Consolidation of municipality-owned water suppliers in Japan
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ABSTRACT
This study examines the characteristics of municipalities owning water utilities that took advantage of incentives provided by the Japanese government to consolidate. We find that economies of scale and government transfers were some of the main factors leading to consolidation of government services. This is expected given the Central Government’s efforts to equalize public service levels, and the large cost savings available to municipal level water monopolies.

Key words | consolidation, merger, water utilities

INTRODUCTION
The Japanese water industry is highly fragmented and dominated by several small water supply systems, almost all of which are owned by municipalities (Urakami 2006). The average served population in a recent Annual Statistics of Local Public Enterprises sample is 16,715 for towns/villages and 136,353 for cities (Annual Statistics of Public Enterprises 2015). Historically, Japanese municipalities have experienced waves of consolidation. Recent consolidations are generally attributed to a specific government incentive given during the Great Heisei Era of Consolidation beginning in 1999 and ending in 2006. Even though the Central Government offered each municipality the same incentive, the decision to consolidate, the choice of a partner and ultimate population size was decentralized (Saito & Yamada 2014; Weese 2015). Besides political factors, the purpose of the amalgamation incentives was to create efficiency gains in the form of economies of scale and to improve public services (Urakami & Parker 2015). It is believed that the governing party’s major rationale for seeking mergers had to do with the country’s demographic (Saito & Yamada 2011) and economic changes. Japan’s rapidly aging population, low birth rate and shrinking population have resulted in lower tax collections and larger public expenditures.

The purpose of this paper is to study the characteristics of municipalities that chose to consolidate, among municipalities that own and operate water utilities with data from water utilities. Water services are classic examples of natural monopolies, firms for which it is more efficient to have a sole provider, given high fixed costs. We expect mergers between municipalities owning and operating water utilities to be driven by cost savings stemming from economies of scale present in the municipalities themselves (resulting from, for instance, less duplication of services, government workers and offices) but also, to a greater extent, from their water utilities. We are assuming that water utilities stand to gain the most from economies of scale arising from consolidation. The local water monopolies have been historically considered too small to be efficient. Another public service known for having economies of scale provided by governments is schooling. We do not believe that economies of scale from schools are a major factor in influencing municipal consolidation from a cost savings perspective in Japan because prefectures (larger areas encompassing several municipalities) are responsible for establishing and managing senior high schools. Prefectures also provide the following services: upgrading of industrial
infrastructure, implementation of job training, and police affairs (Yokomichi 2007). Electricity services, which also have monopoly characteristics, are provided by ten regional companies. The municipalities themselves are responsible for: registration of addresses, operation of elementary and junior high schools, social welfare of infants and seniors, city planning, waterworks, garbage collection, and fire prevention (Yokomichi 2007). Japan’s earlier wave of consolidation was aimed specifically at achieving cost savings via consolidation of junior high schools. Out of all the services provided by municipalities, waterworks is the only sector that is generally considered to be a natural monopoly, so the expected cost savings due to economies of scale arising from consolidation are by definition larger for water utility service provision. In the long run, of course, savings will also be achieved from reducing administrative costs. A consolidated municipality is expected to have fewer assembly members than two separate municipalities (and only one mayor). We do not, however, expect these effects to be large at first because the Central Government offered special provisions to ensure that council members’ fear of losing their jobs did not prevent consolidations from occurring (Hirotta & Yunoue 2011).

To our best knowledge, the only study that uses Japanese water industry data to study consolidation of Japanese municipalities is Urakami & Parker (2011) who discuss the economic effects of consolidation and find that there are limited gains from cost savings. Rather than focusing on gains and losses following consolidations, we focus on the characteristics of entities that made the decision to consolidate.

Our results suggest that municipalities with a lower population have a higher probability to consolidate, presumably because the gains from economies of scale are higher. Furthermore, municipalities that receive subsidies from the prefectoral government have a higher probability to consolidate, illustrating government influence. We also find that Tiebout forces do not seem to play a major role, which is expected given the Japanese government’s long standing policy of equalization of government services across municipalities.

