Municipal Consolidation, Cost Reduction, and Economies of Scale : Evidence from Japan

Miyazaki, Takeshi

Discussion Paper Series

Discussion Paper No.2013-8

Municipal Consolidation, Cost Reduction, and Economies of Scale: Evidence from Japan

Takeshi Miyazaki
Kyushu University
November 2013

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

Municipal Consolidation, Cost Reduction, and Economies of Scale: Evidence from Japan

Takeshi Miyazaki[1,]

Department of Economics, Kyushu University, Fukuoka, Japan
6-19-1 Hakozaki Higashiku, Fukuoka 812-8581, Japan

Abstract

According to the literature, one of the advantages of local government consolidation is the delivery of efficient and effective public services through economies of scale. However, empirical works provide mixed evidence on whether consolidation leads to cost reduction. This study explores the cost-reduction effects of local government consolidation using Japanese municipality data. Specifically, it considers a number of consolidation cases and distinguishes between the effects of economies of scale and other consolidation-related factors such as fiscal incentives to correctly evaluate the cost influence of consolidation. The study uses an instrumental variable methodology to deal with the endogeneity problem regarding consolidation decisions. The findings of this study are twofold. First, consolidation increases costs, and economies of scale do not lead to cost reduction. Second, municipal expenditure rises immediately after consolidation but gradually declines over time, though not through economies of scale.

Key words: Boundary reform, economies of scale, municipal consolidation, municipal expenditure
JEL classification: H11, H72, H77

[1] Tel.: +81-(0)47-355-5120 (ext. 1407); fax: +81-(0)47-350-5504; e-mail: tmiyazak@econ.kyushu-u.ac.jp.

1. Introduction

Over the past 50 years, local government has undergone a process of comprehensive consolidation in many developed countries. In countries such as Sweden, Denmark, and the United Kingdom, for example, more than three-quarters of local governments have disappeared through boundary reforms during this period. Likewise, the number of school districts in the United States sharply declined from approximately 67,000 in 1952 to approximately 15,000 by 1982, while the number of municipalities in Japan almost halved between 1999 and 2012 (from 3,232 to 1,719).

Some advantages for consolidation are suggested in the literature. Local government consolidation is acknowledged to deliver public services more efficiently and effectively. Thus, the main purpose of most consolidations is to take advantage of economies of scale (Fox and Gurley, 2006). A large body of empirical work has shown the existence of economies of scale in local governments' public services (e.g., Blume and Blume, 2007; Callan and Thomas, 2001; DeBoer, 1992; Duncombe and Yinger, 1993; Farsi et al., 2007; Liner, 1992; Reingewertz, 2012). However, some empirical works suggest the absence of scale economies in local public service provision, or that consolidation in fact increases costs (e.g., Gonzalez and Mehay, 1987; Gyimah-Brempong, 1987; Mehay, 1981). Besides, some scholars find evidence of a U-shaped relationship between per capita public expenditure and population size (e.g., Breunig and Rocaboy, 2008; Liner and McGregor, 2002). Such empirical studies are supported by theoretical analyses based on a model developed to explicitly explain merger decisions aimed at economies of scale in public good production (e.g., Alesina et al., 2004; Brasington, 2003b).[2] In addition, theoretical works have investigated, as one of the advantages of consolidation, the role of internalization of spillovers in local public good provision (e.g., Besley and Coate, 2003; Bolton and Roland, 1997; Ellingsen, 1998). According to the theoretical analysis, merged local governments could reduce the efficiency loss generated by spillovers after consolidation.

Some disadvantages of consolidation have also been pointed out, however. First, consolidation brings about unitary provision costs for local public goods, because public goods are provided uniformly in a merged municipality (e.g., Alesina and Spolaore, 1997; Alesina et al., 2004; Bolton and Roland, 1997). Theoretical studies have focused on the trade-off between the efficiency of large municipalities, such as internalization of externality and scale economies, and costs for ignoring the preferences of minority groups. In addition, there is some empirical evidence of a trade-off between scale economies and heterogeneity of preferences, particularly

[2] Alesina and Spolaore (2003) is a good textbook on the issues of jurisdictional boundaries.

with respect to income and race (e.g., Alesina et al., 2004; Austin, 1999; Brasington, 1999, 2003a, 2003b; Gordon and Knight, 2009; Nelson, 1990; Sorensen, 2006). Second, consolidation could reduce competition among local governments; however, the effect of this competition is dependent on governmental type. For example, competition among general-purpose governments decreases the size of local public sector, whereas special-purpose government competition increases government size (Zax, 1989).

This work explores the cost-reduction effects of local government consolidation using Japanese municipality data. Because an endogeneity problem may arise between costs and the consolidation decision (i.e., municipalities that incur inefficiently large costs for providing public services are likely to merge), the fixed-effect (FE) and instrumental variable (IV) methods are used to consistently estimate the coefficients of cost-reduction effects. In the estimation, scale economies are identified from the effect of financial incentives for consolidation, since such incentives influence public expenditure by (i) allocating larger amounts of unconditional grants to merged municipalities compared with their unmerged counterparts and (ii) providing financial subsidies for the reimbursement of debt in order to finance expenditure on consolidation.

The current study makes the following three contributions to the body of knowledge on this topic. First, it uses extensive panel data of municipal consolidation in Japan during 2000–2010, including about 564 consolidation cases out of 3232 municipalities. By contrast, a similar study by Reingewertz (2012) examined just 21 consolidation cases out of the 244 municipalities in Israel. As pointed out by Meyer (1995), unbalanced treatment and control groups in a dataset may make a rigorous estimation of policy impacts difficult. To correctly evaluate the cost effects of consolidation, the present study employs a number of consolidation cases to ensure a sufficient representation of consolidated municipalities.

Second, this research investigates the fiscal impact of economies of scale resulting from consolidation. Reingewertz (2012) found that consolidations lower municipal spending by approximately 9%, without identifying the cost-reduction effect of consolidation through scale economies. On the other hand, some empirical studies show that factors not related to scale economies, such as reform for consolidation and lower competition among municipalities, may influence local governments' behavior, expenditure levels, and economic performance (e.g., Breunig and Rocaboy, 2008; Mehay, 1981). The current study examines how scale economies affect municipal expenditure by distinguishing between the effects of economies of scale and other consolidation-related factors such as fiscal incentives introduced by the central government.

Third, this research deals with the endogeneity problem regarding consolidation decisions. Municipalities may consolidate to overcome financial difficulties, and thus reverse causality may bias the estimation of the public expenditure–consolidation decision relationship. Indeed, fiscal gains, including financial programs for consolidation, become one of the impetuses for school district consolidation and political integration (Austin, 1999; Gordon and Knight, 2009). The current study thus employs an IV methodology with IV dummies for reduction of unconditional grants to small municipalities in 2002. The IVs are considered appropriate because the reduction of grants was based on national government policies implemented for all municipalities with size of population used as an objective standard. Some researchers have also pointed out that the reform induced municipal consolidation by reducing unconditional grants for small municipalities that will confront fiscal difficulties resulting from population aging and declining fertility (e.g., Konishi, 2003; Miyazaki, 2010). Governmental policymaking could then correlate well with consolidations, but remain exogenous.[3]

The findings of this study are twofold. First, evidence suggests that costs increase after consolidation and economies of scale do not lead to cost reduction. Rather than reduce costs, municipal consolidation is shown to significantly increase current expenditure, both statistically and economically. Besides, economies of scale from consolidation do not affect the current municipal expenditure. Second, the results presented here show that municipal expenditure increases immediately after consolidation but then declines gradually, though not through economies of scale. Cost reduction arises at particularly one, five, and six years after consolidation. These estimation results are robust to the specification and choice of IVs. Moreover, these results are consistent with some empirical works and, considering the long-run effect, support the theoretical prediction that municipalities seek to consolidate because of the efficiency gains from consolidation.

The remainder of this paper is organized as follows. Section 2 presents background information regarding the Japanese local government system and boundary reforms. Sections 3 and 4 discuss the empirical model and data, respectively. The main results are outlined in Section 5, and Section 6 concludes the paper.

[3] By contrast, the existing literature on the cost-reduction effects of consolidation in Japan has paid little attention to the endogeneity problem.

2. Japanese Local Government System and Boundary Reforms

In Japan, the local government hierarchy comprises 47 prefectures and approximately 1,700 municipalities under the former. The government at each level is politically elected. Municipalities are composed of cities, towns, and villages, which form the basic local government, while prefectures are wider-area regional governments, encompassing municipalities.

Municipalities in Japan constitute a major part of the public sector, accounting for 30% of total government budget compared to the prefectures' share of 28% (MIC, 2012). However, the local government financing system has also been partly centralized in Japan. Municipalities typically raise only 35% of their revenue through local taxes, in which property tax and inhabitant tax account for 44% and 43% of municipalities' tax revenue, respectively (MIC, 2012). Municipalities are largely dependent on the central government for funds. As much as 31% of their budget comes from intergovernmental transfers, of which 16% represent 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, bonds, and other independent resources.

