Inefficient Boundaries*

Masayoshi Hayashi† Masashi Nishikawa‡ Eric Weese§

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Abstract

The equilibrium size of political jurisdictions may be too small if there are efficiencies of scale in providing public services and mergers require majority approval from all the jurisdictions involved. In the case of Japanese municipalities, estimates of efficiences of scale are available in central government data. By applying a moment inequalities approach to survey data on stated merger preferences from a recent set of decentralized municipal mergers in Japan, we estimate that the inefficiency from the resulting "too small" jurisdictions is approximately $200 per capita per year.

Political boundaries are rarely decided by majority rule. This is particularly obvious at the national level: despite two thirds support for independence in a referendum, the Republic of South Ossetia is currently recognized by only four countries.[1] A similar lack of attention to local views is often displayed during realignments of subnational boundaries, although usually with less media attention. Alesina and Spolaore [1997] provide a theoretical explanation for this aversion to local democracy, using a parsimonious model to show that jurisdictions established via local referenda will be inefficiently small. In this model, a heterogenous population combined with a fixed cost of running a government leads to a tradeoff between disutility from uniform policy on the one hand, and efficiencies of scale on the other. Whether this theoretical result is economically significant in practice depends on the degree of preference heterogeneity of the population and what efficiencies of scale are actually present in the provision of public services. While the existence of efficiencies of

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†University of Tokyo.

‡Aoyama Gakuin University.

§Yale University. Corresponding author email: eric.weese@yale.edu.

[1]More specifically, the 2006 referendum saw 99% support for independence among voters, with about a third of population boycotting.

scale in providing public services seems intuitively plausible, it has been surprisingly difficult to find empirical support for this intuition, and the Alesina and Spolaore model has not been investigated empirically.[2] We use estimates of efficiencies of scale from the Japanese national government, combined with data on preferences regarding merger participation from roughly 300 municipalities to estimate the degree of inefficiency that actually results from a decentralized merger process.

The efficiencies of scale data used includes estimates for both public services provided by municipalities, as well as those provided by prefectures (roughly equivalent to US states). A majority of public services – both in terms of defined areas and total spending – appear to have been allocated between prefectures and municipalities on the basis of efficiencies of scale, with the prefecture providing services that could only be provided by municipalities at a much higher per capita cost. A well-established literature in public finance focuses on externalities, emphasizing the importance of matching the boundaries of political jurisdictions with the area actually affected by their policy decisions [Olson, 1969]. Although some services do appear to have been allocated to prefectures due to significant externalities (eg. network effects from highways), in general the data indicate that efficiencies of scale are more important than externalities in determining the level at which services are provided, at least at the sub-national level. Thus, the Alesina and Spolaore model, although designed with national borders in mind, seems well-suited to model changes in the boundaries of low level jurisdictions as well.

The paper is structured as follows. First, we modify the Alesina and Spolaore model to match the actual local government finance system in Japan. This system involves large transfers from the national treasury to local governments, and these payments required the national government to produce estimates of efficiencies of scale, which we describe in the the second section, along with the other data used. The third section lays out the empirical model, based on a standard discrete choice framework, and the results from the estimation of this model are presented in section four.

1 Theory

Suppose that municipality m is described by a set S_m of individuals that live within the jurisdiction, and that the government of m provides public goods at a level of quality q_m to its residents, and at the same time chooses a (costless) multi-dimensional policy x_m. For example, q_m could be the level of health care services provided at a public clinic, and x_m the geographic location of the clinic. All individuals $i \in S_m$ prefer higher quality, but differ

[2]For a survey of this lack of evidence, see Reiter and Weichenrieder [1997].

in their bliss point x_i^* for the policy. This bliss point is assumed to be fixed.[3] For empirical tractability, consider the following specific utility function:

$$u_i(q_m, x_m, \tau_m) = \beta_0 \log((1 - \tau_m)y_i) + \beta_1 \log(q_m - \underline{q}) + \beta_2 \ell_i(x_m)$$

where the first term is after-tax consumption based on income y_i, the second is government services (of better than $\underline{q}$ quality), and the third disutility from distance $\ell_i = ||x_m - x_i^*||$ from the individual's preferred policy.

In this paper we treat the policy as the geographic location from which public services will be provided.[4] The geography in question is two-dimensional, and there is thus a problem of how a municipality would decide its policy: the median voter theorem does not hold in a multi-dimensional policy space. There is no obvious model for how such a policy would be selected; however, if we make the assumptions that the policy is determined by a single candidate for office, such as a mayor, that the office is allocated via an election with two candidates, and vote probabilities are linear in utility difference between candidates, then a version of the median voter theorem does hold: the policy chosen will be the generalized median of the voters' ideal points Austen-Smith et al. [2005]. This paper is primarily concerned with inefficiencies arising out of interactions *between* jurisdictions, rather than inefficiencies due to the political process *within* a jurisdiction, and thus it is useful to have x_m is selected to maximize utilitarian social welfare. All the inefficiency present in the model will come from decisions over changes to the boundaries of jurisdictions.

Assume that it costs $c(P_m)q_m$ for local government m serving $P_m = |S_m|$ residents to provide quality q_m public goods, and the quality chosen must satisfy the budget constraint:

$$c(P_m)q_m = \tau_m P_m \bar{y}_m + T_m$$

where c is a cost function that exhibits returns to scale, $\bar{y}$ is average income, and T_m is transfer payments received by the local government from the national government. Because of the functional form chosen, the only important variation between individuals is in x_i^*, and

[3] If all individuals were homeowners, a similar model could be constructed where housing stock was fixed, with the distance between the location of a house and x_m entering into the market price for the house.

[4] We have not been able to locate any opinion surveys with a sample size great enough to provide information about the preferences of residents of individual municipalities. Thus, preferences will be measured exclusively by geographic location. While there are obvious problems with this, many of the services provided by municipalities involve a limited number of public facilities, such as schools or libraries. Anecdotal evidence suggests that the location of these services – and the prospect that some would only be available further from home than they were before – was a major concern of residents in municipalities considering mergers. Furthermore, in the absence of linguistic or ethnic cleavages, geographic distance seems to be a reasonable proxy for distance in preference space.

thus all individuals' preferred level of q is

$$q_m^* = \beta_1 \frac{Y_m + T_m - \underline{q}c(P_m)}{c(P_m)} + \underline{q},$$

if $\beta_0 + \beta_1 = 1$, and the optimal tax rate will then be

$$\tau_m^* = 1 - \beta_0 \frac{Y_m + T_m - \underline{q}c(P_m)}{Y_m}.$$

Let $U(S_m) = \sum_{i \in S_m} u_i(q^*(S_m), x^*(S_m), \tau(S_m))$ be the aggregate utility of all residents, given that optimal municipal policies have been selected, and that there is a fixed rule for transfers from the national government.[5] Now consider the set I of all individuals, who must be divided into municipalities in order to receive public services. Let $\pi = \{S_1, S_2, ...S_M\}$ be a partition of I, assigning each individual to one of M municipalities. Suppose that the social planner can choose both the number of municipalities M and the assignment of individuals to each municipality. Then the planner's problem is

$$\max_{\pi \in \Pi} \sum_{S_m \in \pi} U(S_m)$$

where Π is the set of all possible partitions. Given some arbitrary initial partition π_0, the utility gain of moving from π_0 to the socially optimal partition can be calculated. If the set of possible partitions were restricted in some way – for example, only allowing municipalities that were in π_0 or mergers of those municipalities – the utility gain in this case can also be calculated by a similar method.[6]

Now suppose that instead of the social planner choosing a partition, individual municipalities in π_0 are allowed to choose whether to merge with other municipalities, and which municipalities they will merge with. A very simple model for this would be a single-period non-cooperative game following Myerson [1991], where municipalities are the players. The outcome of such a game will be inefficient from a social perspective, because each municipality will not take into account the benefit it provides to other municipalities involved in

[5]Possible changes to the transfer rule are considered in Weese [2010]. In this paper we calculate the financial incentives for mergers created by a change in the rule at the beginning of the merger period, but do not consider any other potential changes.

