Cost-efficiency of Japanese local governments: effects of decentralization and regional integration

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Stochastic frontier analysis is used to examine the cost-efficiency of Japanese local governments at a prefectural level, corresponding to states in the United States. The issue of cost-efficiency has two policy concerns for fiscal decentralization: one is whether fiscal transfers from central government to local governments influence cost-efficiency; the other is whether the size of the local population influences cost-efficiency. This study empirically confirms that the fiscal transfers have a negative effect. In contrast, population size has a positive effect. The two findings may suggest that Japanese local governments can improve their cost-efficiencies by both reducing the amount of fiscal transfers via decentralization and increasing a population growth via regional integration.

Keywords: cost-efficiency; local government; decentralization; regional integration; fiscal transfers; population size; stochastic frontier analysis

Introduction

Many previous studies have argued that decentralization is important for enhancing the cost-efficiency of local governments. They have also discussed that public servants for local government can handle regional issues more efficiently than them for central government (Balaguer-Coll, Prior, & Tortosa-Ausina, 2010; Broersma, Edzes, & van Dijk, 2013). In the United States and European Union, the decentralization of government, often along with regional integration, has been an important regional policy issue towards an ultimate goal of enhancing social welfare (Borghi & van Berkel, 2007a, 2007b; Eichhorst, Kaufmann, & Konle-Seidl, 2008; Habibov & Fan, 2010; Organisation for Economic Co-operation and Development (OECD), 1999, 2003; van Berkel, 2006).

Rodriguez-Pose & Sandall (2008) considered the decentralization as a way to attain greater efficiency and competitiveness. Rodriguez-Pose & Gill (2005) discussed the fact that the decentralization was a vehicle to achieve homogenization and economic change. A conceptual basis for their views depended upon the decentralization theorem proposed by Oates (1972). The theory implies that local governments always operated more efficiently (or at least at the same efficiency) than central government in terms of providing public goods to their respective jurisdictions. However, as indicated by Rodriguez-Pose & Ezcurra (2010), the fiscal decentralization in recent years has been also more associated with a significant rise in regional disparities.

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The policy direction towards decentralization has accelerated in recent years after the major political initiative, referred to as the reform proposed by the Koizumi Cabinet in the 2000s. The administration has been reducing the transfer of tax revenue from central government to local governments. Simultaneously, the Japanese government has promoted regional integration at a municipal level, resulting in an increased population size of each municipality. The government expected that the two policy directions could advance the decentralization. Consequently, the introduction of a new regional system, consisting of a wider administration unit, has been gaining evermore attention as an important policy issue.

In contrast to government’s expectation, there is criticism of the reform that the current system of fiscal transfers from central to local governments has hampered the decentralization (Akai, Sato, & Yamashita, 2003). The fiscal transfer system aims to redress the disparities in fiscal capacities among local governments so that it can guarantee a certain amount of financial resources to each entity. However, studies such as Doi (2010) have disagreed on the policy claim, stating that the current system does not motivate local governments to improve their levels of cost-efficiency.

To examine the overarching objective of Japanese decentralization policy, this study needs to examine how the fiscal transfer system, along with an increase or a decrease in a population size, influences the cost-efficiency of local governments. Under the confirmation of the two influences, it is possible to suggest that Japan needs to expand the population size at a local government unit by regional integration. The nation also needs to review the current fiscal transfer system. The latter concern is because the fiscal transfer system is definitely an important component for successful decentralization, in which the central government delegates its authority to local governments.

As discussed above, the purpose of this study is to analyse the effect of a fiscal transfer and an increased population size due to regional integration on the cost-efficiency of local governments. For this purpose, it uses a data set on Japanese decentralization policy at a prefecture level. Thus, this study is concerned with discussing policy implications on fiscal decentralization. That is a contribution of this study.

It is important to note here that this study defines decentralization as financial independence for local governments because independence provides them with strong autonomy in their administrations. This study also defines the amount of administrative services, provided by a local government, as the size of the population because the administrative services are mainly for individuals and businesses, so that the amount of the services depends on a population size.

