Political Mergers as Coalition Formation*

An Analysis of the *Heisei* Municipal Amalgamations

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Abstract

This paper presents a method of estimating political coalition formation models with many-player coalitions, and then illustrates this method by estimating structural coefficients that describe the behaviour of municipalities during a recent set of municipal mergers in Japan.

JEL codes: C63, D71, H77

This paper presents a method of estimating the structural parameters of a political coalition formation model and applies it to a recent set of Japanese municipal mergers. In the *Heisei Daigappei*, individual Japanese municipalities could choose what merger if any they wished to participate in, given a fixed set of national government transfer policies. The parameters that determine municipal preferences over mergers are estimated, and these estimates are then used to predict the effect of alternative national government transfer policies. The *Heisei* mergers are particularly attractive from a modelling perspective, as government policy led to mergers occurring only during 1999-2010, and thus the resulting coalition structure can plausibly be treated as the outcome of a single period coalition formation game. Furthermore, the mergers are of interest from a policy perspective, since due to efficiencies of scale the smaller

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municipalities spend over ¥1,000,000 per capita per year providing the same services that larger municipalities provide for slightly over ¥100,000, and almost all of this difference was being subsidized by the national government.[1]

Although models of coalition formation date back at least to von Neumann and Morgenstern [1944], relatively few empirical papers have made use of such models, and these papers have tended not to examine the effect of possible changes in the rules of the coalition formation game being studied.[2] Desirable properties of some specific forms of coalition formation games, such as two-sided matching games, have led to extensive empirical study of those game forms [Roth, 2008]. Empirical research on more general coalition formation models has been hampered by the fact that neither existence nor uniqueness of a stable coalition structure is guaranteed, and the number of coalition structures increases exponentially with the number of players. Recently, Fox [2008] and related papers have studied coalition formation games with transferrable utility, which is particularly relevant for issues in industrial organization. This paper studies games where transfers are not possible, the case which is more relevant for issues in political economy [Acemoglu, 2003].

The methodological contribution of the paper consists of the use of a moment inequality framework to obtain structural parameters describing players' preferences over coalitions when the observed coalition structure can be treated as the outcome of a Bogomolnaia and Jackson [2002] hedonic coalition formation game.

Surveys suggest that residents of municipalities at the geographic "edge" of a proposed merger were concerned about the distance to post-merger public facilities, while residents of more centrally located municipalities were not. This implies an Alesina and Spolaore [1997] style model, where players' ideal points are distributed over a geographic policy space. The arrangement of jurisdictions is then the result of a tradeoff between economies of scale in the provision of public goods, and heterogeneity in preferences over the location of those goods.

Existence but not uniqueness of a stable coalition structure is guaranteed via [Ray and Vohra, 1997]. Estimation does not require any assumptions regarding the equilibrium selection rule. The moment inequality method used provides a direct link between a theoretically consistent model of jurisdiction formation and the estimating

[1] For comparisons, ¥1=1¢ is a rough but useful approximation. During the period in which financial data is analyzed, the USD/JPY exchange rate has varied from ¥147=$1 (Aug. '98) to ¥80=$1 (Oct. '10). GDP per capita has remained relatively constant at ¥4,000,000.

[2] Diermeier, Eraslan, and Merlo [2003] is an interesting exception.

equation as actually implemented.

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1 Theory

The objective of this paper is to analyze municipal mergers in an environment where the national government chooses policies that affect which (if any) of these mergers will occur.[3] There is an extensive literature on the provision of public goods by local governments, but in order to focus on between-municipality phenomena specifically related to mergers a very parsimonious model of within-municipality decision making will be used. The model presented below is in the style of Greenberg and Weber [1986], Demange [1994], and in particular Alesina and Spolaore [1997]: there is a tradeoff between heterogeneity in individual preferences, and efficiencies of scale in the production of public goods. The model is designed to be consistent with observed patterns of taxation and public good provision in Japan, while also guaranteeing that for any given set of municipal boundaries, within-municipality decision making is optimal from the perspective of the national government. Disagreement between the national government and local governments thus arises only due to the possibility of changes in municipal boundaries.[4].

The model presented relies on several strong assumptions: preferences over tax

[3]Most empirical studies of political mergers thus far focus on American school districts. Miceli [1993], the earliest example yet found, examines the trade-off that Connecticut school districts faced between efficiencies of scale and locally optimal education quality. Alesina, Baqir, and Hoxby [2004] use a much larger dataset, and examine the relationship between county-level heterogeneity and the number of school districts and other local jurisdictions. While the estimates in each of these papers imply a type of coalition formation game, they do not present an explicit coalition formation model. In general, previous papers regarding empirical political coalition formation papers focus on describing patterns that are observed in political boundaries, while this paper estimates structural parameters and predicts how counterfactual policies would change the set of boundaries forming.

[4]For example, suppose that the political process within municipalities were such that the mayor could extract substantial rents via unnecessary construction projects, but the voters would still re-elect the mayor because they believed that any challenger would behave similarly once elected. If the severity of this rent-seeking behaviour depends on the specific characteristics of the municipality, then a "good" set of municipal mergers might simply be a set of mergers that make mayors engage in relatively less of this rent-seeking. This sort of model is problematic, as there is little specific information regarding how to model inefficiency in government decision-making, but the optimal merger policies implied by such a model are extremely sensitive to the nature of this inefficiency. Attempting to estimate such a model, then, might be informative about decision-making within municipalities, but seems unlikely to be very helpful in analyzing the nature of the coalition formation game that was played or how it might be improved.

rates do not vary with income, there are no externalities, and residents do not move or otherwise change their preferences. The appropriateness of these assumptions is discussed below.

1.1 Public Good Provision

There is a single country, populated by individuals that are distributed across a plane. The location of these individuals is fixed, and they are partitioned into municipalities. For now, suppose that this arrangement of municipalities is also fixed. Each municipality m provides a public good of quality q_m to its N_m residents at a single location θ_m on this plane. Providing this good costs $q_m \cdot c(X_m)$, where the cost $c(X)$ of providing one quality unit of the good depends on the covariates X of the municipality, such as total population. Municipality m levies taxes at rate τ_m on tax base $Y_m = \sum_{i \in m} y_i$, where i indexes individuals. Municipalities also receive a lump sum transfer $T(X_m)$ from the national government. Feasible (q_m, τ_m) pairs are determined by the municipal budget constraint

$$q_m c(X_m) = \tau_m Y_m + T(X_m). \tag{1}$$

The national government obtains funds from an outside source, and spends enough of these on activities that are outside of the model that the marginal opportunity cost of providing transfers is effectively constant. Let this marginal cost of funds for the national government be b.

Individual utility is assumed to take the following additively separable form:

$$u_i(q_m, \tau_m, \theta_m) = \beta_0 \log((1 - \tau_m) y_i) + \beta_1 \log(q_m - \beta_3) + \beta_2 \ell(i, \theta_m) + \epsilon_m, \tag{2}$$

where β_3 is some minimum level of public good provision, and $\ell(i, \theta)$ is the distance between the location of individual i on the plane and the location θ of the public good provided by the municipality that i is a member of.

The first two terms of this utility function have Stone-Geary form, with the minimum level of the private good set to zero. As these are the only terms that contain q_m or τ_m, all individuals will share the same ideal point τ_m^* for taxation. To see this, note that the above equation can be rewritten to treat income as an individual fixed

effect:

$$u_i(q_m, \tau_m, \theta_m) = \beta_0 \log(1 - \tau_m) + \beta_1 \log(q_m - \beta_3) + \beta_2 \ell(i, \theta_m) + \alpha_i + \epsilon_m, \tag{3}$$

where $\alpha_i = \beta_0 \log(y_i)$. There will thus be unanimous support for taxing at rate

$$\tau_m^* = 1 - \frac{\beta_0}{\beta_0 + \beta_1} \frac{Y_m + T(X_m) - \beta_3 c(X_m)}{Y_m} \tag{4}$$

and providing the public good at quality

$$q_m^* = \frac{\beta_1}{\beta_0 + \beta_1} \frac{Y_m + T(X_m) - \beta_3 c(X_m)}{c(X_m)} + \beta_3. \tag{5}$$

On the other hand, there is no agreement among individuals regarding the location θ_m at which the public good should be provided. The set of feasible points is a plane, and thus choosing θ_m^* is a multidimensional policy decision, a problem which has no single accepted solution concept.

To resolve this, political decision-making at both the local and national level is assumed to take place in a probabilistic voting framework, with the standard result that the selected policy maximizes a weighted sum of individual utilities. This is discussed in more detail in Appendix A. Furthermore, at the local level, these weights are assumed to be equal for all individuals: the local politician acts as a Benthamite social planner. The national government is assumed to use equal weights for individuals within a given municipality, but might have unequal weights across municipalities. Thus, for municipality m the θ_m^* chosen by the local government is the same as the policy the national government would want the municipality to select, but the national government might use a transfer function T that provides very large transfers to certain types of municipalities at the expense of others. An optimal transfer function will satisfy the first order condition

$$T = \beta_3 c(X_m) - Y_m + \frac{w_m(\beta_0 + \beta_1)}{b} \tag{6}$$

for any municipality m, where w_m is the total weight placed on individuals in municipality m.[5] In the special case where all individuals have the same y, and the

[5] To derive this optimization problem, plug Equations 4 and 5 into Equation 3, and drop all the terms that do not include T.

government weights all individuals equally, this simplifies to

$$T(X) = \beta_3 c(X_m) - aY_m, \tag{7}$$

where $a = 1 - \frac{\beta_0+\beta_1}{yb}$. While this transfer policy is optimal in the case where there is no potential for changing municipal boundaries, it may not be when there is such a possibility.

1.2 Municipal Mergers

Let M be the set of municipalities, $S \subset M$ a potential merger, and $\mathscr{S}$ the set of all potential mergers, including singletons.[6] If merger S occurs, then the municipalities in S are permanently eliminated and a single new amalgamated municipality is created. This amalgamated municipality behaves exactly as outlined above in Section 1.1, and does not participate in any further mergers. The utility for individual i in merger S is thus as in Equation 3 above, except replacing m with S:

$$u_i(\tau_S, q_S, \theta_S) = \beta_0 \log(1 - \tau_S) + \beta_1 \log(q_S - \beta_3) + \beta_2 \ell(i, \theta_S) + \alpha_i + \epsilon_S. \tag{8}$$

Assume that there is perfect information with the possible exception that the national government may not be able to observe ϵ. Also assume that it is not possible for the municipalities in S to commit to a given τ_S, q_S, or θ_S in advance of a merger. Finally, assume that the sufficient conditions for a unique (q^*, τ^*, θ^*) political equilibrium, described in Appendix A, hold for all potential mergers. With these assumptions, the post merger choice of q_S^*, τ_S^*, and θ_S^* is known in advance for every potential coalition S.[7]

[6] This notation is based on that of Banerjee, Konishi, and Sönmez [2001].

[7] Treating municipal mergers as a pure hedonic coalition formation problem is consistent with anecdotal evidence concerning how mergers are effected. Negotiations regarding compensation seem to be rare, even though controversy is common and the results of unrest sometimes significant.[8] Some of the involved municipalities may be in favour of a proposed merger while others may be opposed, but those in favour do not seem to promise large transfers to those opposed in order to secure their cooperation. This suggests that there is some problem with contractibility in political mergers such that transfers are difficult or impossible, and thus it seems more plausible to model mergers as a coalition formation game without transfers. An additional potential complication is the possibility of future mergers. Given that the most recent previous set of municipal mergers occurred in the 1960s, experience suggests that any future mergers are likely far enough away that a reasonable discount rate reduces their importance to the point where they can safely be ignored. Thus, the use of a one period coalition formation model appears to be appropriate.

Now, with some abuse of notation, let the preferences of the politician from municipality m regarding merger S be described by

$$u_{mS} = \beta_0 \log(1 - \tau_S^*) + \beta_1 \log(q_S^* - \beta_3) + \beta_2 \ell_m(\theta_S^*) + \alpha_m + \epsilon_S, \tag{9}$$

where

$$\ell_m(\theta_S^*) = \frac{1}{N_m} \sum_{i \in m} \ell(i, \theta_S^*),$$
$$\alpha_m = \frac{1}{N_m} \sum_{i \in m} \alpha_i.$$

The first term in Equation 9 is the utility received by members of municipality m from their private consumption. Due to the log functional form, the income term itself becomes the fixed effect α_m, following Equation 3. The first term will thus be the same for all municipalities participating in merger S, as the tax rate is by assumption the same throughout a given amalgamated municipality. Similarly, the level of public goods is also assumed to be the same within the same amalgamated municipality. Thus, the second term will also be the same for all municipalities participating in merger S, as all residents are assumed to value public goods equally.[9] The third term, however, takes into account distance to the location where the public service is provided, and this may differ substantially between municipalities in S. For example, if residents of m would be close to the generalized median voter of S, while residents of m' would be far away, then the disutility from distance will be less severe for m than for m' if merger S occurs.