[6]A problem here is that the transfer rule that determines T_m depends on the cost of funds to the national government and other such features not included in this model. With a fixed transfer rule, certain patterns of borders might be optimal not because those patterns are inherently beneficial, but rather because they are second-best optimal given a certain transfer policy. One possible way to deal with this issue would be to also calculate social welfare net of the redistributive properties of the intergovernmental transfer system, which would give some idea of the degree to which the transfer system might be biasing the results.

a merger via efficiencies of scale in the production of public goods. Intuitively, consider a municipality on the edge of a large merger: the residents in this municipality will be far away from the (geographic) policy chosen by the post-merger amalgamated municipality, but most of the benefits they are providing by participating (via efficiencies of scale) accrue to residents of the other municipalities that are participating in the merger. Thus, some municipalities will choose not to merge despite the fact that it would be socially optimal for them to do so.

The decentralized case will necessarily yield lower social welfare if the social planner is not facing any information problems when trying to implement the social optimum. However, if there is an unobservable "taste for merging" or other such variable that varies across municipalities, then it may be that the decentralized mergers are actually better than a centralized set of mergers from a social welfare perspective. This is equivalent to a classic problem of federalism: a centralized policy internalizes externalities but suffers from information problems, while a decentralized policy can take advantage of more detailed information available locally but not internalize externalities.[7] The estimates for inefficiency of the decentralized case, presented below, suggest that the central government must have been facing substantial information problems if it implemented decentralized mergers because they were more socially efficient that centralized mergers.

2 Data

The actual local government structure in place in Japan is reasonably similar to the model presented in the theory section. Several overviews of this system are available in English, most recently Mochida [2008]. A more detailed discussion is presented in Appendix A, drawing on official Ministry of Internal Affairs and Communications (MIC) sources as well as Ishihara [2000].[8] Two major types of data are used in this paper: data regarding municipal public finance, and data on the stated preferences of residents of various municipalities regarding whether their municipality should participate in a merger or not. Additional standard data, such as population, comes from the census bureau, which provides statistics both by municipality and also at a "grid square" on a national latitude-longitude grid.

[7]Municipalities would have an incentive to try to deceive any central government official who attempted to collect information on their taste for merging. Specifically, municipalitites that did not want to merge in the decentralized case would generally report an infinite distaste for merging in the centralized case. Thus, the central government would not be able to believe any information reported by municipalities regarding tastes if mergers were centralized.

[8]The most detailed formally published document is the annual *chihou koufuzei seido kaisetsu*, which in separate volumes covers the fiscal estimates for the reference municipality, adjustments to those estimates, and the law underlying the calculations.

2.1 Japanese Municipal Public Finance

Given the theoretical model, the items of particular interest are the national government transfer policy (which determines T), and the efficiencies of scale in the provision of local public goods. In the Japanese case, the "Local Allocation Tax" is calculated according to

$$T_m = \max(0, \tilde{c}_m(P_m) - 0.75\bar{\tau}P_m)$$

where $\bar{\tau}$ is a standard tax rate and $\tilde{c}$ a government estimate of the cost of providing a standard level of public services depending on the size of the municipality and other characterists.[9] "Standard Fiscal Revenue" (the last term in the above equation) is calculated deliberately low with the objective of leaving one quarter of local tax revenues with municipal governments. The policy that transfers will not become negative is rarely binding, with almost all municipalities receiving positive transfers under the system. Ignoring the non-negativity constraint, assuming that cost of providing services depends only on population and has been estimated correctly by the central government (that is, $c_m = \tilde{c} = c$), and with the further (non-trivial) assumption that $\underline{q} = 1$, we have that

$$\tau_m^* = 1 - \beta_0(1 - .75\bar{\tau})$$

If this is the case then $\tau_m^* = \bar{\tau}$ when $\beta_0 = \frac{1-\bar{\tau}}{1-.75\bar{\tau}}$, which is about 0.97 when $\bar{\tau} = 0.12$, the observed average tax rate.[10] We thus assume $\beta_0 = 0.97$, as remarkably little variation in taxes is observed among municipalities in Japan, with almost all charging $\tau = \bar{\tau}$.[11] Appendix A discusses the central government estimate of $\tilde{c}$ in detail, including why the assumption that $\tilde{c} = c$ is plausible.

Figure 1 shows that $\tilde{c}$ displays substantial returns to scale.[12] This, combined with the fact that national transfers are based on these estimated costs, creates a strong incentive for

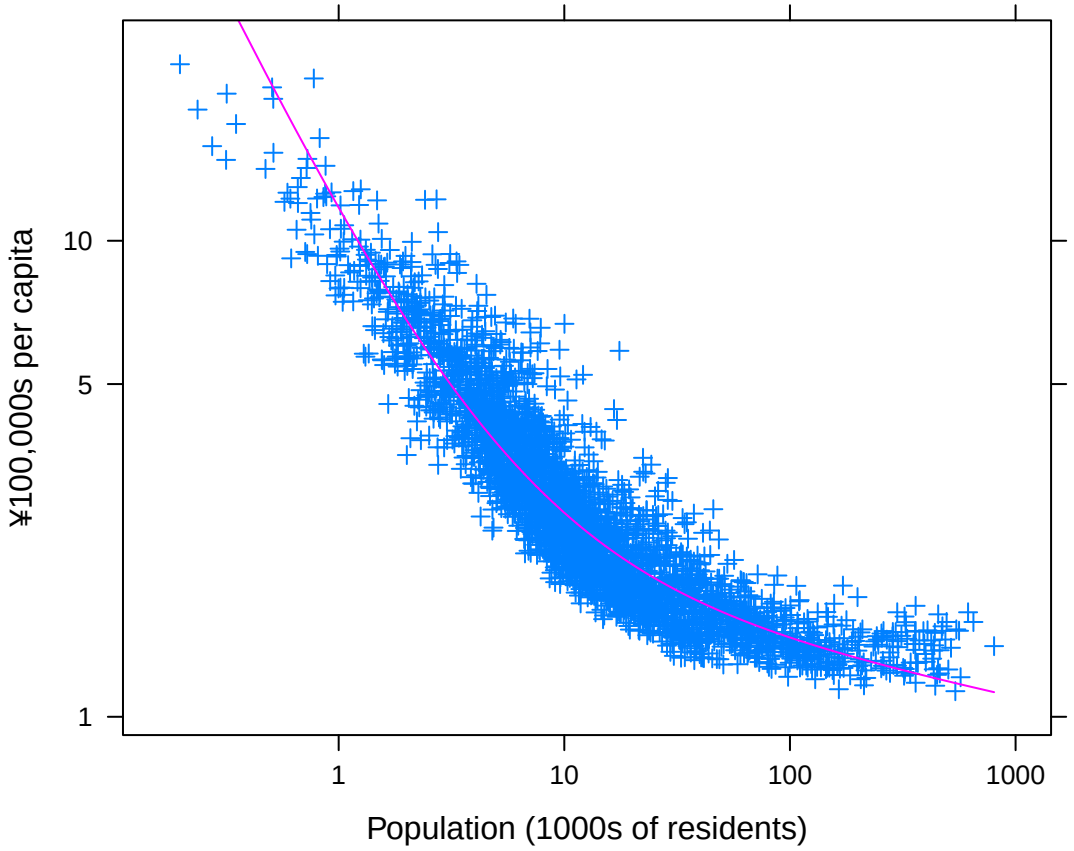
[9] T is referred to as the "Local Allocation Tax" because it is the *local allocation* of tax revenues initially collected by the central government.

