Internalization of Externalities and Local Government Consolidation : Empirical Evidence from Japan

Miyazaki, Takeshi

出版情報：経済学研究院ディスカッション・ペーパー, 2013-11. Faculty of Economics, Kyushu University
バージョン：
権利関係：

Discussion Paper Series

Discussion Paper No.2013-7

Internalization of Externalities and Local Government Consolidation: Empirical Evidence from Japan

Takeshi Miyazaki
Kyushu University
November 2013

Faculty of Economics
Kyushu University
Hakozaki, Higashi-ku, Fukuoka, 812-8581, Japan

Internalization of Externalities and Local Government Consolidation: Empirical Evidence from Japan

Takeshi Miyazaki[a]

[a]Department of Economics, Kyushu University, Fukuoka, 6-19-1 Hakozaki Higashi-ku Fukuoka 812-8581, Japan. E-mail: tmiyazak@econ.kyushu-u.ac.jp; Tel.: ＋81-(0)92-642-4272; Fax: ＋81-(0)92-642-4272.

Abstract

The fact that consolidation overcomes externality problems in the provision of local public goods is one of the best-known benefits of consolidation presented in the theoretical literature. Nevertheless, previous studies provide little evidence of how public service spillovers affect boundary reform decisions. This study empirically tests the hypothesis that spillovers induce consolidation, by estimating the amount of spillovers from the demand function for public goods. Specifically, it uses voting data on local referenda in order to examine the relationship between consolidation preference and spillovers through identifying the preferences of individual jurisdictions. It is shown that municipalities that have suffered from large public good spillover effects prefer consolidation. Moreover, consistent with the findings in the theoretical and empirical literature, economies of scale, population size, differences in median income, and unconditional grants are found to influence the consolidation decision.

Keywords**:** Consolidation, internalization of externalities, local government, spillovers
JEL classification codes: H11, H76, H77

1. Introduction

Throughout the twentieth century, many countries used boundary reform to create larger local governments. Specifically, such municipal consolidation took place in several Western countries, including Canada, Denmark, Israel, Norway, Sweden, and the former West Germany (e.g., Sancton, 2000).[1] Similarly, the number of municipalities in Japan has dropped dramatically in recent years from 3,232 in March 1999 to 1,719 in January 2012. Proponents of municipal consolidation note that larger local governments can improve administrative and financial efficiency through economies of scale in the production of local public services and benefit from centralized decisions by overcoming the externality problems in the provision of local public goods.

Numerous theoretical studies have investigated endogenous boundary reform and fiscal integration. Most such works focus on the trade-off between the efficiency of larger jurisdictions and the loss of the unitary provision of public goods (e.g., Alesina and Spolaore, 1997; Bolton and Roland, 1997). The seminal paper by Oates (1972) uses a formal cost/benefit analysis to examine decentralization, while Ellingsen (1998) shows how region size affects local government behavior by modeling the trade-off between the internalization of externalities and preference heterogeneity. Other studies have investigated theoretical models of governmental and legislative behaviors in order to overcome the assumption of uniform goods provision under centralization (see Besley and Coate, 2003; Lockwood, 2002). Further, Dur and Staal (2008) scrutinize the relationship between this important trade-off in consolidation and the role of intergovernmental transfers from the central government. Indeed, much of the existing theoretical literature investigates the trade-off between the internalization of externalities and unitary public provision.

Theoretical predictions have been tested in several empirical studies. They find evidence of a trade-off between economies of scale and preference heterogeneity, particularly with respect to income and race (e.g., Alesina et al., 2004; Alesina and Spolaore, 2003; Austin, 1999; Brasington, 1999, 2003a, 2003b; Brink, 2004; Gordon and Knight, 2009; Nelson, 1990; Sorensen, 2006). To my best knowledge, however, no studies have thus far investigated whether the spillover effects of public goods influence boundary reform decisions. As pointed out in previous theoretical works, the median voter's motivation to consolidate would generally depend on the degree of spillovers.

[1]This paper uses the terms consolidation and merger interchangeably.

This study explores whether municipalities tend to consolidate in order to overcome the problem of spillovers arising from local public goods provision. Put another way, we investigate whether municipalities that have larger spillovers among potential merging municipalities are more likely to consolidate with them. To this end, a two-step estimation procedure is used to measure how spillovers affect consolidation. First, a typical demand function for public goods, developed by Borcherding and Deacon (1972) and Bergstrom and Goodman (1973) (henceforth, BD-BG), is estimated, assuming that municipal residents enjoy the benefits of public services provided by other municipalities. These two seminal works pioneered the estimation of demand functions for publicly provided goods.[2] BD-BG both assume that the median voter is in charge of decisions on expenditure, and reveal that local governments provide public goods that have almost the same degrees of the crowding effects as private goods do.

Since the publication of BD-BG, most related studies have taken the same approach to estimate the demand function for local public services, and presumed the median voter model and the congestion effects of public services. However, as this approach indirectly measures publicness and the obtained results are problematic in terms of jurisdiction size, alternative approaches have been developed in order to rigorously estimate price elasticity and congestion (Reiter and Weichenrieder, 1997).[3] Nevertheless, subsequent studies mostly agree with the results presented by BD-BG's model, and exhibit that the approach remains adequate for estimating the demand for local public services. Based on this literature, demand for publicly provided goods in the present paper is based on the BD-BG model.

Further, it is also acknowledged that local public goods are often non-excludable from local residents in other regions. In this vein, researchers have hypothesized about the systematic exploitation of cities by suburban residents, assuming that the proportion of the effective users of a public service in a city to its residents is over one and increasing in terms of the number of residents in the city.[4] However, this assumption explains only one aspect of the externality of local public goods, namely exploitation by suburban residents. The present study thus adopts a more general model of spillovers where the distance-weighted average of the local public goods provided by other municipalities is used as the spillover rather than the reciprocal of population. Further, as noted earlier, we use the BD-BG model of demand function in order to determine the extent of spillovers among municipalities. However, since the spillovers are included as an explanatory variable in a demand function, that is, the estimation model is spatial autoregressive,

[2]Reiter and Weichenrieder (1997) survey the empirical literature on demand estimation for local public services.
[3] The subsequent works concerning the estimation of demand function attempt to deal with issues such as the negative agglomeration effect, indivisibility of public goods, Tiebout bias, spillover effects, and migration of capital.
[4]For example, Bradford and Oates (1974) is a well-structured survey.

the empirical equation is estimated by using the maximum likelihood approach for spatial lag models developed by Anselin (1988).

In the second step, the relationship between consolidation preference and spillovers in local public goods is investigated. The total amount of spillovers that can be alleviated through consolidation is calculated by aggregating the predicted spillovers among potential consolidation partners. Then, affirmative rates for consolidation with particular partners are regressed on total predicted spillovers, calculated on an average basis (ATS: average total spillovers), after controlling for variables that explain the other features of the merging municipalities.

Some empirical works that have examined the merger decisions of each community use the bivariate discrete choice model and structural estimation.[5] These studies aim to develop a sophisticated econometric discrete choice method for identifying a specific jurisdiction's decision. However, the information contained in the dummy variables about whether to merge is not sufficient for confirming (a) which jurisdiction refused to merge (in failed consolidations) and (b) what proportion of residents approved the merger. By contrast, the preference variable used in the present work is affirmative rates of consolidation, which allow us to measure consolidation preference in a specific municipality. In the second step, unique data on consolidation preference are exploited to investigate the causal relationship between spillover effects and eagerness to merge.

The findings of this paper shed light on the roles of key features in municipal consolidation decisions. First, municipalities that have larger interregional spillovers in public service provision are more likely to consolidate. The theoretical assumption that the amount of spillovers among potential merging partners is a key determinant of a merger decision is confirmed by the estimation, with ATS being both statistically and economically significant. This paper also attempts to overcome the possibility of specification error by testing functional forms of consolidation preference.[6]

---

[5] In the bivariate choice approach, the dichotomous choice of whether to merge or not depends on the joint decision of two jurisdictions (e.g., Austin, 1999; Brasington, 1999, 2003a, 2003b). By contrast, structural estimation is conducted using econometric models of merger estimation that focus on two-sided decision-making and multiple potential merger partners (e.g., Gordon and Knight, 2009; Saarima and Tukiainen, 2010; Weese, 2008).

[6] I estimate empirical equations in which consolidation preference is not considered, year or prefecture dummies are excluded, or referendum purposes dummies are included, as well as the two-limit Tobit. Tobit model is estimated because local referendum data might be truncated when municipalities whose residents have clear views about consolidation do not intend to hold a referendum.

Second, economies of scale, population size effects, disparities in median income, and unconditional grants are shown to all be determinants of consolidation preference, even after controlling for spillover effects, consistent with theoretical predictions and the existing empirical evidence (e.g., Alesina et al., 2004; Austin, 1999; Brasington, 1999, 2003a, 2003b; Brink, 2004; Gordon and Knight, 2009). Municipalities that could attain larger cost reductions from consolidation prefer to consolidate more strongly. Meanwhile, municipalities that have small and large populations are likely to consolidate. Further, as for the changes of tax base and unconditional grants before and after consolidation, large differences in median income and larger amounts of per capita unconditional grants lower the tendency to consolidate.

The remainder of this paper is organized as follows. The next section presents background information on Japanese local government and municipal consolidation. Section 3 develops the theoretical model, and Section 4 discusses the data used in the regressions. The main results are outlined in Section 5, and Section 6 concludes the paper.