Now consider the payoff for municipality m remaining a singleton. To simplify notation, the singleton merger $\{m\}$ will be referred to simply as m when there is no possibility of confusion: u_{mm} thus represents the payoff to m of not merging with any other municipalities. The benefit to municipality m of participating in merger S can

[9]Equation 9 might appear somewhat odd at first glance: despite representing the utility of residents of municipality m, the first two terms contain no m subscripts, referring instead to τ_S^* and q_S^*. This is due to the specific functional form assumption made regarding the utility function: log utility is necessary in this case because if residents with different incomes had different preferences over tax rates, then estimation becomes computationally infeasible. For example, if utility were CES, the first two terms of Equation 9 would become $\sum_{i \in m} (\beta_0((1 - \tau_S^*) y_i)^\psi + \beta_1 (q_S^* - \underline{q})^\psi)^{\frac{1}{\psi}}$, and the aggregation of individuals i up to the municipal level would have to be done repeatedly each time a different $\hat{\psi}$ estimate is considered.

then be expressed as

$$\begin{aligned} u_{mS} - u_{mm} = \beta_0(\log(1-\tau_S^*) - \log(1-\tau_m^*)) \\ + \beta_1(\log(q_S^* - \beta_3) - \log(q_m^* - \beta_3)) \\ + \beta_2(\ell_m(\theta_S^*) - \ell_m(\theta_m^*)) \\ + \epsilon_S - \epsilon_m, \end{aligned} \tag{10}$$

The first term is positive if the tax rate chosen in the merger is lower: $\frac{Y_S+T(X_S)-\beta_3 c(X_S)}{Y_S} > \frac{Y_m+T(X_m)-\beta_3 c(X_m)}{Y_m}$. The second term is positive if the quality of the public good provided is higher: $\frac{Y_S+T(X_S)-\beta_3 c(X_S)}{c(X_S)} > \frac{Y_m+T(X_m)-\beta_3 c(X_m)}{c(X_m)}$. The third term (the difference in disutility from distance) will be zero or negative so long as distance is undesirable ($\beta_2 < 0$), because θ_m^* minimizes ℓ_m.

If the national government has perfect information and direct control over municipal boundaries, then in the case where $S = \{m, m'\}$ is the only possible merger for both m and m', the national government will mandate that this merger occur when

$$w_m(u_{mS} - u_{mm}) + w_{m'}(u_{m'S} - u_{m'm'}) > 0. \tag{11}$$

An alternative to the central government mandating which specific mergers should occur would be a decentralized system, where a given merger occurs if all municipalities that are a part of it give their approval. Assume that this decentralized decision-making will be done by local politicians based on the utility function in Equation 9. As discussed below, with this decentralized system, once there are multiple potential mergers involving some of the same municipalities it may no longer be obvious which mergers will occur. For now, however, consider the case where each municipality can participate in only one (non-singleton) merger. In this case, if the national government does not know ϵ then it may choose to implement decentralized mergers instead of mandating a certain pattern of municipal mergers. To see this, rewrite Equation 9 as

$$u_{mS} = v_{mS} + \epsilon_S \tag{12}$$

and consider the following example:

Example 1. *Suppose that there are two identical municipalities, the national government weights all individuals evenly, the cost function c is constant returns to scale, and $v_{mm} = v_{mS} = v$. Then if $E[\epsilon_m - \epsilon_S] = E[\epsilon_{m'} - \epsilon_S] = 0$, the national government*

will choose to implement a decentralized merger policy.

A centralized merger policy would have expected payoff of v, regardless of whether the merger is mandated or prohibited, because with the optimal transfer scheme there is no difference in total transfers. The decentralized policy, on the other hand, will result in a merger when both $\epsilon_S - \epsilon_m > 0$ and $\epsilon_S - \epsilon_{m'} > 0$, and no merger otherwise. This improves on either centralized policy choice, and thus the national government will choose to implement decentralized mergers even if it had the option of controlling mergers centrally.

If the government has decided to implement a decentralized merger policy, then the optimal transfer policy may not be the same as that given in the preceding section:

Example 2. *Suppose that the situation is as described in Example 1, except now suppose that c exhibits efficiencies of scale. Then the transfer policy in Equation 6 is not optimal.*

To see this, let $u_{mS}(T)$ be the utility of municipality m in merger S when the national government implements transfer function T, and let $p_S(T)$ be the probability that merger S will occur given the transfer function T. As in Equation 12, let $v_{mS}(T)$ be the non-idiosyncratic component of $u_{mS}(T)$. The national government's problem is now

$$\max_T \quad (1-p_S(T))(v_{mm}(T)+\mathrm{E}[\epsilon_m|S \notin \pi^*, T]-2bT(X_m))+p_S(T)(v_{mS}+\mathrm{E}[\epsilon_S|S \in \pi^*, T]-bT(X_S)). \tag{13}$$

Now, start with the transfer policy given by Equation 6, and consider a small deviation that increases transfers to the municipalities if they merge and decreases transfers by an equivalent total amount if they do not. The cost of this deviation is that the transfer policy is no longer optimal given fixed boundaries. This cost is second-order. On the other hand, there are two first-order benefits. First, if c exhibits efficiencies of scale then the national government spends less money in expectation because $T(X_S) < 2T(X_m)$.[10] Second, in the case where one municipality prefers the merger but the other is indifferent, the indifferent municipality does not internalize the benefits of the merger to its partner, but could be encouraged to merge via a higher

[10]The assumption that the municipalities are identical and $v_m = v_S$ rules out the possibility that there are diseconomies of scale, but there is a trivial case where c is constant returns to scale and distance costs are the same with the merger and without.

$T(X_S)$. Increasing $T(X_S)$ thus helps to resolve two externalities: specifically, local governments consider neither their partners' payoffs nor the national budget. Thus, the transfer policy that was optimal for the national government when municipal boundaries were fixed is no longer optimal when there is the possibility of municipal mergers.

While in Example 1 it was intuitively clear (given ϵ) which mergers would occur and which would not, unfortunately there are other situations where the appropriate solution concept is not so obvious. Let $S \prec_m S'$ indicate that $u_{mS} < u_{mS'}$, and consider the classic "roommates problem":

Example 3 (Gale and Shapley 1962)**.** *Suppose* $M = \{1, 2, 3\}$ *and preferences are*

$$\begin{aligned}
&\{1,2,3\} \prec_1 \{1\} \prec_1 \{1,3\} \prec_1 \{1,2\},\\
&\{1,2,3\} \prec_2 \{2\} \prec_2 \{1,2\} \prec_2 \{2,3\},\\
&\{1,2,3\} \prec_3 \{3\} \prec_3 \{2,3\} \prec_3 \{1,3\}.
\end{aligned} \tag{14}$$

Given these preferences, there is no intuitively obvious solution to this coalition formation game. However, Ray and Vohra develop a solution concept that can be modified to guarantee existence of a stable partition by considering only blocking coalitions that are refinements or coarsenings of existing coalitions. This is discussed in Appendix B. Briefly ...

2 Japanese Context

Japan is a unitary state with two levels of local government: prefectures and municipalities. The country is divided into 47 prefectures, whose boundaries have remained roughly unchanged since the 1890s. Each prefecture is divided into municpalities. Figure 5 shows that the number of municipalities was relatively stable from 1975 to 1999. From 1999 to 2010 there were a large number of voluntary municipal mergers, reducing the total number of municipalities from 3255 to 1748.

2.1 Public Good Provision

Mochida [2008] provides a general overview of Japanese local government public finance. In 1992, local governments were responsible for 69% of total public spending,

but collected only 36% of total government taxes. High spending relative to tax revenue was possible due to large transfers from the national government to local governments, and the recent municipal mergers were due to changes to this national government transfer policy.[11]

Municipalities in Japan are responsible for providing public services in six major categories: firefighting, public works, education, welfare, industry, and administration. The majority of these services are provided via physical facilities, such as schools, nursing homes, libraries, and city hall itself.[12] It was generally understood that a municipal merger involving a smaller municipality and a larger one would result in the closure of city hall and some other facilities in the smaller municipality, and that this would result in substantial cost savings. In surveys, the most popular response to questions regarding the potential benefits of municipal mergers was "avoid duplication of facilities / avoid useless capital expenditures" in Kyoto, "reduce expenditures by improving administrative efficiency, eliminating duplicate facilities, and reducing personnel" in Yamanashi prefecture, "reduce personnel expenses" in Akita, and "reduce personnel and other expenditures and improve efficiency" in Okinawa.

Post-war Japanese fiscal policy emphasized equalization between municipalities, and established national standards for local government services. To ensure that every municipality had sufficient funds to offer services above this minimum level, the national government developed a complicated system of transfers, called the "Local Allocation Tax".[13] In Japan in the period before the municipal mergers began, transfers to municipalities were determined by the formula

$$T(X_m) = \max(\tilde{c}(X_m) - .75\bar{\tau}Y_m, 0), \tag{15}$$

where $\tilde{c}$ is an estimate of the cost to a municipality with characteristics X of providing

[11] This transfer scheme operates similarly for prefectures and for municipalities, but comparatively few changes to the transfer scheme were made for transfers to prefectures, and there were no mergers of prefectures. This paper thus focuses only on municipalities.

[12] Although many services at city hall could be accessed via mail, telephone, or the internet, it is common and in some cases required to visit in person.

[13] The slightly-confusing name is due to the fact that it is an *allocation* to local governments from *taxes* collected by the national government. One possible reason for this transfer policy would be to correct a Flatters, Henderson, and Mieszkowski [1974] "fiscal externality"; however, this requires the possibility of migration between municipalities, which is not included in this paper. Dahlby and Wilson [1994] provide an alternative explanation that is consistent with the model in this paper, where the goal of the transfer scheme is equalizing the marginal cost of public funds across municipalities

public goods at a certain quality standard, and $\bar{\tau}$ a reference tax rate set by the national government. The former is sometimes referred to as the "Standard Fiscal Need", and is calculated via the formula

$$\tilde{c}(X_m) = \sum_{k=1}^{24} X_{mk} \cdot \bar{c}_k(1 + \tilde{H}_k(X_m)). \tag{16}$$

Here the public good is viewed as a sum of 24 component goods, such as firefighting, care for the elderly, resident registration, and so forth.[14] Each of these component goods is associated with a quantity measure X_{mk}, which for firefighting is total population, for elderly care is population over 65, for resident registration is number of families, and so forth. Each of these component goods is also associated with an estimated unit cost $\bar{c}_k$: the estimated cost of providing firefighting for one person, elderly care for one person over 65, resident registration for one family, and so forth. Finally, $\tilde{H}_k$ is an "adjustment coefficient" for each component good, created by multiplying and adding together a set of (usually) decreasing splines determined by X_m. For example, population density affects the estimated cost of firefighting, elderly care, and resident registration, but in different ways, with the effect on firefighting costs being more severe than the effect on the other component goods. X_m is more than a 24-tuple, with some elements used only in the calculation of the adjustment coefficients $\tilde{H}(X)$.

2.2 Municipal Mergers

Historically, although there were provisions for municipalities to merge there were limited incentive for them to do so, because if a coalition S decided to form a new (amalgamated) municipality, T_S would be calculated exactly as in Equation 15:

$$T_S = \max(\tilde{c}(X_S) - .75\bar{\tau}Y_S, 0). \tag{17}$$

Thus savings would be passed to the national government through lower calculated values of $\tilde{H}$, with the result that historically local residents would oppose mergers more than would be warranted from a social perspective.[15] The exact behaviour of

[14] The number of these *saimoku* varies slightly from year to year.

[15] In general, the division of a municipality was prohibited. In one case, such a split did occur, but both of the resulting municipalities were immediately merged with different neighbours.

residents was determined in part by the relationship between the true cost $c(X|\beta_4)$ and the national government's estimate $\tilde{c}(X)$.