The paper is structured as follows. The second section introduces the two hypotheses that the proposed analysis examines. The third section describes the cost function and its related estimation models. The fourth section describes a data set used in the empirical analysis. The fifth section summarizes estimation results obtained in this study. The sixth section concludes along with future extensions.

**Hypotheses development**

**Fiscal transfer**

In Japan, decentralization and fiscal transfers may not be two major components under the same policy direction. Rather, fiscal transfers have functioned to obstruct the financial independence of local governments. They are centred on the allocation of taxes to local governments, which have contributed to the stable growth of Japan’s regional economies after the post-war period with high economic growth. The system of
allocating taxes to local governments plays important roles in correcting financial disparities between local public bodies and adjusting government finances. In addition, it is a system for securing financial resources for local public entities. The taxes allocated to local governments are a financial resource that local public entities can use for any purpose they choose. The Local Allocation Tax Act determines the total amount of tax allocation from the national to local governments. The act establishes the framework of tax allocation that gives a fixed ratio of national taxes to local governments from the general account.

A problem of the allocation system, which fiscally transfers tax from central to local governments, suffers from a policy difficulty of ‘soft budget constraints’. The constraints invite inefficiency in fiscal and administrative management (Akai et al., 2003), because local governments, which conduct inefficient fiscal and administrative management, anticipate central government’s bailout by the fiscal transfers. Consequently, they may neglect cutting expenditures and securing tax revenues. Inherently, if the local government’s decision-making is rational, it attempts to minimize the cost burden from providing local public services and maximize social welfare. However, under the current system, the total amount of taxes allocated to local governments comes from national taxes. Thus, they are not required to undertake an additional cost burden in order to obtain the local allocation tax. As a result, the current system may invite a moral hazard in the manner that local governments strive to obtain more tax allocations for their financial resources.

Under such a generous system, local governments lose incentives to make efforts to gain administrative efficiency. They are also inclined to engage in wasteful public investment, so resulting in a delay of industrial structure conversions in regional economies. Consequently, they invite the rigidification of industrial structures that may cause a decline in production activities in industries. Local governments lose not only their cost-efficiency but also administrative discipline and autonomy. They just follow central government’s policy and rely on the tax allocation to obtain financial resources.

Previous empirical studies have already demonstrated that the current fiscal transfer system does not have incentives for improving cost-efficiency. For example, Otsuka, Goto, & Sueyoshi (2010), and Otsuka & Goto (2013) used a data set at Japanese prefecture level. They argued that the efficiency of regional industries decreased by fiscal transfers from central government to local governments. However, their study belonged to the context of a private sector and it did not measure the cost-efficiency of local governments. Meanwhile, De Borger & Kerstens (1996) measured the cost-efficiency of local governments in Belgium and showed that their efficiency levels declined because of financial dependence on intergovernmental subsidies. In contrast, Kwon (2003) suggested that fiscal decentralization in Korea has played an important role in improving the cost-efficiency of local governments. Admitting those different views in the previous studies and Japan’s unique institutional feature mentioned above, this study formulates its first hypothesis:

\[ H1: \text{Fiscal transfers reduce the cost-efficiency of local governments} \]

**Population size**

In Japan, local governments that have relatively smaller populations receive preferential treatment in terms of enjoying a higher ratio of national fiscal transfers. Thus, it is difficult to motivate these smaller local governments to join regional integration and
facilitate fiscal decentralization. However, even for those smaller local governments, there is a benefit from a larger population. If the population size of a regional administrative unit grows because of regional integration, agglomeration economies come into effect because the size of a regional economy becomes larger and executive power can have a significant strength. Indeed, many municipalities consolidated in Japan during the 2000s attained higher administrative powers. As a result, infrastructure was prepared in various regions, interregional migration increased and the population became concentrated in new centres.

Returning to the topic of financial independence, this study needs to discuss it along with decentralization. For financial independence, an increase in tax revenues received from local areas is essential, which in turn requires an increase in the population size through regional integration. An increase in the population size stimulates regional economies through the externalities generated by agglomeration economies. The stimulation of regional economies can contribute to increased regional migration, so resulting in a further increase in tax revenues. Such a virtuous cycle raises the level of local government’s financial independence. Thus, an increase in a population size after a regional integration may result in decentralization.

