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The Value of Small Regions

Akiyoshi Furukawa

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Abstract

This paper presents a theoretical analysis of whether small municipalities' existence increases efficiency. In recent years, large-scale municipal consolidations have decreased the number of municipalities: however, some small municipalities do not consolidate and remain alive. This paper utilizes land capitalization to present the value of these situations, determining the following results: Only when the travel cost is sufficiently high and the population differences in the non-consolidation case are sufficiently small, non-consolidation is more valuable than consolidation. That effect is mire significant when the private production technology is not large, the scale economies in the production of the local public good are low, and the total population is large. In this case, the existence of small municipalities is more efficient.

JEL classification: R23, R53, H41, H73

Keywords: regional population; local public good; land capitalization

*School of Economics, Chukyo University 101-2 Yagoto Honmachi, Showa-ku, Nagoya, 466-8666, Japan Tel.: +81-52-835-7111 Fax: +81-52-835-7197 e-mail:ecockawa@mecl.chukyo-u.ac.jp

1 Introduction

This paper presents a theoretical analysis to determine whether the existence of some small municipalities increases the efficiency. In recent years, large-scale municipal consolidations have decreased the number of municipalities: however, some small municipalities do not consolidate and remain alive. For example, in Japan, Weese (2008, 2013) shows that the optimal number of municipalities is less than the current number. While some small municipalities should consolidate and disappear for optimality, they do not consolidate and remain alive. Nakagawa (2016) demonstrates that the large scale of municipal consolidations during recent years had little impact on some small municipalities. Moreover, Avellaneda and Gomes (2014) point out that municipal consolidation is promoted in developed countries, though in some developing countries, the number of municipalities has grown in recent years.

This paper follows previous studies about municipal consolidation to evaluate small municipalities. Previously, analyses of municipal consolidations have focused on evaluating local governments policies and expenditure. For example, Dur and Staal (2008) analyze the spillover effects of local public good. Blume and Blume (2007) analyze economies of scale in providing local public goods, while Sørensen (2006) examines cost-sharing. Previous studies indicate that municipal consolidations should decrease the local public expenditure.

Still, it is difficult to evaluate small municipalities to utilize the local public expenditure. Some empirical studies (Miyazaki (2018), Bless and Baskaran (2016)) point out that municipal consolidations may increase local public expenditures, though it is unclear whether these consolidations are desirable. Municipal consolidations affect public expenditures, regional populations, and land areas; they are how municipalities expand populations and land areas. For evaluating the economic effects of municipalities, it is not suitable to utilize local public expenditures; therefore, this paper utilizes land prices.

Some previous studies also utilize land prices. Hu and Yinger (2008) and Duncombe, Yinger, and Zhang (2016) analyze the relationship between school district consolidation and property values based on capitalization effects in New York. Hayashi and Suzuki (2018) analyze these effects in

Japan. This paper utilizes a theoretical capitalization analysis and presents the value of small municipalities compared to municipal consolidations.

In this paper's, the centripetal force is the private and public sector production. For maximizing the production, it is desirable to foster agglomeration that leads to municipal consolidations. Conversely, the centrifugal force is the travel cost for consuming the local public goods. Small municipalities are valuable in contrast to agglomeration when this effect is larger. Then, the land value is greater than that of municipal consolidations cases, as shown in this paper.

This paper is organized as follows. Section 2 presents the model. Section 3 analyzes the social optimum in municipal consolidation and non-consolidation cases. Section 4 compares land rents in each case, and Section 5 concludes.

2 The model

The economy has a one-dimensional space in which the land destiny is one. Consider one region in the economy. The region initially consists of two districts (districts 1 and 2). The population size in district i is n_i

$(i = 1, 2)$, and the region's total population is $N = n_1 + n_2$. Each individual can migrate across regions and districts; therefore, the utility is equal across individuals in equilibrium. In the region, two districts can consolidate into one district. When this consolidation arises, all populations are allocated to the consolidation district.

