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Social welfare and internal and external economies for the integration of public services¹

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Abstract In a country with a declining population growth, public services in rural areas face potentially problematic issues in terms of long-run sustainability, brought about by insufficient economies of scale. Since these services play an important role in the social infrastructure, their disappearance from society would result in a further population decrease in rural areas. Under such circumstances, it is necessary to explore how public services can be made sustainable in the long run, since these services are directly related to social welfare and the well-being of local residents. Although these services are essential, there are some areas that need to be reduced or eliminated as a result of insufficient demand. Since each service should be sustainable on an appropriate scale, scope, and complexity, a theoretical analysis may reveal important implications. The first section of the paper considers a location model, in which public services may operate in an integrated way. In the second section, the integrated managerial structure of public services is evaluated by studying the effects of internal and external economies, which are categorised in terms of scale, scope, and complexity. If these categories are spatially constrained, we then have an agglomeration economy. The final section considers both policy and practice in a realistic case that explores the trade-off between integrated organisation and transportation costs. The results show that the integrated framework can be further enhanced by highly advanced systems of communication in an internal economy and by transportation in an external economy. This

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enhancement may in turn improve other aspects of attaining well-being for people in rural areas.

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1 INTRODUCTION

It is commonly recognised that public policies for sustainable rural development are closely related to economic infrastructure elements, which can be directly relevant to industrial activity. However, social infrastructure elements also need to be enhanced to achieve a sustainable rural economy (RILAC, 2012). Social infrastructure elements, such as well-being, may not be relevant to the gross regional product, but regional development without these elements causes a constant decrease in the population, as is commonly seen in typical rural areas (Nakamura, 2011). Ideally, these elements are maximised for the population, but it is more important that they are also sustainable in the long run. Hence, optimising the attainment of well-being becomes one of the essential objectives for local government. Related to this subject, the OECD has a better-life index, which is composed of the following 11 factors: housing, income, jobs, community, education, environment, civic engagement, health, life satisfaction, safety, and work-life balance.² These elements are closely related to public services, so this paper focuses in particular on the sustainability of public higher-education services. These services maintain well-being attainment by enhancing the community and education criteria. While these services may encourage local talent and provide technology spill-over to local economic activity, they require certain economies of scale and scope, which may not be available in areas with a decreasing population. Only if the local population growth rates recover to a certain level, the centrifugal force of local population and economic activity in rural areas expand further.

To avoid such a vicious circle, the recovery of the centripetal forces of local population and economic activity can be brought about by enhancing higher-education facilities in rural areas. This restructuring process may be relevant to the integration or dispersion of managerial operations of economic activity, which can be examined in terms of

² The OECD Better Life Index - <http://www.oecdbetterlifeindex.org/>.

internal and external economies. Note that there exist both spatially unconstrained and spatially constrained economies, and that the former are not agglomeration economies. Internal and external economies play various roles, as referred to by Stigler (1951), Meade (1952), and Scitovsky (1954). If these economies are spatially constrained, they are called agglomeration economies. Agglomeration economies were investigated in a tripartite method by Parr (2002) with respect to scale, scope, and complexity. While the concept of agglomeration economies has been used by firms and industrial organisations when deciding on location, the idea can also be applied to the structure of business administration in public services. These services include public schools, public universities, public hospitals, and so on. However, sometimes these services need to be reduced or eliminated as a result of insufficient demand by a decreasing local population, which, in the long run, may be more evident in rural areas.

In this paper, the location model considers a situation in which local public services face problems of a revenue decrease and cost increases as a result of a diminishing local population and insufficient economies of scale in public services, such as rural public universities. In the case of Japan, PUA (2009) studied empirical cases for regions in the southern part of Japan and proposed an integration of those organisations. In addition, Yada (2010) revealed that public universities have been suffering from managerial problems in terms of long-run sustainability on a limited scale and scope. By applying the New Economic Geography (NEG) framework, López-Rodríguez and Nakamura (2011) revealed the effects of remoteness on Japanese educational levels. They explained that rural areas tend to have disadvantageous educational disparities across the nation. However, these studies have not provided a sufficient theoretical approach that we can use to solve the problematic issues stated above. Hence, this paper investigates the impact of changes in managerial structure on internal and external economies in terms of scale, scope, and complexity. Since the argument includes the notion of distance, the trade-off between the integrated organisation and transportation costs is also considered.