During the fiscal difficulties of the early 1990s, the Japanese national government implemented a series of reforms designed to reduce the total transfers provided to municipalities while attempting to minimize the negative effects of this decrease. . First, the government substantially reduced transfers, particularly to the smallest municipalities. This was effected mainly by replacing $\tilde{H}_k$ with $\tilde{H}_k^{\text{new}}$, which was less generous towards smaller municipalities. This provided smaller municipalities with an incentive to merge so as to avoid having to either sharply reduce the quality of service that they provided to their residents, or increase the tax rate charged.

Second, with these new transfers T^{new} in place, the government then allowed municipalities to keep more of the savings from a merger. In particular, after 1999, the transfers T_S^{new} for a merger S would be calculated according to the formula

$$T_S^{\text{new}} = \sum_{m \in S} T_m^{\text{new}} \tag{18}$$

for at least ten years starting from the date of the merger.[16] This incentive began to be phased out in 2006, which motivated many municipalities to finalize mergers in 2005. By 2006 there were only 1,844 municipalities remaining, down from 3,255 at the start of the merger period. A small number of mergers occurred during the phase-out period, reducing the final number of municipalities to 1,750 in 2010; for the purposes of this paper, these mergers are treated as though they were finalized prior to 2006, and implementation was simply delayed for exogenous reasons.[17]

A final incentive for mergers was the *Gappei Tokureisai*, special subsidized bond issues allowed for municipalities planning amalgamation.[18] The value of these bonds

[16] An intermediate amount between Equations 43 and 18 was offered for years 11-15 following a merger.

[17] Explaining why a coalition would not form during the 1999-2005 period, but would under the progressively less-advantageous policies in place in 2006-2010 would require adding elements to the model, such as arrival of new information, that would substantially complicate the analysis. This paper treats the entire 12 years as a single period.

[18] The official explanation for these bonds was to eliminate any direct financial cost of merging, such as the construction of a new city hall. The merger bonds appeared to allow significant capital expenditures beyond the actual costs of amalgamation. Relative to the incentive provided by the switch from $\tilde{c}_m$ to $\tilde{c}_m^{\text{new}}$ in the calculation of transfers, these bonds have a relatively small effect on incentives to merge, and thus for simplicity the the bonds are treated entirely as an additional incentive, with the direct financial costs of merging ignored.

is calculated based on the subsidy offered, using information from Ishihara [2000]. Municipalities are presumed to able to save in order to equalize the quality of public services and the municipal tax rate between the decade immediately following the merger, when incentives are provided, and following decades.

Figure 4 shows the mergers that occurred in Shizuoka Prefecture. Mergers were voluntary, and needed to be approved by every participating municipality. An overview of the rules described in the "Special Municipal Merger Law" is described in Appendix E. Figure 5 shows that a large number of mergers occurred during the period in which merger incentives were offered, but very few occurred before this period.

Although a large number of mergers occurred overall, very few of these mergers involved municipalities in the most metropolitan prefectures. Define a prefecture as "metropolitan" if fewer than 10% of its municipalities have a population of less than 10000, and define a prefecture as "rural" if more than 65% of its municipalities have a population of less than 10000. Table 1 shows summary statistics for municipalities in different classes of prefectures. Municipalities in metropolitan prefectures were much less likely to merge during the merger period than those in the other sorts of prefectures.

3 Estimation

To map the data discussed in Section 2 to the theoretical model presented in Section 1, some further simplifications are necessary. Assume, following Section 1, that each municipality must choose a single quality q at which to provide the public good: it is not possible, for example, for municipality m to choose to provide quality $q_m^f = 5$ firefighting, but only quality $q_m^r = 3$ resident registration. Furthermore, suppose that the functional form for the cost function $\tilde{c}(X)$ used by the national government in Equation 16 is the correct functional form but with possibly incorrect adjustments $\tilde{H}$. That is, the true cost function for public goods is

$$c(X_m) = \sum_{k=1}^{24} X_{mk} \cdot \bar{c}_k \cdot (1 + H_k(X_m)), \tag{19}$$

where

$$H_k(X_m) = \beta_4 \tilde{H}_k(X_m). \tag{20}$$

Thus, if $\beta_4 = 0$ there are no efficiencies of scale, and the national government's adjustments $\tilde{H}(X_m)$ are simply distorting the national government's estimated cost function $\tilde{c}(X)$ away from the true (constant returns to scale) cost function $c(X)$. On the other hand, if $\beta_4 = 1$ then the national government's estimate of the cost function precisely equal to the true cost function: $\tilde{H}(X_m) = H(X_m)$ and thus $\tilde{c}(X) = c(X)$.[19]

There are four parameters of interest from Equation 3: the value of private consumption (β_0), the value of public consumption (β_1), the disutility of distance (β_2), and the minimum quality for the public good (β_3). The fifth parameter of interest, β_4, which appears above in Equation 20, enters the utility function in Equation 3 through the cost function $c(X)$. These five parameters can be estimated by examining the mergers that actually occurred in Japan and comparing them to ones that could have occurred but did not, using the data on national government transfers and efficiencies of scale described in Section 2 and further explained in Appendix D.

To do this, first rewrite the utility function in Equation 12 to make explicit the fact that the values of the β parameters affect the structural component, but do not affect the idiosyncratic component:

$$u_{mS}(\beta) = v_{mS}(\beta) + \epsilon_S. \tag{21}$$

Assume that ϵ is distributed normally, with the distribution of ϵ_S identical to that of $\epsilon_{S'}$, but not necessarily independent. Furthermore, note that, as is standard in discrete choice models, multiplying u by a positive constant has no effect on preferences. Thus, as a normalization, multiply such that $\epsilon \sim N(0, 1)$. Let β^0 be the true value of beta. Estimation will be based on four types of moment inequalities:

1. At β^0, it should be possible to find values ϵ^* that rationalize the observed mergers, and are not "too extreme" relative to the $N(0, 1)$ distribution from which they are assumed to have been drawn.

2. At β^0, if the national government had not implemented the merger promotion policies, the number of mergers that would have occurred would not be "too

[19] There are no natural units for quality, and a normalization is thus necessary. The one used here is that the $\bar{c}_k$ from the national government estimates are the true unit costs.

high" relative to the number of mergers that occurred prior to 1999.

3. At β^0, the number of mergers actually observed in metropolitan prefectures is not "too low" relative to the number of mergers predicted in these prefectures by the model.

4. At β^0, the tax rates actually charged by muncipalities are "similar" to those that the model predicts should be charged.

The technical definitions for terms in quotation marks will be given below. The first two types of moment inequalities should hold for metropolitan prefectures, mixed prefectures, and rural prefectures. Thus, a total of 8 (= 3 + 3 + 1 + 1) moment inequalities will be used in estimation. The remainder of this section has the following form: first, the dependence structure of ϵ_S and $\epsilon_{S'}$ is discussed, and then the technical details of each of the above four types of moment inequalities are presented.

3.1 Structure of Idiosyncratic Shocks

There are three important points regarding the set $\mathscr{S}$ of all potential mergers. First, it is potentially very large, containing up to 2^M elements. Second, it is not always clear which coalitions should be in this set: for example, no coalitions of size greater than 15 are observed in the data, but there was also no government policy that expressly prohibited a size 50 coalition from forming. Finally, it is implausible that ϵ is i.i.d across different coalitions: if $S = \{m_1, m_2, ..., m_{14}, m_{15}\}$, and $S' = \{m_1, m_2, ..., m_{14}\}$, then a reasonable econometric model should have ϵ_S correlated with $\epsilon_{S'}$. The following construction makes it possible to generate shocks that are $\epsilon \sim N(0, 1)$, not independent but identically distributed. The basic assumption comes from the literature on ethnic fragmentation: under certain conditions, heterogenous jurisdictions produce bad results for all residents, not only those far from the median voter. While Japan is not known for extreme ethnic or linguistic heterogeneity, one could imagine ability or religion playing a similar role.

First, suppose that each individual resident draws an i.i.d. shock, $\omega_i \sim N(0, 1)$. For municipality m with population N_m, the sample mean and sample variance of

these shocks will be

$$\bar{\omega}_m = \frac{1}{N_m} \sum_{i=1}^{N_m} \omega_i \tag{22}$$

$$s_m^2 = \frac{1}{N_m - 1} \sum_{i=1}^{N_m} (\omega_i - \bar{\omega}_m)^2. \tag{23}$$

As the sample variance, rather than the sample mean, is the measure of heterogeneity here, let $\epsilon_m = -f(X_m) \log s_m^2$, where $f(X) > 0$ is a function that generates weights such for any coalition $S = \{m, m'\}$, then $f(X_S) > f(X_m)$ and $f(X_S) > f(X_{m'})$. That is, heterogeneity is relatively more important for larger municipalities.

Defining $\bar{\omega}_S$ and s_S^2 in the same way for any coalition S, the standard relationships for sample means and variances will hold:

Example 4. *Let A and B be disjoint coalitions, and consider $S = A \cup B$. Then*

$$\bar{\omega}_S = \frac{N_A \bar{\omega}_A + N_B \bar{\omega}_B}{N_A + N_B} \tag{24}$$

$$s_S^2 = \frac{(N_A - 1)s_A^2 + (N_B - 1)s_B^2 + \frac{N_A N_B (\bar{\omega}_A - \bar{\omega}_B)^2}{N_A + N_B}}{N_A + N_B - 1}. \tag{25}$$

Now define the vectors $\bar{\omega}_M$ and s_M^2 to be the sample means and variances for all municipalities. It is possible to calculate ϵ_S for any coalition S given only $\bar{\omega}_M$ and s_M. Let $\epsilon_S(\bar{\omega}_M, s_M)$ be the result of this calculation. The elements of both $\bar{\omega}_M$ and s_M have known distributions, which will be helpful when computing moment inequalities.

With this construction of ϵ, for any guess $\hat{\beta}$ for the parameter vector, any observed partition can be rationalized: simply choose s_S^2 sufficiently close to zero if S is in the observed partition, and large otherwise, and then choose $\bar{\omega}_S$ and $\bar{\omega}_{S'}$ such that $(\bar{\omega}_S - \bar{\omega}_{S'})^2$ is sufficiently large to discourage any coarsenings into larger coalitions.

Finally, using the approximation

$$\begin{aligned} \log s_S^2 &\simeq \log(1 + \delta_S), \qquad \delta_S \sim N(0, \frac{2}{N_S - 1}) \\ &\simeq \delta_S \end{aligned}$$

it is the case that if $f(X_S) = \sqrt{\frac{N_S - 1}{2}}$, then $\epsilon_S \sim N(0, 1)$, n.i.i.d, as desired.

3.2 Moment Inequalities Based on Observed Partition

To construct a moment inequality estimator based on rationalizing the observed coalition structure, choose a set of potential deviations $V \subset \mathscr{S}$, choose functions $h_\omega(\bar{\omega}, X) \geq 0$ and $h_s(s, X) \geq 0$ that will give high values when $\bar{\omega}$ and s are extreme relative to the distributions from which they were drawn, and define the pair of vectors

$$(\bar{\omega}_M^*, s_M^*) = \underset{\bar{\omega}_M, s_M}{\operatorname{argmin}}\, h_\omega(\bar{\omega}_M, X) + h_s(s_M, X) \tag{26}$$

$$\text{s.t.} \forall S' \in V, \exists m \in S' \text{ where } v_{mS}(\beta) + \epsilon_S(\bar{\omega}_M, s_M) \geq v_{mS'}(\beta) + \epsilon_{S'}(\bar{\omega}_M, s_M), \text{ with } m \in S \in \pi^0.$$

That is, for each potential deviation S' from the observed partition π^0, there must be some municipality m that would be participating in S', but prefers the coalition S that it is a part of in π^0. Now let $h^*(\pi, \beta) = h_\omega(\bar{\omega}_M^*, X) + h_s(s_M^*, X)$, with Equation 26 evaluated at parameters β and with π as the observed partition. It is always the case that

$$h^*(\pi^0, \beta^0) \leq h_\omega(\bar{\omega}_M^0, X) + h_s(s_M^0, X) \tag{27}$$

where $\bar{\omega}_M^0$ and s_M^0 are the true values that were drawn for $\bar{\omega}_M$ and s_M, respectively. This is because $(\bar{\omega}_M^0, s_M^0)$ will always satisfy the requirements of Equation 26 at $\beta = \beta^0$, because the observed partition π^0 could only have been observed if it were stable, and the conditions of Equation 26 are necessary for stability. Let F_h be the distribution of $h_\omega(\bar{\omega}_M, X) + h_s(s_M, X)$, with mean μ_h, and let F_h^* be the distribution of $h^*(\beta_0)$. Then by Equation 27, F_h stochastically dominates F_h^*. Consider the moment $g_1(\pi^0, \beta | X) = \mu_h - h^*(\pi^0, \beta)$. This moment can be used as a moment inequality

$$\begin{aligned} E_\pi g_1(\pi^0, \beta^0 | X) &= \mu_h - E_\pi h^*(\pi^0, \beta^0) \\ &\geq 0 \end{aligned} \tag{28}$$

because stochastic dominance ensures that the mean of F_h^* will be lower than the mean of F_h, and the distribution of F_h is known because the distributions of $\bar{\omega}_M$ and s_M are known given X. This will be true regardless of what equilibrium selection rule is used to choose which of potentially many stable partitions will actually be observed, because Equation 27 does not rely on assumptions about equilibrium rules,

but rather relies on assumptions regarding the underlying distribution of idiosyncratic shocks.