2. Background on the Local Government System and Boundary Reform in Japan

This section describes the local government system in Japan with a particular focus on municipal consolidation. Japan has three politically elected levels of government: central government, prefectural government, and municipality. Municipalities, composed of cities, towns, and villages, form the basic local government, while prefectures are wider-area regional governments.

As noted in Section 1, the number of municipalities in Japan had declined to 1,719 by 2012. In 2010, the average municipal population was 73,600 with a large variance ranging from 170 to 3.7 million. The responsibilities of local governments in Japan are similar to those in many developed countries. Municipalities deal with the basic concerns closely related to the daily lives of residents, such as the registration of present and permanent addresses, operation of elementary and junior high schools, social welfare for infant children and senior citizens, city planning, operation of waterworks and sewer systems, collection and disposal of garbage, and fire prevention.[7]

Thus, municipalities in Japan constitute a major part of the public sector, accounting for

[7]Japan has 47 prefectures. Prefectures are responsible for many matters of broad public interest, including the establishment and management of senior high schools, upgrades of industrial infrastructure, and oversight of job training and police affairs.

approximately 30% of the government budget compared with prefectures' share of 28%. Total public spending in Japan was 24% of GDP in 2010, while municipal spending was 7% of GDP. Municipalities are largely dependent on the central government for funds. Indeed, as much as 31% of their budget comes from intergovernmental transfers, of which 16% represents unconditional grants (known in Japan as local allocation tax) and 15% conditional grants (national treasury disbursements).

The remaining 69% of municipal revenues come from taxation (approximately 34%), bonds, and other independent resources. Local taxes consist mainly of income tax (municipal inhabitant tax) and property tax (fixed asset tax), accounting for 43% and 44%, respectively, of the total local tax. Municipalities partly are authorized to set tax rates. However, since they have not been entitled to determine tax rates until recently, municipal income tax rates are nearly uniform throughout the country. By contrast, property tax rates vary because municipalities have long been allowed to change such rates within a limited range fixed by the central government.

Although the legal structure in Japan offers a degree of autonomy to local governments, municipalities do not enjoy a high degree of freedom in their budgetary decisions, such as setting local tax rates and raising bond funds. Although, they can, in principle, borrow from the bond market in consultation with the central government, the latter regulates their bond operations. For example, the central government would most likely control the level of debt. Therefore, in practice, municipalities cannot borrow as much as they want.[8] The Ministry of Internal Affairs and Communications (MIC) has the overall charge of local governments in Japan. The MIC always has a pro-municipality policy unlike the Ministry of Finance, whose chief concern is ensuring the central government's financial soundness.

As for municipal consolidation, the number of municipal consolidations over the past decade has increased substantially because of the so-called Great Heisei Merger, which has aimed to strengthen the administrative and financial foundations of municipalities and promote decentralization because of Japan's declining birth rate, aging population, and the expansion of suburban sprawl.[9] Because a reduction in population causes a loss of efficiency in administrative management and in the provision of local public services, municipalities, particularly small ones, have been eager to merge. Some municipalities have also had found it necessary to consolidate in order to offset severe financial deficits.

[8]Akizuki (2001) describes the relationship between the central and local governments as "controlled decentralization."
[9]See, for example, CLAIR (2009), Yokomichi (2007), and MIC (2006, p. 41).

Until 1999, municipalities did not merge voluntarily, since the 1965 Special Law for Municipal Mergers failed to provide any motivation for consolidation. However, consolidations increased rapidly after the law's 1999 amendment, which provided strong financial and economic incentives for municipal consolidation, including a grace period for local governments to avoid unconditional grant reduction that resulted from the merger and a subsidy for the principle and interest of local bonds municipalities issued in order to finance the additional costs that stemmed from the merger. In 1999, the Japanese government also mandated that prefectural governments report on merger patterns and constructed, in 2001, a headquarters to assist in municipal merger matters.

Local referenda or questionnaire surveys on consolidation have frequently been used by local officials to ascertain public opinion. According to MIC (2010), 352 local referenda on merging with a specific municipality took place from 1999 to 2006. Of these, 306 were votes on whether to consolidate with a group of potential merger partners and 46 were votes on which groups to merge with. During the same period, 66 local referenda on establishing a merger consultation committee (a council municipalities must set up before any merger) were carried out. Referendum results were not necessarily reflected to the municipal decisions on a consolidation or consolidation-related policy such as setting up a committee, but in more than 90% of cases, the wishes of the majority of residents were respected (MIC, 2010).

Figure 1 is inserted here.

Figure 1 shows the numbers of municipalities, consolidations, and local referenda from 1999 to 2008. The number of municipalities in Japan declined sharply between 2003 and 2005 following many consolidation cases. Referenda can be seen to have taken place before the number of consolidations peaked. This consolidation trend shows that boundary reform is a historically salient process in Japan.

3. Empirical Model

As mentioned in the Introduction, a two-step estimation procedure is used to estimate how spillovers affect the provision of local public goods. In the first step, a demand function for local public services is estimated based on the analysis presented by BD-BG. Previous works that estimated demand for public goods by taking into account interregional spillovers have assumed the exploitation of center cities by their suburbs as an externality. By contrast, this paper includes the level of local public goods provided by other municipalities into a utility, in order

to account for spillovers that influence consumer utility. Predictions of spillovers are then calculated using estimated coefficients, a weighting matrix for spillovers, and expenditure, wage, and population levels. In the second step, the relationship between spillover effects among potential consolidation municipalities and consolidation preference is estimated by using these predictions. We then regress the proportion of residents that have positive attitudes toward consolidation on the predicted values of spillovers, controlling for various elements that affect merger decisions.

3.1 Estimation of the demand function

A median voter's utility function in municipality i is denoted as

$$U_i = U(X_i, g_i, \boldsymbol{g}_{-i}), \qquad (1)$$

where X_i is the amount of private goods, g_i is the number of units of public goods an individual can consume, and $\boldsymbol{g}_{-i} = (g_1, \dots, g_{i-1}, g_{i+1}, \dots)$ is a vector of public goods in municipalities other than municipality i. Individuals in a municipality can enjoy public goods provided by other municipalities. The utility function is twice differentiable and well behaved. g_i is a function of the public goods, G_i, provided by a municipality. Like the BD-BG approach, the crowding of local public services can be observed, and its effective level is a function of population size N_i:

$$g_i = \frac{G_i}{N_i^{\alpha}}, \qquad (2)$$

where α is a measure of the crowding effects or the publicness of public goods. If $\alpha = 0$, the good is a pure public good. If $\alpha = 1$, an individual can enjoy only a fraction $1/N_i$ of the total amount of the public good, suggesting that the good is a private good. An individual's budget constraint is

$$X_i + t_i c_i G_i = Y_i, \qquad (3)$$

where t_i is an individual's tax ratio, c_i is the price of public good, which can be interpreted as the marginal cost, and Y_i is the gross income given exogenously to the individual in municipality i. Following previous studies, we assume the median vote to be a crucial factor in deciding the amount of public goods. The median voter maximizes (1) subject to (2) and (3) given $\boldsymbol{g}_{-i}$.

Based on conventional wisdom, it is assumed that demand for the public good has constant price (δ) and income (ϵ) elasticities. We also suppose that the demand depends on a function of public goods provided by all other municipalities, $g_{-i} = g(\boldsymbol{g}_{-i})$:

$$g_i = k[t_i c_i N_i^{\alpha}]^{\delta} Y_i^{\epsilon} g_{-i}^{\gamma}, \qquad (4)$$

where γ is assumed to be the elasticity of spillovers. For empirical convenience, g_{-i} enters

into the equation in multiplicative form. When taking the logarithm of (4), γ also explains the strategic interaction in the choice of public good level, and this can be interpreted as the spatial autoregressive parameter in the spatial econometric model if g_{-i} is expressed as the weighted average of public goods other municipalities supply. The linear specification of strategic interaction between a jurisdiction and the others is widely used in models that analyze problems of externality (see Brueckner, 2003).

By considering that the values of local public goods in all municipalities are jointly determined, γ can be consistently estimated using the maximum likelihood method (Anselin, 1988; Ord, 1975) or the instrumental variable method (e.g., Kelejian and Prucha, 1998). If $\gamma > 0$, the slope of the reaction function of demand for local public services is positive, that is, municipality i's public good level becomes larger as the public goods of all other municipalities grow. If $\gamma < 0$, the increase in public goods provided by other municipalities raises the municipality's public goods. With the substitution of (2) into (3), $t_i c_i N_i^{\alpha}$ is regarded as the demand price of the public good.

As for the supply side, through the assumption of Cobb–Douglas constant returns on production, β, and a uniform rental rate of capital, r, over all municipalities, the marginal cost derived from the maximization problem in public good production can be written as

$$c_i = a' wage_i^{\beta}; \quad a' = \frac{1}{a\beta^{\beta}}\left(\frac{r}{1-\beta}\right), \qquad (5)$$

where a is the Hicks-neutral technology parameter and $wage_i$ is the wage rate. Thus, a supply function is described only on the wage rate, because a' is constant and common to all municipalities. Let us define municipal expenditure as $E_i = c_i G_i$.

, where η is the elasticity of socioeconomic factors.

We can represent the expenditure, using (2), (4), and (5) as

$$E_i = k' t_i^{\delta} wage_i^{\beta(\delta+1)} Y_i^{\epsilon} N_i^{\alpha(\delta+1)} g_{-i}^{\gamma}; \quad k' = (a')^{1+\delta} k.$$

This equation is transformed into logarithmic per capita expenditure, e_i, and the econometric specification is thus obtained to estimate

$$\log e_i = \log k' + \delta \log t_i + \xi \log wage_i + \epsilon \log Y_i + \theta \log N_i + \gamma \log g_{-i} + \eta \log \boldsymbol{Z_i}, \qquad (6)$$

where $\xi = \beta(\delta + 1)$ and $\theta = \beta(1 + \delta) - 1$.