In the following section, we present an overview of the Japanese consolidation laws and water industry background. The data and methods section describes our dataset and empirical method. This is followed by a discussion of our results. The final section concludes.

**JAPANESE CONSOLIDATION AND WATER INDUSTRY BACKGROUND**

Japan has a unitary national government known as the Central Government. The country is divided into 47 prefectures each of which has an elected governor and legislators in a unicameral prefectural assembly. The Central Government has traditionally controlled municipalities through intergovernmental grants aimed at equalization. These grants, known as the Local Allocation Taxes (LAT), are automatic formula-based transfers going from the Central Government to municipalities. The purpose is to provide a standard set of public services across the country and to ensure that local governments provide a minimum quality of services. These transfers by design favor smaller localities on a per capita basis (Mabuchi 2001). Hence, a special fiscal incentive would be required to trigger municipality consolidations. With this in mind, the Central Government amended the Municipal Merger Law in 1999 allowing local governments to consolidate into larger authorities (Urakami & Parker 2011). Specifically, the incentives included a combination of maintaining pre-merger transfer amounts, options for financing consolidation and post-consolidation costs and job protection.

The consolidation decision was decentralized in order to take advantage of local information that would not be available at the national level. The government did not impose a minimum population size nor did it specify potential merger partners (Weese 2015). Urakami & Parker (2011) find some evidence of cost savings due to economies of scale following municipality mergers. Likewise, Miyazaki (2013) finds that municipalities that stood to benefit from economies of scale were more likely to consolidate.

There are several studies that forward alternative theories to explain why consolidations take place in the private sector, including economies of scale and efficiency improvements. Even though consolidation in the public sector is less frequent than in the private sector, the optimal scale of local government services has been a subject of intense study. This topic is closely related to theories of
government competition. According to Charles Tiebout’s (1956) hypothesis, under certain assumptions, individuals will, without cost, sort themselves across local communities according to their preferences for public goods. There is a tradeoff between having local governments that are able to closely match local preferences and economies of scale arising from consolidation.

Despite relatively fewer studies examining the incentives to merge in the public sector, there is some evidence that the public sector seeks to gain efficiency, economies of scale and responds to the government’s direct influence and regulation. Consolidation in the public sector facilitates the combination of similar functions by reducing duplication, minimizing managerial inefficiency, overcoming fragmentation and providing opportunities for innovation and service sharing. Several countries have attempted to lower the cost of public service provision via consolidations. For the water industry specifically, Bottasso & Conti (2009) show that mergers allow for cost-savings in England while Torres & Paul (2006) argue that cost-efficiencies are generated mostly for smaller utilities in the United States.

Economies of scale in the water sector is a topic that has been widely examined. In general, the main findings of these studies are that water utilities do experience economies of scale (Nauges & Van den Berg 2008; Guerrini et al. 2011; Worthington & Higgs 2014) but that these tend to exist over certain ranges or threshold values or over specific stages of growth, rather than persisting indefinitely (Martins et al. 2006; Romano & Guerrini 2011). In other words, we expect economies of scale for smaller firms but not necessarily once firms become very large, implying that consolidation is more beneficial for some firms than others. For example, Marques & DeWitte (2011) study scale economies in Portugal and find that the number of water utilities should be reduced. Ballance et al. (2004) fail to find scale economies resulting from consolidation in England and Wales. Carvahlo et al. (2012) provide an extensive overview of the literature examining economies of scale in the water sector.

In Japan, there is evidence that consolidation among Japanese water utilities had a small but beneficial impact on cost effectiveness (Urakami & Parker 2011). Urakami (2007) confirms the existence of scale economies in the Japanese water industry while Mizutani & Urakami (2001) find low diseconomies of scale. We expect mergers between municipalities to be driven by cost savings stemming from economies of scale present in their water utilities. We also anticipate these cost savings to be strongly expected a priori by the decision makers themselves.