3.3 Moment Inequalities Based on Counterfactual Policy

There is little debate in Japan that the large number of mergers that occurred during the 1999-2010 period were a result of policy changes made by the national government. Figure 5 shows that the merger activity is in marked contrast to the period before 1999: only 18 municipalities participated in mergers during the two decades preceding the implementation of merger promotion policies. The following assumption will thus be used to generate moment inequalities: in the absence of any change in national government policy, merger activity in 1999-2010 should not have been greater than merger activity in 1979-1999.

More specifically, let $F_Q(\beta)$ be the distribution of the number of municipalities that would have participated in mergers during the 1999-2010 period if the government had not implemented any new merger promotion policies. By assumption (and after making an appropriate adjustment for the fact that the 1979-1998 period is longer than the 1999-2010 period) $F_Q(\beta)$ is stochastically dominated by $F_Q^{79}(\beta)$, the distribution of the number of municipalities that participated in mergers during the 1979-1999 period. F_Q is difficult to calculate directly: not only is the true equilibrium selection rule unknown but, as discussed at the beginning of Section 3.1, the precise membership of $\mathscr{S}$ is both unknown and likely very large. Thus, instead consider only mergers of size 2.

If $S = \{m, m'\}$, and $u_{mS} > u_{mm}$, $u_{m'S} > u_{m'm'}$, then any stable partition must have at least one of m and m' participating in a merger, because S is a blocking coalition for all other partitions. Let $\mathscr{S}_a$ be the set of size 2 mergers where the municipalities are geographically adjacent, and both municipalities prefer the merger to remaining as a singleton. This set can be used to construct an easily computable minimal number of municipalities that must be involved in mergers. Consider the following variable, which is random because the membership of $\mathscr{S}_a$ depends on the draw of $\bar{\omega}_M$ and s_M:

$$Q^* = \underset{Q \subset M}{\operatorname{argmin}} \#Q \text{ s. t. } \forall S \in \mathscr{S}_a, S \cap Q \neq \emptyset \tag{29}$$

That is, Q^* is a minimal hitting set for $\mathscr{S}_a$: for each potential geographically contigu-

ous size 2 merger where both participants prefer the merger relative to not merging at all, at least one of those municipalities is in Q^*. Let $F_Q^*(\beta)$ be the distribution of $\#Q^*$. F_Q stochastically dominates F_Q^*, because $\mathscr{S}_a$ is a subset of all mergers whose participants prefer the merger to remaining as a singleton, and thus any stable partition must include at least $\#Q^*$ municipalities participating in mergers regardless of equilibrium selection rule. The moment $g_2(Q, \beta|X) = 0.5 - F_Q^*(Q)$, where Q is the number of municipalities involved in mergers in the 1979-1998 period, can then be used as a moment inequality because

$$\begin{aligned} E_Q g_2(Q^{79}, \beta^0|X) &= 0.5 - E_Q F_Q^*(Q^{79}) \\ &\geq 0.5 - E_Q F_Q(Q^{79}) \\ &\geq 0.5 - E_Q F_Q^{79}(Q^{79}) \\ &= 0 \end{aligned} \tag{30}$$

due to stochastic dominance and Q^{79} having been drawn from F_Q^{79}.

3.4 Moment Inequality Based on Metropolitan Mergers

Table 1 shows that very few mergers occurred in "metropolitan" prefectures, defined in this paper as prefectures with fewer than 10% of municipalities having a population of less than 10000. The same argument used in the previous subsection can thus be extended to mergers actually observed during the merger period: given the national government's actually implemented policies, the number of mergers observed should not be anomalously low.

Specifically, let Q^{99} be the number of municipalities actually participating in mergers in the 1999-2010 period. Then the moment $g_3(Q, \beta|X) = 0.5 - F_Q^*(Q)$, where F_Q^* is as defined in the previous section, can be used as a moment inequality because

$$\begin{aligned} E_Q g_3(Q^{99}, \beta^0|X) &= 0.5 - E_Q F_Q^*(Q^{99}) \\ &\geq 0.5 - E_Q F_Q(Q^{99}) \\ &= 0 \end{aligned} \tag{31}$$

due to stochastic dominance and Q^{99} having been drawn from F_Q.

3.5 Moment Inequality Based on Tax Rates

Finally, tax rates that are actually charged are observed for all municipalities. This is particularly interesting in the merger period, where there is noticeable, although still low, dispersion in the tax rates being charged. One complication here is that *de facto*, municipalities appear not to be able to lower their tax rate below $\bar{\tau}$, although they are free to charge a higher rate. Even with this censoring, however, tax rates (after adjustment for the tax floor) should be correctly predicted by the model. Specifically, suppose that the observed tax rates are a function of optimal tax rates plus some noise:

$$\tau_m^{**} = \max(\tau_m^*(\beta) + \varepsilon_m, \bar{\tau}), \tag{32}$$

where τ_m^* is taken from Equation 4. If the theoretical model is correct, then, including additonal terms should not improve the fit of a Tobit regression. That is, if D is two times the difference in log likelihood between the model in Equation 32 and the model

$$\tau_m^{**} = \max(\tau_m^*(\beta) + \gamma X_{mk} + \varepsilon_m, \bar{\tau}), \tag{33}$$

should have a chi-square distribution, with one degree of freedom if only the kth column of characteristics is added to the regression. Thus, $g_4(\beta, X) = F_\chi^{-1}(.5) - D$ can be used as a moment inequality, even though it cannot be expressed in the same form as the preceding three moment inequalities.

3.6 Identified Set and Confidence Sets

Constructing a 95% confidence set for β is simplified because assumptions regarding the distribution and correlation structure of the error terms have already been necessary in order to develop the model. The data consists of 47 prefectures, which are treated as independent coalition formation games. Prefectures are classified as "metropolitan", "mixed", and "rural" depending on the percentage of municipalities with a population of less than 10000. Let these sets of prefectures be J^{metro}, J^{mixed}, and J^{rural}, respectively. Let $\bar{g}_1^{\text{metro}}(\beta)$ be the sample moment of g_1 with prefectures J^{metro}:

$$\bar{g}_1^{\text{metro}}(\beta) = \frac{1}{\#J^{\text{metro}}} \sum_{j \in J^{\text{metro}}} g_1(\pi_j^0, \beta) \tag{34}$$

where π_j^0 is the actually observed partition in prefecture j. Construct $\bar{g}_2$ similarly: for example, $\bar{g}_2^{\text{mixed}}$ would be

$$\bar{g}_2^{\text{mixed}}(\beta) = \frac{1}{\#J^{\text{mixed}}} \sum_{j \in J^{\text{mixed}}} g_2(Q_j^{79}, \beta) \tag{35}$$

where Q_j^{79} is the actually observed number of municipalities participating in mergers in prefecture j during the 1979-1998 period. There are thus three sample moments calculated from g_1 (metro, mixed, and rural), and another three in the same way for g_2. On the other hand, g_3 is only calculated for "metro" (it will not bind for any value of β for mixed or rural, due to the large number of mergers in these types of prefectures):

$$\bar{g}_3^{\text{metro}}(\beta) = \frac{1}{\#J^{\text{metro}}} \sum_{j \in J^{\text{metro}}} g_3(Q_j^{99}, \beta) \tag{36}$$

where Q_j^{99} is the actually observed number of municipalities participating in mergers in prefecture j during the 1999-2010 period. The text statistic used will be

$$\begin{aligned} \mathbf{T}(\beta) = [\bar{g}_1^{\text{metro}}(\beta)]_-^2 + [\bar{g}_1^{\text{mixed}}(\beta)]_-^2 + [\bar{g}_1^{\text{rural}}(\beta)]_-^2 + \\ [\bar{g}_2^{\text{metro}}(\beta)]_-^2 + [\bar{g}_2^{\text{mixed}}(\beta)]_-^2 + [\bar{g}_2^{\text{rural}}(\beta)]_-^2 + \\ [\bar{g}_3^{\text{metro}}(\beta)]_-^2 + [\bar{g}_4(\beta)]_-^2 \end{aligned} \tag{37}$$

where $[x]_- = \min(x, 0)$. Due to the distributional assumption already made regarding $\bar{\omega}$ and s, the first six of the these terms are uncorrelated. $\bar{g}_3^{\text{metro}}$, however, could well be correlated with $\bar{g}_1^{\text{metro}}$, as π^0 affects both of these sample moments. The worst case scenario is that these sample moments are perfectly correlated. Similarly, $\bar{g}_4$ could plausibly be correlated with other moments, with the worst case scenario being perfect correlation between $\bar{g}_4$ and the sum of the other terms. Critical values of $\mathbf{T}(\beta)$, then, will be computed assuming these worst case scenarios. The identified set is

$$\hat{\beta} = \underset{\beta}{\operatorname{argmin}}\, \mathbf{T}(\beta) \tag{38}$$

and following convention the 95% confidence set will be

$$\{\beta | \mathbf{T}(\beta) < \mathbf{T}(\hat{\beta}) + \mathbf{T}_{0.95}\} \tag{39}$$

where $\mathbf{T}_{0.95}$ is the 0.95 quantile of the distribution of the test statistic. In general $\mathbf{T}_{0.95}$ would depend on β, but in this particular instance the distribution is the same regardless of β.

4 Results

Results are shown in Table 2. Since mergers do not cross prefectural boundaries, each prefecture is treated as a separate coalition formation game, and asymptotics are with respect to the number of prefectures.[20]

Although the model is only set identified in theory, the results show that the minimizer of the test statistic is a single point. This result is standard in the literature.

This value of β_2 roughly implies that an individual would be willing to have a municipal policy that was 1km more distant in exchange for about ¥4000 per year.[21]

Using this value of β_2, if the population of Japan were uniformly distributed across the country, and a social planner could set entirely new boundaries for municipalities, then the optimum size for a municipality would be

$$\beta_0 \log(\frac{y_m N_m - \beta_3 c(P_m)}{y_m N_m}) + \beta_1 \log(\frac{y_m N_m - \beta_3 c(N_m)}{c(N_m)}) + 0.377\beta_2\sqrt{N_m/340}, \quad (40)$$

where 0.377 is a coefficient for the average distance to the centroid based on hexagonal packing, and $P_m/340$ the area in square kilometres given the population density of Japan (340 per km^2). This formula yields an optimal municipal population of about 150,000 (exact calculations pending). This suggests roughly 800 municipalities for all of Japan, which is about half of the current number.

The value of $\frac{\beta_1}{\beta_0+\beta_1}$, the value placed on public goods relative to private goods, is estimated at about 0.025. If the true efficiencies of scale were those estimated by the government, then this value would indicate that the government had selected a reasonable tax rate to serve as $\bar{\tau}$; however, since government estimates of efficiencies of scale appear to be overestimates, the interpretation of this coefficient becomes more difficult. In particular, the government specified tax rate $\bar{\tau}$ is above the optimal tax rate for almost all municipalities.

[20]There is one exception, involving a single municipality switching prefectures. It is treated as though the municipality in question was always part of the "destination" prefecture.

[21]This calculation is complicated by the fact that the municipal tax base is not directly equivalent to GDP, 0.1 percentage point decrease in taxes does not translate into 0.1% of GDP per capita.

The estimate for β_3 indicates that the view of the government estimates of the cost of providing public goods as an estimate of the cost of providing the "national minimum" appears to be correct. There is a fixed Stone-Geary style demand for 1.05 quality units of the public good, which is not statistically different from 1 (that is, the government cost estimates are the estimate for the minimum possible public expenditure), but is statistically different from zero.