With the expansion of administrative districts accompanied by the mergers of municipalities, momentum for institutional reform has grown in Japan which would abolish the current prefectural system that acts as an intermediary government and introduces a new regional system that covers a wider area. Such regional integration may contribute not only to enhancing the administrative functions of local governments, but also to reducing local government’s expenditure by lowering administrative expenses per capita. This study, therefore, proposes a second hypothesis:

\( H2: \text{Increased population size improves the cost-efficiency of local governments} \)

**Methodology**

First, this study describes a cost function for local governments based upon a theoretical model (Otsuka 2007). It then proposes a new empirical model for stochastic frontier analysis (SFA) based on the formulated theoretical model.

**Theoretical model**

This study considers one-region models. The population of region \( i \) is written as \( P_i \) and the area size is denoted by \( L_i \).

Household budgets have a same utility function \( u(x_i, g_i) \), where the consumption of private goods and the public goods of a household in region \( i \) are denoted by \( x_i \) and \( g_i \), respectively, along with their utility function derived from the following log-linear function:

\[
\ln u_i = u(x_i, g_i) = x_x \ln x_i + x_G \ln g_i
\]

where \( 0 < x_x, \ 0 < x_G \).

Here, it is assumed that the benefit of local public goods does not spill over to other regions in order to simplify the model and to facilitate the interpretation of the cost function. The production of private goods in each region is thus expressed by an aggregated Cobb–Douglas production function that considers the external effects of population agglomeration:
where 0 < \( x_P < 1 \), \( 0 < x_L < 1 \), and \( \mathbf{e}_i \) is a vector of control variables consisting of social–environmental factors that affect the externalities of population agglomeration.

Considering the restrictions placed on the production base owing to natural and/or social conditions, this study assumes that the law of diminishing marginal productivity guides the production factor of each population and land. \( f(P, \mathbf{e}) \) is a function that denotes the external effect of population agglomeration. The function is specified as follows:

\[
f(P_i, \mathbf{e}_i) = x_0 P_i^\phi \left( x_P \ln P_i + \sum k_i e_{ki} \right)
\]

where \( \lambda \) is a coefficient parameter of a regional social–environmental factor; and \( k \) is the type of a regional social–environmental factor.

\( C_i \) stands for the fiscal expenditure for local public goods in region \( i \). The expenditure is specified as follows:

\[
C_i = G_i = g_i P_i^\theta
\]

where the (average) cost of marginal product for local public goods is assumed to become 1; \( G_i \) is the amount of local public goods supplied in the entire region; and \( \theta \) is a parameter of commonality that indicates the non-competitive nature of public services.

With such economic conditions in the region, this study assumes that social planners act to maximize the utility of local residents by controlling as far as possible the consumption of private and local public goods. Assuming that the costs of private consumer goods and local public goods are covered by the initial endowments in the region, social planners would have feasibility constraints in the overall economy that are written as:

\[
Y_i(P, L, \mathbf{e}_i) = P_i x_i + g_i P_i^\theta
\]

Thus, this study formulates the utility maximization problem of a social planner as follows:

\[
\max_{(x_i, g_i, P_i)} u(x_i, g_i) \quad s.t. \quad Y_i(P, L, \mathbf{e}_i) = P_i x_i + g_i P_i^\theta
\]

Simultaneously, it is possible to have the following relationship:

\[
P_i \frac{\partial u_i}{\partial g_i} = P_i \frac{z_G / g_i}{z_x / x_i} = P_i^\theta
\]

which this study obtains from the first-order conditions for utility maximization. Equation (7) is the Samuelson condition for the provision of public goods, stating that the total marginal rate of substitution for public goods and private goods for the entire population equals the marginal cost of public goods. Manipulation between (5) and (7) provides the following conditions:

\[
x^* = \frac{z_x}{z_x + z_G} x_0 P_i^\phi \left( x_P \ln P_i + \sum k_i e_{ki} \right) P_i^{\theta-1} L_i^{2}\theta
\]

\[
g^* = \frac{z_G}{z_x + z_G} x_0 P_i^\phi \left( x_P \ln P_i + \sum k_i e_{ki} \right) P_i^{\theta-1} L_i^{2}\theta
\]