Population size clearly matters for costs of municipally provided services. We expect smaller municipalities to have a higher need to consolidate in order to gain from economies of scale. In addition, because we expect the bulk of economies of scale cost savings to arise from increases in size of utilities, we expect water suppliers with lower density of customers to gain more from consolidation. This is because the cost of adding one more customer to a water network is higher in a less densely populated area. Assuming a fixed network length, adding more consumers should translate into higher levels of output given these fixed inputs. Urakami & Parker (2011) hypothesize that cost savings due to consolidations were offset by extra expenditures incurred from having to supply water to areas with low population density.

Given agency problems in publicly owned services, governments are expected to favor consolidations in order to fight inefficiencies stemming from small sizes and duplication of services. Furthermore, public institutions affiliated with the ruling government’s political party may find it beneficial to consolidate for political reasons. In the Japanese case, municipality consolidations were directly incentivized by the Central Government. Nakazawa & Miyashita (2013) argue that intergovernmental grants played a key role in amalgamation of Japanese municipalities. The purpose of these transfers is to provide a standard set of public services across the country and ensure that each local government provides a minimum quality of services (Weese 2008; Miyazaki 2013). These intergovernmental transfers are expected to limit Tiebout sorting, making the loss from moving from a small locally tailored government to a larger one less noticeable.

**DATA AND METHODS**

Data were obtained from the ‘Annual Statistics of Public Enterprises’ publication and the Japan Geographic Data Center. The data report several financial and quantitative
variables for all water utilities in Japan with the exception of a few privately owned utilities. We use the following probit model:

\[
\Pr (\text{merger}_t = 1) = \Phi(a_0 + a_1 \text{Population}_{it} + a_2 \text{Density}_{it} + a_3 X_{it} + a_4 \text{C.sub}_{it} + a_5 \text{P.sub}_{it} + \lambda_t + \kappa_p)
\]

\[
\Pr (\text{merger}_t = 1)
\]

is the probability that municipality \(i\) is ever engaged in a merger and \(\Phi(.)\) is the cdf of a normal distribution. The merger variable takes a value of 1 if the municipality consolidated one or more times during 1999-2007 and a value of 0 otherwise. The incentives were given from 1999 to 2006. Population\(_{it}\) represents the population of municipality \(i\) in year \(t\). Density\(_{it}\) represents the customer density of water utility owned by municipality \(i\). C.sub\(_{it}\) and P.sub\(_{it}\) represent the amount of subsidies of water utility owned by municipality \(i\) received from the central and prefectural government respectively in year \(t\). \(X_{it}\) represents other factors that possibly affect the incentive of municipalities to consolidate. \(\kappa_p\) represents prefecture dummy variables to control for time-invariant differences that may affect consolidation decisions. \(\lambda_t\) represents year dummy variables to control for overall temporal trends that may affect consolidation decisions.

Since data on some utility specific variables are not available for the years 1999-2003, our analysis is based on annual data from 2004 to 2007. Municipalities in our dataset are classified into five groups by the government based on ownership of the water utilities: prefectures, ordinance cities, cities, towns/villages or cooperatives. We analyzed mergers for water utilities owned by towns/villages and cities (including ordinance cities). We did not analyze cooperative and prefecture owned water utilities because few observations were available.

Population and density variables are used to measure the expected cost savings resulting from economies of scale. We measure population as the number of inhabitants in a given municipality and customer density as the number of customers per length of pipe (person/1,000 m).