[10] The standard municipal income tax rate is 6%, and thus half of municipal tax revenues come from other sources, such as property tax. We abstract away from this, and assume that all revenue comes from individual income tax.

[11] Recently municipalities have been allowed to vary income tax rates within a band; however, very few have chosen to do so. Another explanation for this would be political: although municipalities may *de jure* be allowed to charge a tax rate other than $\bar{\tau}$, *de facto* they are somehow prohibited from doing so. This would suggest that a more complicated model is needed, one that includes political elements at the national level. In the interests of simplicity, we assume instead that the tax rates charged are optimal.

[12] The fitted curve was estimated based on the functional form given in Appendix A. We believe that the underprediction at the right tail represents a problem with the data (additional responsibilities and thus additional funding are allocated to large cities) rather than a misspecified functional form.

Figure 1: Standard Fiscal Need



the national government to either encourage or force municipal mergers. During the 1990s, as a result of fiscal difficulties at the national level, such a merger promotion policy was promulgated in an attempt to reduce the total transfers provided to municipalities. Because $\tilde{c}$ displays considerable returns to scale, merged municipalities would receive considerably lower tranfers than the sum of the transfers to the pre-merger municipalities. To provide an incentive for municipalities to merge, municipalities that merged between 1999 and 2005 would not have their transfers lowered due to the merger for at least ten years starting from the date of the merger.[13] That is,

$$T_{\text{merger}} = \sum_{m \in \text{merger}} T_m$$

would be provided for the decade following the merger. .There was also a reduction in

[13]This incentive was phased out between 2005 and 2009, and with municipalities merging in that period receiving the benefit for less than ten years.

transfers that was effectively lump sum: under a new formula, all municipalities would receive approximately ¥300 million less than they had previously, regardless of whether they participated in a merger or not. This created a strong incentive for small municipalities to merge, as the cut in per capita terms was largest for those municipalities. There were further incentives for mergers in the form of heavily subsidized bonds that amalgamated municipalities were authorized to issue. The merger promotion policy thus consisted both of "carrot" and "stick" aspects, and resulted in considerable debate and controversy at the local level.

From 1999 to 2009, the number of municipalities was reduced from 3232 to 1821, entirely through voluntary mergers. Mergers were approved by city council, but a petition with a sufficient number of signatures could force council to consider a merger, and a recall petition with a large number of signatures could replace a mayor proposing a merger that was not favoured by the majority of the population. The mergers were thus substantially democratic, although the financial incentive structure was set by MIC bureaucrats. In many municipalities, some sort of survey or referendum was undertaken in order to gauge the opinion of residents regarding potential mergers. This is the other major data source that is used in this paper.

Although the precise form of the referendum or survey varies from case to case, in general referenda regarded the approval of a merger with a specific other municipality or set of municipalities, and offered a single "Yes" or "No" choice. Surveys frequently had two questions: the first was some variation on "should our municipality participate in a merger?" often with potential responses of "Yes", "Maybe Yes", "Maybe No", and "No"; the second question asked respondents to choose a most preferred merger parter from a set of potential partners. Currently, only survey data is used, but the empirical framework could accommodate referendum data.[14]

3 Empirical Model

The major issue with the data is that of the options actually available to the municipality in question: some municipalities that rejected one merger in a referendum went on to participate in a different merger, and some municipalities that wished to participate in a merger were rejected by their desired partners, and ended up participating in a different merger or not merging at all. In order to be able to analyze the data within a moment inequalities framework we make two assumptions regarding how individuals responded to the questions

[14]For example, those individuals voting for a merger in a referendum must prefer that merger to the possibility of remaining independent.

they were asked. Consider an individual i who is a resident of municipality m, and who is asked whether he thinks m should merge, and assuming that m does merge, whether it should merge so as to form new amalgamated municipality m', or m'', or m'''.

Our first assumption is that i's response regarding whether the municipality should participate in a merger is only considered so long as mergers within the stated list of possibilities (m', m'', and m''') are being considered. That is, if at some future point a merger to form m'''' is contemplated, we assume that the fact that a majority of residents responded "yes" to the question of whether m should merge is not taken as an endorsement of the m'''' merger, as it was not presented as a possibility when the survey was conducted. Furthermore, assume that the merger options presented on the survey are the "best possible" options: if m'''' is not on the survey, but appears later, this is because m'''' is not as good as the options on the survey, but because those have become unavailable for some reason less attractive options are being considered.

With these assumptions, if individual i has preferences

$$m \succ_i m', \qquad m \succ_i m'', \qquad m \succ_i m'''$$

then i will respond "no" to the question of whether m should merge. Conversely, if individual i has preferences

$$m' \succ_i m, \qquad m'' \succ_i m, \qquad m''' \succ_i m$$

then i will respond "yes" to the question of whether m should merge. If individual i has some other preferences, such as

$$m \succ_i m', \qquad m'' \succ_i m, \qquad m''' \succ_i m$$

then we do not make any claims regarding how individual i will respond. This is because although individual i would like municipality m to merge, there is the danger that a "yes" vote might lead to an m'' or m''' merger. For similar reasons, we do not analyze responses to the question regarding which merger out of $\{m', m'', m'''\}$ should be pursued, as there are significant strategic voting issues in this sort of "multi-candidate election".

From the theory section, we have that

$$u_i(q_m, x_m, \tau_m) = \beta_0 \log((1-\tau_m)y_i) + \beta_1 \log(q_m - \underline{q}) + \beta_2 \ell_i(x_m)$$

with $\beta_0 + \beta_1 = 1$. Based on observed tax rates we calibrated $\beta_0 = 0.97$, and thus $\beta_1 = 0.03$. The only parameter that needs estimating, then, is β_2, the (dis)utility of distance. Rewrite

the above as

$$u_i(m) = \alpha_i + v(m) + \beta_2 \ell_i(m)$$

since q_m, x_m, and τ_m will be set to optimal values by municipality m. Now supposing that there is an unobserved variable that determines how attractive it would be to participate in any merger, we will have that $m' \succ_i m$ if

$$v(m') + \beta_2 \ell_i(m') > v(m) + \beta_2 \ell_i(m) + \epsilon_m$$

where ϵ_m varies across municipalities, but not across proposed mergers or individuals, and we assume that $E[\epsilon] = 0$. Within a municipality, even though ϵ is the same for all individuals, some may respond "yes" while others respond "no" to the question of whether the municipality should participate in a merger because some individuals might be closer to the center of the post-merger amalgamated municipality, while others might be very much on the edge. The survey response data is available only at the municipality level, but we have census grid square data for population on a square kilometer basis.