By substituting (9) into (4), the cost of supplying local public goods in the entire region can be written as:
By taking the log of both sides, we have:

\[
\ln C_i = \ln \left( \frac{x_G}{x_s + x_G} + x_0 \right) + \left[ (\phi_1 + x_P) + \sum_k \hat{\lambda}_k e_{ki} \right] \ln P_i + \phi_2 \{\ln P_i\}^2 + x_L \ln L_i \quad (11)
\]

**Empirical model**

The SFA was first presented by Meeusen & van den Broeck (1977), Aigner, Lovell, & Schmidt (1977), and Battese & Coelli (1977). Since the publication of these articles, other researchers have proposed various models, which hold different assumptions, to measure the productive efficiency of firms and industries. For instance, Kumbhakar & Lovell (2000) discussed comprehensive surveys and various advanced SFA models. This study applies the SFA proposed by Battese & Coelli (1995) to estimate both a cost frontier and factors that affect efficiency levels. The advantage of Battese and Coelli’s model is that it can estimate the parameters for cost-inefficiency, along with those for the cost function, but not assuming the same trajectory for all firms under the panel data setting (Greene, 2004, 2005).

The following equation based on (11) is estimated by considering recurrent administrative expenses in addition to total expenditure for calculating prefectural government spending:

\[
\ln C_{it} = A_0 + \left\{ \beta_1 + \sum_{k=1}^5 \gamma_k e_{kit} \right\} \ln P_{it} + \beta_2 \{\ln P_{it}\}^2 + \delta \ln L_{it} + v_{it} + u_{it} \quad (12)
\]

where \( i \) denotes the prefecture; and \( t \) denotes the time. \( C \) is total expenditure or administrative expenses; \( P \) is the population; and \( L \) is the area size. Social—environmental factors used in this paper are specified as follows: the densely inhabited district (DID) population ratio \((e_1)\), daytime population ratio \((e_2)\), population ratio of ages under 15 \((e_3)\), population ratio of ages 65 or older \((e_4)\), and inhabitable land area ratio \((e_5)\) \(A_0(= \ln[x_G/(x_s + x_G) + x_0])\), \( \beta_1(= \phi_1 + x_P)\), \( \beta_2(= \phi_2)\), \( \gamma(= \hat{\lambda})\), and \( \delta(= x_L) \) are the parameters to be estimated.

The error term \((v_{it} + u_{it})\) consists of two parts: an observational error term \(v_{it}\) and a managerial error term associated with cost-inefficiency \(u_{it}\). The \(v_{it}\), which has the distribution of \(N(0, \sigma^2_v)\), is assumed to be independent from \(u_{it}\) and all explanatory variables. The term \(u_{it}\) in the stochastic frontier model (12) describes a non-negative random variable associated with cost-inefficiency, which is assumed to be independently distributed in such a manner that \(u_{it}\) is obtained by truncation at zero of the normal distribution with mean, \(R_u\delta\), and variance, \(\sigma^2_u\). That is, \(u_{it}\) is a non-negative truncation of \(N(R_u\delta, \sigma^2_u)\) distribution. Here, \(R_u\delta\) is a \((1 \times m)\) vector of explanatory variables associated with cost-inefficiency; and \(\delta\) is a \((m \times 1)\) vector of unknown coefficients.

This study employs a population size \(P_{it}\), and an fiscal transfer indicator \(Z_{it}\) to explain cost-inefficiency. The fiscal transfer indicator is the ratio of national tax allocation to the local government (local allocation tax grant) to its total general budget. Using these explanatory variables, average cost-efficiency \(R_{it}\delta = \mu_{it}\) is specified by the following equation:
\[ \mu_{it} = \delta_0 + \delta_Z \ln Z_{it} + \delta_P \ln P_{it} \]  

(13)

where \( \delta_0, \delta_Z \) and \( \delta_P \) are parameters to be estimated. The maximum likelihood method is used for simultaneous estimation of the parameters regarding the stochastic cost frontier and the equation for cost-inefficiency effects.

