

Individuals in Region i have the following utility function :

$$U_i = {x_i}^{\alpha} {z_i}^{1-\alpha} G_i$$

where x_i is the manufactured good, z_i is the agriculture good and G_i is the local public good. The budget constraint of an individual is as follows:

$$(1 - t_i)w_i = p_x x_i + p_z z_i$$

where p_x is the price of the manufactured good, p_z is the price of the agriculture good, w_i is the wage, and t_i is the tax rate.

Initially, the manufacturing sector agglomerates in Region 1. The production function

of the manufactured good is as follows:

$$X_1 = \left\{ \int_0^{N_1} q_j^{\rho} dj \right\}^{\frac{1}{\rho}} \qquad 0 < \rho < 1$$

where q_j denotes the intermediate goods j ($j \in [0, N_1]$) and N_1 is the variety of intermediate goods. One intermediate good is produced by one firm. The production function of each intermediate good is given by the following:

$$L_{q_j} = f + bq_j$$

L_{q_j} is the labor input, f is the fixed labor input and b is the marginal labor input.

An intermediate goods producer can relocate to Region 2. When producers disperse in each region, manufacturers in Region 1 use all of the intermediate goods of each region. In this case, the production function of the manufactured good is as follows:

$$X_1 = \left\{ \int_0^{N_1} q_j^{\rho} dj + \int_0^{N_2} q_k^{\rho} dk \right\}^{\frac{1}{\rho}}$$

where q_j is the intermediate good j ($j \in [0, N_1]$) produced in Region 1 and q_k is the intermediate good k ($k \in [0, N_2]$) produced in Region 2. N_i is the variety of intermediate goods produced in Region i. For using the good produced in Region 2, the producer must pay the transportation cost. This cost is the iceberg transportation cost, that is, $\tau > 1$ unit of the good is required to provide one unit of good in Region 1. The production function of each intermediate good is the same as that in the case of agglomeration.

The production function of agriculture good z is as follows: $z = L_z$ where L_z is the labor input. This good is produced under perfect competition.

In each region, the local government can produce the local public good. The production function is as follows:

$$G_i = {X_{G_i}}^{\gamma}$$

where X_{G_i} is the manufactured good's input. The budget constraint of the local government is given as follows:

$$t_i w_i L_i = p_x X_{G_i}$$

The local government maximizes individual utility in its own region.

2.3 Equilibrium of the agglomerated case

First, the case in which the manufacturing sector agglomerates in Region 1 is analyzed. From the first-order condition of production through manufacturing, the following condition holds true:

$$p_{mj} = p_x X_1^{1-\rho} q_j^{d\rho-1} \tag{1}$$

where p_{mj} is the price of intermediate good j and q_j^d is the demand for intermediate good j. Because the intermediate goods are produced under monopolistic competition, the first-order condition for profit maximization is given by the following:

$$p_{mj} = \frac{w_i b}{\rho} \tag{2}$$

Moreover, from the zero-profit condition, the output of goods and labor input are obtained as follows:

$$q_j = \frac{\rho f}{b(1-\rho)} \tag{3}$$

$$L_{q_j} = \frac{f}{1-\rho} \tag{4}$$

It is assumed that the agricultural good is not produced in Region 1. Conversely, in Region 2, only the agricultural good is produced. The first-order condition for profit maximization is as follows:

$$p_z = w_2 \tag{5}$$

The demand for agricultural production is L_{2z}. In the following, it is assumed that $p_z = 1$. This assumption and (5) means that Region 2's wage is 1. If the agricultural good is produced in Region 1, then $1 = p_z = w_1$ holds true. However, if w_1 is larger than 1 in the equilibrium, workers in Region 1 do not supply labor to the agricultural producer, and the agricultural good is not produced. The assumption that it is not produced means that the wage is larger than 1 in the equilibrium.