We also assume that the amount of spillovers is based on distance.[10] For example, residents that live close to other regions are likely to enjoy the benefits of public services provided by them, whereas those located far from another region cannot benefit in the same way, partly because travel costs are higher compared with those for residents in closer regions. By applying a general specification of spatial weights based on distance decay, the logarithm of the spillovers from public services provided by municipalities other than i is thus defined as

$$\log g_{-i} \equiv [\boldsymbol{W} \log \boldsymbol{g}]_i = \sum_{j=1,\dots,n} w_{ij} \log g_j. \qquad (7)$$

Here, w_{ij} is the ith row and jth column of the spatial weighting matrix $\boldsymbol{W}$, where distance is the spatial weight and the off-diagonal element of $\boldsymbol{W}$ is $w_{ij} = (1/d_{ij})/\sum_{j=1}^{M}(1/d_{ij}),\ j \neq i$, while $w_{ii} = 0$. d_{ij} measures the distance between municipal capitals i and j in kilometers. Moreover, $[\boldsymbol{W} \log \boldsymbol{g}]_i$ is a spatial lag for $\log \boldsymbol{g}$ $(\equiv (\log g_1, \log g_2, \dots, \log g_n)')$ in i, where n is the total number of municipalities. By using $g_j = e_j N_j^{1-\alpha}/(a' wage_j^{\beta})$ from (2), (5) and the definition of expenditure ($E_i = c_i G_i$), we rewrite the spatial weighted spillover (7) as

$$\log g_{-i} = -\log a' + \sum_j w_{ij} \log e_j - \beta \sum_j w_{ij} \log wage_j + (1 - \alpha) \sum_j w_{ij} \log N_j. \qquad (8)$$

By substituting (8) into (6) and adding a row vector of the logs of socioeconomic variables, $\log \boldsymbol{Z}_i$, we obtain the estimation equation that is estimated in the first regression:

$$\log e_i = K + \delta \log t_i + \xi \log wage_i + \epsilon \log Y_i + \theta \log N_i + \gamma \sum_j w_{ij} \log e_j + \gamma' \sum_j w_{ij} \log wage_j + \gamma'' \sum_j w_{ij} \log N_j + \eta \log \boldsymbol{Z_i} + u_i, \qquad (9)$$

where $\xi = \beta(\delta + 1)$, $\theta = \beta(1 + \delta) - 1$, $\gamma' = -\gamma\beta$, $\gamma'' = \gamma(1 - \alpha)$, and η is a coefficient vector of $\log \boldsymbol{Z_i}$. K is a constant and u_i denotes a standard error.

In this model, per capita expenditure is jointly determined in a Nash equilibrium. Because municipality i's expenditure is a function of municipality j's expenditure ($i \neq j$), the variables are endogenous, implying that ordinary least squares estimates of the parameters of (9) are

[10]There are other conceptual ways to analyze the impact of spillovers. Another theoretical approach is the exploitation hypothesis, where the inhabitants of a suburb are assumed to benefit from the services provided by the city center in which they work. Therefore, city centers are exploited by suburbs. See, for example, Bradford and Oates (1974).

inconsistent. Then, such an empirical model, known in the econometric literature as the *spatial lag model*, is consistently estimated by using the maximum likelihood method, which is efficient under standard regularity conditions.[11] The specifications for the spatial lag model can be tested by applying the Lagrange multiplier test suggested by Anselin (1988).[12] However, unlike the typical spatial econometric specification, this model is subject to non-linear constraints. Thus, a non-linear-constrained spatial lag model, equation (9), is estimated by extending the maximum likelihood method developed by Anselin (1988).

3.2 Estimation of consolidation preference

As can be shown the below, the second step of the analysis is to estimate the causal association between spillovers of local public goods and consolidation preference. First, spillovers are calculated using spatial weights and variables for expenditure, wage, and population as well as the estimated coefficients obtained from the regression of demand function (9). To measure accurately the internalization of spillovers owing to consolidation, the amount of total spillover effects that will diminish following the integration of public good provision is defined as the sum of spillovers among potential consolidation partners, averaged by the number of merging municipalities.

Figure 2 is inserted here.

Figure 2 depicts an illustrative example. We assume that a local referendum is held in municipality A, and examine whether its inhabitants are more likely to consolidate with municipalities B to E than they are to remain separate. Because spillovers among municipalities A to E would be internalized if the consolidation were realized, the total internalized spillovers calculated per municipality (*ATS*) are denoted, from (8), as

$$ATS\ (average\ total\ spillovers) \equiv \frac{1}{M}\sum_{k=A}^{E} \log g_{-k}$$

$$= \frac{1}{M}\sum_{k=A}^{E}\sum_{h=A}^{E}\left(w_{kh} \log e_h - \hat{\beta}\, w_{kh} \log wage_h + (1-\hat{\alpha}) w_{kh} \log N_h \right) \qquad (10)$$

where $\hat{x}$ denotes the estimate of x and M is the number of potential consolidation partners.

[11]Another econometric approach that provides consistent estimates is the instrumental variable method developed by Kelejian and Robinson (1993) and Kelejian and Prucha (1998). See, for example, Brueckner (2003).
[12]The Lagrange multiplier test is preferable to the Wald or log likelihood tests in that the alternative model need not be estimated.

Second, we regress the proportion of voters who agree to consolidation on the average total spillover effects that can be internalized through consolidation, controlling for the factors that affect the referendum. Voting data are collected from the referenda held in Japanese municipalities between FY2002 and FY2005, and are used to proxy for residents' preferences on municipal consolidation.

The estimated equation is derived from the theoretical model of the median voter approach (Austin, 1999; Brasington, 1999, 2003a, 2003b; Brink, 2004; Gordon and Knight, 2009; Miyazaki, 2013). The econometric model in the present study is therefore expressed as

$$REFERENDUM_i = f(ATS_i, \Delta COST_i, \Delta POP_i, \Delta TAXINC_i, SHAREPOP_i, (SHAREPOP_i)^2, \Delta MEDINC_i, \Delta EDUC_i, \Delta POPDEN_i, \Delta DEBT_i, \Delta SPEC\_GRANT_i, \Delta UNCON\_GRANT_i), \quad (11)$$

where i is an index of the municipality that held a local referendum.[13]

Here, $REFERENDUM_i$ represents the proportion of voters who support consolidation with potential merger partners. ATS_i is calculated according to (10). $\Delta COST_i$ captures efficiency gains, namely improvements in efficiency from economies of scale due to consolidation.[14] Because in Japan the logarithm of the per capita cost function of public service provision is U-shaped for the logarithm of population, it is thus modeled for population size and its square.[15] Based on the estimation results, efficiency gains are defined as the difference between the predicted costs of an existing municipality and those of a group of potential merger partners.

The benefit derived from consolidation is also dependent on the difference between taxable incomes before and after consolidation. As predicted in the theoretical models proposed by, for example, Austin (1999) and Brink (2004), the larger the expected per capita taxable income after a potential merger, the more likely a merger is to occur. Moreover, according to the theoretical analysis presented by Miyazaki (2013), this taxable income effect can be divided into ΔPOP_i (change in taxable income due to population variations resulting from consolidation) and $\Delta TAXINC_i$ (change caused by variations in per capita income). Thus, in the presented model, we adopt the two effects of variations in per capita taxable income as the explanatory variable. Size effects are expressed as $SHAREPOP_i$ and$(SHAREPOP_i)^2$, which represent the

[13] More detailed explanation for the specification and variables is presented in Miyazaki (2013).
[14] Many previous studies of mergers show that economies of scale frequently prevail in public schooling and that efficiency gains are a typical driving force behind local government mergers (e.g., Austin, 1999; Gordon and Knight, 2009).
[15] See, for example, CLAIR (2006).

original population as a percentage of the merged population and its square, respectively. If the population percentage is negative but its square is positive, the size effect curve is U-shaped, suggesting that large and small municipalities are likely to consolidate (e.g., Brasington, 1999).[16]

Preference heterogeneity is also closely related to the extent of welfare gains from consolidation and the motivation to merge (Brasington, 1999; 2003a; Gordon and Knight, 2009). According to the above-mentioned studies, residents' preferences for public service rest on their median incomes and educational levels. Some of the difference in residents' preferences is therefore measured by $\Delta MEDINC_i$, which is defined as the original median income minus the potential median income of the proposed consolidation partners, and by $\Delta EDUC_i$, the ratio of residents in the concerned municipality who have at least graduated from university to the expected number of graduates in the potential merging municipalities. Further, to reflect the difference in the extent of urbanization, we use $\Delta POPDEN_i$, which is the population density of the relevant municipality minus the post-consolidation density. All these preference variables are calculated as absolute values, and the greater preference heterogeneity, the less likely is a merger.[17]

As a fiscal incentive for consolidation, we use accumulated debts and the specific and unconditional grants. $\Delta DEBT_i$ represents the per capita accumulated bonds in the municipality in question minus that after consolidation and serves as a proxy for free-riding effects, a common pool problem in pre-merger debt accumulation caused by boundary reform (Tyrefors Hinnerich, 2009).[18] Because intergovernmental transfers from central government to local governments may influence the extent of consolidation preference (e.g., Dur and Staal, 2008; Gordon and Knight, 2009), two types of intergovernmental grants, $\Delta SPEC\_GRANT_i$ (the difference in specific grants to municipalities from national and prefectural governments between the relevant municipalities and the post-merged municipality) and $\Delta UNCON\_GRANT_i$ (the same difference in unconditional grants as specific grants) are added into the regression.