The degree to which the central government's estimates of efficiencies of scale in the provision of public services match the true efficiencies of scale is estimated to be about 0.5. This means that two null hypothesis can be rejected at very high confidence levels: that there are no efficiencies of scale in the provision of public goods ($\beta_4 = 0$), and that the efficiencies of scale in the provision of public goods are equal to the initial government estimates ($\beta_4 = 1$). The hypothesis that the revised (H^{new}) government estimates of efficiencies of scale are equal to the true efficiencies of scale ($\beta \simeq 0.76$) can also be rejected at the 95% confidence level (further details pending).

5 Conclusion

This paper estimated the parameters determining preferences in a cooperative form political coalition formation game, using a moment inequalities framework. ...

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	Units	Metropolitan	Mixed	Rural
$\tilde{c}$ (std. fiscal need)	¥100,000,000	361.86	64.42	53.85
		(776.37)	(182.15)	(169.60)
$\bar{\tau}Y$ (std. fiscal rev.)	¥100,000,000	281.60	40.84	24.75
		(665.12)	(146.98)	(112.47)
POPULATION	100,000	2.04	0.34	0.23
		(3.90)	(0.96)	(0.89)
AREA (sq. km.)	100	0.45	0.98	1.93
		(0.54)	(1.06)	(2.05)
CITY (vs. town/vill.)	%	70.83	19.51	16.00
MERGED_PRE_1999	%	1.39	1.41	0.00
MERGED_POST_1999	%	6.25	67.58	64.64
# municipalities		144	2486	625
# prefectures		3	36	8

Table 1: Summary Statistics by Type of Prefecture

Table 2: Dependent variable is v_{mS}, (structural) utility to muni m from merger S

	tax floor	no tax floor
CONSUMPTION (β_0)	200.99^{**}	98.91^{**}
		$(60.0, 350.0)$
GOVERNMENT (β_1)	4.58^{**}	2.73
	$(2.0, 12.0)$	$(0.0, 9.0)$
DISTANCE (β_2)	-0.21^{**}	-0.25^{*}
	$(-0.70, -0.02)$	$(-0.35, 0.0)$
STONE_GEARY (β_3)	1.05^{**}	1.03^{**}
	$(0.95, 1.13)$	$(0.94, 1.25)$
EFF_OF_SCALE (β_4)	0.49^{**}	0.55^{**}
	$(0.38, 0.61)$	$(0.29, 0.68)$
N (prefectures)	47	47

** 95% level
* 90% level
(a, b) Extreme points for this variable in (five dimensional) 95% confidence set
tax floor: municipalities cannot charge a tax rate less than $\bar{\tau}$, the national government's reference tax rate

Figure 1: Prefectures of Japan

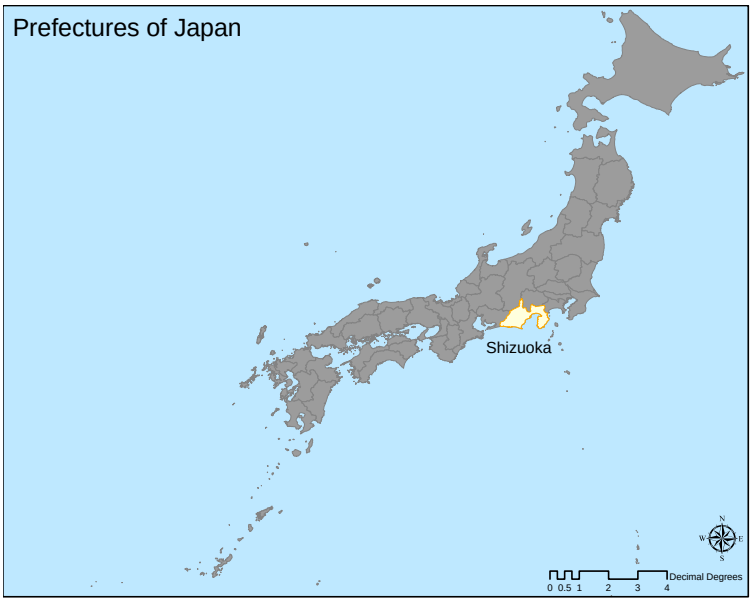


Figure 2: Shizuoka Prefecture

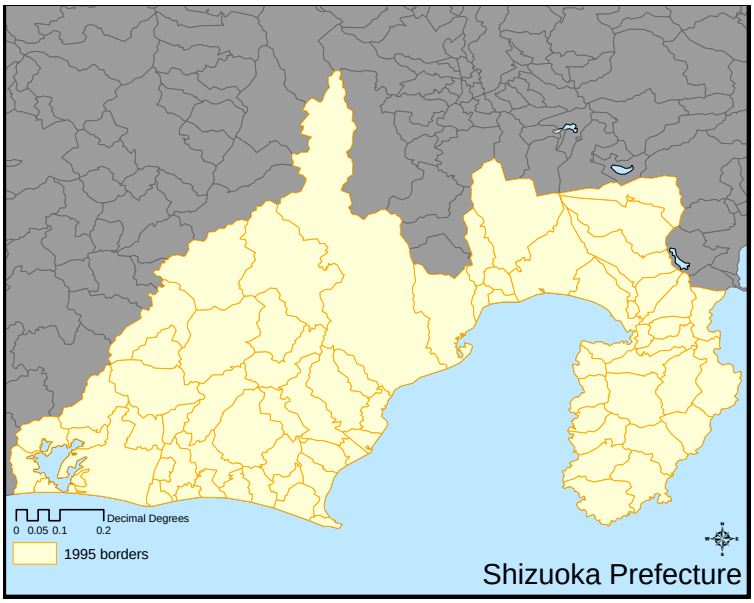


Figure 3: Standard Fiscal Need

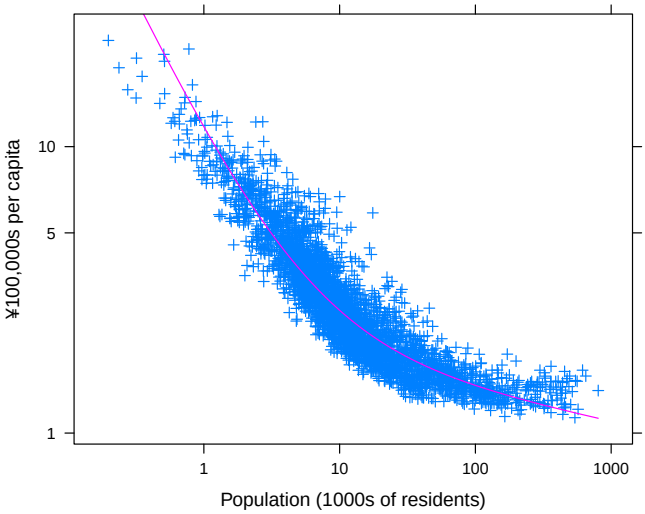


Figure 4: Mergers in Shizuoka Prefecture

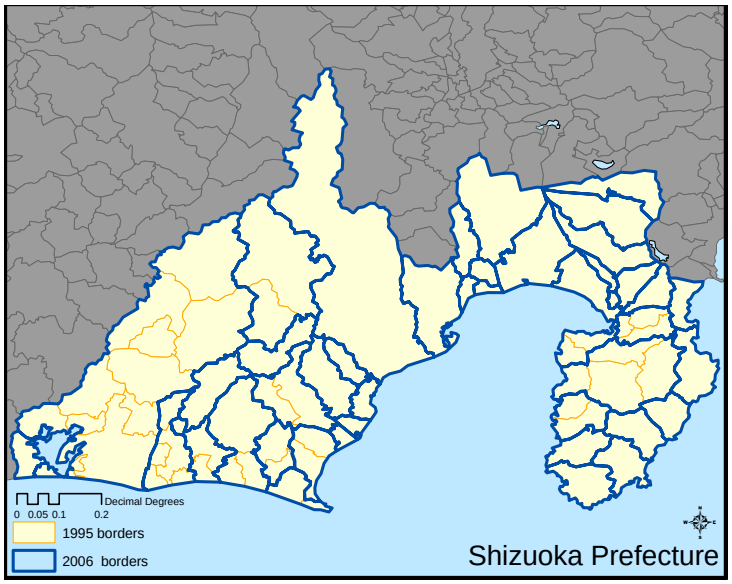
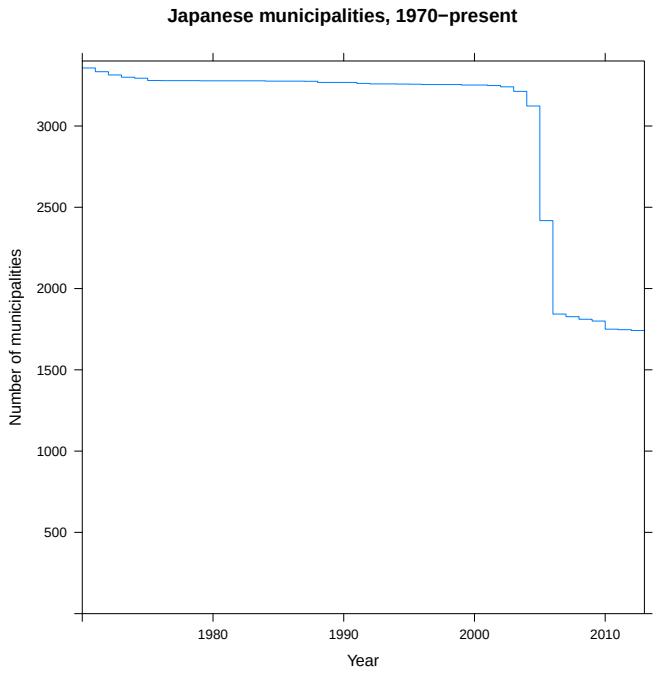


Figure 5:


Japanese municipalities, 1970−present
Number of municipalities
3000
2500
2000
1500
1000
500
1980
1990
2000
2010
Year

A Voting Model

Theorem 1 (Banks and Duggan 2005)**.** *If (a) two office-motivated candidates run on the basis of policy platforms, (b) voting in elections is determined via a probabilistic voting model where vote probabilities are linear in utility difference between two candidates, and (c) other technical conditions are satisfied, then the policy resulting from such an election will in fact be the socially optimal policy.*[22]

Proof. This is Theorem 4 from Banks and Duggan [2005]. □

Given that disutility from distance is assumed to be linear in distance, the location selected will be that of the "generalized median voter", where the sum of distances is minimized.[23]

In reality, municipal politics in Japan involves both a mayor and a municipal council, and thus there is in reality more than the one decision maker supposed in the theorem; however, with the exception of about a dozen "designated municipalities" the council is elected on an entirely at-large basis, without any wards or other subdivisions. The mayor has veto power, which can be over-ruled by a 2/3rds vote of the municipal council. Given the lack of wards in the municipal council, it is not entirely clear how or why policies proposed by council might diverge from policies proposed by the mayor, although obviously examples of this sort of conflict can be found in municipal records. Because this paper's focus is inter- rather than intra- municipal decision-making, the following assumption will be used: mayors will veto anything other than the policy proposed in their campaign, and less than 2/3rds of council will be opposed to this (socially optimal) policy.[24] Thus, θ_m^* will be set to the location of the generalized median voter.

[22]Another option would be some variation of the median voter theorem, but this would mean that the national government, which is maximizing an objective based on the weighted sums of utilities, would prefer that municipalities choose a policy other than that actually chosen.

[23]This point is not necessarily unique, but empirically this is never important given actual population distributions.

[24]Prior to the merger period, mayors were responsible for delivering hundreds of "agency delegated functions" from higher levels of government, making them bureaucrats as well as politicians, and making it possible (at least in theory) for central ministries to fire a mayor for not performing a delegated function according to specifications. "Agency delegated functions" were abolished during the merger period, and municipal policies are thus modeled as being determined by local residents through a political process.