Unconditional grants are a fiscal transfer system that aims to reduce vertical and regional fiscal imbalances,[4] and are paid to local governments so as to provide a standard set of local public services, depending on the disparity between their tax revenue-raising capacity and expenditure needs for basic public service provision.[5] Expenditure needs are calculated based on objective factors that can capture demands for local public services, such as population, area, and population density, as well as specific needs for each expenditure item. Because poor municipalities are much more reliant on grants than their richer counterparts are, this equalization system reduces regional fiscal inequalities.

Prefectures and municipalities have a central role in providing public services, including school education, public welfare and health, police and fire services, and public works such as roads and sewage systems. In municipalities, revenues are primarily utilized for public welfare expenses, general administrative expenses, debt expenses, and civil engineering work expenses. Debt payment (principal, interest, etc.), which account for 12% of municipal expenditure, have been increasing recently, reflecting higher municipal borrowings to meet the growing outlays on

[4] A vertical imbalance is the difference in the share of tax revenue and expenditure between the central government and local governments.

[5] For more details, see Mochida (2006) and Reschovsky (2007).

public welfare and economic stimulus packages.

Next, I briefly explain Japan's municipal consolidation. Over the past decade, there has been a major increase in the number of municipal consolidations as a way of strengthening the administrative and financial foundations of municipalities.[6] The Japanese government promoted municipal consolidations so that local governments have the autonomy to perform a diversified and intricate administrative role. Facing declining birth rates and aging populations, which decrease tax revenue and increase social security expenditure, municipalities have had to provide public services beyond traditional boundaries. In order to improve administrative efficiency, some found it necessary to merge with other municipalities to overcome severe financial constraints.

Originally, municipalities did not voluntarily merge, since the Special Law for Municipal Mergers (SLMM) enacted in 1965 did not provide a positive impetus for consolidation. However, the number of consolidations increased rapidly following amendments to the SLMM in 1999, which provided strong financial and economic incentives to promote municipal consolidation. These included a grace period for the local governments to avoid a reduction in unconditional grants following consolidations. Municipalities were allowed, as another incentive, to issue local bonds to finance the additional costs of consolidations, and could eventually receive unconditional grants to finance part of the debt expenses. The SLMM of 1999 was applied to municipalities that had implemented municipal consolidation by March 31, 2006.[7] Furthermore, the Japanese government required prefectures to report merger patterns for municipalities in 1999 and, in 2001, even constructed a headquarters to assist with municipal mergers.[8] In contrast, the new 2005 SLMM, implemented from April 1, 2005 to March 31, 2010, abolished subsidies provided under the 1999 SLMM for debt expenses on consolidation.

[Figure 1 is inserted here.]

Figure 1 shows the number of municipalities and consolidations between 1999 and 2008 in Japan. This figure highlights the sharp decline in the number of municipalities and increase in the number of consolidations between 2003 and 2005. The sharp fall in the number of municipal consolidations in 2006 reflects the abolition in that year of the 1999 SLMM.

---

6 See, for example, CLAIR (2009), MIC (2006d, p. 41), and Yokomichi (2007).

7 However, this was conditional on the submission of a consolidation application by March 31, 2005.

8 However, municipal mergers are not compulsory under Japanese law. Rather, consolidations are more voluntary now than they were in the past (Yokomichi, 2007).

3. Empirical Model and Econometric Issues

[Table 1 is inserted here.]

The existing empirical literature has applied a difference-in-differences (DID) methodology to identify the causal effects of consolidation. Reingewertz (2012) regresses the log of each budgetary item per capita on the treatment and year dummy variables and fixed effects to correctly estimate the treatment effect. The current study makes use of a fixed-effect (FE) methodology because it uses panel data for three years (2000, 2005, and 2010). Unlike Reingewertz (2012), however, I cannot identify the pre- and post-treatment terms, since some of the municipalities consolidated before 2005 and others after; therefore, the DID approach cannot be applied here. Thus, the econometric model in the current study is specified as follows:

$$Y_{it} = \beta_1 TREAT_{it} + \beta_2 TREND_{it} + \boldsymbol{X_{it}\beta_x} + c_i + \epsilon_{it} \quad i = 1, \ldots, N, t = 2001, 2005, 2010, (1)$$

where Y_{it} is the log of one of the budgetary items per capita, which includes $LEXP\_CU_{it}$ (log of current expenditure per capita), $LEXP_{it}$ (log of expenditure per capita), $LDEBT_{it}$ (log of per capita debt expenditure), and $LPUBWK_{it}$ (number of public servants).[9] $TREAT_{it}$ represents a treatment effect and is a dummy for consolidated municipalities. The treatment effect presented in equation (1) could be suitable to identify the financial impact of municipal consolidation on budgetary items. However, this consolidation impact may depend on how many years have elapsed since consolidation; that is, the consolidation effect might have a decreasing or increasing time trend. A trend term, $TREND_{it}$ (number of years since consolidation), is then included as an explanatory variable in some estimations to control for the trend. $\boldsymbol{X_{it}}$ is a vector of explanatory variables that comprise $LAREA_{it}$ (log of area), $LPOPDEN_{it}$ (log of population density), $LTAXINC_{it}$ (log of per capita taxable income), $POP65_{it}$ (proportion of residents aged at 65 or over), and $FOREIGNER_{it}$ (proportion of foreign residents). β_1, β_2, and $\boldsymbol{\beta_x}$ are coefficients of these variables; c_i denotes individual effects, and ϵ_{it} is the usual residual. Subscripts i and t denote municipality and year indexes, respectively, and N is the number of municipalities adopted in the estimation. Table 1 provides

[9] $LEXP\_CU_{it}$ is calculated from total expenditure minus debt payments and investment, because debt and investment expenditures are affected by the decisions in the past years, and thus might be inadequate for analyzing the impacts of consolidation on costs. Since such current expenditure includes expenses financed by specific grants, which the central government can control for, excluding specific grants from the data is preferable. However, considering the availability of data and comparable estimation results regardless of whether $LEXP\_CU_{it}$ or $LEXP_{it}$ is used as the dependent variable, as shown later, I chose current expenditure calculated as such in the regression analysis.

the definition, units, and statistical sources of these variables. A fixed-effects model of panel data analysis is estimated in order to control for individual effects and eliminate any omitted-variable bias from the correlation between these individual effects and the explanatory variables.

[Figure 2 is inserted here.]

The current study also investigates the possibility of reducing costs through scale economies stemming from municipal consolidation. The estimation procedure is as follows. First, a simple cost function is estimated, where the dependent variable is the log of per capita current expenditure, and the log of population and its square are employed as explanatory variables. In Japan, the per capita cost function of public service provision is U-shaped with regard to the log of the population of Japan (e.g., CLAIR, 2009).[10] This is, therefore, modeled as a cross-section of the population size as of 2000 and its square as follows:

$$LEXP_i = \alpha + \beta LPOP_i + \gamma LPOPSQ_i + \epsilon_i \qquad (2)$$

where ϵ_i is a random error term. Figure 2 depicts the log of per capita current expenditure against that of the 2000 population, indicating that the cost function is U-shaped in Japan.

Second, for each consolidation, two types of predicted logarithmic current expenditure per capita are calculated, one based on the pre-merger and the other on the post-merger municipal population. The difference between the pre-merger municipalities' average predicted costs weighted by population and the post-merger municipality's predicted cost is then calculated as the scale economy effects of consolidation, $SCALE\_ECON_{it}$.[11] In other words, the scale economy effect is the difference between the logs of per capita current expenditure before and after consolidation, with all elements other than the size effect of the population excluded. The larger the predicted economies of scale from consolidation, the larger the amount of cost reduction merging municipalities can expect from the consolidation. The scale economy effect for merged municipalities can thus be calculated as we can identify consolidation partners. In addition, for exploring the trend effect of scale economies, $SCALE\_ECON\_TREND_{it}$ (=$SCALE\_ECON_{it}$ times $TREND_{it}$) is employed as a policy variable in some models.

[10] The cost function may consist of other variables such as area and proportions of the elderly and the young. However, since we focus on calculation of scale economies in costs, that is, the relationship between costs and the population size, such other elements are omitted here. That is, including the log of area and proportions of the elderly and young usually does not alter the estimated coefficients of $LPOP_i$ and $LPOPSQ_i$.

[11] All costs are in a logarithmic form.

[Figure 3 is inserted here.]