[16]Brasington (1999) investigates the relationship between size difference and attitude toward consolidation, incorporating the difference between the numbers of pupils in two neighboring school districts, and shows that large and small cities are likely to consolidate. By contrast, if the population percentage is positive or if the size effect is linear and upward, a larger municipality would want to consolidate with a smaller one. Brasington (2003a) shows that larger districts that could account for a decisive number of voters after consolidation prefer to merge with smaller districts.

[17]Although racial composition is an important feature that may affect the preference for local public goods (Brasington, 2003b), it is not taken into account here because Japan is mostly composed of people of the same ethnic group.

[18]Tyrefors Hinnerich (2009) finds that a local government that has a strong tendency to free-ride increases its pre-merger per capita debt by approximately 25%.

4. Data

Table 1 is inserted here.

Table 2 is inserted here.

The variables used to estimate demand for public goods comprise the logs of $MEDSHARE_i$ (median share of taxable income), $WAGE_i$ (wage of public servants, per public servant), $MEDINC_i$ (median taxable income), POP_i, (population), and $POPDEN_i$ (population density), $POP65_i$ (proportion of the population aged 65 or over), and $FOREIGNER_i$ (proportion of foreign residents).[19] Table 1A defines these variables in detail. The data set relates to 3225 municipalities as of 2000.[20] The year 2000 is adopted for two reasons. First, simultaneous bias can be avoided because consolidations among Japanese municipalities only began to grow rapidly after 2000. Second, the 2000 data from the Government Census are the latest available before the frequency of consolidations increased.[21] The descriptive statistics of the data are provided in Table 2A.

To estimate merger preference, the data set employed herein consists of $\Delta COST_i$, ΔPOP_i, $\Delta TAXINC_i$, $SHAREPOP_i$, $\Delta MEDINC_i$, $\Delta EDUC_i$, $\Delta POPDEN_i$, $\Delta DEBT_i$, $\Delta SPEC\_GRANT_i$, and $\Delta UNCON\_GRANT_i$ for the 309 municipalities that held local referenda on consolidation between FY2002 and FY2005.[22] Definitions and statistical sources are given in Table 1 B, and Table 2B provides the descriptive statistics of these variables.

The range of affirmative rates of consolidation is considerable, meaning that merger preference varies by municipality; however, its mean is close to 50%, suggesting that, on average, one in every two residents approves municipal consolidation. The positive difference in predicted costs at the minimum shows that all municipalities could benefit from the economies of scale that result from possible consolidation. Finally, as shown in the sixth row of Table 2B, the disparity in $SHAREPOP_i$ is extremely large, implying that various sizes of municipalities have held a merger vote.

---

[19]The median ratio of taxable income is used as a proxy for the median tax ratio. Both coincide if a proportional tax rate is adopted without any income exemption.

[20]Similar sized municipalities in terms of population are often chosen to estimate demand for public services for comparability reasons. However, because this study examines the relationship between the amount of spillovers and merger preference for municipalities that held local referenda regardless of municipal size, it seems better to use as many municipalities as possible; therefore, all municipalities are used for the estimation.

[21]The Government Census is carried out at five-year intervals.

[22]For more details, see the Appendix herein or Appendices A and C in Miyazaki (2013).

5. Estimation and Results

5.1 Regression Results

Table 3 provides the estimation results for the cost function. $L(POP)$ and its square are, respectively, significantly negative and positive, implying that the logarithm of per capita expenditure is U-shaped compared with that of population. Table 4 presents the estimated results of the non-linear-constrained spatial lag regression model of public good demand. All estimates excerpt for θ are shown to be statistically significant, and income elasticity (ϵ) has an expected positive sign, although price elasticity (δ) is also significantly positive, inconsistent with the theory. Because $\alpha = (1+\theta)/(1+\delta)$ from the theoretical model, a congestion parameter, α, equals approximately 0.85 and is statistically significant.

According to Reiter and Weichenrieder (1997), the range of crowding estimates is approximately 0.8–2.0, but this is valid in the 0 to 1 range in light of the theoretical model. Therefore, the estimated crowding parameter is valid according to the findings of previous empirical works and the theory. In addition, the public services provided by Japanese municipalities are more public than those examined in previous empirical studies,[23] that is, Japanese municipalities provide services that present more intense economies of scale in production.

Table 3 is inserted here.

Table 4 is inserted here.

Figure 3 is inserted here.

Figure 4 is inserted here.

Based on the estimated coefficients, ATS (Average total spillovers) is calculated according to (10). Its histogram is depicted in Figure 3, showing that ATS is distributed uniformly between 0 and 0.3 but that its frequency drops precipitously above that threshold. Figure 4 illustrates the distribution of ATS against the population size of pre-merger municipalities. The findings confirm that the larger the population size, the higher is the level of ATS, indicating that larger merging municipalities could internalize a relatively large amount of public service spillovers.

[23] See, for example, Reiter and Weichenrieder (1997).

Table 5 is inserted here.

The basic estimation results derived using municipal-level data on local referenda are reported in Table 5. The analyses presented herein include year dummies to capture the varying economic situation over time and reformation of financial incentive schemes for consolidation as well as prefecture dummies to reflect prefecture-level differences in eagerness for consolidation and policies.[24]

Column (1) of Table 5 provides the basic regression estimates. The estimated coefficient of ATS is significantly positive and economically large as well. We see that a one-point increase in average spillovers among potential consolidation partners raises the proportion of voters who agree with consolidation by approximately 17%. Roughly speaking, since ATS is calculated from the weighted sum of the logarithmic form of local public services, this result can be interpreted as a 17% increase in approval rates for every one percentage point increase in public services, weighted by the inverse of distance, provided by other merger partners. This finding implies that a municipality that can largely alleviate public good spillovers through consolidation has a strong incentive to consolidate, supporting the theoretical assumption that the internalization of externalities is an advantage of consolidation or the centralization of public service provision (e.g., Besley and Coate, 2003; Dur and Staal, 2008; Ellingsen, 1998; Lockwood, 2002). Moreover, $\Delta COST$ is also significantly positive, implying that economies of scale provide an incentive for consolidation; therefore, smaller municipalities are likely to consolidate, consistent with the empirical literature that has investigated the motivating effects of economies of scale on consolidation (e.g., Alesina and Spolaore, 2003; Alesina et al,, 2004; Austin, 1999; Brasington, 1999, 2003a, 2003b; Gordon and Knight, 2009; Nelson, 1990; Sorensen, 2006).

The presented estimation results also show that $REFERENDUM$, the rate of support for consolidation, is U-shaped with regard to $SHAREPOP$, suggesting that small and large municipalities tend to consolidate (Brasington, 1999). This result agrees with the theoretical prediction that larger jurisdictions prefer to merge more strongly than small jurisdictions (Dur and Staal, 2008; Ellingsen, 1998). This result could also be explained by the institutional background of small municipalities, which are required to consolidate in order to cope with the fiscal difficulties anticipated to result from the aging population and declining birth rates in

[24]Financial support for mergers was subtly reviewed almost annually from 1999 to 2006 in order to encourage municipal mergers.

Japan.[25] Concerning the other variables, $\Delta MEDINC_i$ and $\Delta UNCON\_GRANT_i$ have significantly negative signs with large point estimates. The estimate of $\Delta MEDINC_i$ infers that consistent with theoretical and empirical works, a large difference in median income before and after consolidation makes municipal residents less likely to choose consolidation. The coefficient of $\Delta UNCON\_GRANT_i$ also has the expected sign. It is known from simple theoretical analyses that municipalities that receive relatively large unconditional grants per capita compared with other consolidation members are less likely to consolidation (Dur and Staal, 2008; Miyazaki, 2013).

Column (2) of Table 5 presents the estimates of the regression that drops the potential effects of preference heterogeneity and financial incentives. Column (3) further omits $(SHAREPOP)^2$ from the regression in order to check the robustness of the estimation results regarding share of population, since this variable was not included in some earlier empirical works (e.g., Brasington, 2003b; Gordon and Knight, 2009). Finally, column (4) presents the same specifications as the baseline model in Table 4 except for the exclusion of the year dummy. In columns (2) to (4), similar signs and significance levels to those in column (1) are obtained for ATS. Although $\Delta COST$ in column (2) and $SHAREPOP$ in column (3) become non-significant, the other estimates in columns (2) to (4) that are significant in the basic regression remain significant.

5.2 Robustness Check

Table 6 is inserted here.

Columns (1) to (3) of Table 6 show the estimation results of a variant of the baseline model presented in Table 5. These models are different in that they include dummy variables on the local referendum. $NEWCREAT$ takes 1 when a new municipality is created through consolidation, while $CONSOLIDATION$ takes 1 if the referendum question is whether to consolidate and 0 if it is whether to establish a merger consultation committee.[26] $NEW \times CONSOL$ is the variable of $NEWCREAT$ times $CONSOLIDATION$, which takes 1 if the local referendum issue is whether to create a new municipality by consolidation. As shown in columns (1) to (3), including these dummies as explanatory variables does not change the signs and significance levels of the estimated coefficients other than $SHAREPOP$ in column (3). Moreover, the numerical values of the coefficients are similar to the baseline estimates

[25] These situations were pointed out as a reason to encourage small municipalities to consolidate by CLAIR (2009).
[26] A brief explanation of the merger consultation committee is presented in Section 2.

presented in Table 5. The estimates, therefore, seem to be valid and robust. Meanwhile, $NEW \times CONSOL$ turns the estimates of $SHAREPOP$ non-significant, suggesting that the impact of population share might be vulnerable to a regression specification.