Each individual in district i earns an income w_i. They have a utility composed of private and local public goods. Moreover, they consume one unit of land for housing, meaning that the length of district i equals the population. The utility function of an individual in district i is:

$$u(x_i, g_i) = x_i + \alpha \log g_i$$

where x_i is the amount of private good consumption, the price of which is 1; g_i is the amount of the local public good in district i.

Individuals must travel to where the local government makes the goods available to consume the local public goods. When the individual is located at a distance r from the local government, the travel cost is mr, where m is the travel cost per unit of distance. The land is homogeneous except for this travel cost. Moreover, the cost of the local public good must be imposed on each individual. Let $C(g_i)$ is the cost function of the local public good; each individual must pay the burden, $C(g_i)/n_i$. The budget constraint of the individual residing at distance r is:

$$x_i + R(r) + \frac{C(g_i)}{n_i} + mr = w_i$$

where $R(r)$ is the land rent at r.

In the following analysis, the model utilizes the bid rent function $R^*(r, u)$, representing the maximum rent the individual is willing to pay at distance r from the local government when the utility level is given at u. From the model, we have

$$R^*(r, u) = \beta_i - mr - (u - \alpha \log g_i) - \frac{C(g_i)}{n_i} \tag{1}$$

The private good is produced with the labor as the input. In district i, each individual supplies one unit of labor, which can produce β_i units of the private good. We assume that $\beta_1 > \beta_2$, meaning that district 1 is more productive than the other district. To maximize the production of the private good, it is optimum that all populations agglomerate in district 1. Other than the private production, the two districts are homogeneous. Because of the private production, if two districts must consolidate, all populations should allocate to district 1 instead of district 2. The private good is utilized for consumption and the production of the local public good. Because the private good sector operated under perfect competition, the wage in district i, w_i, must satisfy $w_i = \beta_i$.

Initially, in each district, the local government provides the local public goods where it is located. In equilibrium, the local government locates in the district center over the interval $[-\frac{n_i}{2}, \frac{n_i}{2}]$ and the distribution of consumers is uniform. The local public good is pure and does not have spillover effects on the other district. Only individuals in district i utilize its local public good, produced using the private good as the input. The cost function $C(g_i)$ is given as:

$$C(g_i) = g_i^{\gamma}$$

where γ represents the scale economies in producing the local public good. The government imposes this cost on residents, and the burden is equal among individuals.

The land market is perfectly competitive and the opportunity cost of land is assumed to be zero. Absentee landlords are assumed to own the land, and firms and governments do not consume the land; only residents use the land for housing. In this model, each resident uses a fixed unit of one land size, and the land at each point is allocated through a bidding process. In equilibrium, because residents are identical, the utility is equal across locations. Therefore, the equilibrium land rent at distance r equals the bid rent. At the district's boundary, the land rent equals the opportunity cost, which is zero. In the following analysis, it is assumed that the equilibrium utility level u is given. Then, the land rent at distance r is as follows:

$$R^*(r, u) = \beta_i - mr - (u - \alpha \log g_i) - \frac{g_i^\gamma}{n_i} \tag{2}$$

This paper analyzes the efficient allocation that maximizes the aggregate land rent.

3 Social optimum

This section analyzes the social optimum that maximizes the aggregate land rent in the region. For example, the problem of minimizing the resource cost in the fixed level of utility leads to the maximization problem, which Fujita and Thisse (2002) analyze. First, this study analyzes the case that two districts exist in the region, and second, we consider the case that two districts consolidate into one district.

3.1 The case of two districts

Consider the case where two districts exist in the region. A social planner maximizes the aggregate land rent in which the utility level is fixed across individuals. When the utility level is u, the land rent at distance r from district i local government, leading to equation (2). In equilibrium, the local government locates in the center over the interval $[-\frac{n_i}{2}, \frac{n_i}{2}]$, and the distribution of individuals is uniform. Then, the aggregate land rent in district 1 (ALR_1) is:

$$\begin{aligned} ALR_1 &= 2\int_0^{\frac{n_1}{2}} \left[\beta_1 - mr - \{u - \alpha \log g_1\} - \frac{g_1^\gamma}{n_1}\right] dr \\ &= \{\beta_1 - u + \alpha \log g_1\} n_1 - g_1^\gamma - \frac{mn_1^2}{4} \end{aligned}$$