Figure 3 illustrates the estimation of the predicted economies of scale. The vertical line represents the log of per capita current expenditure, c_i $(i = 1,2)$, and the horizontal one the log of population, n_i, where i is the index of the municipality (1, 2) and 1+2 represents the new municipality created from the merger of municipalities 1 and 2. The solid curve is the predicted cost function, and $\hat{c}_i$ denotes the predicted cost at n_i. The points x $(x = \mathrm{A,B,D})$ are the realized values, whereas the corresponding values x' are the predicted ones. $SCALE\_ECON_{it}$ is defined as the difference between logs of the average of predicted per capita current expenditure of the merging municipalities, point C', which is calculated from the population-weighted average of A' and B', and that of the merged municipality, point D'.

The condition needed to consistently estimate a treatment effect is one in which no correlation exists between municipal expenditure and the consolidation decision, conditional on regressors. Put another way, the treatment criterion should not correlate with the outcome variables This condition is, however, not necessarily satisfied in the current estimation, because small municipalities that have been suffering from a weak financial base and are aware of the fact are likely to have a strong incentive to merge. The IV methodology is then employed to overcome this endogeneity problem.

[Table 2 is inserted here.]

Changes in the laws on unconditional grants are used as IVs for the municipal consolidation decision. In particular, this paper focuses on the institutional reform of one of the correction coefficients for unconditional grants, where correction coefficients are the framework used to allocate grants to conform to financial needs of municipalities. We are interested in the correction coefficients that allocates grants based on population size, especially where municipalities with smaller populations receive more grants (*Dankai Hosei* in Japanese).[12] The correction coefficient framework was modified in 1998 and 2002. In 1998, the degree of correction was alleviated so as to treat municipalities with fewer than 4000 inhabitants as 4000 municipalities, which led to a reduction in unconditional grants for municipalities with population sizes of under 4000. In 2002, unconditional grants for small municipalities were further reduced so that less populous municipalities incur larger losses in revenue. Table 2 presents the reduction in per capita grants following these reforms, showing that the smaller the municipality, the larger the reduction is.

[12] Reschovsky (2007, p. 415) briefly describes the mechanism of correction (modification) coefficients.

Whether the reduction in unconditional grants through a reform of correction coefficients induces consolidation by small municipalities has been a matter of debate (e.g., Konishi, 2003). Miyazaki (2010) has empirically shown that the 1998 reform had no effect on, but the 2002 reform did have a causal relationship with, consolidation decisions. We therefore employ as instruments two dummies that take one for municipalities with a population of (1) <1,000 and (2) 1000–8000, respectively, for the years after 2002. For robustness check, however, corresponding instruments for other population size thresholds (<1,000 and 1000–4000) are also constructed because the range of impact of the 2002 reform could not be determined exactly.

4. Data

[Table 3 is inserted here.]

The dataset employed herein consists of *LEXP_CU*, *LAREA*, *LPOPDEN*, *LTAXINC*, *POP65*, *FOREIGNER*, *LEXP*, *LDEBT*, and *LPUBWK* for 4858 municipalities in 2000, 2005, and 2010.[13] Table 3 provides summary statistics for level values of *LEXP_CU*, *LPOP*, and all control variables. All statistics relate to treatment and control groups for 2000, 2005, and 2010 to check the tendency of each variable in both groups.

As shown in row 1 of Table 3, the mean per capita current expenditure grows in both treatment and control groups, but the increase is greater in the former than the latter. The basic statistics do not agree with the theoretical prediction that consolidation is likely to lower costs. Rows 4 and 5 show that the decrease in the mean taxable income per capita is greater in the control than the treatment group, while the increase in average proportion of people aged 65 or more is greater in the control group. Row 7 reports that the population of the treatment group is falling while that of the control group is increasing. This is a surprising result as the treatment group can likely strengthen its financial status and allure more people from neighboring municipalities. The result may reflect the possibility that municipalities favoring consolidation have declining birthrates and aging populations for the years before consolidation, whereas those not opting for consolidation are conveniently located and therefore lure people living in other areas.

[Figure 4 is inserted here.]

[13] To compare outcomes before and after consolidation, all the pre-merger variables of merged municipalities are calculated by aggregating variables among all merging municipalities. Outliers, which outweigh two standard errors of *LEXP_CU*, are excluded from the regression.

Figure 4 presents per capita current expenditure for merged and non-merged municipalities during 2002–2009. The year lines indicate the average expenditure of municipalities that merged in the year, and the "Non-merged" line represents that of non-merged municipalities. The average expenditure for non-merged municipalities declined during the years 2003–2006 and rose sharply from 2006 to 2009. As for the merged municipalities, their costs have not declined definitively during 2003–2006, except for municipalities that merged in 2006. However, their means increased soon after consolidation, but decreased sharply in the next year and gradually thereafter.

5. Estimation and Results

5.1 Baseline Results

Table 4 presents cost function estimates from equation (2) based on 2000 data. I selected 2000 because estimating a valid cost function for a later period would be difficult with the surge in municipal consolidations thereafter transforming the cost–population size relationship. As *LPOP* is negative and *LPOPSQ* is positive, the cost function is shown to be U-shaped.

[Table 4 is inserted here.]

[Table 5 is inserted here.]

Estimation results of the cost-reduction effects of consolidation are reported in Table 5. Estimates shown in columns other than (3) and (6) were obtained using a pooled panel data model. Column (1) provides the results of an OLS estimation without socioeconomic variables. Columns (2) and (3) include socioeconomic factors as explanatory variables, while column (3) present estimates of fixed-effect panel data. Similar to columns (1)–(3), (4)–(6) present the estimation results of OLS and a fixed-effect model with and without explanatory variables. The estimated coefficient of *TREAT* is found to be significantly positive in all estimates except column (4). Unlike some recent empirical works (e.g., Blume and Blume, 2007; Reingewertz, 2012), this result reveals that municipalities that merged during 2000–2010 likely experienced a higher cost increase than they would had they not merged. A merged municipality may raise its public expenses to cover costs of some consolidation-related projects such as computer and compensation system integration, reallocation of public facilities, and so on. However, this result might have occurred because municipalities that did not merge voluntarily reduced budget growth to maintain their fiscal health in the face of a declining population and an aging society.[14]

Column (2) shows the estimation of the baseline specification, including several control variables. *TREAT* is significantly positive with a coefficient larger than the one in column (1). *LAREA* and *LPOPDEN* are negatively correlated with per capita current expenditure, whereas *LTAXINC*, *POP65*, and *FOREIGNER* are positively related. It probably reflects the fact that the larger the relative population of the elderly and foreigners, the greater the expenditure incurred by municipalities for social insurance like elderly care and schools for foreigners. The estimates of a fixed-effect model, shown in column (3), are similar to those in column (2), except that *LTAXINC* is statistically insignificant and the sign of *POP65* is negative.

Unlike the estimates shown above, however, *TREAT* in column (4) of Table 5 is negative and significant. The impact of consolidation on current expenditure changes with the inclusion of the term representing economies of scale, *SCALE_ECON*. However, the coefficient of determination in column (4) is extremely low relative to other regressions, indicating that the specification is inadequate for the estimation. On the other hand, columns (5) and (6), which contain socioeconomic explanatory variables, show that *TREAT* is significantly positive, but with a lower point estimate in column (5) than in column (2).

SCALE_ECON has positive signs when significant, suggesting that current expenditure is unlikely to decrease through economies of scale from municipal consolidation. Contrary to the results in column (4) and (5) of Table 5, the fixed-effect model—see column (6)—finds that *SCALE_ECON* is negative but not significant. Thus, these results indicate that neither do economies of scale lead to a decline in per capita current expenditure after consolidation nor is consolidation itself likely to lower expenditure.

[Table 6 is inserted here.]

Table 6 presents the regression estimates that take account of potential endogeneity problems in the consolidation decision. The IV model represents instrumental variable estimation based on pooled data, and the FEIV model indicates fixed-effect instrumental variable estimation. We exploit instrumental variables that represent how unconditional grant allocation to small municipalities has changed after 2002. Dummy variables take one for years after 2002 with municipal population sizes of (1) under 1,000 and (2) between 1,000 and 8,000. The validity of

[14] Yamashita (2011) points out that in Japan non-merged municipalities reduced their expenditure as municipal consolidation proceeded.

IVs is confirmed from a list of IV test statistics or by the Hausman test, partial F statistics, and Hansen J statistics. In all regressions, these statistics show that IVs are sufficiently correlated with *TREAT* and *SCALE_ECON*, but nearly uncorrelated with disturbances, thus supporting the decision to use the IV methodology to consistently estimate the causal effects of consolidation on municipal expenditure.

In columns (1) and (3), the IV estimates of *TREAT* become negative and statistically significant, while the signs of *TREAT* were significantly positive when the endogeneity problem was ignored. Meanwhile, as for the policy variables *TREAT* and *SCALE_ECON*, the same coefficient signs are obtained in the FEIV models as in the FE model, although IV model estimates show the different signs of coefficients. IV model estimates thus seem to be less robust than FEIV because individual-specific errors are not considered under the IV estimation. It could be inferred from these findings that municipal consolidation raises costs per capita, but not via economies of scale.