Finally, a Tobit model is estimated with both lower and upper censoring limits, because the approval rate data might be censored on both sides. That is because a local referendum is unlikely to be held if the mayor or legislature can recognize whether the majority of residents are in favor of consolidation. The smallest observation is assumed to be the lower and the highest, the upper limit. The results of the two-limit Tobit are shown in column (4) of Table 6. The coefficients and standard errors obtained here remain unchanged, and all estimates significant in the basic model are also significant with the large point estimates.

In sum, the regression results imply that larger interregional spillovers in municipality's public services raise its preference for consolidation, as is consistent with the theoretical prediction. Moreover, besides spillover effects, economies of scale, population size effects, disparities in median income, and unconditional grants are shown to be significantly associated with consolidation preference.

6. Conclusion

Extensive theoretical and empirical work worldwide has investigated the factors that drive boundary reform in local governments. Most such theoretical formulations, based on a median voter model, demonstrate the importance of the amount of public good spillovers in the choice of whether to integrate or remain separate. However, no empirical study has thus far provided valuable insights into how spillover effects influence the structure of local government.

In order to bridge this gap in the body of knowledge on this topic, the present study examined local government boundary reform, focusing on the relationship between the degree of spillover and residents' consolidation preferences and made the following two main findings. First, municipalities that have larger interregional spillover effects in public good provision are more likely to consolidate. The presented data on the approval rates for consolidation confirm that the amount of spillovers among potential partners is a key determinant of the merger decision. Second, after controlling for such spillovers, we showed that economies of scale, population size, disparities in income levels and intergovernmental transfers all help explain consolidation preference.

There is, however, a limitation to this study that should be recognized. Spillovers that can be internalized after consolidation (ATS) are calculated from the estimates of a demand function for local public services. Thus, ATS is not directly observed and measured from data on public service spillovers, but rather estimated from predicted values. This restriction implies that the amount of spillovers is sensitive to the regression results as well as to the specification of the demand function. Nevertheless, public service spillovers are usually unobserved and difficult to measure unlike the study of environmental externalities, for example, where the amount of air pollution is measured by the distance from pollution sources (Banzhaf and Walsh, 2008). Further research to measure public goods externalities accurately is therefore needed.

APPENDIX

Referendum data were collected from the homepage of the MIC, specifically the Digital Archives of Mergers (DAM) (http://www.gappei-archive.soumu.go.jp/). However, because DAM covers only the referendum cases in which consolidation is realized after the referendum, all referendum data cannot be collected from the homepage. Then, information on other referendum cases was obtained from the homepages run by the merger consulting committee or municipalities, or from other offline documents, such as newspaper articles and municipal public documents. More details on the referendum data are presented in Chapter 2, Appendices A and C of Miyazaki (2013).

Acknowledgements

I would like to thank Nobuo Akai, Haruaki Hirota, and Kazuko Nakata as well as the participants of the 2012 Japanese Economic Association Autumn Meeting at Kyushu Sangyo University, Fukuoka, the 68th Congress of the International Institute of Public Finance held in August 2012 at Technische Universitat Dresden, and the seminar held in February 2012 at Doshisha University, Kyoto, for their helpful comments. This work is supported by JPSP Grant-in-Aid for Young Scientists (B) 22730256.

REFERENCES

Akizuki, Kengo, 2001. Partnership in Controlled Decentralization: Local Governments and the Ministry of Home Affairs, in: Muramatsu, M., Iqbal, F., and Kume, I. (Eds), Local Government Development in Post-War Japan, Oxford University Press,New York, 63–84.

Alesina, A., Spolaore, E., 1997. On the size and number of nations, Quarterly Journal of Economics 112, 1027–1056.

Alesina, A., Spolaore, E., 2003. The Size of Nations. MIT Press, Cambridge.

Alesina, A., Baqir, R., Hoxby, C., 2004. Political jurisdictions in heterogeneous communities, Journal of Political Economy 112, 348–396.

Anselin, L., 1988. Spatial Econometrics: Methods and Models. Kluwer Academic, Dordrecht.

Austin, D.A., 1999. Politics vs. economics: Evidence from municipal annexation. Journal of Urban Economics 45, 501–532.

Banzhaf, S.H., Walsh, R.P., 2008. Do people vote with their feet? An empirical test of Tiebout's mechanism. American Economic Review 98(3), 843–863.

Bergstrom, T.C., Goodman, R.P. 1973. Private demand for public goods. American Economic Review 63, 280–296.

Besley, T., Coate, S., 2003. Centralized vs. decentralized provision of local public goods: A political economy approach. Journal of Public Economics 87, 2611–2637.

Bolton, P., Roland, G., 1997. The breakup of nations: A political economy analysis, Quarterly Journal of Economics 112, 1057–1089.

Borcherding, T.E., Deacon, R.T., 1972. The demand for the services of non-federal governments, American Economic Review 62, 891–901.

Bradford, D.F., Oates, W.E., 1974. Suburban exploitation of central cities and governmental structure, in: Hochman, H.M., Peterson, G.E. (Eds.), Redistributions through Public Choice, New York and London, pp. 44–90.

Brasington, D., 1999. Joint provision of public goods: The consolidation of school districts, Journal of Public Economics 73, 373–393.

Brasington, D., 2003a. Size and school district consolidation: Do opposites attract? Economica 70, 673–690.

Brasington, D., 2003b. Snobbery, racism, or mutual distaste: What promotes and hinders cooperation in local public good provision? Review of Economics and Statistics 85, 874–883.

Brink, A., 2004. The breakup of municipalities: Voting behavior in local referenda, Economics of Governance 5, 119–135.

Brueckner, J.K., 2003. Strategic interaction among governments: An overview of empirical

studies, International Regional Science Review 26(2), 175–188.
CLAIR, 2009. Municipal Mergers in Japan, CLAIR Fact Sheet. Tokyo, CLAIR.
Dur, R., Staal, K., 2008. Local public good provision, municipal consolidation, and national transfers. Regional Science and Urban Economics 38, 160–173.
Ellingsen, T., 1998. Externalities vs. internalities: A model of political integration, Journal of Public Economics 68, 251–268.
Ferris, J., Graddy, E., 1988. Production choices for local government services, Journal of Urban Affairs 10, 273–289.
Gordon, N., Knight, B., 2009. A spatial merger estimator with an application to school district consolidation, Journal of Public Economics 93, 752–765.
Kelejian, H., Prucha, I, 1998. A generalized spatial two stage least squares procedure for estimating a spatial autoregressive model with autoregressive disturbances. Journal of Real Estate Finance and Economics 17, 99–121.
Kelejian, H.H., Robinson, D.P., 1993. A suggested method of estimation for spatial interdependent models with autocorrelated errors, and an application to a county expenditure model. Papers in Regional Science 72, 297–312.
Lockwood, B., 2002. Distributive politics and the costs of centralization, Review of Economic Studies 69, 313–337.
MIC, 2000. Kokusei Chosa (Population Census of Japan).
MIC, 2002a–2005a. Shichoson Kessan Jokyo Shirabe (Settlement of Municipality Finances).
MIC, 2002b–2005b. Shichoson Zei Kazei Jokyo Tou no Shirabe (Taxation of Municipal Taxes).
MIC, 2006. White Paper on Local Public Finance.
MIC, 2010, “Heisei no Gappei ni Tsuite (On Heisei Municipality Consolidation),” Report.
Miyazaki, T., 2013. Municipal consolidation and local government behavior: Evidence from Japanese voting data on merger referenda, Discussion Paper Series A, No. 588, Institute of Economic Research, Hitotsubashi University.
Nelson, M., 1900. Decentralization of the subnational public sector: An empirical analysis of the determinants of local government structure in metropolitan areas in the U.S. Southern Economic Journal 57, 443–457.
Oates, W., 1972. Fiscal Federalism. Harcourt Brace Jovanovich, New York.
Ord, J.K., 1975. Estimation methods for models of spatial interaction. Journal of the American Statistical Association 70, 120–126.
Reiter, M., Weichenrieder, A., 1997. Are public goods public? A critical survey of the demand estimates for local public services. Finanzarchiv 54, 374–408.
Saarima, T., Tukiainen, J., 2010. Coalition formation and political decision making: Evidence from Finnish municipal mergers. VATT Working Papers 19/2010, Helsinki, Finland.

Sancton, A., 2000. Merger Mania. McGill Queens University Press, Montreal, Kingston.

Sorensen, R., 2006. Local government consolidations: The impact of political transaction costs. Public Choice 127, 75–95.

Tyrefors Hinnerich, B., 2009. Do merging local governments free ride on their counterparts when facing boundary reform? Journal of Public Economics 93, 721–728.

Weese, E., 2008. Political mergers as coalition formation: Evidence from Japanese municipal amalgamations. Global COE Hi-Stat Discussion Paper Series 017.

Yokomichi, K., 2007. The development of municipal mergers in Japan – COSLOG up-to-date documents on local autonomy in Japan, No. 1, Tokyo, CLAIR.