Similarly, the aggregate land rent in district 2 (ALR_2) is:

$$ALR_2 = \{\beta_2 - u + \alpha \log g_2\} n_2 - g_2^\gamma - \frac{mn_2^2}{4}$$

The aggregate land rent in the region is:

$$\begin{aligned} S &= ALR_1 + ALR_2 \\ &= \{\beta_1 - u + \alpha \log g_1\} n_1 - g_1^\gamma - \frac{mn_1^2}{4} + \{\beta_2 - u + \alpha \log g_2\} n_2 - g_2^\gamma - \frac{mn_2^2}{4} \end{aligned}$$

The central planner must solve the following problem:

$$\max_{g_1, g_2, n_1} S \qquad s.t.\ N = n_1 + n_2 \tag{3}$$

First-order conditions for g_1, g_2, n_1 are as follows:

$$\alpha \frac{n_1}{g_1} = \gamma g_1^{\gamma-1} \tag{4}$$

$$\alpha \frac{(N-n_1)}{g_2} = \gamma g_2^{\gamma-1} \tag{5}$$

$$\beta_1 - \beta_2 + \alpha (\log g_1 - \log g_2) + \frac{m}{2}(N - 2n_1) = 0 \tag{6}$$

Equation (4) and (5) show the optimal allocation of local public goods and equation (6) indicates the optimal allocation of population. From equations (4) and (5), the following conditions are derived:

$$g_1 = \left(\frac{\alpha n_1}{\gamma}\right)^{\frac{1}{\gamma}} \qquad g_2 = \left(\frac{\alpha (N-n_1)}{\gamma}\right)^{\frac{1}{\gamma}} \tag{7}$$

By substituting these equations into (6), the efficient allocation condition of the population is obtained as:

$$L(n_1) = \beta_1 - \beta_2 + \frac{\alpha}{\gamma} \log \frac{n_1}{N - n_1} + \frac{m}{2}(N - 2n_1) = 0 \tag{8}$$

From (8), we obtain the efficient allocation of the population: When $\frac{\alpha}{\gamma}\frac{4}{N} > m$, that is, the travel cost is small, the optimal population of district

1 is smaller than the other district, and this allocation is a unique solution. Conversely, when the travel cost is not small, the case arises where the optimal population of district 1 is larger than the other district. Then, the following lemma is derived.

> **Lemma 1** Consider a region where two districts exist. In the optimal allocation of population, when the travel cost is sufficiently small, the population of the more productive district is smaller than the other district, and this allocation is a unique solution. Conversely, if the travel cost is sufficiently high, the case arises where the population of the more productive district is larger than the other district.

Individuals can consume more local public goods if the travel cost is sufficiently small. Then, the effect of local public goods is more significant. In the low productive district, more local public good should be produced through the larger population to compensate for the low income. Therefore, the low productive district should have more population; however, when the travel cost is higher, the effect of the private production is more significant. Then, more private goods must be produced. For producing the good, the high productive district should have more population. In the following analysis, the high productive district (district 1) is assumed to have more population, though the population difference is small. These populations are ${n_1}^*$ and ${n_2}^*$ and satisfy that ${n_1}^* > {n_2}^*$, $\frac{\partial L(n_1)}{\partial n_1} \leq 0$, and the travel cost is not small. From the following analysis, in this case the existence of the small district may be valuable.

The comparative statics for the optimal population ${n_1}^*, {n_2}^* = N - {n_1}^*$ are as follows. First, the increase in the production technology β_1, β_2 has the following effect. Using (8), when the production technology in one district rises, the population of that district increases, having a direct effect. Next, consider the effect on the local public good. If the utility weight of the local public good increases, the population of district 1 increases. In district 1, the rising population may increase the production of local public good through private production. In district 2, the decreasing population improves the utility by decreasing the travel cost. Similarly, consider the effect of scale economies in producing the local public good. When the scale economies increase (γ decreases), the population of district 1 increases.

This rising population could utilize more scale economies through private production.