[Table 7 is inserted here.]

Table 7 provides the estimation results of FE and FEIV models, which include as policy variables *TREND* and *SCALE_ECON_TREND* as well as *TREAT* and *SCALE_ECON,* to examine the transition of expenditure after consolidation. *TREND* represents the number of years since consolidation, and therefore increases with each passing year. *SCALE_ECON_TREND* is equal to *TREND* times *SCALE_ECON*, measuring the expected impact of scale economies after consolidation, depending on the elapsed time. However, because the estimation spans just three years, 2000, 2005, and 2010, the trend variables do not necessarily reflect the entire post-consolidation period. We consider three types of trends: linear, quadratic, and square root.

Part A of Table 7 shows the treatment and trend effects of consolidation without distinguishing the total impact of consolidation from the scale economy effect. Similar to the previous estimation, *TREAT* has a significantly positive sign in each estimation. Treatment effects are represented by a per capita cost increase of approximately 5–7% in FE models and approximately 34–47% in FEIV models. The results of *TREND* indicate that the longer the period after consolidation, the lower the municipal expenditure, although the size of coefficients varies according to the estimation method and type of trend. The FEIV model estimates in even-number columns are more than sixfold compared to the FE. The magnitude is largest in a square-root trend followed by a linear trend, and is smallest in a quadratic trend, reflecting the size of growth in trend values. *SCALE_ECON_TREND* is included in the regression equations in Part B of Table 7. *TREAT* exhibits nearly equal or smaller point estimates relative to those in Part A. Similar to the estimates in Part A, *TREND* is negative and statistically significant in FE models, but insignificant in FEIV estimation. *SCALE_ECON_TREND* is not significant in all estimates, implying that economies of scale do not bring about municipal expenditure efficiency. These results suggest that per capita current expenditure rises temporally following consolidation, but declines gradually over time.

The reasoning behind the results is as follows. As explained above, municipalities had to expand their budgets to finance municipal integration costs. To address this widely recognized problem, the central government prepared a package of subsidies for merged municipalities, which would likely increase municipal budgets. Therefore, the merged municipalities might have to prepare for subsidy reduction that starts ten years after consolidation, as mentioned above, and repayment of debts borrowed to finance the expenses relating to consolidation.[15]

5.2 Robustness check

[Table 8 is inserted here.]

For an in-depth investigation of expenditure transition, we examine different treatment effects, consisting of time dummies that take the value of one depending on the number of years after consolidation. In Table 8, for example, the explanatory variable "2 years after treatment" indicates a dummy that equals one if merged municipalities have seen two years of consolidation. Columns (1) and (2) present the results of different treatment effects corresponding to the number of years after consolidation. Columns (3) and (4) show treatment effects for specific numbers of years before and after consolidation. Different treatment effects are allowed for economies of scale as well, which is presented on the right side of columns (2) and (4). Since it is difficult to find rigorous exclusion restrictions for many endogenous policy variables, I did not conduct an IV estimation. To estimate treatment effects three years before consolidation, municipalities that consolidated from 2000 to 2002 are excluded from the estimation in columns (3) and (4). If economies of scale are ignored, municipalities succeeded in cost reduction mainly one, five, and six years after consolidation, with particularly large cost cuts five and six years after. Economies of scale affect cost reduction to some extent, but do not

[15] Some years after consolidation, merged municipalities might decrease expenses for the legislature; some of these municipalities were required to downsize the number of seats in the local legislature to cut costs when the four-yearly municipal elections are held (Yokomichi, 2007).

alter the main results. Indeed, municipal costs decline four years after consolidation through scale economies, whereas, by the factors other than scale economies, municipalities attain cost reduction five and six years after consolidation.

[Table 9 is inserted here.]

Table 9 is based on data for the years 2000–2010. We can analyze in detail the transition of municipal expenditure before and after consolidation using an 11-year sample. However, we would have to give up using the explanatory variables *POP65* and *FOREIGNER* since these are collected in the census held every 5 years—in 2000, 2005, and 2010. Coefficients of *TREAT* obtained by the FE method are nearly equal to those of the previous estimation, while *TREAT* calculated by FEIV is much larger in size than previous estimates. *TREND* is negative and statistically significant as shown in the former results although the point estimates of the FEIV model are large in absolute value. The results of *SCALE_ECON_TREND* are either significant or insignificant depending on the estimation method. Estimates of different trends resemble prior findings, indicating that costs rise one year before and drop annually up to seven years after consolidation. In addition, economies of scale are effective and can decrease expenditure up to six years after consolidation. A large sample of municipalities allows us to estimate the consolidation and cost relationship, in particular the transition in municipal expenditure. We can confirm a positive treatment effect and a negative trend.

[Table 10 is inserted here.]

A variety of tests for program evaluation with regard to the consolidation–cost relationship and IV estimation are presented in Table 10. Placebo effect tests are executed to check whether treatment and trend effects cause increment and reduction of current expenditure randomly. As shown in the descriptive statistics (see Table 3), both merged and non-merged municipalities exhibit an increasing expenditure trend. Thus, a different sample with randomly chosen municipalities defined as the treatment group might provide results similar to those obtained in this study. I provide Monte Carlo simulation results with a random sample of municipalities in which the treatment is randomly assigned. The results of 1000 repetitions are presented in columns (1) and (2) of Table 10. As can be seen, treatment and trend effect variables are insignificant or, even if significant, have opposite signs to those of the above estimates. Matching estimates, in column (3), are obtained from nearest-neighbor matching estimation for average treatment effects for the overall sample, developed by Abadie and Imbens (2002). The results in column (3) point to a positive relationship between municipal expenditure and consolidation. Columns (4)–(6) provide FEIV estimates based on different instrumental variable definitions. As for IVs, I use two dummy variables that take one for years after 2002 where the population size of the municipality is respectively (1) under 1,000 and (2) 1000–4000, representing the policy change of unconditional grants in 2002. *TREAT* is significantly positive in all estimations, but *TREND* is insignificant or significantly negative. In sum, it is inferred that municipal expenditure rises following consolidation and then gradually falls, though occasional findings to the contrary are also obtained.

[Table 11 is inserted here.]

The estimated consolidation effects on total expenditure, debt payments, and the number of public servants are shown in Table 11. Similar to the regression results of current expenditure, per capita total expenditure grows temporarily but then drops significantly, whereas economies of scale do not lead to expenditure reduction. In contrast, debt payments do not change after consolidation. Consolidation raises the number of public servants in the FE model, whereas FEIV regression shows no correlation between consolidation and the number of public servants. It is noted that the number of public servants increases immediately after consolidation and continues to rise further, unlike the expenditure trend in a fixed-effect model.

6. Conclusion

From the literature, smaller (i.e., suboptimal) municipalities might be able to enjoy economies of scale from municipal consolidation as per capita expenditure of municipalities is negatively related to population size, or U-shaped relative to population. However, consolidation may increase costs because of disparities in stakeholder preferences and the decline in competition between municipalities, as pointed out in the previous literature. It is thus important to examine whether municipal consolidation in fact lowers per capita expenditure compared to premerger levels.

The literature does not provide conclusive results on the effects of consolidation on expenditure, and has never revealed the factors leading to a cost reduction or increase following consolidation. In addition, few empirical studies have considered reverse causality in local governments' consolidation decisions and costs. This paper estimated the consolidation effects on the cost efficiency of Japanese municipalities, using fixed-effect and instrumental variable methodologies. Consolidation effects on municipal expenditure via economies of scale are also analyzed by distinguishing scale economy effects from other expenditure-influencing factors.

This paper's findings are twofold. First, the results indicate rising expenditure after consolidation but show no evidence of scale economy effects of consolidation on cost reduction. The empirical results show that Japanese municipal consolidation causes a statistically and economically significant increase in per capita current expenditure. Second, municipalities are likely to see a gradual decline in expenditure after consolidation irrespective of scale economies. In sum, municipal expenditure tends to increase immediately after consolidation but decline over time thereafter.

However, a caveat needs to be made about this analysis. One, the analysis does not explain the reasons behind the expenditure growth soon after consolidation and the subsequent gradual decline. Some authors relate the phenomenon to the conventional wisdom about the consolidation–cost relationship such as internalization of spillovers in local public provision, increased heterogeneity of preferences in merged municipalities, and less competitiveness among municipalities. Others attribute it to the institutional background inherent in Japan. For example, concerning financial incentives for merged municipalities, the fiscal relationship between the central and local governments (intergovernmental transfers, personnel exchange between them, and so on), and the local government system (election, tax autonomy, and so on) can be listed as possible reasons. Therefore, further research is needed to empirically reveal the financial effects of municipal consolidation.