Consider the set of municipalities $\{m_1, m_2, ...\}$ within which surveys have been conducted. Let $\{Y_1, Y_2, ...\}$ be the fraction of people in these municipalities who responded "yes" to the merger question, and $\{N_1, N_2, ...\}$ the fraction who responded "no". In most cases, $Y_m + N_m < 1$ because some individuals who took the survey either responded "don't know" to the question or (much less frequently) chose not to respond to the question at all. Using the Pakes [2010] framework, our identified set for β_2 are those values of β_2 such that there exist ϵ_{m_1}, ϵ_{m_2}, etc. where the mean of the ϵ is zero and for each municipality m

$$N_m \geq \int_m 1[m \succ_i m', \forall \text{ proposed mergers } m'] di$$

$$Y_m \geq \int_m 1[m' \succ_i m, \forall \text{ proposed mergers } m'] di.$$

This approach leaves a significant amount of leeway in how individuals are allowed to respond to the survey. In many cases, although several potential mergers are offered as possibilities on the survey, the vast majority of respondents identify the same merger as their preferred option. In these cases, if a majority of residents are in favour of a merger, the issue then becomes whether the partner municipalities in that amalgamation are interested in participating. If the surveyed municipality we are considering is relatively rich, then the other participants in that merger might be more likely to be in favour of participating in the merger. Thus, it is possible that for poorer municipalities, who might have their residents' third or fourth choice merger, the second inequality is more likely to be binding; conversely,

for richer municipalities, who are more likely to be able to participate in any merger they wish to, the first inequality is more likely to be binding (people only respond "no" if they don't like any of the options). Thus, creating additional moment inequalities by subdividing the data may allow for a smaller identified set. On the other hand, Ponomareva and Tamer warn of the dangers of erroneous point identification, and it would be relatively easy to divide the data so finely that no value of β_2 satisfied all the inequalities. Using the leave-one-out cross-validation exercise described by Menzel [2010], we conclude that our data should be divided into four based on per capita tax base, giving a total of eight moment inequalities.

4 Results

Given the above approach, the identified set for β_2 is

$$\beta_2 \in [0.808, 1.062]$$

if distance is measured in thousands of kilometers. The Rosen [2008] 95% confidence set is

$$\beta_2 \in [0.807, 1.064]$$

perhaps because of the relatively large sample size (340). 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 ¥1000 per year.[15] This appears to be a bit low, once the importance of having schools and other local facilities within walking distance is considered, but a simple alternative OLS specification presented later will yield similar results.

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

$$\beta_0 \log(\frac{y_m P_m - c(P_m)}{y_m P_m}) + \beta_1 \log(\frac{y_m P_m - c(P_m)}{c(P_m)}) + 0.377\beta_2\sqrt{P_m/340}, \tag{1}$$

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 between 225,000 and 325,000, depending on where β_2 is in the identified set. This suggests roughly 500

[15] 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.

municipalities for all of Japan, which is less than one third of the current number.[16] Using actual population distribution, and actual municipal boundaries (to force new boundaries to be mergers of existing municipalities), the Hajiaghayi et al. [2003] approximation algorithm can be used to compute the optimal arrangement of municipal mergers. We find that the difference in welfare is equivalent to $200 per capita per year, although this is a preliminary result estimated using a very small number of prefectures.[17] For comparison, the efficiency gain from decentralized mergers, relative to no mergers, is approximately $500 per capita per year.[18]

4.1 OLS results

Rather than running a relatively complicated moment inequality analysis, suppose that we used the Austen-Smith et al. [2005] framework to analyze the stated preferences on the survey. In particular, suppose that all individuals compared the most popular merger option with the possibility of not merging, and their probability of stating a "yes"/"no" opinion (vs. "don't know" or item non-response) was linear in the utility difference between the merger and not merging. This approach would also allow the estimation of β_2.

Running OLS gives an estimate of $\hat{\beta}_2 = 0.993$ (s.e. .265), but as the partial correlation in Figure 5 shows, this may be due to an outlier (a very small very wealthy municipality whose residents were overwhelmingly opposed to merging). Figure 5 shows deliberately censored data, where all data has been top and bottom coded at [-0.01, 0.05], and change in distance (figure not shown) topcoded at 20km. Running OLS on this censored data results in an estimate of $\hat{\beta}_2 = 1.687$ (s.e. .612), which does suggest that the outliers have a substantial effect on the regression results. Using this modified estimate for β_2, the optimal number of municipalities becomes about 1000, which is still less than the outcome of the decentralized merger process, but not as dramatic as the 500 municipality result obtained previously. Further analysis of the data is thus required to determine how robust the results are to a small number of influential data points.

[16] A previous version of this paper produced the same quantitative estimate using a mixed multinomial logit framework [McFadden and Train, 2000] and the data regarding preferences across potential mergers.

[17] This result is from a previous version of the paper, but will likely remain similar because the estimate for β_2 has not changed.

[18] This result is also from a previous version of the paper, and may increase substantially due to the change from a quasilinear to a Cobb-Douglas utility function.

5 Conclusion

Relying on majority rule decision making to adjust political boundaries results in substantial inefficiencies due to jurisdictions being "too small" relative to the optimal size. Although this effect was shown theoretically by Alesina and Spolaore, it has not previously been examined empirically, and the size of the inefficiency is not easy to determine from the theoretical work in this area. In this paper, we show that there are substantial inefficiencies in relying on majority rule to adjust boundaries. One possible reason why such a mechanism may have been employed notwithstanding these issues would be information problems: municipalities are aware of their idiosyncratic taste for merging, but the central government is not, and is unable to convince municipalities to provide this information.

Figure 2:

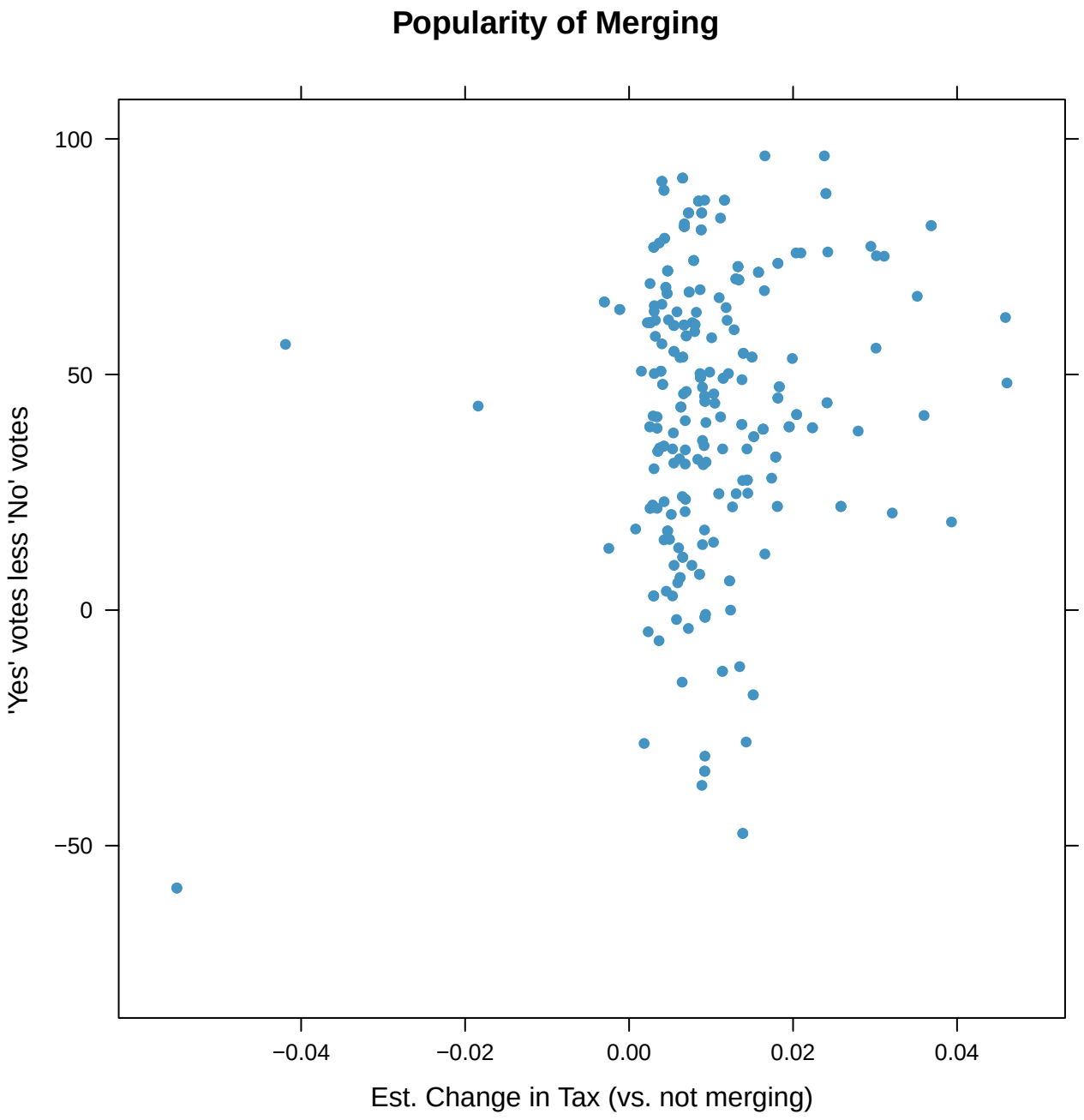
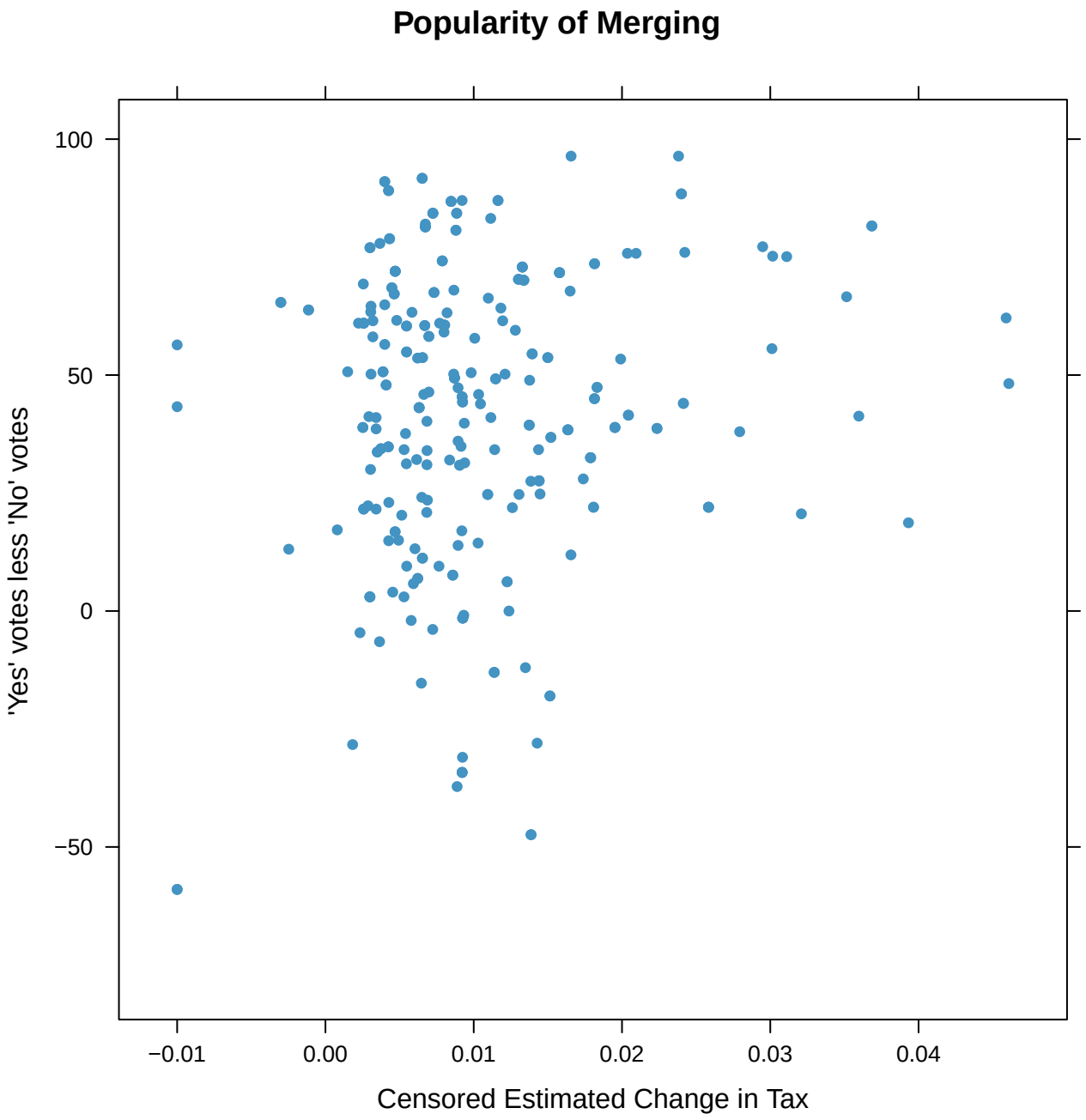

Popularity of Merging
'Yes' votes less 'No' votes
100
50
0
−50
−0.04
−0.02
0.00
0.02
0.04
Est. Change in Tax (vs. not merging)

Figure 3:


Popularity of Merging
'Yes' votes less 'No' votes
100
50
0
−50
−0.01
0.00
0.01
0.02
0.03
0.04
Censored Estimated Change in Tax

References

A. Alesina and E. Spolaore. On the number and size of nations. *The Quarterly Journal of Economics*, 112(4):1027–1056, Nov. 1997. ISSN 00335533. doi: 10.1162/003355300555411. URL http://www.jstor.org/stable/2951265.

D. Austen-Smith, J. Duggan, J. Banks, and J. Duggan. Probabilistic voting in the spatial model of elections: The theory of office-motivated candidates. In *Social Choice and Strategic Decisions*, Studies in Choice and Welfare, pages 15–56. Springer Berlin Heidelberg, 2005. ISBN 978-3-540-27295-3. URL http://dx.doi.org/10.1007/3-540-27295-X_2.