Third, we analyze the effect of the travel cost. Using (8), when the travel cost per unit of distance m increases, the population of district 1 decreases. It is necessary to decrease the scale of district 1 to decrease the total travel cost because it is larger than the other district in the model assumption.

Finally, consider the effect of total population N. The impact on the population level in each district is not obvious, though we can show the effect on the difference between these population. If the total population N increases, the difference of the population $n_1 - n_2$ decreases. Because the population of district 1 is enough to utilize the scale effect, the agglomeration in district 1 should be restricted to limit the travel cost.

We utilize the regions aggregate land rent in the following analysis to evaluate the social optimum. In this section, concerning the case where two districts exist in the region, the aggregate land rent is:

$$N\left[\beta_1 + \frac{\alpha}{\gamma}\log n_1^* - \frac{mn_1^*}{2}\right] + \frac{m}{4}n_1^{*2} + \frac{m}{4}(N - n_1)^2 - uN + \frac{\alpha}{\gamma}N\left\{\log\frac{\alpha}{\gamma} - 1\right\} \quad (9)$$

The following analysis compares equation (9) and the aggregate land rent in the consolidation case.

3.2 The consolidation case

In this region, two districts can consolidate to one district. Then all populations allocate to district 1. In the consolidation district, only one local government locates in the district center over the interval $[-\frac{N}{2}, \frac{N}{2}]$ and provides the local public good. All individuals must travel to that place to consume the local public good. The aggregate land rent is:

$$\begin{aligned} S_A &= 2\int_0^{\frac{N}{2}} \left[\beta_1 - mr - \{u - \alpha \log g\} - \frac{g^\gamma}{N}\right] dr \\ &= \{\beta_1 - u + \alpha \log g\}N - g^\gamma - \frac{mN^2}{4} \end{aligned}$$

where g is the amount of the local public good in the consolidation district. Similar to the two-district case, the central planner maximizes the aggregate land rent. From this maximization problem, the optimal amount of local public good is as follows:

$$g = \left(\frac{\alpha N}{\gamma}\right)^{\frac{1}{\gamma}}$$

Then, the aggregate land rent is:

$$S_A = N\left[\beta_1 + \frac{\alpha}{\gamma}\log N - \frac{mN}{2}\right] + \frac{m}{4}N^2 - uN + \frac{\alpha}{\gamma}N\left\{\log\frac{\alpha}{\gamma} - 1\right\} \quad (10)$$

The next section compares the aggregate land rent in the two-district case and that in the consolidation case.

4 The comparison of land rent

This section analyzes whether the existence of small districts increases efficiency relative to the consolidation case. First, we compare the land rent in each case and show that the two-district case is more efficient than the consolidation case. Second, we analyze the comparative statics to analyze the social optimum.

4.1 The comparison of land rent

This section analyzes the effect that two districts coexist in the model where they can consolidate into one district that exploits economies of scale in producing private good. This study utilizes land rent to evaluate that effect.

From the analysis of the previous section, when two districts coexist, the aggregate land rent S is the equation (9). Conversely, if they consolidate into one district, the aggregate land rent S_A is the equation (10). The difference between these land rents is as follows:

$$S_A - S = N\frac{\alpha}{\gamma}\log\frac{N}{n_1^*} - \frac{m}{2}(N - n_1^*)^2 \tag{11}$$

When the equation (11) is positive, the land rent in the consolidation case is more significant than in the two-district case, meaning that the consolidation is valuable. Conversely, when the equation (11) is negative, the land rent in the coexistence of two districts is worthwhile.

First, consider that the travel cost m is sufficiently small, though it is assumed that this cost is not small in the model. Then, the equation (11) is always positive. From these results and the analysis of the previous section, the following lemma is derived:

> **Lemma 2** Consider the optimal allocation of the population in the two-district case. If the allocation of the population of a more productive district is smaller than the other district is a unique optimal solution, the consolidation is always more valuable than the coexistence of two districts.

When the travel cost is sufficiently small, in the effect of local public good, the diseconomies of scale disappear. Then, the consolidation that can exploit economies of scale in producing the private good is a valuable policy.