The following section establishes a basic model in location theory. In section 3, the model is explained in more detail with the notion of agglomeration economies in terms of both cost and revenue. In section 4, policy and practice are analysed, followed by a consideration of social welfare in section 5. Finally, we show that highly advanced systems of communication in an internal economy and of transportation in an external economy may play important roles, together with the reorganisation of the spatial administrative structure.

2 A LOCATION MODEL

The model argues a situation in which public services in each district face problems of insufficient economies of scale and so attempt to establish an integrated managerial linkage. Here, we consider public facilities such as state universities. It is first assumed that there are n spatially dispersed public universities in each district within a state or province. Here, public universities are neither national nor private universities, and they have a state-wide association with other public universities. Formally, the initial situation can be represented using the following cost structure:

$$C_U = \sum_{i=1}^n \left(F_i + [(c_i + h_i) \cdot q_i]^{1/\alpha} \right) \quad (1)$$

where F_i = fixed cost for the i th university ($i = 1, \dots, n$), c_i = unit cost for the operation of facility elements, h_i = unit cost for human resources, and q_i = the number of students. The remaining variable, α ($0 < \alpha < 1$), represents the relative quality of teaching. A higher value of α indicates a higher quality of teaching so that the total cost can be saved, and vice versa.

In terms of revenue, each university is assumed to receive subsidies from the local government, as well as tuition fees from registered students. Hence, the total revenue of all universities can be expressed as

$$R_U = \sum_{i=1}^n (s_i + r \cdot q_i) \quad (2)$$

where s_i = fixed subsidiary payment from the local government and r = unit tuition fee from each student. Hence, the profit is the combination of (1) and (2):

$$\pi_U = \sum_{i=1}^n (s_i + r \cdot q_i) - \sum_{i=1}^n \left(F_i + [(c_i + h_i) \cdot q_i]^{1/\alpha} \right). \quad (3)$$

As we would intuitively expect, this implies that public universities in rural areas may not be sustainable under conditions of a decreasing population, since the number of students in public universities is generally positively related to the local population. In addition, the decrease in the local population also reduces tax revenue for the local government, which in turn affects the revenue available to public universities. In addition, a university can sustain its profit level by increasing the tuition fee. In this case, under the condition where each university i has a symmetric cost and revenue structure, yielding the profit function π_i as follows:

$$\pi_i = s_i + r \cdot q_i - \left(F_i + [(c_i + h_i) \cdot q_i]^{1/\alpha} \right). \quad (4)$$

Since public services do not generally operate in a perfectly competitive market, they can maximise profit at the point where marginal revenue, MR , equals marginal cost, MC , as illustrated in Fig. 1.

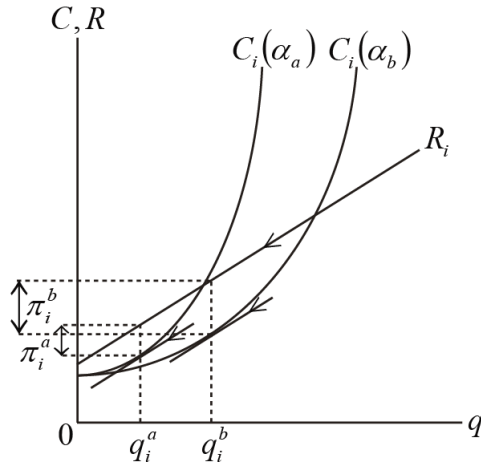


Fig. 1 The parameter α and profit level

In Fig. 1, the two cost curves indicate cases where α is lower (α_a) and higher (α_b) for a corresponding optimal scale, q_i^a and q_i^b , and profit level, π_i^a and π_i^b . These are also summarised in Table 1.