Acknowledgements

I would like to thank Takero Doi, Junya Hamaaki, Yusuke Kinari, Chung Mo Koo, Kensuke Miyazawa, Toru Takemoto, Taro Takimoto, Hiroki Tanaka, Konari Uchida, Kunio Urakawa, Satoshi Watanabe, Izumi Yokoyama, and the seminar participants at the 69th meeting of the Japanese Institute of Public Finance, the 2013 Japanese Economic Association Spring Meeting, and the Hitotsubashi University and Kyushu University seminars for their helpful comments. This work was supported by JPSP Grant-in-Aid for Young Scientists (B) 22730256.

References

Alesina, A., and E. Spolaore, "On the Size and Number of Nations," *Quarterly Journal of Economics* 112 (1997), 1027–1056.

Alesina, A., and E. Spolaore, *The Size of Nations*, Cambridge: MIT Press (2003).

Alesina, A., R. Baqir, and C. Hoxby, "Political Jurisdictions in Heterogeneous Communities," *Journal of Political Economy* 112 (2004), 348–396.

Abadie, A. and G. Imbens, "Simple and Bias-Corrected Matching Estimators. Technical Report," Department of Economics, University of California, Berkeley (2002).

Austin, D. Andrew, "Politics vs. Economics: Evidence from Municipal Annexation," *Journal of Urban Economics* 45 (1999), 501–532.

Besley, T., and S. Coate, "Centralized vs. Decentralized Provision of Local Public Goods: A Political Economy Approach," *Journal of Public Economics* 87 (2003), 2611–2637.

Blume, L., and T. Blume, "The Economic Effects of Local Authority Mergers: Empirical Evidence for German City Regions," *Annals of Regional Science* 41 (2007), 689–713.

Bolton, P., and G. Roland, "The Break-up of Nations: A Political Economy Analysis," *Quarterly Journal of Economics* 112 (1997), 1057–1089.

Brasington, D., "Joint Provision of Public Goods: The Consolidation of School Districts," *Journal of Public Economics* 73 (1999), 373–393.

Brasington, D., "Size and School District Consolidation: Do Opposites Attract?" *Economica* 70 (2003a), 673–690.

Brasington, D., "Snobbery, Racism, or Mutual Distaste: What Promotes and Hinders Cooperation in Local Public Good Provision?" *Review of Economics and Statistics* 85(4) (2003b), 874–883.

Breunig, R., and Y. Rocaboy, "Per-capita Public Expenditures and Population Size: A

Non-parametric Analysis Using French Data," *Public Choice* 136 (2008), 429–445.

Callan, S.J., and J.M. Thomas, "Economies of Scale and Scope: A Cost Analysis of Municipal Solid Waste Services," *Land Economics* 77 (2001), 548–560.

CLAIR (Council of Local Authorities for International Relations), "Municipal Mergers in Japan," *CLAIR Fact Sheet* (2009).

DeBoer, L., "Economies of Scale and Input Substitution in Public Libraries," *Journal of Urban Economics* 32 (1992), 257–268.

Duncombe, W., and J. Yinger, "An Analysis of Returns to Scale in Public Production, with an Application to Fire Protection," *Journal of Public Economics* 52 (1993), 49–72.

Ellingsen, T., "Externalities vs. Internalities: A Model of Political Integration," *Journal of Public Economics* 68 (1998), 251–268.

Farsi, M., and A. Fetz, M. Filippini, "Economies of Scale and Scope in Local Public Transportation," *Journal of Transport Economics and Policy* 41 (2007), 345–361.

Fox, W.F., and T. Gurley, "Will Consolidation Improve Sub-National Governments?" World Bank Working Paper 3913 (2006).

Gyimah-Brempong, K., "Economies of Scale in Municipal Police Departments: The Case of Florida," *Review of Economics and Statistics* 69 (1987), 352–356.

Gordon, N., and B. Knight, "A Spatial Merger Estimator with an Application to School District Consolidation," *Journal of Public Economics* 93 (2009), 752–765.

Gonzalez, R. A. and S. L. Mehay, "Municipal Annexation and Local Monopoly Power," *Public Choice* 52 (1987), pp. 244-55, 1987.

Konishi, S., "Shichoson Gappei to Chiho Zaisei Seido, Shichoson no Zaisei Un-ei (Municipal Consolidation, the System of Local Public Finance, and Municipality's Financial Management)," *Jichi Kenkyu* 79 (9) (2003), 22–49.

Liner, G. H., "Annexation Impact on Municipal Efficiency," *Review of Regional Studies* 22 (1992), 75–87.

Liner, G. and R. McGregor, "Optimal Annexation," *Applied Economics* 34 (2002), 1477–1485.

Mehay, S. L., "The Expenditure Effects of Municipal Annexation," *Public Choice* 36 (1981), 53–62.

Meyer, B. "Natural and Quasi-Experiments in Economics," *Journal of Business and Economic Statistics* 13(2) (1995), 151–161.

MIC, "*Kokusei Chosa (Population Census of Japan)*" (2000a, 2005a, 2010a).

MIC, "*Shichoson Kessan Jokyo Shirabe (Settlement of Municipality Finances)*" (2000b–2010b).

MIC, *Shichoson Zei Kazei Jokyo Tou no Shirabe (Taxation of Municipal Taxes)* (2000c–2010c).

MIC, *White Paper on Local Public Finance* (2006d, 2012).

Miyazaki, T., "Chiho Koufuzei Kaikaku ga Shichoson Gappei ni Oyobosu Eikyo (The Effects of the Reform of Local Allocation Tax on Municipal Annexations)," *Nihon Keizai Kenkyu* 63 (2010), 79–99.

Mochida, N., "Taxes and Transfers in Japan's Local Finances," in *Local Government Development in Post-War Japan* edited by Muramatsu, Michio, Iqbal, Farrukh, and Kume, Ikuo, 85–111, Oxford University Press, New York (2001).

Mochida, N., "Local Government Organization and Finance: Japan," Public Sector Governance and Accountability Series, Washington, DC: World Bank (2006).

Nelson, M., "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(2) (1990), 443–457.

OECD (Organization for Economic Co-operation and Development), *Economic Surveys: Japan*, (2005), Paris: OECD.

Reingewertz, Y., “Do Municipal Amalgamations Work? Evidence from Municipalities in Israel,” *Journal of Urban Economics* 72 (2012), 240–251.

Reschovsky, A., “Compensating Local Governments for Differences in Expenditure Needs in a Horizontal Fiscal Equalization Program,” in *Intergovernmental Fiscal Transfers,* edited by Boadway, Robin, Shah, Anwar, The World Bank, Washington DC (2007).

Sorensen, R., “Local Government Consolidations: The Impact of Political Transaction Costs,” *Public Choice* 127 (2006), 75–95.

Yamashita, K., “Migappei Dantai no Zaisei Kodo nikansuru Zisshou Bunseki (Empirical study of municipal government behavior in finance),” *Nihon Keizai Kenkyu* 65 (2011), 43–64.

Yokomichi, K., “The Development of Municipal Mergers in Japan,” COSLOG Up-to-date Documents on Local Autonomy in Japan No.1 (2007), Council of Local Authorities for International Relations (CLAIR).

Zax, J., “Is There A Leviathan in Your Neighborhood?” *American Economic Review* 79 (1989), 560–567.

Table 1. Variable Definition, Unit, and Sources

Variable	Definition	Unit	Source
LEXP_CU	Log of the per capita current expenditure of the municipality	Million yen/population	2
LAREA	Log of the area of the municipality	ha	2
LPOPDEN	Log of population density	1,000 population/ha	2
LTAXINC	Log of per capita taxable income	1,000 yen/population	3
POP65	Proportion of residents aged 65 or over	Percentage	1
FOREIGNER	Proportion of foreign residents	Percentage	1
LPOP	Log of the population of the municipality	1,000 population	2
LPOPSQ	Square of *LPOP*	-	2
TREAT	Coded one for municipalities that have consolidated and zero otherwise	-	
TREND	Number of years elapsed since consolidation	-	
SCALE_ECON	The scale economy effect, calculated as log of the difference between the average predicted per capita expenditure for pre-merged municipalities, weighted by population, minus the predicted per capita expenditure of the post-merged	-	2
SCALE_ECON_TREND	*SCALE_ECON* times *TREND*	-	
LDEBT	Log of the per capita debt expenditure of the municipality	Million yen/population	2
LPUBWK	Log of the number of public servants, per capita	Million yen/population	2
LEXP	Log of the per capita expenditure of the municipality	Million yen/population	2

Note: One yen is equal to approximately 0.01 USD. Pre-consolidation values are calculated by summing those of consolidation partners.
Source: 1 = MIC (2000a, 2005a, 2010a); 2 = MIC (2000b–2010b); 3 = MIC (2000c-2010c).