TABLE 1. Definitions and Units of Variables

Variable	Definition	Unit	Source
	A. Variables for the estimation of public good demand		
EXP	Per capita total expenditure	1,000 yen/population	1
MEDSHARE	Median taxable income as a percentage of total taxable income	Percentage (%)	2
WAGE	Salary payment for official public servants, per official public servant	1,000 yen/population	1
MEDINC	Median taxable income	1,000 yen	2
POP	Population		1
POPDEN	Population density	1,000s of population /ha	1
POP65	Proportion of residents aged 65 or over	Percentage (%)	3
FOREIGNER	Proportion of foreign residents	Percentage (%)	1
	B. Variables for local referendum analysis		
REFERENDUM	Percentage of voters who agree to consolidation	Percentage (%)	
ΔCOST	Predicted per capita expenditure of the relevant municipality minus the expected amount after the potential consolidation	Millions of yen/population	
ΔPOP	Population of the relevant municipality minus the expected population after the potential consolidation		1
ΔTAXINC	Per capita taxable income of the relevant municipality minus the expected per capita taxable income after the potential consolidation for each merging municipality	Billions of yen	2
SHAREPOP	Population of the relevant municipality as a percentage of the population after the potential consolidation	Percentage (%)	1
ΔMEDINC	Median income of the relevant municipality minus the expected amount after the potential consolidation—absolute value as of 2000	1,000s of yen	2

TABLE 1. Definitions and Units of Variables (Continued)

Variable	Definition	Unit	Source
ΔEDUC	Residents of the relevant municipality who have at least graduated from a university as a percentage of the population minus the corresponding amount in the potentially merging municipalities—absolute value as of 2000	Percentage (%)	3
ΔPOPDEN	Population density of the relevant municipality minus the expected density after the potential consolidation	1,000s of population/ ha	1
ΔDEBT	Accumulated municipal bonds per capita in the relevant municipality minus the potential amount after consolidation	1,000s of yen/population	1
ΔSPEC_GRANT	Per capita specific grants provided by the central government and the prefecture to the relevant municipality minus the potential amount after consolidation	1,000s of yen/population	1
ΔUNCON_GRANT	Per capita general grants provided by the central government (Chiho Kofuzei, in Japanese) to the relevant municipality minus the potential amount after consolidation	1,000s of yen/population	1

Note: One yen is about 0.01 dollars. Predicted per capita expenditure is a cost function predicted from a regression of expenditure (in thousands of yen) on population, squared population, and year dummies. Its estimates can be presented in Table 3.
Source: 1 = MIC (2002a–2005a); 2 = MIC (2002b–2005b); 3 = MIC (2000).

TABLE 2. Descriptive Statistics for Key Variables

Variable	Mean	Standard Deviation	Maximum	Minimum	N
	A. Variables in the estimation of demand for public good				
EXP	383	169	11709	221	3143
MEDSHARE	0.006	0.013	1.186	2.E-04	3143
WAGE	6010	665	8951	3474	3143
MEDINC	2422	318	4072	1707.7	3143
POP	30624	64222	786882	200	3143
POPDEN	0.267	0.683	13.527	0.001	3143
POP65	18.0	5.1	51.7	7.7	3143
FOREIGNER	0.82	0.76	13.38	0.00	3143

TABLE 2. Descriptive Statistics for Key Variables (Continued)

Variable	Mean	Standard Deviation	Maximum	Minimum	N
	B. Variables in the estimation of local referendum				
REFERENDUM	51.5	15.0	86.6	11.0	309
ATS	0.18	0.13	0.98	0.00	309
ΔCOST	119.2	135.1	3381.1	2.1	309
ΔPOP	-132287	159082	-1661	-788194	309
ΔTAXINC	-77.0	181.5	470.3	-797.7	309
SHAREPOP	12.6	14.2	81.8	0.4	309
ΔMEDINC	100.3	88.6	457.7	0.3	309
ΔEDUC	1.60	1.41	7.99	0.0024	309
ΔPOPDEN	0.14	0.27	2.51	0.0004	309
ΔDEBT	-2.4	169.9	2455.4	-389.4	309
ΔSPEC_GRANT	-2.7	18.7	192.5	-92.7	309
ΔUNCON_GRANT	16.4	62.1	889.7	-275.8	309

Note: Variable definitions and units are described in Table 1.

TABLE 3. Estimates of Cost Function

Variable	
L(POP)	-1.814***
	(0.048)
$L(POP)^2$	0.072***
	(0.002)
City dummy	0.309***
	(0.014)
Constant	16.803***
	(0.236)
Observations	3225
Adjusted R square	0.792

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. All columns are the results of OLS estimation. The sample basically comprises all municipalities in 2000.

TABLE 4. Estimates of Demand for Public Good

Variable	
L(MEDSHARE) δ	0.160***
	(0.050)
L(WAGE) ξ	0.227***
	(0.055)
L(MEDINC) ϵ	0.752***
	(0.051)
L(POP) θ	-0.019
	(0.053)
L(POPDEN)	-0.124***
	(0.006)
POP65	0.014***
	(0.001)
FOREIGNER	0.032***
	(0.007)
Spatial lag parameter γ	0.951***
	(0.015)
Congestion parameter α	0.846***
P-value	(0.000)
Specification test of spatial lag	
Robust Lagrange multiplier test	176.29
P-value	0.000
Likelihood ratio test H_0: coeff=0	1170.241
Observations	3143
Log pseudo likelihood	7.627

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Variable definitions and units are described in Table 1. The congestion parameter is calculated from the estimates.

TABLE 5. Estimates of Local Referendum

Variable	Baseline model	No socio-economic and financial factors	No squared ratio of population	Excluding year dummy
	(1)	(2)	(3)	(4)
ATS	17.245**	20.047**	19.378**	15.190*
	(8.369)	(8.384)	(8.402)	(8.055)
ΔCOST	0.011**	0.004	0.013***	0.011**
	(0.005)	(0.003)	(0.005)	(0.005)
ΔPOP	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
ΔTAXINC	-0.010	-0.006	-0.013	-0.010
	(0.008)	(0.006)	(0.008)	(0.008)
SHAREPOP	-0.416*	-0.400*	0.073	-0.423*
	(0.223)	(0.221)	(0.068)	(0.223)
$(SHAREPOP)^2$	0.006**	0.006**		0.006**
	(0.003)	(0.003)		(0.003)
ΔMEDINC	-0.023*		-0.025**	-0.023*
	(0.012)		(0.012)	(0.011)
ΔEDUC	0.890		1.098	0.686
	(0.900)		(0.910)	(0.891)
ΔPOPDEN	1.992		2.305	1.583
	(2.288)		(2.279)	(2.240)
ΔDEBT	0.004		0.004	0.005
	(0.005)		(0.005)	(0.005)
ΔSPEC_GRANT	0.028		0.024	0.024
	(0.039)		(0.040)	(0.039)
ΔUNCON_GRANT	-0.039**		-0.037**	-0.040***
	(0.015)		(0.016)	(0.015)
Year dummy	Yes	Yes	Yes	
Prefecture dummy	Yes	Yes	Yes	Yes
Observations	309	309	309	309
Adjusted R square	0.159	0.147	0.143	0.158

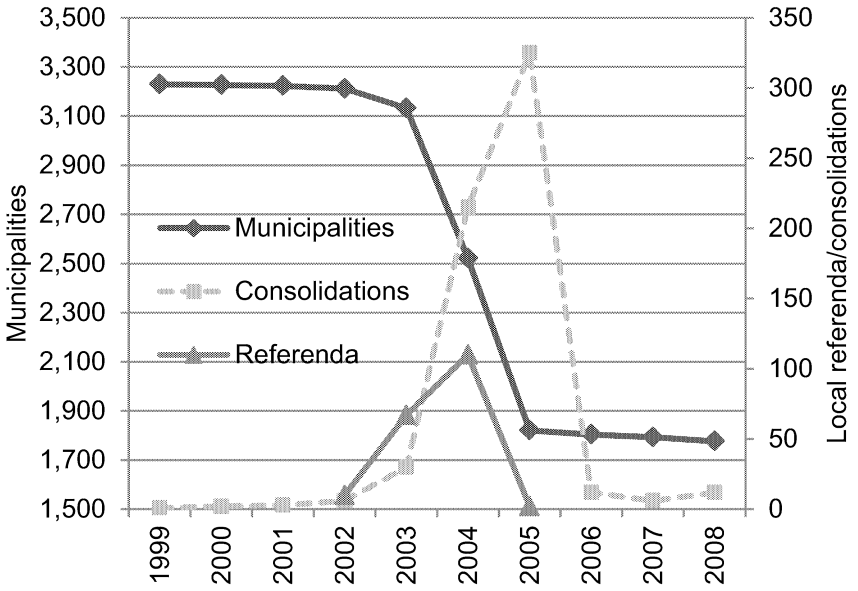
Notes: Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%. All columns are the results of OLS estimation. Variable definitions and units are described in Table 1.