Table 1. The parameter α and corresponding outcomes for q_i and π_i

α	$\alpha_a < \alpha_b$
q_i	$q_i^a < q_i^b$
π_i	$\pi_i^a < \pi_i^b$

Formally, this evidence can be expressed as

$$\frac{\partial \pi_i}{\partial q_i} = r - \frac{1}{\alpha} [(c_i + h_i) \cdot q_i]^{(1/\alpha)-1} = 0. \quad (5)$$

The sufficient second-order condition for revenue maximisation is satisfied by

$$\frac{\partial^2 \pi_i}{\partial q_i^2} = -\left(\frac{1}{\alpha} - 1\right) \frac{1}{\alpha} [(c_i + h_i) \cdot q_i]^{(1/\alpha)-2} < 0. \quad (6)$$

From equation (4), it is apparent that an increase in the number of students raises the profit level. To maximise their profit level, each university should either increase the tuition fee or decrease the cost factors, including the parameter α . However, the former may be difficult, since there are other alternatives in the market, such as national and private universities ($dq_i / dr_i < 0$) when the total revenue significantly exceeds the total cost. As a result, reducing cost factors may be a more plausible option. Hence, each public university needs to improve the quality of education, α , reduce fixed costs, F_i , reduce unit costs for facility elements, c_i , or reduce human resource costs, h_i .

Under such circumstances, improvement can be further enhanced by a managerial integration across the state. For reasons of simplicity, the integration is limited to the existing operation of the university, and therefore does not consider relocating an existing university. In other words, there is a state-wide university association, and there are $n-1$ existing universities that fall under the full control of the main managerial office. The argument for integration is related to the advantages of agglomeration economies together with the trade-offs in transportation costs.

3 INTERNAL AND EXTERNAL ECONOMIES

The impact of an integration of public services on costs and benefits can be analysed in terms of agglomeration economies. As explained earlier, agglomeration economies are spatially constrained internal and external economies categorised in terms of scale, scope, and complexity. With respect to spatially constrained internal economies, the following argument may be provided. First, the integration utilises internal economies of scale. This is simply as a result of the horizontal addition of the total number of students and the human-resource supply. In other words, in this situation, the average fixed cost decreases as the quantity of product increases within the framework of conventional economic theory. Hence, the anticipated problem of insufficient economies of scale can be solved. Second, the internal economies of scope may also be enhanced. For example, if a particular public university does not have a department of medical science but another university does, then these facilities can be shared. This enhancement of variety increases potential applicants to these public universities as long as the love of variety assumption works. This argument is relevant in

terms of the market competition with other groups of universities, such as national and private universities. Finally, internal economies of complexity may be available when the leadership between the headquarters and the universities is well-organised. If these universities are located close to each other, these enhancements can be completed within this framework. However, if the universities are physically dispersed, distance factors need to be included, such as transportation costs, communication costs, and other spatial-cost elements. These costs are examined in the following section.

With regard to spatially constrained external economies, first, localisation economies can be utilised by collaborating on advanced research and development for the specialised production of goods and services within directly related activities in these regions. Those may be available without public university integration. However, the involvement of integration offers more benefits through the spill-over effect of highly qualified intellectual knowledge. For instance, if a local firm needs more advanced machinery and a local public university has a laboratory that can create new machines in a highly qualified intellectual research environment, a joint project between the two agents may be mutually beneficial. Second, urbanisation economies cannot directly relate to this analysis. However, there are some indirect effects. If the spatial administrative system works with interregional coordination and university integration, the state population may increase to a level such that each economic agent can engage in self-sufficient activity. The increase of the state population further expands urbanisation economies. However, it should be noted that this particular mechanism requires interregional administrative coordination by means of the reorganisation of the spatial administrative structure. This will be examined in more detail in the following sections. Finally, activity-complex economies would be available through collaborative research and development across different economic activities within the region. The fundamental difference between activity-complex economies and localisation economies is that localisation economies are engaged within the same industry, whereas activity-complex economies involve different types of industries that are indirectly related to each other.

These combinations can improve the quality of teaching and research so that the value of α declines. To be precise, external economies may attract firms to locate themselves in the area, which creates jobs and so helps the local population recover to a sustainable level. To utilise these economies, namely localisation and activity-complex economies, internal economies need to be expanded as well. Hitherto, the impact of the integration on the costs and benefits of public services is examined under the condition that the spatial administrative

structure is fixed. However, if the universities to be integrated are geographically dispersed, a reorganisation of the spatial administrative structure further expands these beneficial criteria on agglomeration economies by reducing the trade-off factor on spatial costs. A detailed analysis will be provided in the following section.