Influence of the Central Government is measured using data on Treasury subsidies and Prefectural subsidies received by each water utility. Data on the LAT are not publicly available. The LAT is mainly determined by formulae, while the Treasury subsidies are attached to individual tasks. We assume that the LAT is less likely to suffer from political influence because it is based on formulae. On the other hand, Treasury subsidies serve as a measure of political influence because, even though transfers are meant for equalization, studies have shown that the transfer decision can be affected by politics. For instance, Meyer & Naka (1998) found evidence that the Liberal Democratic Party manipulated transfers from the Central Government to local governments presumably to maintain their electoral positions. We indirectly assume that LAT and Treasury subsidies move together. This is safe to assume in general, since municipalities with more difficult fiscal situations receive heavier allotments of both transfers and vice versa. In addition to the Treasury subsidy, we control for the level of Prefectural subsidies. Revenue at the prefectural level comes from tax collections and Central Government transfers. Major programs including education, health, and public works are formulated and financed at the national level by intergovernmental grants that are disbursed directly to each municipality or prefecture (Mochida 2001).

We also control for other factors that possibly affect the incentive of municipalities to consolidate. A recent measure the Japanese government has undertaken to ameliorate the effects of demographic changes and fiscal problems is to allow outsourcing of municipal water utility functions. Outsourcing in Japanese water utilities takes place for routine operations, maintenance, repair works, engineering design, construction, information and telecommunication technology services, and metering/billing (Ueda & Benouahi 2009). The entire operation can be outsourced to another municipality’s water utility or to private firms. We measure outsourcing as the ratio of number of staff based on outsourcing to the number of total staff. We expect the probability of consolidation to decrease with outsourcing, since an alternative to consolidation for water utilities is the outsourcing of certain functions.

All else being equal, we expect municipalities to choose whether or not to merge based on performance measures. We examine the ratio of total revenue to total expenditure of the municipality’s water utility and overstaffing, which we define as the ratio of total staff to population of customers. We also control for the number of potential merger
partners by considering the number of municipalities in each prefecture. Having more municipalities in a given prefecture could be a reflection of Tiebout tendencies, even though we expect this to be low in Japan due to the equalization subsidies. Areas with heterogeneous tastes are expected to have a higher level of inter-jurisdictional competition for residents, reflected by a larger number of municipalities being available to provide differing levels of municipal services. However, studies indicate that there is a tradeoff in the public sector between the benefits of providing each citizen with the quality they demand and cost savings arising from economies of scale (Kenny & Schmidt 1994). Thus, if there are any Tiebout forces still present, we expect prefectures with more municipalities to be less likely to merge, since these prefectures have homogeneity within each municipality (and more heterogeneity across municipalities). On the other hand, if Tiebout forces are no longer present, we expect prefectures with several municipalities to be more likely to merge, because they would have several options for possible merger partners. Miyazaki (2013) finds that conventional measures of preferences (education and income level) do not seem to matter for consolidation of Japanese municipalities. A possible explanation for this is that several years of intergovernmental grants aimed at equalization have resulted in local governments that do not necessarily reflect the preferences of their residents (Miyazaki 2013). Table 1 presents summary statistics of the main variables used in this study.

### RESULTS AND DISCUSSION

Tables 2 and 3 present results of several probit models and are based on sub-samples of utilities owned by towns/villages and cities. Columns 2c and 3c in each table present regressions based on standard errors clustered at the prefecture level. We present robust standard errors in parentheses. Pseudo $R^2$ is calculated based on McKelvey and Zavoina’s $R^2$. All regressions include prefecture and year fixed effects. Marginal effects are calculated at average values. Superscripts a, b, and c represent significance levels at 1%, 5% and 10%, respectively.

The coefficient on the population variable is significant, and negative for most of the regressions on the towns/villages sample, indicating that the probability of consolidation decreases with population size. Municipalities that serve smaller populations benefit more from consolidation than municipalities that serve larger populations, given that smaller populations stand to benefit from economies of scale arising from mergers.