A. DeWit. Dry rot: The corruption of general subsidies in japan. *Journal of the Asia Pacific Economy*, 7(3):355–378, Oct. 2002. ISSN 13547860. doi: 10.1080/1354786022000007889. URL http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=7452568&site=ehost-live.

M. T. Hajiaghayi, M. Mahdian, and V. S. Mirrokni. The facility location problem with general cost functions. *Networks*, 42(1):42–47, 2003. ISSN 0028-3045. doi: 10.1002/net.10080. URL http://doi.wiley.com/10.1002/net.10080.

N. Ishihara. *Shin chihō zaisei chōsei seidoron*. Gyōsei, Tōkyō, shohan. edition, 2000.

D. McFadden and K. Train. Mixed MNL models for discrete response. *Journal of Applied Econometrics*, 15(5):447–470, 2000. URL http://ideas.repec.org/a/jae/japmet/v15y2000i5p447-470.html.

K. Menzel. Consistent estimation with many moment inequalities. Technical report, 2010.

N. Mochida. *Fiscal Decentralization and Local Public Finance in Japan*. Number 107 in Routledge frontiers of political economy. Routledge, London, 2008. ISBN 9780415437462.

M. Olson. The principle of "Fiscal equivalence": The division of responsibilities among different levels of government. *The American Economic Review*, 59(2):479–487, May 1969. ISSN 00028282. URL http://www.jstor.org/stable/1823700.

A. Pakes. Alternative models for moment inequalities. *Econometrica*, 78(6):1783–1822, 2010. ISSN 1468-0262. URL http://dx.doi.org/10.3982/ECTA7944.

M. Ponomareva and E. Tamer. Misspecification in moment inequality models: Back to moment equalities? *Econometrics Journal*. forthcoming.

M. Reiter and A. Weichenrieder. Are public goods public? a critical survey of the demand estimates for local public services. *FinanzArchiv: Public Finance Analysis*, 54(3):374–408, 1997.

A. M. Rosen. Confidence sets for partially identified parameters that satisfy a finite number of moment inequalities. *Journal of Econometrics*, 146(1):107–117, Sept. 2008. ISSN 0304-4076. doi: 10.1016/j.jeconom.2008.08.001. URL http://www.sciencedirect.com/science/article/B6VC0-4T5TPS2-1/2/d94e499b22c7c0088978b9d911238699.

E. Weese. Political mergers as coalition formation: an analysis of japanese municipal amalgamations. Technical report, 2010.

A Estimates of Efficiencies of Scale

Municipalities are responsible for providing public services in six major categories: firefighting, public works, education, welfare, industry, and administration. With the exception of firefighting, these categories also describe prefectural responsibilities, and thus each of these categories are divided into sub-categories.[19] 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.[20] 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. 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. Municipalities tax their residents, with "Standard Fiscal Revenue" calculated based on standard tax rates and a Ministry estimate of the actual municipal tax base.[21] [22] The amount transfered to municipality m is then

[19] 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.

[20] 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.

[21] 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.

[22] "Standard" appears to be used as a translation for both *kijun* and *hyoujun*. The "true", and generally accurate, estimate of local tax revenues could be called the *hyoujun* Fiscal Revenue, but is referred to by a

given by the formula

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 muncipalities would require to provide the same level of service is then estimated.[23] 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, 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 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.[24] 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"

variety of names in the Japanese literature. This estimate is multiplied by 0.75 to produce the *kijun* Fiscal Revenue, which is then used in the above formula.

[23]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 4000, 8000, 12000, 20000, and 30000 for municipalities below the reference size, and at 250000, 400000, 1000000, and 2000000 for municipalities above the reference size.

[24]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.

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.[25] 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; this paper will instrument these with non-capital expenditure estimates, in particular total salary requirements.[26] Efficiencies of scale in capital expenditures roughly follow efficiencies of scale in other expenditures, and there is effectively no difference between using this IV approach and estimation using capital expenditure estimates directily.

Applying the model described in the theory section above to actual data presents a number of challenges. In particular, municipalities provide a number of types of public services rather than just one, and preference heterogeneity of individuals is unobservable. Regarding the first of these, we consider the following functional form for c:

$$c^{\text{per}}(P_m) = \alpha + \beta P_m^{\gamma}$$

and estimate α, β, and γ via least squares in logs:

$$log(c^{\text{per}}(P_m)) = log(\alpha + \beta P_m^{\gamma}) + \epsilon_m$$

where $c^{\text{per}}(P_m)$ is required personnel expenditures taken from Ministry estimates, and P_m from the census bureau. Table 2 gives the estimates for salary requirements by category of public good, with the first column allowing γ to vary across goods, the second column assuming that γ is the same for all goods, and the third column eliminating the parameter entirely by assuming $\gamma = 1$. Figures 1 through 3 show that the assumption that $\gamma = 1$ does

[25]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 a small number of municipalities this effect is substantial, and both policies originated within the Ministry.

[26]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.

not appear to fit the data very well, although the assumption that all categories of services have the same γ appears more reasonable. If γ is the same across services, then the total cost of providing all services can be obtained by summing the estimated α and β coefficients accross all categories, yielding a $\hat{\alpha}$ of about \$1.7 million and $\hat{\beta}$ of about \$2200. γ is estimated to be 0.84.

There is also some evidence that true efficiencies of scale that differed substantially from the official estimates would be inconsistent with observed land price, migration, and observed merger patters, but this analysis has not yet been performed.

A major concern regarding the validity of the estimates presented is that they are themselves based off of estimates by the Japanese national government regarding efficiencies of scale. Even though, as previously described, there does not appear to have been political interference with the particular estimates used, they may still be inaccurate for any number of other reasons. Given other observed outcomes, however, it is implausible that efficiencies of scale were radically different than those reported.

First, suppose that efficiencies of scale were much higher than were actually reported. In this case, the level of public services provided by small municipalities would always have been lower than the level provided by larger municipalities, despite the central government's attempt at equalization. As small municipalities became even smaller due to population shifts, they would have encountered progressively stronger incentives to merge. However, despite an increasing number of very small municipalities between 1965 and 1995, there is very little trend in the number of mergers during that period, and most mergers that did occur did not involve extremely small municipalities. That is to say, the same municipalities that demonstrated a significant response to only moderate government incentives during the *Heisei* mergers would have no response to large incentives during the preceding three decades. It thus seems implausible that efficiencies of scale are higher than reported in the government estimates.