4 POLICY AND PRACTICE

It has been clarified that spatially constrained internal and external economies are relevant to transaction and transportation costs if the activity includes geographically dispersed universities. Hence, transaction and transportation costs between two agents should always be minimised as long as the size of region is significantly large. Namely, first, the argument involves interregional movement by communication rather than by the physical movement of economic agents. In other words, public services can be coordinated online, so a well-established network of communication eliminates the notion of distance. Second, there are several cases in which the physical movement of an economic agent is required. For instance, face-to-face matters affect the accessibility between two different locations. If a lecture taught by a particular person is held once a week at every university, that person's travel costs are much higher than in a non-integrated system. In addition, if a monthly board meeting is held at an integrated location, all members of the committee have to travel to that venue on a regular basis.

Taking these factors into account, we can re-express equation (1) as follows:

$$C_I = \sum_{i=1}^n \left[t_i d + (F_i + [(c_i + h_i) \cdot q_i]^\alpha) \right]^{\sigma/n} \quad (7)$$

where t_i = total transportation costs at university i to access other universities located at a distance d , and σ ($0 < \sigma < n$) = the effect of internal and external economies by virtue of the integration. The other variables are the same as in equation (1). When internal and external economies work well, the value σ approaches zero. In contrast, the value σ approaches n if these economies are not working well. As investigated by Weber (1909), followed by Isard (1956), there is a trade-off between transportation costs and agglomeration economies. Although this integrated framework may be spatially unconstrained, it is still possible to discuss the trade-off between extra transportation costs as a result of integration and the benefits of integrated internal and external economies. The integration indicator, A_I , in the cost term can be defined as follows:

$$A_i = \sum_{i=1}^n \frac{\left(t_i d + F_i + [(c_i + h_i) \cdot q_i]^\alpha \right)^{\sigma/n} - \left(F_i + [(c_i + h_i) \cdot q_i]^\alpha \right)}{t_i d}. \quad (8)$$

Here, integration is only possible if A_i is less than 1. Otherwise, the integration causes excess transportation costs, which are greater than the advantages of the internal and external economies. Such operational decision-making can depend on the initial location of these facilities, as well as the interregional transportation network.

The situation is illustrated in Fig. 2. Here, two representative facilities are located at L_A and L_B , respectively. Note that they each have the same cost structure. In the original non-integrated case, the total cost of each facility is C_1 , while the integrated total cost is C_2 , which is much lower than the original situation. However, in the integrated case, we need to include transportation costs, and so the total cost becomes C_3 . The transportation-cost rate is given by the slope, t_i , as well as the physical distance, d . As d increases, this excess-cost problem becomes more serious and an alternative system should be coordinated. If an additional investment in a more advanced communication system is available, such as satellite lectures and web-based meetings at level C_R , further cost-saving opportunities exist. Here, if the advanced communication system covers half the distance between the two locations, the total cost, C_M , becomes

$$C_M = \frac{1}{2}(C_3 + C_R) + F_M. \quad (9)$$

where F_M = additional investment for the more advanced communication system. More generally,

$$C_M = (1 - \lambda) \cdot C_3 + \lambda C_R + F_M. \quad (10)$$

where λ ($0 < \lambda < 1$) = the relative weight of the advanced communication system. To achieve lower cost levels than in previous situations, the following condition has to be satisfied:

$$(1 - \lambda) \cdot C_3 + \lambda C_R + F_M < C_3 < C_1 \quad (11)$$

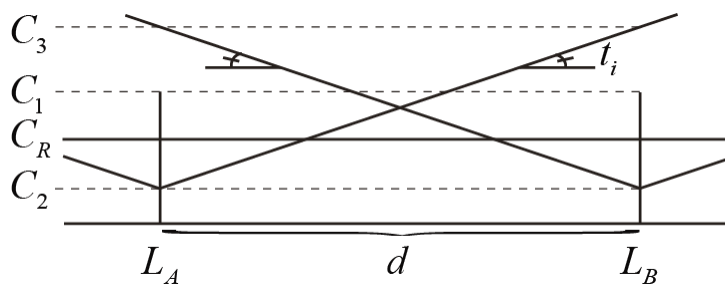


Fig. 2 Non-integrated and integrated cases

As a result, it is important to only invest in additional communication facilities up to the level where the excess transportation-cost rate, t , is completely offset. If the additional investment exceeds the given economies of scale for the integrated framework, the amount of investment should be limited to the optimal level. Once the integrated system works in an appropriate cost-benefit ratio, each public facility may be sustainable in terms of scale, scope, and complexity without a need for subsidies from the local government. Additionally, such effects can have a positive impact on the regional economy through the improvement of social welfare, which is discussed further in the following section.