B Stability Concept

B.1 Solution Concept

Now define Π as the set of all possible coalition structures, where a coalition structure $\pi \in \Pi$ is a set of coalitions such that every player is in exactly one of these coalitions. Suppose that player $m \in M$ has preferences $\preceq_m$ defined over the set $\{S \subset M | m \in S\}$, with $\prec_m$ indicating a strict preference. The extension of these preferences to partitions is easy: if $\pi(m)$ is the coalition that municipality m belongs to in partition π, then $\pi \preceq_m \pi'$ if $\pi(m) \preceq_m \pi'(m)$. Let $\pi \prec_S \pi'$ for some coalition S if $\forall m \in S, \pi \prec_m \pi'$. The observed coalition structure is treated as the result of a pure hedonic coalition formation game, where the payoff to each player depends only on the coalition to which it belongs, and not on what other coalitions occur. This is the game introduced by Dreze and Greenberg [1980], except without the possibility of even within-coalition transfers. The inability to negotiate transfers prevents some coalitions from forming:

Example 5. *Let $M = \{1, 2\}$, and u_m be a utility function describing the preferences of player m over coalitions, with*

$$\begin{aligned} u_1(\{1,2\}) &= u_1(\{1\}) + \epsilon_1, \\ u_2(\{1,2\}) &= u_2(\{2\}) + \epsilon_2. \end{aligned} \tag{41}$$

If $\epsilon_1 > 0$, $\epsilon_2 < 0$, $|\epsilon_1| > |\epsilon_2|$, then the stable coalition structure is $\{\{1, 2\}\}$ if transfers are possible, but $\{\{1\}, \{2\}\}$ if they are prohibited.

Ideally, given a set of preferences, there would exist a unique stable partition. The solution set is defined using the von Neumann and Morgenstern [1944] "stable set". Although the VNM stable set was originally defined in terms of imputations rather than coalition structures, this paper follows Lars [2007] in defining the stable set over coalition structures. Specifically, the von Neumann-Morgenstern solution requires that (i) no coalition structure in the stable set be dominated by another coalition structure in the set, and that (ii) any coalition structure outside of the set is dominated by a coalition structure belonging to the set.

Definition 1 (Lars 2007)**.** *Let $<$ be a dominance operator, and $\Pi^{VNM} \subseteq \Pi$. Then Π^{VNM} is called a stable set for $<$ if the following two properties hold:*

1. $\forall \pi, \pi' \in \Pi^{VNM}$, $\pi \not< \pi'$. *(Internal stability)*

2. $\forall \pi \notin \Pi^{VNM}, \exists \pi' \in \Pi^{VNM}$ *where* $\pi < \pi'$. *(External stability)*

The goal is to define the dominance operator $<$ in a way that is intuitively plausible yet at the same time guarantees that the stable set exists, but this turns out not to be trivial. Consider, for example, the following definition of $<$: $\pi < \pi'$ if $\exists S \in \pi'$ such that $\pi \prec_S \pi'$ and $\forall S' \in (\pi \setminus \pi'), (S' \setminus S) \in \pi'$ or is empty. Unfortunately, with this definition not only is a stable set not guaranteed to exist, but in general it is not possible to devise another plausible method of selecting a single partition as the solution of this type of coalition formation game [Barberà and Gerber, 2007].

Existence (but not uniqueness) of a stable partition can be guaranteed if restrictions are placed on the types of blocking coalitions that can form. This can be accomplished by considering only two types of potential deviations when evaluating whether a given partition is stable: refinements, where a subcoalition of a single existing coalition breaks off to form a coalition, and coarsenings, where two or more existing coalitions merge in order to form a new coalition.[25]

To guarantee existence, Ray and Vohra [1997] only allow deviating coalitions to force refinements of a partition, and Diamantoudi and Xue [2007] show that this creates a stable set.[26] Because hedonic games are simpler than the "equilibrium coalition structures" that Ray and Vohra examine, in this paper both refinements

[25]One potential objection to this approach is that, with a dataset consisting of prefectures with perhaps 10^{40} potential partitions each, non-existence should be of no more than theoretical concern. If, with high probability, one of these partitions will be stable under some stricter definition of stability, then any relaxation of the solution concept presented in that section does nothing except needlessly multiply equilibria. Previous work on non-transferable utility coalition formation games, however, shows that non-existence is not merely a hypothetical problem. In particular, Pittel and Irving [1994] prove that a large random roommate problem is "unsolvable" at least 17.6% of the time, and then show that this bound appears to be very conservative: in simulation exercises, over two-thirds of games with 2000 players had no stable coalition structure. Empirically, the probability of non-existence appears to increase with the number of players. The Japanese data examined has 3325 players, and the Pittel and Irving simulation results suggest that the fact that these municipalities are separated into prefectures likely makes the probability of non-existence higher, rather than lower. Although the simulation results cited allowed only size 2 coalitions, and the game considered in this paper allows coalitions up to size 15, it seems unlikely that allowing additional coalitions - and thus additional potential deviations - would eliminate this problem of non-existence. It is thus not appropriate to combine a restrictive stability criterion with a utility function allowing arbitrary preferences, and ignore the resulting potential non-existence of a stable coalition structure.

[26]An alternative approach would be to allow only single player deviations, as in Greenberg [1979]. Ray and Vohra [1997] is used instead because anecdotal evidence suggests that multi-player deviations involving a refinement or a coarsening were more common than single player deviations not to a refinement or a coarsening during the coalition formation process.

and coarsenings will be allowed. Otherwise, the theory follows that presented in Ray and Vohra. Let $\pi \nearrow_S \pi'$ and $\pi \searrow_S \pi'$ mean that $\pi \prec_S \pi'$, $S \in \pi'$, where π' is a coarsening and a refinement of π, respectively. Using the terminology of Ray and Vohra, π is blocked by π' if either there is a set of coalitions in π that are unanimously in favour of merging to create π', or there is a subset of "perpetrators" in π that are unanimously in favour of deviating from their current coalition. In the former case, π' is the coarsening that results from the merger, while in the latter it is a refinement that includes a coalition for these perpetrators and some arrangement of the "residual" left behind when the perpetrators deviated, such that the configuration of perpetrators and residual is stable. More formally, where $\rightarrow$ should be read as "blocked by":

Definition 2. *$\pi \rightarrow \pi'$ if $\exists S$ such that either $\pi \nearrow_S \pi'$ or $\pi \searrow_S \pi'$, where*

1. *$\pi \nearrow_S \pi'$ if $\pi' \setminus \pi = S$ such that $\pi \prec_S \pi'$, and*
   a) *$S = \bigcup Q$ for some $Q \subset \pi$, and*
   b) *$\nexists S' \subset S$ such that $\pi' \searrow_{S'} \pi''$.*
2. *$\pi \searrow_S \pi'$ if $\exists S \in \pi'$ such that $\pi \prec_S \pi'$, and*
   a) *$\pi \setminus \pi' = S'$ with $S' = \bigcup Q'$ for some $Q' \subset \pi'$, and*
   b) *$\nexists \tilde{Q}$ such that $Q' \rightarrow \tilde{Q}$.*

The recursion is well defined since Q' is a proper subset of π'. Now let $\twoheadrightarrow$ be the transitive closure of $\rightarrow$.[27] Then

Theorem 2. *1. $\Pi^* = \{\pi | \nexists \pi'$ such that $\pi \rightarrow \pi'\}$ is a stable set with respect to $(\Pi, \twoheadrightarrow)$.*

2. Π^* is unique.

3. Π^* contains a Pareto optimal partition.

Proof. Straightforward given Ray and Vohra [1997]: □

[27] That is, $\pi \twoheadrightarrow \pi'$ if either $\pi \rightarrow \pi'$ or $\exists \{\pi_1, \ldots, \pi_n\}$ where $\pi \rightarrow \pi_1 \rightarrow \ldots \rightarrow \pi_n \rightarrow \pi'$. To see why the transitive closure is used here, consider the case where $\pi_1 \searrow_S \pi_2 \nearrow_{S'} \pi_3$. π_1 and π_2 should not be in the stable set, while π_3 should, but $\{\pi_3\}$ is not a VNM stable set with respect to $\rightarrow$ because $\pi_1 \nrightarrow \pi_3$.

(existence). By construction, Π^* is internally stable. Now take some $\pi \notin \Pi^*$. Then $\exists\{\pi_1, \ldots, \pi_n\} \subset \Pi$ such that $\pi \to \pi_1 \to \cdots \to \pi_n$ and either $\pi_n \in \Pi^*$ or there is a cycle with $\pi_n = \pi_l$ for some $l < n$. If there is such a cycle, then it must contain both mergers and dissolutions. However, such a cycle cannot exist because $\nearrow$ is defined such that there are no refinements. $\square$

(uniqueness). Suppose that Π^{**} is also a stable set with respect to $(\Pi, \twoheadrightarrow)$. Consider the bipartite directed graph defined by $\twoheadrightarrow$ with $\Pi^{**} \setminus \Pi^*$ and $\Pi^* \setminus \Pi^{**}$ as the two sets of nodes. Every node must have in-degree of at least one, but there can be no cycles. The only such graph is empty, and thus $\Pi^{**} = \Pi^*$.[28] $\square$

(PO element). Let $\Pi^{\text{PO}} \subset \Pi$ be the set of Pareto optimal partitions, and $\rightsquigarrow$ the Pareto dominance operator. Suppose that $\Pi^{\text{PO}} \cap \Pi^* = \emptyset$ and consider the directed graph defined by $\twoheadrightarrow \cup \rightsquigarrow$ with Π^{PO} and Π^* as two sets of nodes. A cycle must exist, because $\forall \pi \in \Pi^{\text{PO}}, \exists \pi' \in \Pi^*$ such that $\pi \twoheadrightarrow \pi'$, but at the same time $\forall \pi \in \Pi^*, \exists \pi' \in \Pi^{\text{PO}}$ such that $\pi \rightsquigarrow \pi'$. Choose the starting point in this cycle such that $\pi_0 \rightsquigarrow \pi_1 \twoheadrightarrow \cdots \twoheadrightarrow \pi_n = \pi_0$. Let S_1^+ be the set of agents that strictly prefer π_1 to π_0. It cannot be that $\pi_1 \nearrow \pi_2$ because this is also a pareto improvement. Thus $\pi_1 \searrow_{S'} \pi_2$, and $S_2^+ = (S_1^+ \setminus R) \cup P$ where R is some subset of the residual, and $P \neq \emptyset$ is some subset of the perpetrators, and $(R \cup P) \subset S'$. Since $S_n^+ = \emptyset$, at some point the agents in S_2^+ must be made worse off. This can only happen via refinements, and only if there is a residual smaller than S_2^+. The latter, though, implies that either some subset of S_2^+ cannot be made worse off, or that S_3^+ will contain some new element. Thus, S^+ can never be empty. Thus a cycle cannot exist, and there is some pareto optimal element in Π^*. $\square$

All partitions in Π^*, including those that are not Pareto optimal, will be treated equally, since imposing additional restrictions at this stage would mean that the solution set would no longer be the outcome of the cooperative game coalition formation process described above.[29]

[28] This does not imply that $|\Pi^*| = 1$.

[29] There may be some "solutions" that seem particularly unattractive: $\{\pi \in \Pi^* | \exists \pi' \in \Pi^*, \pi \rightsquigarrow \pi'\}$, where $\rightsquigarrow$ indicates Pareto dominance. While the theory above could likely be rewritten to shrink the stable set, eliminating these elements, in the Japanese case it is unfortunately computationally infeasible to impose any restrictions that require enumerating the entire stable set.

C Data

Population data comes from the 1995 national census, which provides data at the kilometer grid square level. Taxable income per capita is used as a proxy for income per capita, with 1996 tax year data taken from the Asahi Shimbun *Minryoku*. The list of mergers that actually occurred is from the Japan Geographic Data Center. To construct the set of possible coalitions information on which municipalities share a border is derived from shape files for 1995 boundaries from ESRI Japan. These files are also used in conjunction with the census grid square data to calculate the location of generalized median voters.[30]

Municipal financial data is from the '96-'97 and (for comparison) the '06-'07 fiscal year *Shichōsonbetsu Kessan Jōkyō Shirabe*, an official national government report of municipal finances.[31] Because of the large transfers from the national treasury to local governments, this data is handled quite carefully by officials in the central ministries and is generally regarded as accurate, particularly the sections produced by the central government itself. The isolated incidents of fraud reported generally relate to variables reported by the municipalities, which are not used in this paper.

Table 1 gives summary statistics for this data. Units for population and surface area are chosen to be close to the Ministry of Internal Affairs' "reference municipality". There are no missing values in any of the financial, population, or surface area data. In the income data, four values are missing because one merger took place after the data was collected but before it was published, and the old municipalities were not reported. This variable, however, is only used in the preliminary financial regressions described below, and thus the data used in the main estimator does not have any missing values.[32]

[30] A precise calculation of the generalized median is computationally intensive, and infeasible given the number of such values that need to be computed. A simple calculation of median latitude and median longitude, however, yields a good approximation, and is used throughout the paper. Using the mean voter, which is easy to calculate but not consistent with the model presented, yields similar results.