Next, consider the case where the travel cost is not small. In the model, we assume that n_1^* is larger than $\frac{N}{2}$ and $n_1^* - n_2^*$ is not significant. In this assumption, equation (11) is minimized when n_1^* is nearly $\frac{N}{2}$ and increases with an increase in n_1^*. Therefore, the following proposition is derived:

> **Proposition 1** When the travel cost per distance is sufficiently high and the difference in population between the two-district case is sufficiently small, the aggregate land rent in the two-district case is larger than that in the consolidation case. The difference between these land rents increases with a decrease in the population differentials.

Regarding land rent, we show that the coexistence of the two-district is more valuable than the consolidation when travel cost is sufficiently high, and the difference in population between the two districts is sufficiently small. If these two districts consolidate, this consolidation doubles the travel distance for consuming the local public goods because their scales are almost the same. Moreover, because the travel cost per distance is high, the negative effect of consolidation is larger than the economies of scale. Then, the relative value of coexistence is more significant.

4.2 Comparative statics

Section 4.1 shows that the coexistence of the two districts is more valuable than the consolidation. This section utilizes comparative statics to analyze that case in detail.

First, the increase in the production technology $\beta_1(\beta_2)$ has the following effect. Using (8), when the production technology in district 1 increases, the difference in land rents (11) increases. Because the population of district 1 increases, the difference between the two districts increases. This effect decreases the relative land rent in the coexistence of two districts. Otherwise, if the production technology in district 1 decreases, the population difference between the two districts decreases. Then, the relative value of coexistence is more considerable.

Next, consider the effect on the local public good. If the scale economies in the production of the local public good increases (γ decreases), the difference in land rents (11) increases. From the analysis of the previous section, the population in district 1 increases; thus, the difference between the two districts increases, and the consolidation is more valuable. Conversely, if γ increases, the difference between the two districts decreases, increasing the value of the coexistence between the two districts.

Finally, we analyze the effect of total population N. From the equation (11), the following equation is derived:

$$\frac{\partial}{\partial N}\{S_A - S\} = \frac{\alpha}{\gamma}\log\frac{N}{n_1^*} - \frac{m}{2}(N - n_1^*) \tag{12}$$

Consider the population $\hat{n}_1$ that satisfies the equation (12) is zero. When $n_1^* < \hat{n}_1$, (12) < 0, meaning that the difference in land rents (11) decreases with the increase of the total population N. Conversely, when $n_1^* > \hat{n}_1$, (12) > 0, meaning that (11) increases with the rise in the total population. Section 4.1 shows that only when the travel cost per distance is sufficiently high and the difference in population in the two-district case is sufficiently small, the coexistence of the two districts is more valuable than the consolidation; therefore, we only analyze this case. In this case, $n_1^* < \hat{n}_1$ is satisfied, and the difference in land rents decreases with the increase of the total population N. If the total population increases, the difference of the population decreases and the relative land rent increases in the coexistence case. Conversely, when the total population decreases, the agglomeration in district 1 is fostered, and the relative land rent decreases. Though the land rent in the consolidation case decreases, the negative effect in the two-district case is more important, increasing the value of the consolidation.

In summation, the coexistence of the two districts is more valuable than the consolidation when the production technology is not large, the scale economies in producing the local public good are insignificant, and the total population is large.

5 Conclusion

This paper analyzes whether district consolidation is efficient. In each district, the local government provides the local public good with a centrifugal effect because of the travel cost; however, consolidation is efficient for private sector's production. This paper utilizes the land price in the model analysis. We compare land rents in the consolidation case and the division of two districts, showing that the division of two districts is more valuable than in the consolidation case. Additionally, we analyze when that case arises.

This paper found the following results. When the travel cost is sufficiently high, and the difference in populations in the division case is sufficiently small, the aggregate land rent in the division case is more significant than that in the consolidation case; the division of two districts is more valuable than the consolidation. That difference in land rents is more significant when the private production technology is not large, the scale economies in producing the local public good are not large, and the total population in the two districts is large. In this case, the small district division is more efficient and the consolidation of these district is not efficient.

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