5 SOCIAL WELFARE

In previous sections, the focus of the argument has been on the managerial restructuring of public services. As noted in the introductory section, the main objective of this paper is to reveal the impact of these changes on social welfare at local levels. The better organisation of public universities exemplified in previous sections can be beneficial to local residents in terms of the community and education category in the OECD better-life index, which is one of the social infrastructure elements. These elements not only contribute to the enhancement of consumer welfare, but also increase producer surplus. Moreover, other elements, such as housing, income, jobs, environment, civic engagement, health, life satisfaction, safety, and work-life balance can also be improved if additional affiliation with local institutions, firms, and other economic and social activities are expanded across the wider coordinated region.

To be precise, such an approach is related to the regional social welfare in terms of spill-over and financial factors. First, if each university achieves a significant improvement in the quality of education, research collaboration and development schemes may enhance the regional economy through spatially constrained external economies of scale and complexity, as revealed in the previous section. These applications to localisation and activity-complex

economies can secure regional economic growth and development in the long run, beyond the sustainability of public universities. In addition, a reorganisation of the spatial administrative structure that eliminates regional boundaries across the state expands the physical capacity of economic activity, and centralisation at the state level provides opportunities for urbanisation economies. These economies can improve well-being by enhancing the interregional transportation network. Here, it should be noted that the expansion of the interregional transportation network needs to be limited in its extent to the local population level so that the relevant service is sustainable. If such a limitation excludes some residents, an alternative community-level central-place system must be established (see Nakamura, 2012).

Second, the inefficient operation of a public university consumes a larger amount in local subsidies. If the operation recovers to a certain level, the ratio of local subsidies may be reduced by obtaining external funding through research in conjunction with local business. Since local subsidies are essentially paid from regional taxes, paid by local citizens, these costs should reflect certain benefits, such as those in localisation and activity-complexity economies. These benefits can be observed in the value of s_i in equation (2), which indicates a fixed subsidiary payment from the local government. In this case, the absolute value of s_i increases, but as a result of external funding rather than funding from the local government. At the same time, the amount of local subsidies declines as a result of the reduction of the ratio of local subsidies. Hence, the total profit may increase because of the improvement in revenue in equation (3). Moreover, the total cost can reduce by taking a higher value of α through more qualified teaching in equation (1), as well as the parameter σ in the previous section. These increased profits may allow more investment in research and education facilities, which will help expand the regional economic system in the future.

In this way, a structural change in public services brings about better levels of social welfare. In addition, an enhancement in higher education is needed in developed countries, as they tend to become less competitive internationally as a result of generally higher prices and costs. In other words, they need to maximise revenue rather than minimise costs to maintain their overall profit level. Interregional cooperative coordination may play an important role in the effectiveness of these positive effects on social welfare. More precisely, it becomes apparent from the previous section that the integrated framework can be further enhanced by highly advanced systems of communication in the internal economy and by transportation in the external economy. The transportation infrastructure needs to be arranged by local

authorities, aided by interregional coordination, which allows better organised and more efficient transportation networks. The additional improvement in accessibility may also improve other elements of well-being in rural areas with decreasing populations.

6 CONCLUDING COMMENTS

This paper has examined a systematic restructuring of public services in rural areas with decreasing populations. First, we explained that there is a trade-off between integrated organisation and transportation costs. Second, the results show that the integrated framework can be further enhanced by highly advanced systems of communication in the internal economy and by transportation in the external economy, both of which may further improve other elements of well-being attainment in rural areas with decreasing populations. In addition, it is argued that the reorganisation of the spatial administrative structure within the state may play an important role in expanding these strategies. While this paper mainly explores the case of public universities in rural areas, the method used here can also be applied to other types of public services, such as the management of public hospitals, to accelerate regional economic development and growth.

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