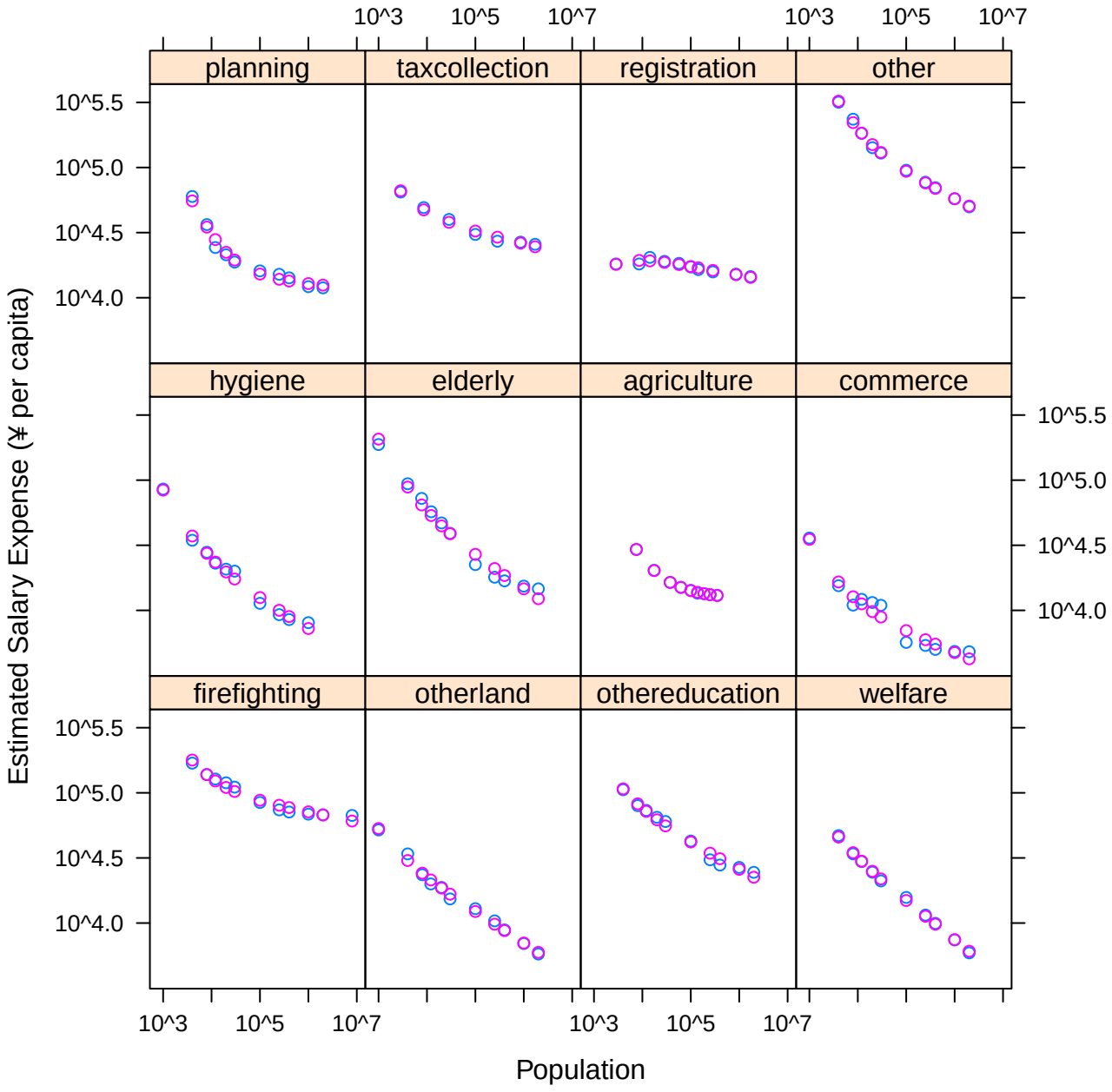
The more interesting case is that where the true efficiencies of scale are lower than what is estimated by the government. In this case, small municipalities have traditionally been able to offer higher levels of service that large municipalities, since they have been over compensated for their small size.[27] This additional service, however, must not have much value, since land values changed barely at all even though funding, and thus service level, dropped considerably around 2003.

Matching land assessments across borders between very small (< 2000 resident) municipalities and larger (> 4000 resident) municipalities suggests that there was little if any

[27]Ignoring temporarily the effect of differences in tax base combined with the 25% of tax revenues retained by the municipality.

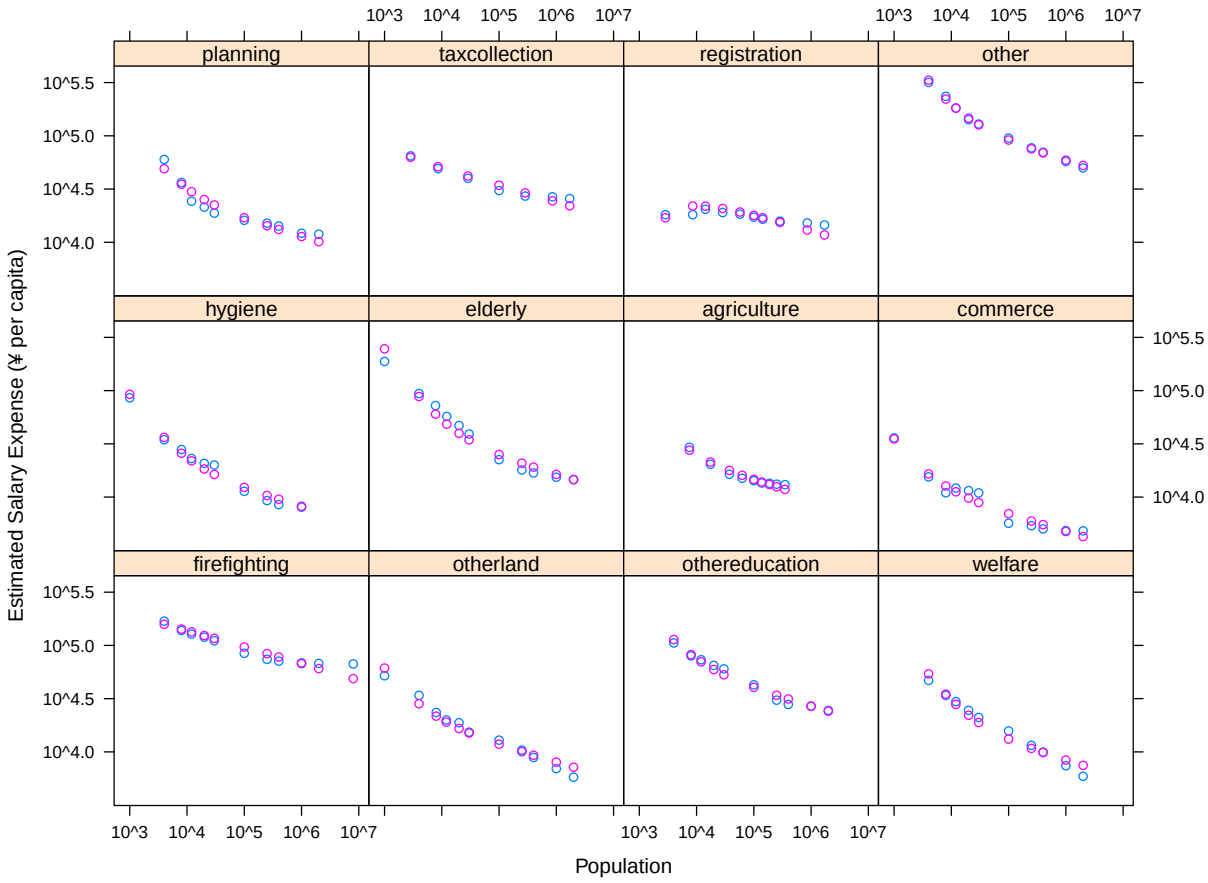
relative change in land value during the 2003-2009 period, despite the fact that relative subsidies changed dramatically. Residential land prices declined 13% overall, so if we assume that this is entirely due to the change in transfers (likely not true), and ignore the fact that larger municipality's had their land prices decline by more, then we get a per family decrease in land price of $3000, which is tiny compared to the present value of the subsidy being received. At $r = .05$, this present value implies a flow of only $150 per year, or $300,000 for a municipality with 2000 residential lots. This suggests that the cut in government subsidies did not particularly affect resident welfare. Despite this, the vast majority of municipality's chose to merge. Land value did not appear to decrease more in these merging municipalities relative to non-merging ones, thus implying that the value residents placed on having this municipality (relative to it being merged into one of its neighbours) was not high.