When the factors of the inefficiency term improve the level of efficiency, the signs of \( \delta_Z \) and \( \delta_P \) become negative. From the structure of the model, \( CE_{it} \), the level of cost-efficiency to be estimated has a non-negative value equal to or larger than 1:

\[ CE_{it} = E(\exp(u_{it})|v_{it} + u_{it}), \quad 1 \leq CE_{it} \leq \infty. \]

Data

This study uses the Nikkei Economic Electronic Database System to derive the balance sheet data on 47 prefectures required for the estimation. Basic demographic data such as population, area size and population by age group are obtained from the Population Census. The paper also computes inhabitable land area based on information provided by the System of Social and Demographic Statistics of Japan. The observation period consists of each census year that is measured every five years between 1980 and 2010. Thus, this study has 329 samples (47 prefectures × 7 periods) in a data set.

This study computes administrative expenses as the total sum of personnel, social assistance and public debt expenditure. Information on fiscal transfers is obtained from local tax revenue, local allocation tax grant and local transfer tax (i.e. the national tax allocated to local public entities) pertaining to municipality-level data in each prefecture. After obtaining the total general budget by summing these three taxes within each prefecture, the fiscal transfer ratio for each prefecture is computed by using the following equation:

Fiscal transfer ratio = local allocation tax grant/total general budget

Table 1 summarizes the means and standard deviations of the data set. On average, population in each prefecture only grew from approximately 2.5 million to 2.7 million, or by 9.4%, between 1980 and 2010. However, total expenditure doubled from 522.7 billion yen in 1980 to just over 1 trillion yen in 2010, while administrative expenses exhibited a similar increment, from 242.4 billion yen in 1980 to 466.6 billion yen in 2010. In contrast, the fiscal transfer ratio fluctuated throughout the observation period. It increased from 48.1% in 1980 to 52.2% by 2000, and then declined to 46.2% by 2010. Despite the decline in the second half of the study period, fiscal transfers received by local governments comprise almost half the general budget. The average area size of the prefectural administrative divisions of Japan is 8000 km². This study does not assume inter-regional spillovers between prefectures. In general, municipalities cause inter-regional spillovers, but such spillovers do not occur in prefectural administrative divisions that encompass a number of municipalities. Otsuka & Yamano (2008) demonstrated the concern by testing whether spillovers from production activity were generated between regions at the level of prefectural administrative divisions in Japan. From the test results, they concluded that spillovers between regions did not exist at the level of prefectural administrative divisions in Japan.
Table 1. Basic statistics.

| Variable                               | 1980            | 1990            | 2000            | 2010            |
|----------------------------------------|-----------------|-----------------|-----------------|-----------------|
|                                        | Mean            | SD              | Mean            | SD              |
| Total expenditure (yen, millions)      | 522,743         | (437,252)       | 912,520         | (956,487)       |
| Administrative expenses (yen, millions)| 243,398         | (224,667)       | 379,465         | (337,025)       |
| Population (persons)                   | 2,490,647       | (2,269,205)     | 2,630,025       | (2,423,078)     |
| Area size (km²)                        | 8033            | (11,710)        | 8034            | (11,694)        |
| DID population ratio                   | 0.4539          | (0.185)         | 0.4858          | (0.186)         |
| Daytime population ratio               | 0.9904          | (0.042)         | 0.9879          | (0.053)         |
| Population ratio: ages under 15        | 0.2326          | (0.016)         | 0.1874          | (0.013)         |
| Population ratio: ages 65 or older     | 0.1025          | (0.018)         | 0.1358          | (0.024)         |
| Inhabitable land area ratio            | 0.3627          | (0.145)         | 0.3659          | (0.146)         |
| Fiscal transfer ratio                  | 0.4811          | (0.195)         | 0.4566          | (0.216)         |

Note: A densely inhabited district (DID) describes a district with a population concentration that is set statistically using Japan’s Populations Census data. Within the districts of municipalities, it is set as a district containing basic unit blocks with a population density of 4000 people or more per km², such districts adjacent to each other in a municipality, and a district consisting of these adjacent basic unit blocks whose population is 5000 or more. However, basic unit blocks with strong urban tendencies, such as airports, ports, industrial districts and parks, are included in DIDs even if they have low population densities. DID is used to divide urban and rural regions and is an indicator used to show the size of urban areas as cities in a narrow sense.
Finally, Figure 1 exhibits the relationship between population size and prefectural government spending in 2010. In terms of both total expenditure and administrative expenses, it describes the shape of a quadratic function for population size. This suggests that (12) is worth for empirical examination.