In the equilibrium, Region 1's intermediate good market and each region's labor markets must clear. From these conditions, the following condition hold true:

$$q_j^d = q_j \tag{6}$$

$$L_1 = N_1 L_{q_j} \tag{7}$$

$$L_2 \quad = \quad L_{2z} \tag{8}$$

Because the intermediate goods are symmetric, (6) is satisfied for each good and the labor demand in Region 1 is $N_1 L_{q_j}$.

In the equilibrium, equations (1) through (8) determine the variables w_1, w_2, p_{mj}, N_1, L_{q_j}, L_{2z}, q_j, and q_j^d . The exogenous variables are P_x, P_z, L_1, and L_2. From these equations, we get the following:

$$q_j = q_j^d = \frac{\rho f}{b(1-\rho)} \quad L_{2z} = L_2 \quad L_{q_j} = \frac{f}{1-\rho} \quad w_2 = 1$$

And the variety of intermediate goods is given by the following:

$$N_1 = \frac{L_1(1-\rho)}{f}$$

The wage in Region 1 is given by the following:

$$w_1^a = p_x \frac{\rho}{b} \left\{ \frac{1-\rho}{f} \right\}^{\frac{1-\rho}{\rho}} {L_1}^{\frac{1-\rho}{\rho}} \tag{9}$$

In the following, w_1^a reflects Region 1's wage in the agglomerated case. From the wage, the price of intermediate goods is as follows:

$$p_{mj} = p_x \left\{ \frac{1-\rho}{f} \right\}^{\frac{1-\rho}{\rho}} {L_1}^{\frac{1-\rho}{\rho}}$$

In this equilibrium, the amount of the manufactured product is as follows:

$$X_1^a = \left\{ \frac{1-\rho}{f} \right\}^{\frac{1-\rho}{\rho}} \frac{\rho}{b} {L_1}^{\frac{1}{\rho}} \tag{10}$$

2.4 Equilibrium of a dispersed case

Now, the case in which intermediate producers disperse in each region is analyzed. The profit maximization conditions of the manufactured good producer are as follows:

$$p_{1j} = p_x X_1^{1-\rho} {q_{1j}^d}^{\rho-1} \tag{11}$$

$$p_{2k}\tau = p_x X_1^{1-\rho} {q_{2k}^d}^{\rho-1} \tag{12}$$

where p_{1j} is the price of the intermediate goods j produced in Region 1. p_{2k} is the price of good k produced in Region 2, and q_{1j}^d and q_{2k}^d denote the demand for corresponding goods. In addition, τ is the iceberg transportation cost.

With regard to the intermediate goods, from the profit maximization and zero-profit conditions, the following condition holds true:

$$p_{1j} = \frac{b}{\rho} w_1 \tag{13}$$

$$p_{2k} = \frac{b}{\rho} w_2 \tag{14}$$

$$q_j = q_k = \frac{\rho f}{(1-\rho)b} \tag{15}$$

$$L_{q_j} = L_{q_k} = \frac{f}{1-\rho} \tag{16}$$

In Region 2, intermediate goods producers begin to provide the intermediate goods if they can use Region 2's labor employed by the agricultural producer in the agglomerated case. It is possible when they pay a higher wage than the agricultural producer, that is, $w_2 \geq 1$. Then, the intermediate producer uses all of Region 2's labor force and the

agricultural good is not produced. In the equilibrium of the dispersed case, each region does not produce the agricultural good and imports it from the national market.

The market clearing condition for intermediate goods and labor are as follows:

$$q_{1j}^d = q_j \tag{17}$$

$$\tau q_{2k}^d = q_k \tag{18}$$

$$L_1 = N_1 L_{q_{1j}} \tag{19}$$

$$L_2 = N_2 L_{q_{2k}} \tag{20}$$

Because the intermediate goods are symmetric in each region, (17) and (18) are satisfied for each good. From this symmetric condition, (19) and (20) are derived.