[31] This report also provides by municipality population data from the 1995 census, and surface area data from a 1996 Geographical Survey Institute survey.

[32] The 23 "special wards", which cover roughly the area of pre-war Tokyo City, have powers similar to cities but are excluded from the analysis because any enlargement of this *sui generis* area would likely involve adding more wards, rather than changing the borders of existing ones. The twelve "designated cities", which have some powers normally reserved for prefectures, are omitted from the preliminary financial calculations because their additional responsibilities increase their required spending, but they are included in the rest of the analysis as regular cities. The categories of "core

The initial laws implementing the merger incentive scheme were passed in 1995, and thus it would be optimal to use data from before this point. However, electronic data availability improves around 1995, and most of the data used is from the '95-'97 period. Endogeneity problems seem unlikely, as most of the merger negotiations and approvals occurred in the middle of the 1999-2010 window. In fact, the "Trinity" tax reforms were not even finalized until 2002, and this uncertainty provided municipalities with an incentive to wait until after 2002 to conduct any mergers. Consequently, using data from '95-'97 should not cause difficulties. In particular, the financial data used is calculations by the national government, not actual spending by municipalities, and thus is not vulnerable to "last minute" capital spending, where a municipality planning on merging in 1999 might increase expenditures in its '96-'97 budget.

The determination of $\mathscr{S}$, the set of potential alternative mergers that need to be checked during estimation, is slightly more problematic. There are a number of large mergers observed, with the largest involving fifteen municipalities. Almost all observed mergers are geographically contiguous. However, even after restricting $\mathscr{S}$ to contiguous coalitions of size fifteen or less, there are still over 10^{16} possibilities, which is computationally infeasible.[33] Most of these coalitions, however, look very different than the actually observed coalitions. In particular, they tend to be a thin line of municipalities, stretching almost all the way across a prefecture. On average, individuals in these coalitions would have very high distance ℓ, and the coalitions are thus not likely to form. Including this group of "low probability" coalitions in the calculations would be ideal. However, for computational reasons these will instead be ruled out through the use of a restriction: coalitions will not be allowed to cross more than two county boundaries, using county definitions from the Meiji era.[34]

city" and "special city" were created during the merger period, and therefore do not appear in the data used.

[33]More specifically, there are thirteen observed mergers that are not geographically contiguous, usually because one of the participants dropped out late in the merger process. Islands with only a single municipality on them are treated as being connected to the closest municipality on the "mainland" (i.e. Hokkaidō, Honshū, Shikoku, or Kyūshū) if it is within 50km. There are, however, two cases in which municipalities on an island merged with municipalities on the mainland other than the closest one. There are also six cases where municipalities on two separate islands merged together. Thus, about 3.5% of mergers (21/588) are not contiguous. No additional mergers violating contiguity are generated as comparison coalitions, although the mergers did occur are retained in the observed partitions, and may also appear in alternative partitions.

[34]In particular, the county boundaries used are from 1878 for eastern Japan, and 1896 for western Japan. Counties are statistical divisions, and have not had any political function since the 1920s.

This restriction dramatically reduces the number of large coalitions that need to be considered: with fifteen-municipality coalitions, only one coalition in a billion involves three or fewer counties. This reduces the total number of alternatives that need to be considered to about 20 million per prefecture, which is computationally feasible. Two actual mergers violate the restriction on number of counties that is imposed: one size twelve merger in Shizuoka, and one size eleven merger in Niigata. This represents 0.3% of all observed mergers.

Counties in Tokyo and Nagano Prefectures are anomalously large, and thus in those prefectures only the restriction is to one and two counties, respectively, rather than three.

D Japanese Local Public Finance

With the exception of firefighting, these categories also describe prefectural responsibilities, and thus each of these categories are divided into sub-categories.[35] For example, within public works, rivers are a prefectural responsibility while parks are a municipal responsibility; within welfare, sanitation is a municipal responsibility while labour is a prefectural responsibility.[36]

For each category and sub-category, central government officials construct estimates of the cost of providing a certain "national standard" level of service for municipalities with various characteristics. For example, the cost of providing this level of firefighting is judged to be ¥1.009 million for a city of 100,000 people, but this is increased to ¥1.029 million if the population density is 150 per km^2 rather than 200. There are 15 types and sub-types of these "adjustment coefficients", but for the purposes of this paper the most relevant of these is the *dankai* (literally "step" or "grade") adjustment, which is based on the scale of the service provision. The *dankai* adjustment is generally based on the total number of residents, but in some cases the relevant subgroup may be considered instead: the adjustment for services to the elderly is based on the number of residents over 65, the adjustment for agricultural services is based on the number of farmers, and so forth. This adjustment is substantial, with the per capita cost of providing services usually estimated to be 2 to 3 times higher for a municipality of 4000 people than one of 100000. Overall, the 2009 version of the exposition of these formulae (the *Chihō Kōfuzei Seido Kaisetsu*) consists of 600 pages of Japanese legal text, 460 pages of formulae, and 240 pages of reference values. After all adjustments are applied, the cost of providing the national standard level of services is aggregated across services to produce the "Standard Fiscal Need" for each municipality. The estimated cost $\tilde{c}_m$ for the provision of public services varies from municipality to municipality, depending on the precise characteristics of each municipality; however, as Figure 3 shows, $\tilde{c}_m$ can be approximated by the non-linear regression

$$\tilde{c}_m(P_m) = (\gamma_0 + \gamma_1 P_m^{\phi})\nu_m, \tag{42}$$

[35] Firefighting is "metropolitan government" responsibility in the special ward (i.e. old Tokyo City) area of Tokyo prefecture. Special wards did not participate in municipal mergers, however, and thus the discussion that follows does not cover the *sui generis* government in place there.

[36] Of the 30 sub-categories that were listed in 1998, 13 are related to both prefectural and municipal responsibilities, presumably resulting in sub-sub-categories. These are not enumerated in the data used.

	I	II	III	IV	V
(Intercept)	9.57*	5.67*	6.15*	5.94*	6.16*
	(0.19)	(0.12)	(0.17)	(0.12)	(0.17)
ϕ	0.90*	0.90*	0.87*	0.93*	0.89*
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
POPULATION$^{\phi}$	137.19*	139.17*	143.01*	146.76*	145.21*
	(2.89)	(3.04)	(3.14)	(3.02)	(3.01)
AREA		3.19*	2.73*	3.13*	2.58*
		(0.10)	(0.10)	(0.10)	(0.09)
INCOME		0.01	0.09*	−0.03	−0.00
		(0.02)	(0.03)	(0.03)	(0.03)
INCOME.INEQ		−0.07*	−0.07*	−0.03*	−0.04*
		(0.00)	(0.01)	(0.01)	(0.01)
POP$^{\phi}$*INCOME				1.02*	2.11*
				(0.25)	(0.27)
POP$^{\phi}$*INCOME.INEQ				−0.60*	−0.81*
				(0.07)	(0.07)
PREFECTURE	N	N	Y	N	Y
CITY	N	N	Y	N	Y
N	3220	3216	3216	3216	3216

Table 3: Dependent variable is Standard Fiscal Need ('96-'97)

where ν_m is a lognormal error term.[37]

The fixed cost is thus γ_0, and the average variable cost is $\gamma_1 P_m^{\phi-1}$. The values in Table 3 reflect the fact that the central ministries believed that there were economies of scale in the production of public goods, and thus per capita costs would be higher in municipalities with lower population: the fixed cost estimate is about ¥600 million for Columns II-V, and the marginal cost ($\gamma_1 \phi P_m^{\phi-1}$) is about ¥200,000 per capita at

[37]The underprediction for large municipalities in Figure 3 is not necessarily evidence that Equation 42 is misspecified. Although "designated cities" have been removed, large cities that do not quite meet the criteria to be so designated appear to have been allocated some additional responsibilities on a more *ad hoc* basis. Because the underlying data that the Standard Fiscal Need calculations are based on is not available, the amount allocated for these additional responsibilities is difficult to remove; however, Hayashi, Nishikawa, and Weese [2010] show that the functional form used here matches cost estimates generated by the *dankai hosei* adjustment coefficient, which is the adjustment that creates most of the per capita cost difference between municipalities with large and small populations. Weese [2008] used a simpler specification which matched the data in Figure 3 better for large municipalities: this specification was changed to that in Equation 42 after consulting with the Ministry of Internal Affairs officials responsible for the cost estimates.

a population of 1,000, but ¥100,000 per capita at a population of 100,000.[38] Taking into account both the fixed cost and the variable cost, the per capita cost of providing national minimum level public goods in Ashiyasu village (population 567) would be roughly ¥1.5 million, compared with roughly ¥100,000 in Sakai city (population 790,000).

The central government estimates of the Standard Fiscal Need of municipalities, and more specifically the *dankai* adjustment, are based on the expert opinion of a group of MIC career-track officers. They are not, in particular, created via a regression of municipal characteristics on previous municipal spending, nor by applying a specific set of *a priori* assumptions regarding returns to scale. The process first involves estimating the cost of providing services for a reference municipality, one with a population of 100,000, a surface area of 160km^2, and other standard characteristics. The number and type of bureaucrats necessary to provide the service is then estimated, along with the cost of equipment and materials, plus any transfers to the relevant target population (eg. child benefit payments). The number and type of bureaucrats that smaller and larger municipalities would require to provide the same level of service is then estimated.[39] National Personnel Authority salary scales are then used to convert employee numbers to a total wage bill, which is added to an adjusted estimate for equipment and materials. By definition there are no economies of scale with respect to transfers to individuals, since the same level of service would imply the same level of transfers in the cases where there are transfer payments.

As the estimates of the cost of providing the "national standard" level of service are expert opinion, it is not possible to give a formal specification describing how they are derived. According to MIC officials, however, each year estimates are modified based on formal and informal feedback from municipalities and prefectures, observed spending patterns, and in-house research. There is also outside interference, both

[38] Column I is provided for reference, but as there are explicit expense categories dealing with land administration (particularly forests and farmland), surface area is an obvious variable to include. The results in Column I show that the null hypothesis that there are no economies of scope between administering land and providing services to residents cannot be rejected: the difference in estimates for γ_1 and ϕ are both statistically insignificant between Column I and Column II. Comparisons with Columns III-V do yield some statistically significant differences, but using parameter values from these columns does not change the results in the following sections of the paper.

[39] The sizes at which these estimates are performed varies slightly from year to year and from service to service, but in recent years estimates have generally been produced for populations of 4,000, 8,000, 12,000, 20,000, and 30,000 for municipalities below the reference size, and at 250,000, 400,000, 1,000,000, and 2,000,000 for municipalities above the reference size.

political and bureaucratic. This interference comes in two forms, both of which affect the capital spending estimates but not the "ordinary" (i.e. non-capital) estimates. First, the amount of transfers allocated needs to somehow match the budget agreed upon with the Finance Ministry. This is accomplished by modifying capital spending estimates, with the result that official municipal capital spending "needs" vary radically from year to year; estimates of the non-capital spending required to provide municipal services, on the other hand, change very little.[40] Second, line ministries such as the Construction Ministry, as well as politicians, apply pressure to promote specific types of local projects. Over time, this has resulted in the addition of numerous "project" adjustment coefficients, each providing a special incentive for a specific variety of public works project. DeWit [2002] describes the history of this interference, which both makes it impossible to calculate total estimated capital spending requirements, and renders such a calculation – if it were performed – useless except for analyzing political lobbying. With respect to the ordinary expense estimates, however, the officials responsible for recent estimates did not experience any interference either from politicians or other ministries. In fact, these cost estimates do not appear to be influenced even by other MIC policies.[41] The detailed breakdown of expense elements published with each ordinary expense item would make justifying abrupt changes difficult, while capital expense amounts are often reported on a single line without explanation. Pork thus attaches to capital spending estimates. Hayashi et al. [2010] instruments these with non-capital expenditure estimates, in particular total salary requirements.[42] Efficiencies of scale in capital expenditures, however, follow efficiencies of scale in other expenditures, with the result that there is effectively no difference between using this IV approach and estimation using capital expenditure

[40]Occasionally modifications are also made by adding additional expense categories. These are distinguishable from the usual expense categories by their placement at the end the list of expenses, their short lifespan, and their non-specific names. The usual expense categories have remained effectively unchanged since at least 1968.

[41]There was no formal discussion, for example, of the effect that a cap on the *dankai* adjustment would have on municipal mergers, despite the fact that for smaller municipalities this effect is substantial, and both policies originated within the Ministry.