Table 2. Reductions in Unconditional Grants following the Reform of the Correction Coefficient

Population	Reduction in unconditional grants, per year (yen)	unconditional grants, per year (yen/population)
1,000	8,000,000	8,000
4,000	18,000,000	4,500
8,000	17,000,000	2,125
12,000	17,000,000	1,416.7
20,000	17,000,000	850
30,000	10,000,000	333

Note: One yen is equal to approximately 0.01 USD. The table was created based on *Chiho Koufuzei no Aramashi* (Guide for Unconditional Grants).

Table 3. Summary Statistics in the Treatment and Control Groups

Variable	Treatment group					Control group				
	Year 2000	Year 2005	Year 2010	Diff	Diff	Year 2000	Year 2005	Year 2010	Diff	Diff
	(1)	(2)	(3)	(2)-(1)	(3)-(2)	(4)	(5)	(6)	(5)-(4)	(6)-(5)
Per capita current expenditure	253.75	276.20	306.80	22.45	30.59	240.60	247.25	274.80	6.65	27.55
	(58.6)	(68.8)	(67.4)			(72.9)	(68.9)	(71.7)		
Area	368.94	351.61	355.04	-17.33	3.43	129.12	133.02	131.33	3.90	-1.69
	(299.5)	(287.2)	(288.6)			(168.1)	(171.3)	(168.2)		
Population density	0.39	0.40	0.375	0.00	-0.02	1.02	1.06	1.15	0.04	0.09
	(0.7)	(0.7)	(0.7)			(1.8)	(1.9)	(2.0)		
Per capita taxable income	3369.2	3165.7	2870.8	-203.45	-294.94	3643.3	3437.6	3139.4	-205.70	-298.16
	(344.7)	(354.1)	(327.4)			(515.4)	(495.8)	(460.8)		
Proportion of population	19.03	21.72	24.73	2.69	3.01	16.39	19.36	22.59	2.97	3.23
aged 65 or over	(4.3)	(4.5)	(4.2)			(4.7)	(4.6)	(4.3)		
Proportion of foreigners	0.80	0.98	0.98	0.18	-0.01	0.86	1.05	1.07	0.19	0.02
	(0.7)	(0.9)	(0.8)			(0.8)	(0.9)	(0.9)		
Population	96.53	86.68	81.60	-9.85	-5.08	41.37	42.66	46.02	1.29	3.36
	(124.4)	(119.4)	(108.7)			(69.2)	(72.0)	(75.4)		

Note: The upper line in a row indicates means, and the lower, standard deviations, within parentheses.

Table 4. Estimates of the Cost Function: Year 2000

Dependent variable	*LEXP_CU*
LPOP	-0.656***
	(0.011)
LPOPSQ	0.070***
	(0.002)
CONST	6.926***
	(0.015)
Observations	3351
Adjusted R^2	0.727

Notes: Robust standard errors are in parentheses. * Significant at 10%, ** significant at 5%, *** significant at 1%. *CONST* denotes a constant term. The data do not include merged municipalities.

Table 5. Estimates of the Cost Reduction and Scale Economy Effects

	Cost reduction effect			Including scale economy effect		
	Simple OLS	OLS	FE model	Simple OLS	OLS	FE model
	(1)	(2)	(3)	(4)	(5)	(6)
TREAT	0.040***	0.068***	0.035***	-0.172***	0.026***	0.040***
	(0.011)	(0.007)	(0.005)	(0.013)	(0.010)	(0.006)
SCALE_ECON				0.991***	0.190***	-0.031
				(0.042)	(0.029)	(0.027)
LAREA		-0.081***	-0.091***		-0.080***	-0.097***
		(0.004)	(0.027)		(0.004)	(0.027)
LPOPDEN		-0.189***	-0.234***		-0.188***	-0.239***
		(0.004)	(0.029)		(0.004)	(0.030)
LTAXINC		0.502***	0.074		0.502***	0.073
		(0.031)	(0.069)		(0.031)	(0.069)
POP65		0.016***	-0.003***		0.015***	-0.003***
		(0.001)	(0.001)		(0.001)	(0.001)
FOREIGNER		0.010***	0.005*		0.010***	0.005*
		(0.003)	(0.003)		(0.003)	(0.003)
Fixed effect			Yes			Yes
Observations	4869	4858	4858	4869	4858	4858
Adjusted R^2	0.027	0.724	0.595	0.070	0.726	0.595

Notes: Robust standard errors are in parentheses. * Significant at 10%, ** significant at 5%, *** significant at 1%. FE model implies a fixed-effect estimation. All estimations include year dummies in 2005 and 2010.

Table 6. IV Estimation of the Cost Reduction and Scale Economy Effects

	Cost reduction effect		Including scale economy effect	
	IV model	FEIV model	IV model	FEIV model
	(1)	(2)	(3)	(4)
TREAT	-0.449***	0.073***	-1.548***	0.093***
	(0.049)	(0.016)	(0.355)	(0.035)
SCALE_ECON			4.472***	-0.130
			(1.268)	(0.159)
LAREA	0.023**	-0.093***	0.117***	-0.107***
	(0.011)	(0.022)	(0.037)	(0.029)
LPOPDEN	-0.129***	-0.215***	-0.069***	-0.228***
	(0.008)	(0.026)	(0.024)	(0.028)
LTAXINC	0.311***	-0.073	0.198***	-0.079
	(0.043)	(0.049)	(0.074)	(0.050)
POP65	0.020***	0.001	0.016***	0.001
	(0.001)	(0.001)	(0.002)	(0.001)
FOREIGNER	0.016***	0.006**	0.026***	0.006**
	(0.004)	(0.002)	(0.008)	(0.002)
Fixed effect		Yes		Yes
Observations	4858	4858	4858	4858
Hausman test	119.600	129.788	45.827	140.001
P-value	0.000	0.000	0.000	0.000
Partial F-statistics 1	178.099	325.355	290.052	379.785
Partial F-statistics 2			536.189	179.670
Hansen J statistics	1.955	0.145	1.995	0.130
P-value	0.162	0.703	0.158	0.719

Notes: Robust standard errors are in parentheses. * Significant at 10%, ** significant at 5%, *** significant at 1%. IV model implies an instrumental variable estimation for pooled data; FEIV model stands for a fixed-effect instrumental variable estimation. All estimations include year dummies in 2005 and 2010. The Hausman test is used to examine endogeneity between the OLS (FE) and IV (FEIV) models. Partial F-statistics 1 (2) are used to test whether all instruments correlate with endogeneity variables in the first-stage regression of two stage least square estimation. The Hansen J statistics are employed to test correlation between instrumental variables and errors.

Table 7. Estimates with Trend in Treatment

	Linear trend		Quadratic trend		Square root trend	
	FE model	FEIV model	FE model	FEIV model	FE model	FEIV model
	(1)	(2)	(3)	(4)	(5)	(6)
A. Cost reduction effect						
TREAT	0.061***	0.388**	0.054***	0.343**	0.068***	0.473**
	(0.005)	(0.173)	(0.005)	(0.151)	(0.006)	(0.221)
TREND	-0.010***	-0.108*	-0.001***	-0.018*	-0.026***	-0.291*
	(0.001)	(0.058)	(0.000)	(0.010)	(0.003)	(0.156)
Hausman test		176.281		151.680		142.848
P-value		0.000		0.000		0.000
Partial F-statistics 1		241.733		241.733		241.733
Partial F-statistics 2		86.296		74.560		94.792
Hansen J statistics		1.363		1.368		1.371
P-value		0.506		0.505		0.504
B. Including scale economy effect						
TREAT	0.060***	0.287**	0.054***	0.259**	0.067***	0.339**
	(0.005)	(0.128)	(0.005)	(0.113)	(0.006)	(0.156)
TREND	-0.009***	-0.080	-0.001***	-0.013	-0.018***	-0.197
	(0.001)	(0.054)	(0.000)	(0.009)	(0.005)	(0.149)
SCALE_ECON_TREND	-0.005	0.037	0.001	0.018	-0.020	0.013
	(0.006)	(0.084)	(0.002)	(0.030)	(0.013)	(0.157)
Hausman test		300.938		174.770		307.175
P-value		0.000		0.000		0.000
Partial F-statistics 1		253.024		253.024		250.670
Partial F-statistics 2		88.610		74.210		96.507
Partial F-statistics 3		53.215		17.722		80.441
Hansen J statistics		1.890		1.827		1.922
P-value		0.596		0.609		0.589

Notes: Robust standard errors are in parentheses. * Significant at 10%, ** significant at 5%, *** significant at 1%. Explanations of models and test statistics are the same as in Table 6. Estimates of explanatory variables, *LAREA, LPOPDEN, LTAXINC, POP65, FOREIGNER* , are omitted.