From equations (11) through (20), the following variables are derived: w_1, w_2, p_{1j}, p_{2k}, N_1, N_2, $L_{q_{1j}}$, $L_{q_{2k}}$, q_{1j}, q_{2k}, q_{1j}^d, and q_{2k}^d. The exogenous variables are P_x, P_z, L_1, and L_2 . Then the following is obtained:

$$q_{1j} = q_{1j}^d = \frac{\rho f}{b(1-\rho)} \quad q_{2k} = \frac{\rho f}{(1-\rho)b} \quad q_{2k}^d = \frac{\rho f}{\tau(1-\rho)b} \quad L_{q_{1j}} = L_{q_{2k}} = \frac{f}{1-\rho}$$

And the varieties of intermediate goods in each region are as follows:

$$N_1 = \frac{1-\rho}{f} L_1 \quad N_2 = \frac{1-\rho}{f} L_2$$

The wage in each region is given by the following:

$$w_1^d = p_x \frac{\rho}{b} \left\{ \frac{1-\rho}{f} \right\}^{\frac{1-\rho}{\rho}} \left[L_1 + L_2 \tau^{-\rho} \right]^{\frac{1-\rho}{\rho}} \tag{21}$$

$$w_2^d = \tau^{-\rho} p_x \frac{\rho}{b} \left\{ \frac{1-\rho}{f} \right\}^{\frac{1-\rho}{\rho}} \left[L_1 + L_2 \tau^{-\rho} \right]^{\frac{1-\rho}{\rho}} \tag{22}$$

Comparing (9) and (21), we can observe that (21) is larger than (9). The dispersion of the manufacturing sector increases the Region 1's wage. This is because the portion of Region 2's labor force that is not used for the manufactured good in the agglomerated case can be utilized for the production of the good. Moreover, (21) and (22) show that $w_1/w_2 = \tau^\rho > 1$. This means that Region 1's wage is greater than Region 2's wage in the case of dispersion. From these wages, the prices of intermediate goods are given by the following: $p_{1j} = w_1 b/\rho$ and $p_{2k} = w_2 b/\rho$.

In this equilibrium, the total amount of the manufactured goods produced is given by the following:

$$X_1^d \left\{ \frac{1-\rho}{f} \right\}^{\frac{1-\rho}{\rho}} \frac{\rho}{b} \left[L_1 + L_2 \tau^{-\rho} \right]^{\frac{1}{\rho}} \tag{23}$$

Comparing (10) and (23), we can observe that the amount of production is larger than that in the agglomerated case because the labor in Region 2 can be utilized for manufactured goods.

2.5 The location decision of intermediate goods firms

Initially, it is assumed that all firms making intermediate goods agglomerate in Region 1. However, these firms are able to relocate to Region 2. When the transportation cost of the intermediate goods decreases, some firms relocate to Region 2 for the sake of lower labor costs. Consequently, the case arises that the intermediate goods firms disperse across regions. In equilibrium, this case (dispersed) is realized whenever a higher wage is

created in Region 2 than that in the agglomerated case. When these firms agglomerate in Region 1, Region 2's wage w_2^a is 1. If they distribute across regions, Region 2's wage w_2^d is (22). Therefore, if (22) is larger than 1, these firms disperse in equilibrium. Consider the transportation cost τ^* that satisfies (22) = 1. Because (22) is a decreasing function of τ, if the transportation cost is larger than τ^*, then $w_2^d < 1$ and the dispersed case does not arise. Conversely, if the transportation cost decreases and $\tau < \tau^*$, firms disperse across regions.

3 The behavior of local governments

This section analyzes the local governments behavior in each region. Each local government seeks to maximize individual utility in its own region.

In Region 1, the local government always provides the local public good. From the model specification, the local governments problem is as follows:

$$\max_{t_1} V_1 = \left(\frac{\alpha}{p_x}\right)^{\alpha} \left(\frac{1-\alpha}{p_z}\right)^{1-\alpha} (1-t_1) w_1 \left(\frac{t_1 w_1 L_1}{p_x}\right)^{\gamma}$$

where V_1 is the indirect utility in Region 1. When the manufacturing sector agglomerates in Region 1, w_1 is (9). Conversely, in the case of dispersion, w_1 is (21). From the first-order condition of this problem, the tax rate is $t_1 = \gamma/(\gamma+1)$ and the following is obtained:

$$G_1 = \left[\frac{\gamma w_1 L_1}{(\gamma+1)p_x}\right]^{\gamma} \tag{24}$$

Then, the utility in Region 1 is given by the following:

$$V_1 = \left(\frac{\alpha}{p_x}\right)^{\alpha} \left(\frac{1-\alpha}{p_z}\right)^{1-\alpha} \frac{w_1^{\gamma+1} L_1^{\gamma}}{\gamma+1} \left[\frac{\gamma}{(\gamma+1)p_x}\right]^{\gamma}$$