TABLE 6. Estimates of Local Referendum, Robustness Check

Variable	Dummy for creating municipality	Dummy for consolidation	Cross-term of the two dummies	Tobit regression
	(1)	(2)	(3)	(4)
ATS	15.578*	16.831**	16.926**	12.244*
	(8.551)	(8.446)	(8.391)	(6.838)
ΔCOST	0.011**	0.011**	0.011**	0.012**
	(0.005)	(0.005)	(0.005)	(0.005)
ΔPOP	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
ΔTAXINC	-0.010	-0.010	-0.010	-0.011*
	(0.008)	(0.008)	(0.008)	(0.006)
SHAREPOP	-0.422*	-0.409*	-0.363	-0.314*
	(0.222)	(0.225)	(0.223)	(0.180)
$(SHAREPOP)^2$	0.006**	0.006**	0.005*	0.005**
	(0.003)	(0.003)	(0.003)	(0.002)
ΔMEDINC	-0.022*	-0.023**	-0.024**	-0.023**
	(0.012)	(0.012)	(0.012)	(0.011)
ΔEDUC	0.835	0.839	0.939	0.847
	(0.901)	(0.913)	(0.894)	(0.808)
ΔPOPDEN	2.095	2.075	1.906	2.082
	(2.297)	(2.313)	(2.285)	(2.491)
ΔDEBT	0.004	0.004	0.004	0.004
	(0.005)	(0.005)	(0.005)	(0.005)
ΔSPEC_GRANT	0.023	0.028	0.027	0.045
	(0.040)	(0.040)	(0.039)	(0.034)
ΔUNCON_GRANT	-0.038**	-0.038**	-0.039***	-0.042***
	(0.015)	(0.015)	(0.015)	(0.014)
NEWCREAT	2.419			
	(2.232)			
CONSOLIDATION		1.844		
		(2.433)		
NEW × CONSOL			34.628***	
			(7.878)	
Observations	309	309	309	309
Adjusted R square	0.159	0.158	0.170	
Log Pseudo Likelihood				-1216.756

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. All the regressions include year and prefecture dummies. All columns other than (4) are the results of OLS estimation; Column (4) is the estimation result of the two-limit Tobit. *NEWCREAT* is a dummy that takes 1 when a new municipality is created through consolidation. *CONSOLIDATION* is a dummy that takes 1 if the referendum question is whether to merge and 0 if it is whether to establish a merger consultation committee. *NEW × CONSL* is the variable of *NEWCREAT* times *CONSOLIDATION* .

Figure 1. Number of Municipalities, Consolidations, and Local Referenda



Source: Miyazaki (2013).

Figure 2. Illustrative Example

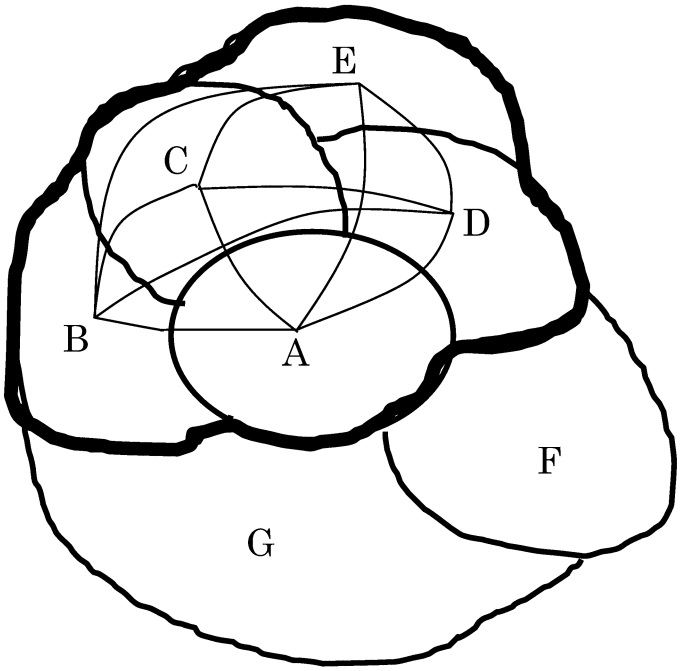
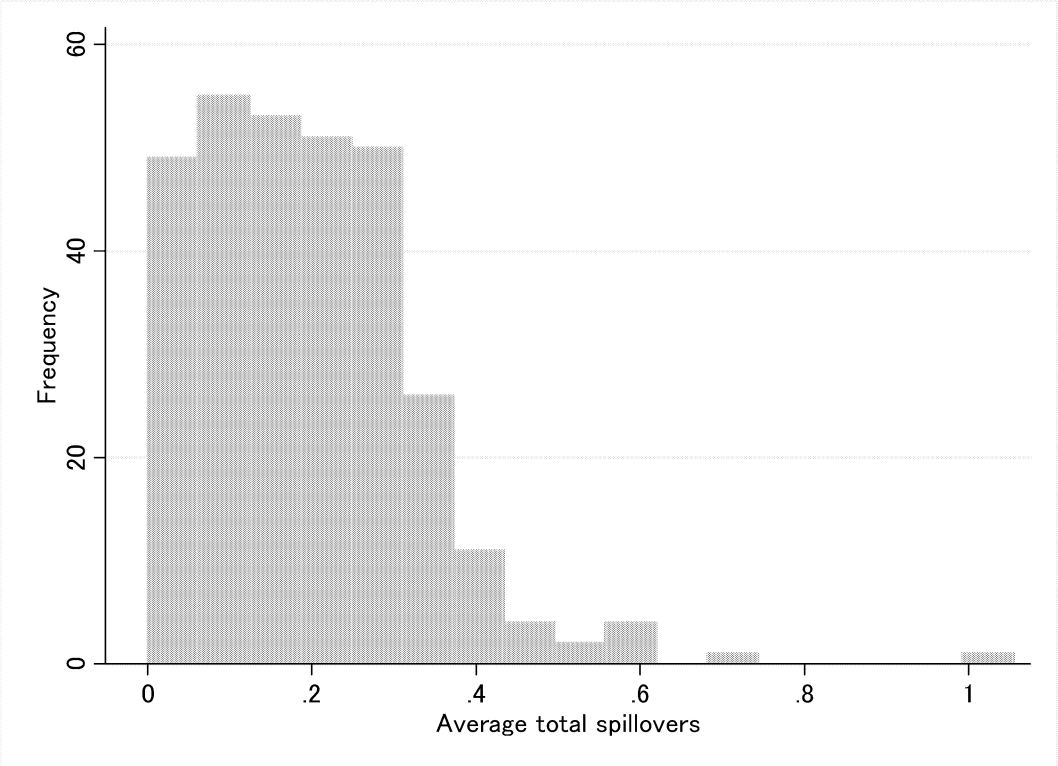
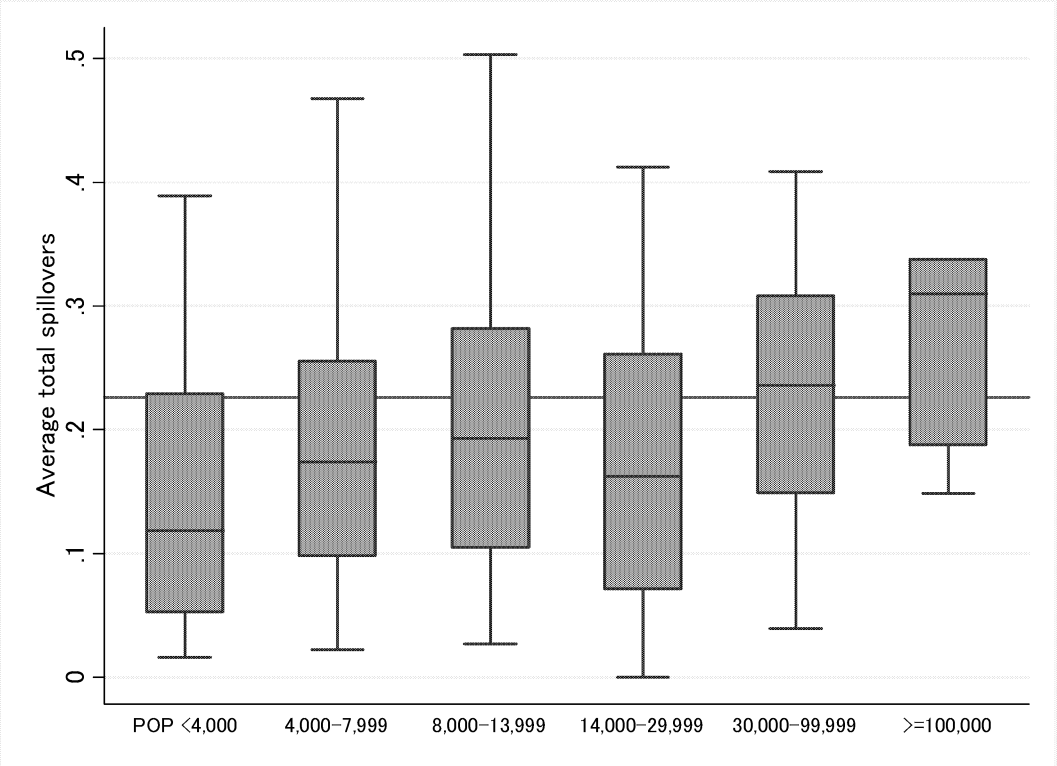


Figure 3. Histogram of Average Total Spillovers



Note: Average total spillovers (*ATS*) is calculated following equation (10).

Figure 4. Box Plots of Average Total Spillovers against Population Size



Note: Horizontal line around 0.125 of average total spillovers depicts their mean.