Empirical results

Table 2 summarizes the results of the model estimation. This study uses Frontier Version 4.1, developed by Battese & Coelli (1995), to estimate the models so that one can consider fixed effects. The proposed analysis uses the three models. Model A takes into account the effects of both population and the fiscal transfer ratio. Model B considers only the fiscal transfer ratio. Model C considers only population because of the high correlation between population and the fiscal transfer ratio.

The parameters related to the cost function (i.e., $\beta$ and $\delta$) are statistically significant in all three models. The variance parameters ($\sigma^2_u + \sigma^2_v$, $\sigma^2_u/(\sigma^2_u + \sigma^2_v)$) are also statistically significant, indicating that the estimates of the cost-efficiency is valid. Under the null hypothesis ($H_0 : \gamma = 0$), the likelihood ratio (LR) test assesses the applicability of the stochastic frontier functions and the presence of inefficiency. The results of the LR test support the existence of inefficiency and the applicability of the stochastic frontier functions for all models of both total expenditure and administrative expenses. Thus, this study can examine the hypotheses, developed in the second section, from the estimation results. The empirical results of Table 2 indicate the two implications. One implication is that, looking at the total expenditure, this study finds a statistically significant positive effect of fiscal transfers on the cost-inefficiency of local governments.
In other words, the incentives decrease the cost-minimizing effort of local governments because of the existence and dependence on the fiscal transfer system. Therefore, the estimation results support the first hypothesis (H1), which fiscal transfers exacerbate the cost-efficiency of local governments. Next, the effect of population size on cost-inefficiency is not statistically significant, although it has a negative sign. However, the effect of a population size on cost-inefficiency in Model C, which considered only a population size, is negative and statistically significant. Therefore, the results support the second hypothesis (H2) that increased population size improves the cost-efficiency of local governments.

The other implication is that, looking at administrative expenses, this study finds a significant positive impact of fiscal transfers on cost-inefficiency. This result also demonstrates that the existence of the fiscal transfer system reduces the incentives for local governments to minimize their costs. In contrast, the effect of a population size on cost-inefficiency is not statistically significant, as with total expenditure. However, Model C again exhibits that the effect of a population size on cost-inefficiency is