The local government in Region 2 decides whether to provide the local public good. First, we consider the case in which the local government provides the local public good. In what is similar to Region 1, the tax rate is $t_2 = \gamma/(\gamma+1)$ and the following holds true:

$$G_2 = \left[\frac{\gamma w_2 L_2}{(\gamma+1)p_x}\right]^{\gamma}$$

Moreover, the utility is given by the following:

$$V_2 = \left(\frac{\alpha}{p_x}\right)^{\alpha} \left(\frac{1-\alpha}{p_z}\right)^{1-\alpha} \frac{w_2^{\gamma+1} L_2^{\gamma}}{\gamma+1} \left[\frac{\gamma}{(\gamma+1)p_x}\right]^{\gamma} \tag{25}$$

when the manufacturing sector agglomerates in Region 1, $w_2 = 1$. Conversely, w_2 is (22) in the dispersed case.

Next, we consider the case in which Region 2's local government does not provide the local public good. In this case, the local government does not impose the tax on individuals. Individuals in Region 2 consume the local public good in Region 1. For consuming the goods, they pay the commuting cost. The commuting cost is T_c , making an individual's income $w_2 - T_c$. Therefore, the utility in Region 2 is as follows:

$$V_{2n} = \left(\frac{\alpha}{p_x}\right)^{\alpha} \left(\frac{1-\alpha}{p_z}\right)^{1-\alpha} (w_2 - T_c) \left[\frac{\gamma w_1 L_1}{(\gamma+1)p_x}\right]^{\gamma} \tag{26}$$

when the manufacturing sector agglomerates in Region 1, w_1 is (9) and $w_2 = 1$. Conversely, w_1 is (21) and w_2 is (22) in the dispersion case. Region 2 government does not

provide the local public good when the utility is larger than that in the case where it does provide the local public good. When the manufacturing sector agglomerates, the relative utility is as follows:

$$\frac{V_2}{V_{2n}} = \frac{1}{1-T_c}\frac{1}{\gamma+1}\left[p_x\frac{\rho}{b}\left(\frac{1-\rho}{f}L_1\right)^{\frac{1-\rho}{\rho}}\frac{L_1}{L_2}\right]^{-\gamma} \tag{27}$$

When (27) is larger than 1, the local governments will want to supply the local public good. Conversely, when (27) is smaller than 1, it does not.

On the right-hand side of (27), the first term is the effect of commuting cost. The second term is the effect of the tax rate. The third term represents the effect of the local public good. Because of the model specification, the second term and the third term are smaller than 1. Therefore, if the effect of commuting cost vanishes, that is, the commuting cost is sufficiently small, (27) is smaller than 1–and the local government in Region 2 does not provide the local public good.

Next, consider the case in which the manufacturing sector disperses across regions. Then, the relative utility is as follows:

$$\frac{V_2}{V_{2n}} = \frac{w_2}{w_2-T_c}\frac{1}{\gamma+1}\left[\left(\frac{1}{\tau}\right)^{\rho}\frac{L_2}{L_1}\right]^{\gamma} \tag{28}$$

where w_2 is determined by (22). When (28) is larger than 1, the local government provides the local public good. Conversely, when (28) is smaller than 1, it does not.

In what is similar to the agglomerated case, the first term on the right-hand side of (28) constitutes the effect of commuting cost and the second term is the tax effect. The

third term constitutes the effect of the local public good. If the first term disappears, (28) is smaller than 1–and the local government in Region 2 does not provide the local public good.