Table 8. Different Treatments on Cost Reduction and Scale Economy Effects

	After treatment			Before and after treatment		
	Cost reduction effect	Including scale economy effects		Cost reduction effect	Including scale economy effects	
	(1)	(2)		(3)	(4)	
		(Cost reduction)	(Economies of scale)		(Cost reduction)	(Economies of scale)
TREAT	0.070***	0.064***		0.070***	0.064***	
	(0.007)	(0.010)		(0.007)	(0.010)	
3 Years before treatment				0.011	0.003	
				(0.017)	(0.016)	
2 Years before treatment				-0.039	-0.042	
				(0.054)	(0.052)	
1 Year before treatment				0.027*	0.027*	
				(0.016)	(0.016)	
1 Year after treatment	-0.032***	-0.016	-0.081	-0.032***	-0.016	-0.082
	(0.009)	(0.013)	(0.062)	(0.009)	(0.013)	(0.062)
2 Years after treatment	-0.026	0.000	-0.140	-0.017	0.003	-0.139
	(0.018)	(0.020)	(0.102)	(0.020)	(0.023)	(0.101)
3 Years after treatment	-0.047	-0.024	-0.144	-0.051	-0.061	0.100
	(0.039)	(0.047)	(0.231)	(0.070)	(0.072)	(0.454)
4 Years after treatment	-0.018	0.038*	-0.629**	0.021	0.066***	-0.558***
	(0.035)	(0.021)	(0.245)	(0.040)	(0.013)	(0.209)
5 Years after treatment	-0.052***	-0.047***	-0.028	-0.052***	-0.046***	-0.028
	(0.007)	(0.011)	(0.058)	(0.007)	(0.011)	(0.058)
6 Years after treatment	-0.079***	-0.058***	-0.099*	-0.078***	-0.058***	-0.099*
	(0.009)	(0.014)	(0.060)	(0.009)	(0.014)	(0.060)
7 Years after treatment	-0.050***	-0.051*	-0.048	-0.041*	-0.048	-0.048
	(0.018)	(0.028)	(0.104)	(0.022)	(0.031)	(0.104)
8 Years after treatment	-0.070	-0.075	0.043	-0.100	-0.064	-0.617
	(0.045)	(0.064)	(0.290)	(0.074)	(0.072)	(0.618)
9 Years after treatment	-0.029	0.019	-0.823***			
	(0.034)	(0.023)	(0.245)			
Fixed effect	Yes	Yes		Yes	Yes	
Observations	4858	4858		4843	4843	
Adjusted R^2	0.607	0.607		0.606	0.606	

Notes: Robust standard errors are in parentheses. * Significant at 10%, ** significant at 5%, *** significant at 1%. All estimations include year dummies.

Table 9. Estimates Using Data for the Years 2000-2010

	Cost reduction effect		Including scale economy trend		Different treatment		
	FE model	FEIV model	FE model	FEIV model	FE model		
	(1)	(2)	(3)	(4)	(5)	(6)	
						(Cost reduction)	(Economies of scale)
TREAT	0.047***	0.845**	0.045***	0.845**	0.063***	0.060***	
	(0.003)	(0.390)	(0.003)	(0.403)	(0.005)	(0.005)	
TREND	-0.009***	-0.332**	-0.006***	-0.331**			
	(0.001)	(0.158)	(0.001)	(0.155)			
SCALE_ECON_TREND			-0.016***	-0.007			
			(0.005)	(0.512)			
3 Years before treatment					-0.000	-0.001	
					(0.002)	(0.002)	
2 Years before treatment					0.002	0.002	
					(0.003)	(0.003)	
1 Year before treatment					0.017***	0.016***	
					(0.004)	(0.004)	
1 Year after treatment					-0.021***	-0.009*	-0.058***
					(0.004)	(0.005)	(0.021)
2 Years after treatment					-0.041***	-0.015**	-0.118***
					(0.005)	(0.006)	(0.023)
3 Years after treatment					-0.048***	-0.028***	-0.091***
					(0.005)	(0.006)	(0.023)
4 Years after treatment					-0.046***	-0.024***	-0.100***
					(0.005)	(0.006)	(0.024)
5 Years after treatment					-0.051***	-0.033***	-0.079***
					(0.005)	(0.006)	(0.023)
6 Years after treatment					-0.058***	-0.046***	-0.055**
					(0.005)	(0.008)	(0.024)
7 Years after treatment					-0.050***	-0.055***	0.003
					(0.009)	(0.016)	(0.047)
8 Years after treatment					-0.078**	-0.048	-0.359
					(0.038)	(0.036)	(0.512)
Observations	17877	17877	17877	17877	17817	17817	
Adjusted R^2	0.435		0.435		0.437	0.439	

Notes: Robust standard errors are in parentheses. * Significant at 10%, ** significant at 5%, *** significant at 1%. Explanation of models is the same as in Table 6. Estimates of explanatory variables, *LAREA, LPOPDEN, LTAXINC,* and test statistics for instrumental variable estimation are omitted.

Table 10. Tests for Placebo Effects, Matching Estimation, and Different Instrumental Variables

	Placebo effects		Matching estimation	Different instrumental variables		
	Cost reduction	Including scale economy trend		Treatment effect	Trend effect	Including scale economy trend
	(1)	(2)	(3)	(4)	(5)	(6)
TREAT	-0.022***	-0.004	0.022***	0.086***	0.347***	0.532**
	(0.004)	(0.004)	(0.007)	(0.026)	(0.103)	(0.208)
TREND	0.002***	-0.001			-0.077***	0.129
	(0.001)	(0.001)			(0.029)	(0.168)
SCALE_ECON_TREND		-0.000				-1.226
		(0.003)				(0.937)
Model	FE	FE		FEIV	FEIV	FEIV
Observations	4858	4858	4858	4858	4858	4858
Adjusted R^2	0.590	0.588				

Notes: Robust standard errors are in parentheses. * Significant at 10%, ** significant at 5%, *** significant at 1%. Estimates of explanatory variables, *LAREA, LPOPDEN, LTAXINC, POP65, FOREIGNER* , are omitted in all columns other than (3). *LAREA, LPOPDEN, LTAXINC, POP65, FOREIGNER* , and two year dummies are used as matching variables in column (3), and the number of matches to be made per observations is four. Test statistics for instrumental variable estimation are omitted in columns (4)-(6).

Table 11. Estimates of Per Capita Expenditure, Debt, and Public Servants

Dependent variables	Per capita expenditure		Per capita debt expenses		Number of the public servants, per capita	
	FE model	FEIV model	FE model	FEIV model	FE model	FEIV model
	(1)	(2)	(3)	(4)	(5)	(6)
A. Cost reduction effect						
TREAT	0.069***	0.491***	0.110*	0.771	0.074***	0.926
	(0.007)	(0.186)	(0.060)	(2.015)	(0.012)	(1.622)
TREND	-0.010***	-0.117*	0.019	-0.001	0.041***	-0.148
	(0.001)	(0.062)	(0.019)	(0.684)	(0.014)	(0.527)
Observations	4858	4858	4858	4858	4858	4858
Adjusted R^2	0.284		0.002		0.036	
B. Including scale economy effect						
TREAT	0.068***	0.430**	0.104*	0.867	0.074***	0.890
	(0.007)	(0.168)	(0.059)	(1.748)	(0.012)	(1.427)
TREND	-0.009***	-0.101	0.030	0.069	0.039***	-0.103
	(0.002)	(0.071)	(0.023)	(0.700)	(0.014)	(0.541)
SCALE_ECON_TREND	-0.008	0.023	-0.067	-0.579	0.009	-0.178
	(0.007)	(0.131)	(0.043)	(0.834)	(0.022)	(0.538)
Observations	4858	4858	4858	4858	4858	4858
Adjusted R^2	0.284		0.002		0.036	

Notes: Robust standard errors are in parentheses. * Significant at 10%, ** significant at 5%, *** significant at 1%. Explanation of models is the same as *in* Table 6. Estimates of explanatory variables, *LAREA, LPOPDEN, LTAXINC, POP65, FOREIGNER* , are omitted. Test statistics for instrumental variable estimation are omitted in columns (2), (4), and (6).