| Table 2. Estimation results. |
|-----------------------------|
| **Total expenditure** | **Administrative expenses** |
| Model A | Model B | Model C | Model A | Model B | Model C |
| $A_0$ | 25.974 | 25.985 | 26.334 | 17.222 | 15.845 | 20.108 |
| $(24.93)**$ | $(24.78)**$ | $(8.73)**$ | $(17.03)**$ | $(6.44)**$ | $(9.15)**$ |
| $\beta_1$ | $-2.601$ | $-2.587$ | $-2.664$ | $-1.534$ | $-1.319$ | $-1.898$ |
| $(-17.90)**$ | $(-17.36)**$ | $(-6.44)**$ | $(-11.04)**$ | $(-3.88)**$ | $(-6.22)**$ |
| $\beta_2$ | $0.111$ | $0.110$ | $0.113$ | $0.077$ | $0.068$ | $0.088$ |
| $(21.83)**$ | $(20.95)**$ | $(7.93)**$ | $(15.46)**$ | $(5.73)**$ | $(8.12)**$ |
| $\gamma_1$ | $-0.009$ | $-0.007$ | $-0.012$ | $0.005$ | $0.014$ | $0.009$ |
| $(-1.32)$ | $(-1.10)$ | $(-1.76)$ | $(0.78)$ | $(2.36)*$ | $(1.52)$ |
| $\gamma_2$ | $0.125$ | $0.118$ | $0.133$ | $0.058$ | $0.059$ | $0.069$ |
| $(10.08)**$ | $(9.81)**$ | $(13.89)**$ | $(5.72)**$ | $(6.47)**$ | $(8.08)**$ |
| $\gamma_3$ | $-0.560$ | $-0.540$ | $-0.588$ | $-0.366$ | $-0.354$ | $-0.400$ |
| $(-14.82)**$ | $(-14.16)**$ | $(-15.20)**$ | $(-10.43)**$ | $(-11.05)**$ | $(-13.81)**$ |
| $\gamma_4$ | $-0.119$ | $-0.109$ | $-0.139$ | $0.024$ | $0.027$ | $0.002$ |
| $(-4.44)**$ | $(-4.01)**$ | $(-5.20)**$ | $(0.95)$ | $(1.21)$ | $(0.10)$ |
| $\gamma_5$ | $0.020$ | $0.021$ | $0.018$ | $0.020$ | $0.022$ | $0.020$ |
| $(3.29)**$ | $(3.37)**$ | $(2.94)**$ | $(3.43)**$ | $(4.06)**$ | $(3.72)**$ |
| $\delta$ | $0.177$ | $0.173$ | $0.186$ | $0.137$ | $0.139$ | $0.154$ |
| $(9.22)**$ | $(9.30)**$ | $(10.39)**$ | $(7.24)**$ | $(7.90)**$ | $(9.02)**$ |
| $\delta_0$ | $0.683$ | $0.224$ | $2.514$ | $0.584$ | $0.206$ | $5.688$ |
| $(1.09)$ | $(3.41)**$ | $(2.51)**$ | $(0.97)$ | $(4.90)**$ | $(2.53)**$ |
| $\delta_Z$ | $0.227$ | $0.227$ | $0.133$ | $0.058$ | $0.059$ | $0.069$ |
| $(3.18)**$ | $(3.17)**$ | $(2.70)**$ | $(8.84)**$ |
| $\delta_P$ | $-0.031$ | $-0.178$ | $-0.025$ | $-0.625$ | $-0.625$ |
| $(-0.72)$ | $(-2.35)**$ | $(-0.62)$ | $(-2.16)*$ |
| $\sigma^2$ | $0.049$ | $0.047$ | $0.069$ | $0.023$ | $0.020$ | $0.316$ |
| $(5.20)**$ | $(5.34)**$ | $(2.74)**$ | $(5.25)**$ | $(4.64)**$ | $(1.79)$ |
| $\gamma$ | $0.924$ | $0.917$ | $0.947$ | $0.766$ | $0.720$ | $0.977$ |
| $(31.38)**$ | $(30.94)**$ | $(43.68)**$ | $(9.12)**$ | $(10.00)**$ | $(66.84)**$ |
| Log-likelihood | $175.870$ | $174.940$ | $168.213$ | $243.299$ | $245.230$ | $236.814$ |
| LR test | $56.132$ | $54.273$ | $40.819$ | $40.634$ | $44.197$ | $27.666$ |
| Mean efficiency | $1.23$ | $1.22$ | $1.22$ | $1.17$ | $1.16$ | $1.10$ |

Note: Figures in parentheses are t-values.
**Significance at the 1% and *5% levels.
negative and statistically significant. Therefore, the results support the two hypotheses (H1 and H2) in the case of administrative expenses as they are for total expenditure.

Next, the comparison between the results of total expenditure and administrative expenses provides the two implications. One implication is that a larger impact of fiscal transfers exists on cost-efficiency in the case of total expenditure, compared with that for administrative expenses. In other words, fiscal transfers significantly influence cost-inefficiency in terms of total expenditure. The other implication is that the impact of a population size on cost-efficiency in the case of administrative expenses is larger than that of total expenditure. The result suggests that a larger population size can serve to improve the efficiency of administrative expenses. Importantly, the average inefficiency for total expenditure is larger than that of administrative expenses. For example, while the loss of efficiency in total expenditure is approximately 23% (= 1.23 – 1), it remains at approximately 17% (= 1.17 – 1) for administrative expenses. This finding indicates a relatively large space for cost-efficiency on total expenditure than administrative expenses.