To summarize these results, the following lemma is obtained.

Lemma Whether the manufacturing sector agglomerates or not, Region 2's local government, which maximizes individual utility in its own region, does not provide the local public good when the commuting cost that individuals in Region 2 must pay for consuming the local public good in the other region is sufficiently small.

When the commuting cost is sufficiently small, individuals in one region can utilize the other region's local public goods without great burden. Then, the region wants a free ride. If individuals can migrate across regions, Furukawa (2017) shows that the region may not want a free ride in the case of a small commuting cost. However, in this paper's setting, not all individuals can migrate across regions. Thus, the region wants a free ride when the commuting cost is sufficiently small.

4 Joint provision of the local public good

The previous section shows that the local government of a small region (periphery) prefers to have a free ride on the local public goods of the larger region (city) when the commuting

cost is sufficiently small. In this case, this section analyzes whether the joint provision of local public goods stops the free riding when firms' location patterns change.

The joint provision of local public goods is implemented as follows: The local government in Region 1 provides the local public good in its own region, and the local government in Region 2 does not produce the local public good. Individuals in Region 2 utilize Region 1's local public good by paying a commuting cost. To finance the production of the local public good, the local government in Region 1 imposes an income tax on individuals in Region 1. Moreover, Region 2 bears that expenditure partly. This paper follows Miceli (1993) with regard to this sharing rule. The ratio of expenditure burden is proportional to the population. That is, Region 2 spends the fraction $L_2/\bar{L}$ of that expenditure. Individuals in Region 2 incur that burden evenly. Region 1 finances the rest of the burden.

When the joint provision of local public goods is implemented, the local government in Region 1 maximizes the utility in its own region. The budget constraint of Region 1's local government is as follows:

$$t_1 w_1 L_1 = \left(1 - \frac{L_2}{\bar{L}}\right) p_x X_{G_1}$$

where $L_2/\bar{L}$ reflects the fraction of Region 2's burden. Region 1's local government takes that fraction as given and behaves accordingly. The local government's problem is as

follows:

$$\max_{t_1} V_1 = \left(\frac{\alpha}{p_x}\right)^{\alpha} \left(\frac{1-\alpha}{p_z}\right)^{1-\alpha} (1-t_1) w_1 \left(\frac{t_1 w_1 \bar{L}}{p_x}\right)^{\gamma}$$

where w_1 is (9) in the agglomerated case and (21) when the dispersed case arises.

Similar to the previous section, the tax rate is $t_1 = \gamma/(\gamma+1)$ and the following holds true:

$$G_1 = \left[\frac{\gamma w_1 \bar{L}}{(\gamma+1)p_x}\right]^{\gamma}$$

This amount of local public goods is larger than that in the previous section. This means that the joint provision of local public goods improves individual utility in Region 1. Region 1's local government always wants to carry out joint provision. Therefore, when Region 2's local government wants to do it, the joint provision is realized. In this case, each region's utility is as follows:

$$V_{1jp} = \left(\frac{\alpha}{p_x}\right)^{\alpha} \left(\frac{1-\alpha}{p_z}\right)^{1-\alpha} \frac{w_1^{\gamma+1}}{\gamma+1} \left[\frac{\gamma \bar{L}}{(\gamma+1)p_x}\right]^{\gamma} \tag{29}$$

$$V_{2jp} = \left(\frac{\alpha}{p_x}\right)^{\alpha} \left(\frac{1-\alpha}{p_z}\right)^{1-\alpha} \left(w_2 - \frac{\gamma}{\gamma+1} w_1 - T_c\right) \left[\frac{\gamma \bar{L}}{(\gamma+1)p_x}\right]^{\gamma} \tag{30}$$

Region 2's local government decides whether to carry out the joint provision or not. From the previous section, when the commuting cost is sufficiently small, the local government prefers a free ride. In this setting, when the utility (30) is larger than the utility in the free ride case (26), Region 2's local government implements joint provision.