Figure 4: Gamma variable



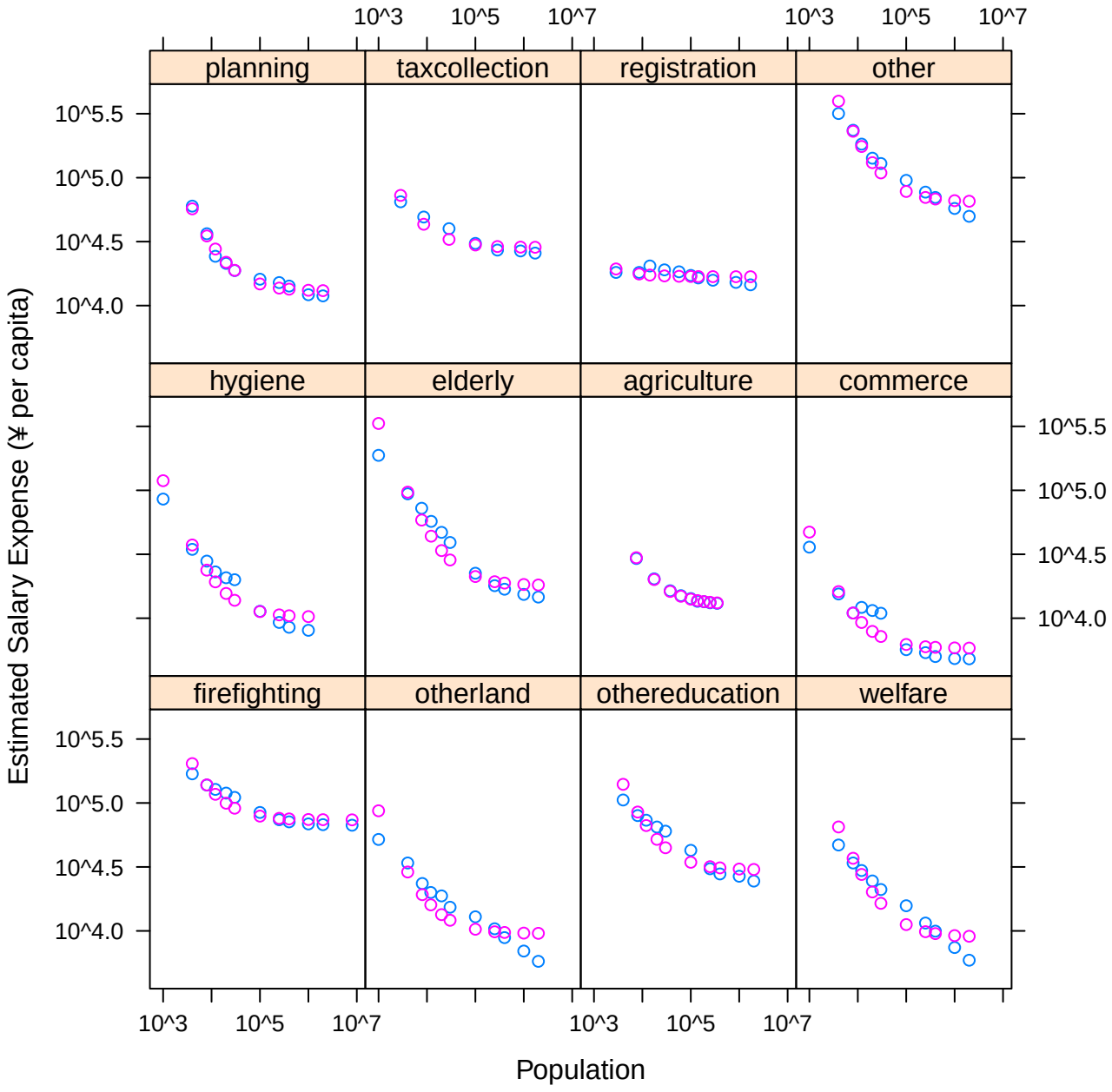
(Ministry estimates are in cyan, fitted values from model in magenta)

Figure 5: Gamma fixed



(Ministry estimates are in cyan, fitted values from model in magenta)

Figure 6: Gamma=1



(Ministry estimates are in cyan, fitted values from model in magenta)

Table 1: Estimated efficiencies of scale of various services

	γ varies	γ fixed	$\gamma = 1$
α.firefighting	0.28*	−0.01	0.52*
	(0.08)	(0.08)	(0.13)
α.otherland	0.02*	0.04*	0.08*
	(0.01)	(0.01)	(0.01)
α.othereducation	0.12	0.20*	0.44*
	(0.06)	(0.05)	(0.08)
α.welfare	0.03	0.14*	0.22*
	(0.03)	(0.02)	(0.03)
α.hygiene	0.05*	0.07*	0.11*
	(0.01)	(0.01)	(0.02)
α.elderly	0.13*	0.20*	0.32*
	(0.02)	(0.02)	(0.04)
α.agriculture	0.12*	0.05	0.13*
	(0.03)	(0.03)	(0.04)
α.commerce	0.02*	0.02*	0.04*
	(0.00)	(0.00)	(0.01)
α.planning	0.16*	0.09*	0.18*
	(0.02)	(0.02)	(0.03)
α.taxcollection	0.06*	0.01	0.13*
	(0.03)	(0.02)	(0.04)
α.registration	−0.01	−0.04*	0.01
	(0.01)	(0.01)	(0.01)
α.other	0.67*	0.78*	1.33*
	(0.16)	(0.13)	(0.22)
β.firefighting	0.21*	0.58*	0.07*
	(0.05)	(0.03)	(0.01)
β.otherland	0.19*	0.07*	0.01*
	(0.04)	(0.00)	(0.00)
β.othereducation	0.40*	0.23*	0.03*
	(0.14)	(0.01)	(0.00)
β.welfare	0.42*	0.07*	0.01*
	(0.16)	(0.00)	(0.00)
β.hygiene	0.16*	0.07*	0.01*
	(0.05)	(0.00)	(0.00)
β.elderly	0.44*	0.14*	0.02*
	(0.12)	(0.01)	(0.00)
β.agriculture	0.02	0.09*	0.01*
	(0.01)	(0.00)	(0.00)
β.commerce	0.04*	0.04*	0.01*
	(0.01)	(0.00)	(0.00)
β.planning	0.02*	0.10*	0.01*
	(0.01)	(0.01)	(0.00)
β.taxcollection	0.09*	0.21*	0.03*
	(0.03)	(0.01)	(0.00)
β.registration	0.04*	0.11*	0.02*
	(0.01)	(0.00)	(0.00)
β.other	0.71*	0.50*	0.06*
	(0.28)	(0.03)	(0.01)
N	120	120	120