Figure 1. Numbers of Municipalities and Consolidation, 1999–2008

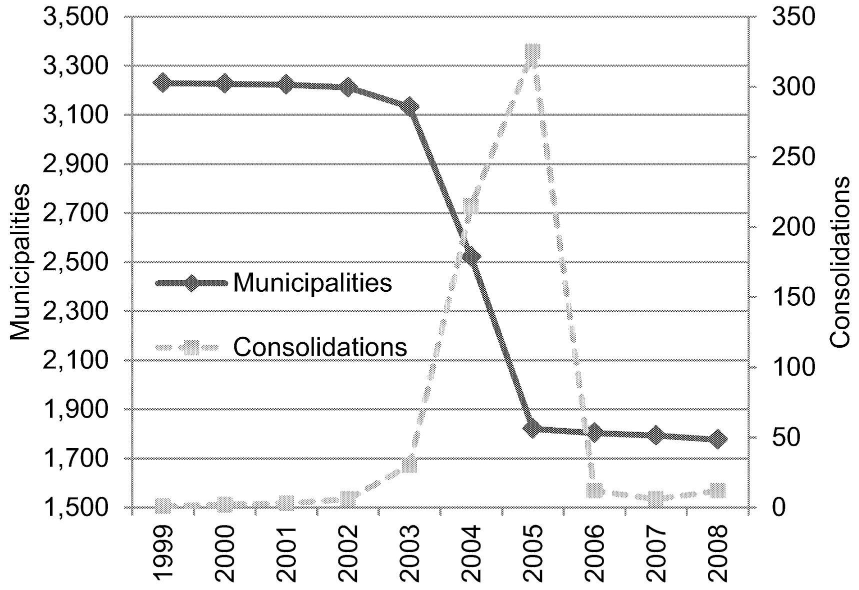
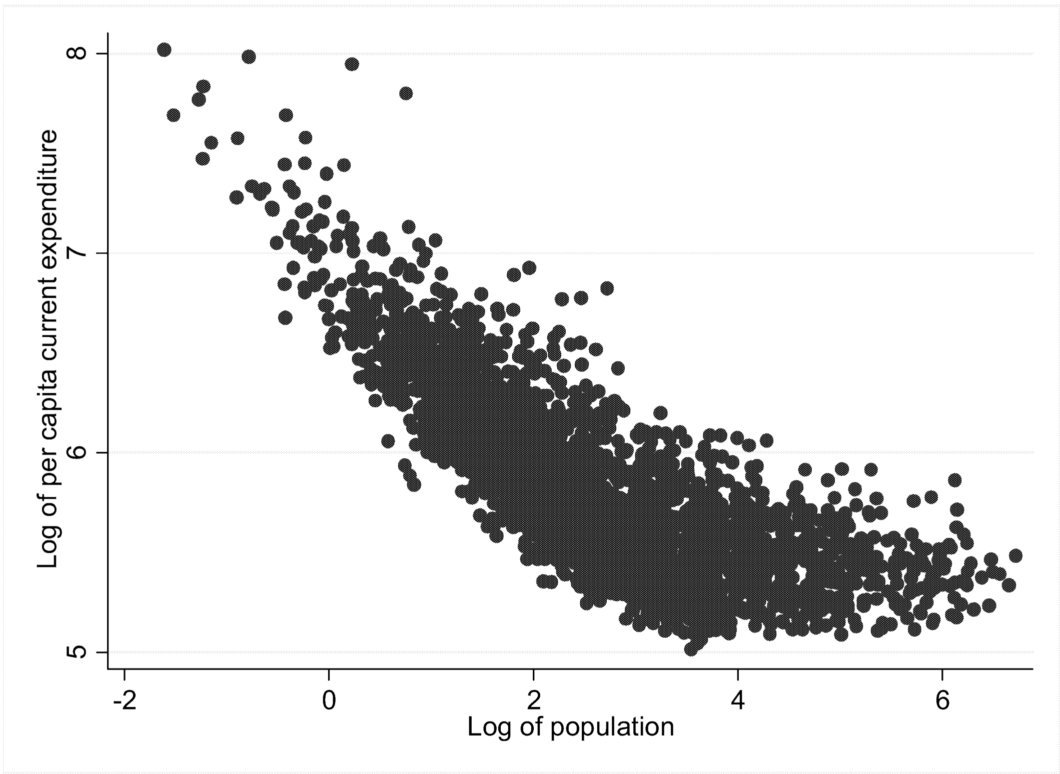
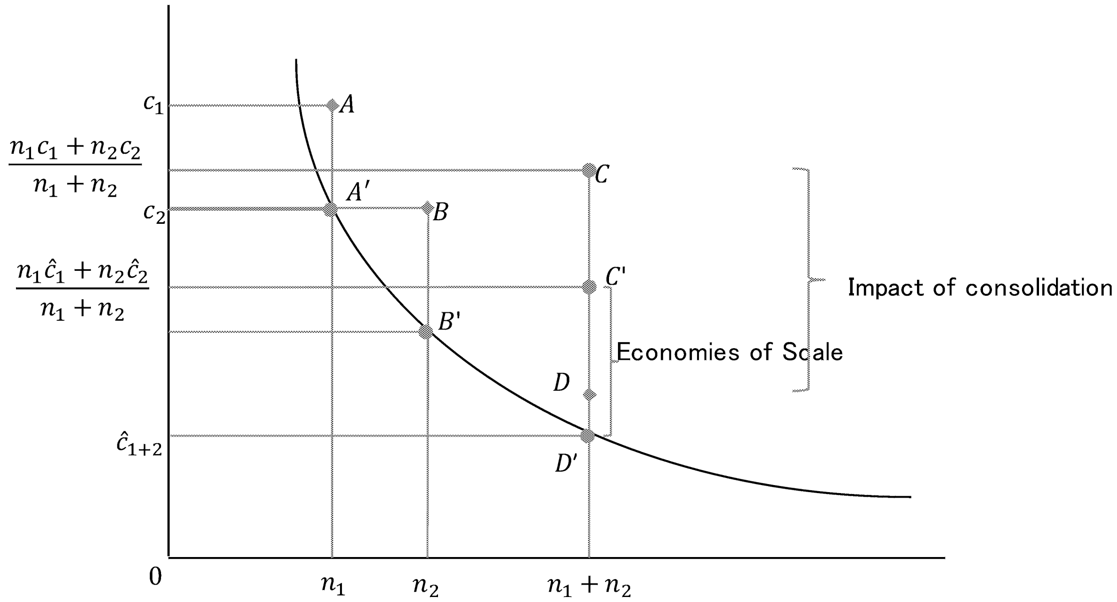


Figure 2. Log of Per Capita Current Expenditure against That of Population



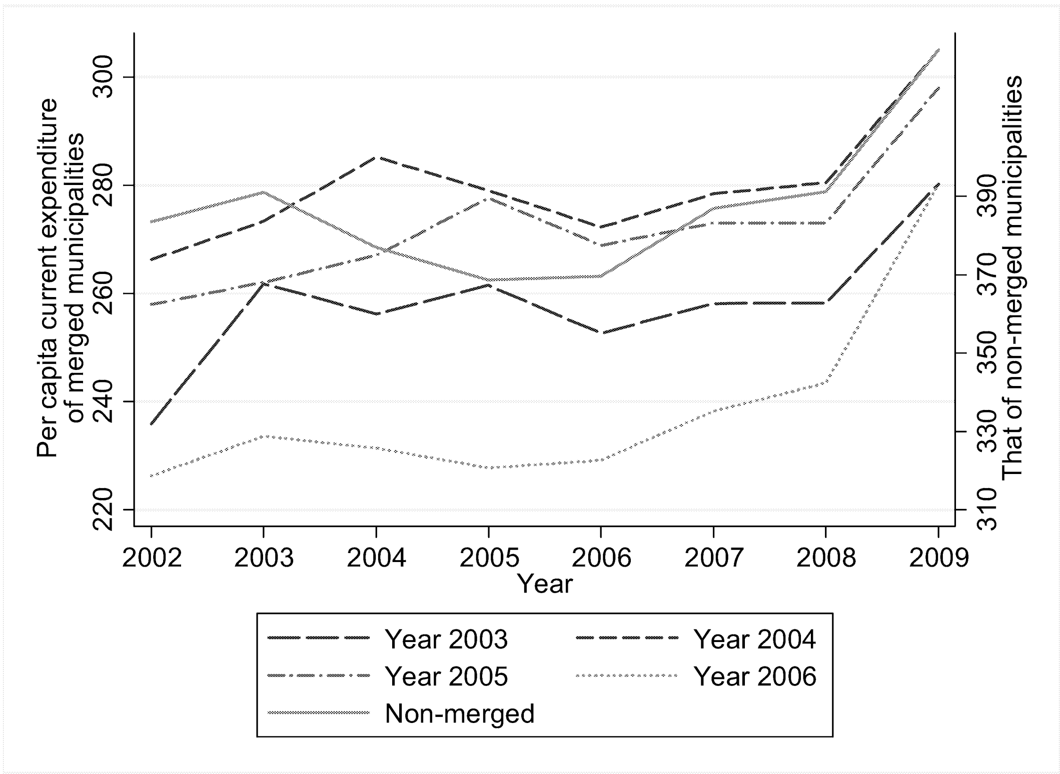
Note: Units and definition are described in Table 1.

Figure 3. Calculation of Scale Economy Effect



Note: The possibility of trend in per capita costs is ignored in this figure.

Figure 4. Per Capita Current Expenditure for Merged and Non-merged Municipalities, 2002–2009



Note: "Year #" in the box indicates the averaged current expenditure of municipalities that merged in the year; "Non-merged" represents that of non-merged municipalities. Unit of per capita current expenditure is million/population.

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逐次的価格競争と 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
2013-8	Takeshi Miyazaki	Municipal Consolidation, Cost Reduction, and Economies of Scale: Evidence from Japan	2013/11