[42]An additional problem with capital expenditure estimates, which extends to equipment and materials estimates and other areas, is that complicated patterns of subsidization make it difficult to determine what the total necessary spending has actually been estimated to be. The expenditure estimates in the data are only sometimes reported pre-subsidy, and in many cases it is not possible to determine total spending from spending-less-subsidies. Labour requirements are unique, in that data is always provided regarding the number and type of bureaucrats required, and thus total salary requirement data is not contaminated by subsidies from other levels of government.

estimates directly. Thus, this paper simply uses the total "Standard Fiscal Need" numbers provided directly from the MIC.

Municipalities tax their residents, with "Standard Fiscal Revenue" calculated based on standard tax rates and a Ministry estimate of the actual municipal tax base.[43] The amount transferred to municipality m is equal to its Standard Fiscal Need less Standard Fiscal Revenue, with a non-negativity constraint (this is given by Equation 15 in the main text).

With almost half of pre-merger municipalities having a population less than 10,000, the decision to provide additional subsidies to smaller municipalities due to their size was an expensive one. To attempt to reduce this inefficiency, in the 1990s the government implemented three policies designed to promote mergers.

An approximation to the reduction is

$$T_m^{\text{new}} = \max(\tilde{c}_m^{\text{new}}(P_m) - .75\bar{\tau}Y_m, 0) \tag{43}$$

$$\tilde{c}_m^{\text{new}}(P_m) = (\gamma_0^{\text{new}} + \gamma_1 P_m^{\phi})\nu_m \tag{44}$$

as shown in Table 4, with γ_0^{new} being about 40% lower than γ_0.[44] The government documents describing $\tilde{c}_m^{\text{new}}$ make it obvious that this is not a re-estimate of costs required to provide services, but rather an arbitrary decrease in transfers to small municipalities: to compute a transfer based on $\tilde{c}_m^{\text{new}}$, a set of per capita ceilings are applied to the original components of $\tilde{c}_m$ and the result summed.

[43]Municipal taxes include "fixed asset" taxes (land, housing, and some business assets), a personal income tax, a poll tax, and various types of corporate taxes, with the first two of these being the most important. Municipalities are *de jure* allowed to change these tax rates, but the amount of actual variation is quite low. For example, in the extreme case of Yuubari City, effectively bankrupt with a debt of over ¥3 million per capita, the income tax rate was raised from 6.0% to 6.5%, but almost all other municipalities charge the standard 6.0%. Corporate tax rates do differ from municipality to municipality, but all are between the standard 12.3% and an upper bound of 14.7% due to Ministry regulations. The standard fixed asset rate of 1.4% is levied by about nine out of ten municipalities, with the remaining tenth mostly charging 1.5% or 1.6%. Any request to charge more than 1.7% requires Ministry approval, and no municipalities are charging in this range. Thus, *de facto* tax rates appear to be fairly uniform across municipalities.

[44]The sample in Table 4 is restricted to those municipalities that did not participate in a merger in order to have the same sample in both periods. Thus, the change in coefficients represents a change in national government transfer policy on the same group of municipalities during the period in question. Inflation during this period was negligible. The difference in the POPULATION coefficient is statistically insignificant, and the difference in ϕ and the AREA coefficient is marginally statistically significant (p roughly 0.05). The only economically significant change is in the intercept, indicating that the new policy effectively involved a lump sum reduction compared to the old policy.

	96-97	06-07
(Intercept)	6.05*	3.62*
	(0.23)	(0.23)
ϕ	0.89*	0.87*
	(0.01)	(0.01)
POPULATION$^{\phi}$	133.83*	133.30*
	(5.31)	(8.55)
AREA	3.45*	2.99*
	(0.19)	(0.24)
N	1129	1129

Table 4: Dependent variable is Standard Fiscal Need

A potential objection to this approach for estimating $\underline{q}$ is that this parameter, along with others discussed in Appendix D, should be estimated based on revealed preference using the mergers that were actually observed and the methodology that is developed and used later in the paper. While this approach might be more elegant, the dataset available is in absolute terms not that large: about 1150 municipalities chose to remain independent, and there were about 600 mergers. There is basically a single cross-section of discrete choice data, and the parameters that enter in different parts of the model exhibit substantial colinearity: for example, geographic distance to the generalized median voter is correlated with the population and surface area variables that enter in the cost of providing public services. For this reason, only the essential tradeoff between distance and efficiencies of scale is estimated using the revealed preference data.

Another feature of the system of public goods provision in Japan is that most public goods that generate substantial externalities appear to be provided by higher levels of government, rather than by municipalities. For example, waterways and major roads are the responsibility of prefectures. Obviously, there will still be some externalities from locally provided services: visitors driving to a home in the municipality will be driving on local roads, and the person who invited them may not internalize the benefit of higher quality local roads to their visitors. Similarly, it *might* be possible for residents of another municipality to enter a library in order to sit and read books, although this depends on how access is controlled.[45] Continuing

[45]One example of library access control is at the central Tsurumai library in Nagoya. A seat chit must specifically be requested, with high school students (and textbooks) banned from the above

in this vein, it would be theoretically possible, although illegal, to dump garbage at a collection point in another municipality. Schooling is an interesting case, because the elements of the elementary and middle schools that are under municipal control (physical plant, food service, school buses/boats, etc.) are precisely those that seem less likely to generate large externalities. Teachers are hired by the prefecture, and the curriculum determined by the national Ministry of Education. While it may not be plausible to claim that there are absolutely no externalities, it seems unlikely that externalities played a major role in municipal decision-making regarding potential mergers and they are thus not included in the model.[46]

A final restriction imposed by the model described in this section is that individuals do not move or otherwise change their ideal point and population is assumed to be constant. In reality, residence choice is endogenous to government characteristics, as discussed in the literature established by Tiebout [1956] and others. A more complicated model could be incorporated in order to reflect this endogeneity, but is not for three reasons. First, the majority of Japanese households own their own home: if all households have preferences similar those given in Equation 3, then (at least in some simple models) homeowners would vote over mergers so as to maximize land value and then choose a new location based on post-merger land prices and other municipal characteristics. The case where all households own their own home thus has similar implications but a much more complicated setup compared to the case where there is no mobility. Second, observed mobility is lower in Japan than in most other developed countries and a large portion of the inter-municipality moves reported in the census appear to be temporary. Endogenous relocation is thus less of a concern than in other countries. Third, there is no evidence of tax competition. The majority of municipalities charge a standard tax rate and even though municipalities are allowed to set a different rate (within a band), few choose to exercise this option. This is consistent with the model presented above, and combined with the national government transfer scheme results in the endogeneity problem being less severe than it would be in other contexts.[47]

ground air-conditioned floors.

[46]The earlier Showa municipal mergers in the 1960s were determined more centrally using prefectural committees. As those committees should have internalized externalities across municipal boundaries, an ongoing project comparing the Heisei and Showa mergers may be able to offer quantitative evidence of the importance of externalities in the determination of municipal boundaries.

[47]From an implementation perspective, endogeneity would result in future population and other characteristics of a municipal merger depending on what other mergers occurred in the surrounding

E Municipal Merger Law

The general rules for municipal mergers were the following:[48]

0. Mayors of municipalities can create "voluntary merger committees" and "study committees" to gather information, but there are no regulations regarding these committees, and they are not necessary in order to proceed with a merger.

1. A petition for a specified merger from 2% of eligible voters (or the municipal council) in any single municipality forces an official response from all the municipalities included in the proposed merger, based on a debate in their municipal councils. Unanimous "yes" responses result in the creation of an "official merger committee". There is no requirement regarding previous voluntary committees or study committees.

2. If a municipal council rejects the proposed merger committee, a petition from 1/6th of eligible voters in the relevant municipality forces a referendum on the creation of the merger committee. A majority vote in the referendum overrides the council's rejection.

3. The merger committee produces reports on the financial situation of the municipalities and proposes some characteristics of the merger (eg. the name of the merged municipality). A majority vote in each municipal council is required to finalize the merger.

The existence of an official referendum process during the planning stage but not at the final approval stage suggests that the best strategy for politicians opposed to a merger might have been to remain silent during the initial stage, but then prevent the final resolution from passing in council. Behaviour such as this did in fact occur in a small number of municipalities, but does not appear to have been particularly common or successful. First, the process of creating the merger committee generally

area. This would change the nature of the coalition formation game from a characteristic function game to a partition function game, which is substantially more computationally intensive to estimate, and likely infeasible without further theoretical or technological developments. Population dynamics are thus ignored, with the estimates that follow focusing on a single period game with player characteristics determined based on current government data sources. Exogenously changing population is also a concern, but similar results were obtained when 2005 census data is used instead of the 1995 data currently used. Predicted future municipal population could be created based on census data, but the similarity of results obtained with data from different census years suggests that this exercise may not produce particularly interesting results.

[48]This discussion ignores many details, such as the distinction between *hennyuu* municipalities, where bylaws are inherited from one of the merger participants (normally the largest city), and *shinsetsu* mergers, where bylaws and regulations are developed from scratch.

attracted a considerable amount of attention, particularly in smaller municipalities. In cases where there was controversy, referendum turnout rates could exceed 90%. It was thus difficult for politicians facing a potentially controversial merger to prevent a referendum regarding the creation of the merger committee, and conditional on that referendum passing it was difficult to then vote against the final proposed merger. Furthermore, in cases where politicians did vote against mergers that appeared to have popular support, a hitherto seldom used recall process was employed to remove them from office via a majority vote in a recall referendum. Whereas there was only one recall referendum during the 1990s, there were at least 41 during the merger period.

A formal interpretation of these rules is somewhat difficult; however, a common element in all mergers is that they were approved by all municipalities in question, either via local referendum, or in the municipal council.[49] As council resolutions were subject to veto by the mayor, this paper will assume that the binding constraint on the behaviour of a municipality is the ability of its residents to recall the mayor. Suppose that there is perfect information regarding what mergers are feasible (i.e. will be approved by all other participants). The mayor proposes a merger for the municipality to participate in, or proposes remaining independent. A single challenger then appears, and similarly proposes a policy. If the policies proposed are the same, the incumbent mayor remains in office; if the challenger's policy is preferred, then the mayor is replaced. Once again referring to Theorem 1, given the assumptions there the resulting policy will be socially optimal from the perspective of municipal residents.[50]

[49]In about a third of cases, referenda were held. Most of these were nominally consultative, but there is only one instance in which a municipal council voted opposite to a referendum result. This case was complicated due to multiple referenda with conflicting results as well as a number of of other procedural irregularities, and finally resulted in a recall of the mayor and a request to the prefectural governor to reverse the merger. The request for reversal was denied.

[50]The assumption here that mayors do not have a large effect on mergers might still seem suspicious. Kawaura [2010] investigates the effect of a mayors length of tenure on merger configurations, and finds effects that are small and not statistically significant at the 95% level. While there is certainly anecdotal evidence that certain mayors may have obstructed certain mergers, there is no immediately obvious relationship in the aggregate data. The private incentive for municipal politicians to maintain the independence of their municipality in order to preserve their own employment is not as strong as might be anticipated. This is due to central government policies: for example, the length of service required to receive a pension were reduced for politicians in a municipality participating in a merger, and following the merger period the pension system was abolished, with a (disadvantageous) one-time payment to those who did not meet the standard 12 year length of service requirement.

A potential objection here is that the costs of organizing a recall election could be large, and thus the mayor's incumbency advantage significant enough to allow merger proposals far from the optimal to be enacted.[51] There are two responses to this objection: first, the merger period was sufficiently long that at least one regularly scheduled election occurred during the merger period, and during this election the merger issue was particularly salient; second, the cost of organizing a recall does not appear to be as large as might be supposed. Specifically, in 4 of the 41 recalls, a majority voted against the recall in the referendum, and in another 6 of the recalls, the mayor was re-elected in the special election following the recall process (usually after resigning voluntarily to avoid the recall referendum). Thus, a full quarter of the organized recall referenda did not succeed in removing the mayor. If the costs of organizing a recall referendum were very high, one would expect that they would be organized only when the mayor would not have majority support in the recall referendum or the subsequent election. Thus, this paper will use the assumption that the municipal merger selected by each municipality was socially optimal for that municipality, given the other alternative mergers that were feasible.[52]

[51] A recall referendum required a petition by between 1/6th and 1/3rd of residents.
[52] A formal definition of "feasible" will be given in Section 1.