The coefficient on the population variable for mergers involving at least one large city is statistically significant with a positive coefficient, indicating that the probability of consolidation increases with population size. Because this sample only includes areas large enough to be considered cities, we expect the dynamics to be different than for small towns and villages. A possible explanation for this unexpected result is that mergers involving large cities predominantly involved large cities absorbing smaller

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Summary statistics</th>
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<tr>
<td></td>
<td>Town/villages</td>
</tr>
<tr>
<td>Variables</td>
<td>Mean</td>
</tr>
<tr>
<td>Population of municipality</td>
<td>16,715</td>
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<tr>
<td>Density (person/1000 m)</td>
<td>128.20</td>
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<tr>
<td>Revenue/Expenditure</td>
<td>1.07</td>
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<tr>
<td>Central subsidy (1000 yen)</td>
<td>10,764</td>
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<tr>
<td>Prefecture subsidy (1000 yen)</td>
<td>1,330</td>
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<tr>
<td>Number of municipalities per prefecture</td>
<td>40.80</td>
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<tr>
<td>Overstaff ($10^{-4}$)</td>
<td>4.80</td>
</tr>
<tr>
<td>Outsourcing</td>
<td>0.63</td>
</tr>
<tr>
<td>Merger dummy ($1 = yes, no = 0$)</td>
<td>0.23</td>
</tr>
</tbody>
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Note: All monetary units are expressed in real terms (2004 base year).
The literature showing that while economies of scale tend to be available in small water utilities, they seem to be limited to certain ranges and are not expected to persist indefinitely as firms grow larger.

towns/villages, rather than mergers between entities of similar sizes. It is possible that while economies of scale were an important objective for small water utilities, this was not the case for already large utilities. This result is consistent with
The density and Central Government subsidies variables are not statistically significant for any of the regressions. The Central government result may be because, assuming that LAT and Treasury subsidies move together, these transfers remain relatively constant during deteriorating economic situations. The variable used to measure Prefectural subsidies, however, is statistically significant with a positive coefficient in most of the specifications. The Prefectural subsidies variable suggests that, as expected, municipalities that are already getting more help from Prefectural governments would be more likely to need to merge.

The overstaffing variable is not statistically significant, suggesting that the managerial performance of municipalities in regards to staff levels does not affect the probability of consolidation. The revenue–expenditure ratio variable is statistically significant with a consistently negative coefficient, suggesting that municipalities that had better monetary performance were less likely to merge. This may be because as water utilities are able to generate more revenue the need for their municipalities to consolidate may be lower.

The outsourcing variable is not statistically different from zero for towns/villages but is statistically significant with a negative coefficient for cities, suggesting that municipalities with more outsourcing are less likely to merge. This is consistent with our expectation since outsourcing is an alternative to mergers.

The number of municipalities in a given prefecture is statistically significant and has a positive coefficient for the towns/villages sample, indicating that the probability of merging increases with the number of municipalities nearby. If Tiebout forces are no longer present we expect prefectures with more municipalities nearby to be more likely to merge, since they would have more possible merger partners.

In this study, we use data from municipalities which own and operate water utilities to characterize municipalities that chose to consolidate. Our results indicate that for utilities owned by towns and villages, the probability of consolidation decreases with population size and increases with the number of municipalities nearby and amount of prefectural subsidies, meanwhile for utilities owned by cities, the probability of mergers increases with population size and amount of prefectural government subsidies. Furthermore, for all utilities the probability of merger declines with increases in monetary performance suggesting that better-off utilities may have less of a need for merging. Future studies in this area should focus on examining the effects consolidations had on cost savings stemming from economies of scale and on dependence on the Central Government and on figuring out why financial data appear to be important (compared to structural data) in merging decisions. The importance of the ratio of revenues/expenses and prefectural subsidy variables in our study seem to indicate that bad economic conditions had a strong bearing on whether or not a merger took place. It is well known that one of the big issues facing the Liberal Democratic Party in recent years was the need for deficit control, which is consistent with this idea and our results. It would also be interesting to see what can be learned from independent water utilities.

**REFERENCES**


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