Discussion Paper Series

Number	Author	Title	Date
2000-1	Seiichi Iwamoto	Nearest Route Problem	2000/ 5
2000-2	Hitoshi Osaka	Productivity Analysis for the Selected Asian Countries : Krugman Critique Revisited	2000/ 5
2000-3	徳賀　芳弘	資産負債中心観への変化の検討 －会計観の変化と会計処理－	2000/ 7
2000-4	堀江　康熙	地域金融機関の不良債権問題	2000/ 7
2000-5	Hitoshi Osaka	Economic Development and Income Distribution : Survey and Regional Empirical Analysis	2000/10
2001-1	Yoshihiko Maesono	Nonparametric confidence intervals based on asymptotic expansions	2001/ 2
2001-2	堀江　康熙 川向　　肇	大都市所在信用金庫の営業地盤	2001/ 3
2001-3	Akinori Isogai	The Increasing Fluidity of Employment Re-examined	2001/ 4
2001-4	Hitoshi Osaka	Empirical Analysis on the Economic Effects of Foreign Aid	2001/ 5
2001-5	Toru Nakai	Learning Procedure for a Partially Observable Markov Process and its Applications	2001/ 6
2001-6	Isao Miura	Secret Collusion and Collusion-proof Mechanism in Public Bidding	2001/ 8
2001-7	堀江　康熙	金融政策の有効性と貸出行動	2001/11
2001-8	大坂　　仁	環境クズネッツ曲線の検証： 国際データによるクロスカントリー分析	2001/11
2001-9	堀江　康熙 川向　　肇	信用金庫の営業地盤分析	2001/12
2002-1	Horie Yasuhiro	Economic Analysis of the "Credit Crunch" in the late 1990s	2002/ 3
2002-2	大坂　　仁	日本のODA政策と経済効果：民主主義と経済発展における アジア地域とサブサハラ・アフリカ地域の比較分析	2002/ 6

Number	Author	Title	Date
2002-3	Hirofumi Ito	Can the Local Allocation Tax Break Free of the Doldrums? - Japan's Development of and Difficulties with Fiscal Equalization	2002/ 9
2002-4	堀江　康熙	信用格付を用いた不良債権規模の推計	2002/ 10
2003-1	三浦　　功	長期公共契約の経済分析 ―コミットメント，ラチェット効果および再交渉の問題―	2003/ 2
2003-2	Toshiyuki Fujita	Design of International Environmental Agreements under Uncertainty	2003/ 3
2003-3	Tōru Nakai	Some Thoughts on a Job Search Problem on a Partially Observable Markov Chain	2003/ 3
2003-4	Horie Yasuhiro	Monetary Policy and Problem Loans	2003/ 7
2003-5	磯谷　明徳	企業組織への契約論アプローチと能力論アプローチ ―知識・制度・組織能力―	2003/ 8
2003-6	Horie Yasuhiro	Credit Rating and Nonperforming Loans	2003/ 9
2003-7	磯谷　明徳	制度経済学のエッセンスは何か	2003/ 11
2004-1	磯谷　明徳	制度とは何か	2004/ 2
2004-2	大坂　　仁	日本ODAの再考：国際資本フローと主要援助国の動向に 関するデータからの考察	2004/ 2
2004-3	Toshiyuki Fujita	Game of Pollution Reduction Investment under Uncertainty	2004/ 10
2005-1	大坂　　仁	東アジアの所得配分と平等性の再検証	2005/ 3
2005-2	大坂　　仁	東アジアにおける成長会計分析の再考	2005/ 3
2005-3	佐伯　親良 福井　昭吾	産業連関分析―IOMetrics の開発―	2005/10
2005-4	Koichi Matsumoto	Optimal Growth Rate with Liquidity Risk	2005/11
2006-1	三浦　　功 川﨑　晃央	ネットワーク外部性下での遂次的価格競争と 最適特許戦略	2006/ 3
2006-2	石田　　修	市場の階層化と貿易構造	2006/ 3
2006-3	Koichi Matsumoto	Portfolio Insurance with Liquidity Risk	2006/ 4
2006-4	Kazushi Shimizu	The First East Asia Summit (EAS) and Intra-ASEAN Economic Cooperation	2006/ 7

Number	Author	Title	Date
2006-5	Yuzo Hosoya Taro Takimoto	A numerical method for factorizing the rational spectral density matrix	2006/ 8
2006-6	三浦　　功	公共入札における総合評価落札方式	2006/12
2007-1	佐伯　親良 福井　昭吾 森田　　充	所得分布と不平等度尺度の計量分析 ―PPID の開発―	2007/ 3
2007-2	Koichi Matsumoto	Mean-Variance Hedging in Random Discrete Trade Time	2007/ 4
2007-3	清水　一史	東アジアの地域経済協力とFTA ―ASEAN域内経済協力の深化と東アジアへの拡大―	2007/ 6
2007-4	Kazushi Shimizu	East Asian Regional Economic Cooperation and FTA: Deepening of Intra-ASEAN Economic Cooperation and Expansion into East Asia	2007/ 7
2008-1	Naoya Katayama	Portmanteau Likelihood Ratio Tests for Model Selection	2008/ 1
2008-2	三浦　　功 大野　正久	ソフトな予算制約とスピルオーバー効果	2008/ 1
2008-3	Koichi Matsumoto	Dynamic Programming and Mean-Variance Hedging with Partial Execution Risk	2008/ 3
2008-4	Naoya Katayama	On Multiple Portmanteau Tests	2008/ 5
2008-5	Kazushi Shimizu	The ASEAN Charter and Regional Economic Cooperation	2008/ 7
2008-6	Noriyuki Tsunogaya Hiromasa Okada	Boundaries between Economic and Accounting Perspectives	2008/11
2009-1	Noriyuki Tsunogaya	Four Forms of Present Value Method: From the Standpoint of Income Measurement	2009/ 2
2009-2	日野　道啓	市場的手段の効果と環境イノベーションに関する一考察	2009/ 3
2009-3	松本　浩一 坪田　健吾	アメリカンオプション価格の上方境界の改善	2009/ 3
2009-4	Naoya Katayama	Simulation Studies of Multiple Portmanteau Tests	2009/ 4
2009-5	北澤　　満	両大戦間期における三池炭の販売動向	2009/ 5
2009-6	Koichi Matsumoto	Option Replication in Discrete Time with Illiquidity	2009/ 6

Number	Author	Title	Date
2009-7	Naoya Katayama	合理的バブルの検定の検出力について	2009/ 7
2009-8	Mika Fujii Koichi Matsumoto Kengo Tsubota	Simple Improvement Method for Upper Bound of American Option	2009/ 7
2009-9	Kazushi SHIMIZU	ASEAN and the Structural Change of the World Economy	2009/ 9
2010-1	Tadahisa Ohno Akio Kawasaki	Who should decide the corporation tax rate?	2010/ 2
2010-2	大野　正久	環境税の分権的政策決定と民営化	2010/ 2
2010-3	Yuta Katsuki Koichi Matsumoto	Tail VaR Measures in a Multi-period Setting	2010/ 3
2010-4	清水　一史	ASEAN域内経済協力と生産ネットワーク ―ASEAN自動車部品補完とIMVプロジェクトを中心に―	2010/ 6
2011-1	三浦　　功	市場化テストの競争促進効果	2011/ 1
2011-2	Fujita Toshiyuki	Realization of a self-enforcing international environmental agreement by matching schemes	2011/ 2
2011-3	Yasuhisa Hirakata	British Health Policy and the Major Government	2011/ 2
2011-4	西釜　義勝 藤田　敏之	組織能力の構築メカニズムとリーダーシップの役割 －インドにおけるスズキの国際戦略を事例として－	2011/ 5
2011-5	Noriyuki Tsunogaya Chris Patel	The Accounting Ecology and Change Frameworks: The Case of Japan	2011/ 6
2011-6	三浦　　功 前田　隆二	医療機関の競争と最適リスク調整 ：Jack（2006）モデルの再検討	2011/ 7
2011-7	瀧本　太郎 坂本　直樹	国・都道府県レベルにおける歳入・歳出構造について	2011/ 8
2011-8	Kunio Urakawa Yusuke Kinari	Impact of the financial crisis on household perception - The case of Japan and the United States -	2011/10
2011-9	Koichi Matsumoto	Hedging Derivatives with Model Risk	2011/10
2011-10	三浦　　功	PFIを活用した公立病院の経営改革に関する経済分析 ：医療・介護の連携にシナジー効果が存在するケース	2011/10
2011-11	Yusuke Kinari	Time Series Properties of Expectation Biases	2011/11

Number	Author	Title	Date
2011-12	西釜　義勝 藤田　敏之	企業活性化に向けたイノベーションの検討 －自動車の環境技術開発の事例より－	2011/11
2012-1	阪田　和哉 瀧本　太郎 中嶌　一憲 生川　雅紀 坂本　直樹 阿部　雅浩	「心拍再開」の内生性を考慮したウツタイン統計データによる救命曲線の推定	2012/ 9
2012-2	西釜　義勝 藤田　敏之	経営戦略論における資源アプローチの理論研究 －経営資源・能力論の展開－	2012/10
2012-3	Masaharu Kuhara	Employment Issues Involving Japanese Banks: A Case Study of Shinsei Bank	2012/10
2012-4	Yuzo Hosoya Taro Takimoto	Measuring the Partial Causality in the Frequency Domain	2012/12
2013-1	平方　裕久	イギリス・メジャー政権の公共政策： 「評価」を通したガバナンスの構想	2013/ 1
2013-2	川脇　慎也	D. ヒュームにおける社会秩序論の展開 ―『政治論集』における租税・公債論との関連で―	2013/ 2
2013-3	Satoshi HOSOKAWA Koichi MATSUMOTO	Pricing Interest Rate Derivatives with Model Risk	2013/ 3
2013-4	平方　裕久	イギリスにおけるニュー・リベラリズムの経済思想： ひとつの学説的接近	2013/ 6
2013-5	三浦　　功 前田　隆二	医療サービスの質に関する競争と診療報酬制度	2013/ 7
2013-6	三浦　　功	医療機関の競争と連携：重複検査が存在するケース	2013/ 7
2013-7	Takeshi Miyazaki	Internalization of Externalities and Local Government Consolidation: Empirical Evidence from Japan	2013/11