Besides these implications discussed above, empirical results obtained in this study indicate the effectiveness of regional policy that consolidates small local governments for increased cost-efficiency and high financial independence of the region, along with decentralization. For instance, the population size that would minimize per capita expenditure may predict the scale of an ‘efficient municipality’. Although the measure does not promptly suggest the social optimal population size, it guides local governments in determining the desirable scale of local administration in future. That is, it is possible to determine the scale of an ‘efficient municipality’ under the assumption that local governments look for the minimum cost, because the inefficiency of local governments caused by excessive fiscal transfers may be controlled by using our estimation results. Through the partial differentiation of (12) by population, we can obtain a minimum cost regional size $N_{c-min}$ by the following equation:

$$N_{c-min} = \exp \left( -\frac{\beta_1 + \sum_{k=1}^{5} \gamma_k e_{kit}}{2\beta_2} \right)$$

(14)

where the bar above the variable $e$ represents the average.

Based on (14), the amount is approximately 10 million people when calculated using total expenditure and 11 million people using administrative expenses. These population sizes are thus recognized to be optimal at a prefecture level (or at the state level in the United States, for example) based on the premise of efficient financial management.

**Conclusions**

This study analysed how the fiscal transfer ratio and local population size affected the cost-efficiency of local governments. It used the SFA framework for the proposed analyses. The empirical results obtained indicated that the fiscal transfer ratio negatively affected the cost-efficiency of local governments, but the size of local government, measured by population size, positively influenced the degree of cost-efficiency. These findings supported the two hypotheses discussed for improving the cost-efficiency of local governments. This study has identified that Japan needs to reduce the amount of fiscal transfers at a prefectural level through regional integration and it needs to increase the size of the population of local administrations through regional integration of municipalities.
This study had two contributions. First, it provided a theoretical basis of economics that was applicable to an empirical model for the cost-efficiency measurement on local governments. In particular, this study derived a cost function from local government’s cost-minimizing behaviour. Through the derivation, the parameter estimates provided policy implications based on the economic theory. Second, this study measured the cost-efficiency of Japanese local governments by using a data set at a prefectural level and analysed the influential factors. It revealed that the fiscal transfers and population size significantly influenced the cost-efficiency of local governments. The findings suggest that progressing decentralization, or fiscal independence, is important for increasing the cost-efficiency of Japanese local governments.

Finally, decentralization in Japan may depend on changes made to the fiscal transfer system and mergers at the prefectural level. To attain the decentralization and improve the overall cost-efficiency of local governments, this study recommends that the Japanese government not only review and refine the fiscal transfer system, but also expand the population size through regional integration.

This study has the following three limitations. First, although the results obtained have exhibited the effect of fiscal transfers and a population size on cost-efficiency, they have never demonstrated exactly how each factor affects the cost-efficiency and the decision-making processes of local governments. As another future extension, it is necessary to investigate such effects in detail. Second, it is important to apply the proposed approach to examine the effect of decentralization on cost-efficiency in other countries. Finally, this study needs to discuss policy implications for regional integration at the smaller level of municipal administrative divisions. By conducting such analysis at the smaller municipality level, this study will obtain much wider policy implications on the consolidation of municipalities in Japan.

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**Notes**

1. It has been well established in the literature that population agglomeration plays a role in improving firm productivity. Indeed, the economic benefits that arise from population agglomeration have been discussed for more than a century (Marshall, 1890). The term ‘agglomeration economies’ represents the cost savings and productivity improvements that local governments can obtain through a population size increase in the administrative districts (Eberts & McMillen, 1999; Rosenthal & Strange, 2004). Many previous empirical studies have also demonstrated that such agglomeration economies play a role in improving the international competitiveness and production efficiency of local firms (Beeson & Husted, 1989; Driffield & Munday, 2001; Mitra, 1999, 2000; Tveteras & Battese, 2006). Furthermore, agglomeration economies result in reduced costs and increased tax revenue for local governments, which positively influences their levels of cost-efficiency.

2. A two-region model, which takes into consideration the spillover effect of neighboring regions, makes it difficult to derive the cost function. Such extension should be explored in future research.

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