First, we analyze the case in which the manufacturing sector agglomerates in Region 1. From the model specification, the relative utility is as follows:

$$\frac{V_{2n}}{V_{2jp}} = \frac{1}{1 - \frac{\gamma w_1}{(\gamma+1)(1-T_c)}} \left(\frac{L_1}{\bar{L}}\right)^{\gamma} \tag{31}$$

where w_1 is (9). When (31) is larger than 1, Region 2's local government wants a free ride. Conversely, when (31) is smaller than 1, it wants joint provision.

On the right-hand side of (31), the first term represents the effect of the cost and the second term is the effect of local public goods. If the population in Region 2 is larger, the second term is smaller and (31) is smaller than 1. This means that Region 2' s local government wants joint provision. Consequently, the following proposition is obtained:

Proposition 1 Consider the case in which the manufacturing sector agglomerates in Region 1. When the population in Region 2 is larger, Region 2's local government wants joint provision of local public goods when compared with the free ride.

Compared to the case of a free ride, joint provision causes additional costs for Region 2. Nevertheless, Region 2 wants joint provision if the population is larger because the amount of local public goods is attractive. However, if the population is not large enough, Region 2 does not want joint provision so as to avoid the additional burden. In this setting, Region 2's local government may change its policy when the firm location pattern

changes.

In the following, we analyze the case in which the manufacturing sector disperses across regions. In what is similar to the agglomerated case, the relative utility is as follows:

$$\frac{V_{2n}}{V_{2jp}} = \frac{1}{1 - \frac{\gamma w_1}{(\gamma+1)(w_2 - T_c)}} \left(\frac{L_1}{\bar{L}}\right)^{\gamma} \tag{32}$$

where w_1 is (21) and w_2 is (22). Similar to (31), on the right-hand side of (32), the first term represents the effect of the cost and the second term denotes the effect of the local public good. From the analysis of the location of intermediate goods firms, the decision regarding location is not of concern if the transportation cost (τ^*) that satisfies (22) = 1. In this case, we assume that (31) is 1, that is, the policy of Region 2's local government is one of indifference in the agglomeration. When the location pattern changes, (32) becomes larger than 1 because of Region 1's wages being higher than that in the agglomerated case. This means that the local government in Region 2 will not accept joint provision because the wages in Region 2 do not change. When the transportation cost τ decreases sufficiently, (32) decreases and is smaller than 1 because Region 2's wage increases. In this case, the local government accepts joint provision. We summarize these results in the following proposition.

Proposition 2 In the case of agglomeration, assume that it is not of concern to Region 2's local government whether or not the joint provision of local

public goods is implemented. The manufacturing sector disperses because of the reduction of transportation cost, and when that cost is sufficiently small, Region 2's local government wants the joint provision of local public goods when compared with the free ride.

From Proposition 1, if the population in Region 2 is not large, Region 2's local government does not want joint provision. In this case, when the transportation cost decreases and equals τ^*, the local government does not change the policy though firm location pattern changes. However, from Proposition 2, if the transportation cost decreases sufficiently, that local government accepts joint provision. The reduction of the transportation cost decreases the regional wage disparity. Then, Region 2's relative revenue increases and Region 2 can pay the additional cost. Although the population in Region 2 is smaller, the change in industrial distribution may change the local government's policy.

5 Conclusion

This paper analyzes how industrial location affects the joint provision of local public goods. Normally, the local government in a peripheral region prefers to obtain local public goods from the city as a free ride. Joint provision requires the government of the periphery to bear a part of the cost of a local public good, preventing a free ride situation. The industrial location induces the local government to accept joint provision.

The results depend on the population in the peripheral region. When the population

is large, the local government in the peripheral region accepts the joint provision of local public goods regardless of the industrial location. Conversely, if the peripheral population is small, when the manufacturing sector agglomerates in the city, the local government does not want joint provision. Only when the manufacturing sector disperses and the wages in the periphery increase sufficiently does the peripheral region's government accept joint provision. In this case, for the cost of local public goods, local governments behave efficiently without a merger.

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