Political Mergers as Coalition Formation
Evidence from the *Heisei* Municipal Amalgamations

Eric Weese

Hitotsubashi University

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Political Coalition Formation

- Lots of work in this area (e.g. Alesina & Spolaore 1997)

- The coalitions that form affect observed outcomes:
  - redistribution
  - program implementation
  - ...

- Underlying structure determines which coalitions form

- Sometimes this structure can be changed

- ...but empirical work here is limited
  - Gordon, Knight [2006]
  - Brasington [2003]
  - Diermeier, Eraslan, Merlo [2003]
Examine *Heisei* municipal mergers (1996-2006):

1. Why did the observed mergers occur and not others?

2. Did the “right” mergers occur?

3. How would changes to the underlying structure affect the mergers observed?

Estimate a structural model of the municipal merger process and simulate counterfactual policies to answer these questions.
Plan

1. Basic model of preferences over coalitions
2. Special characteristics of Japanese case
3. Estimation strategy
4. Estimates
5. Counterfactual government policies
6. Conclusion
1. Preferences over Coalitions

- Municipalities provide public goods to residents

- Cost of quality $g$ goods is $c(g, \text{POP})$, subadditive in POP

- ...but there is a policy benefit to having small populations:
  - not modeled here explicitly

- Tradeoff implies some optimal population
1. Preferences over Coalitions

- Revenue is from taxes (rate $\tau$) on tax base $Y$ and transfers $T$ from national government:

$$c_S(g_S) = \tau Y_S + r \int_0^\infty e^{-rt} T_{st} dt$$

$\tau$ is fixed at $\bar{\tau}$ by national government

- Each coalition $S$ is a set of municipalities that will merge
  - Municipality $i$ gets utility $u_i(g_S, POP_S, X_S)$ from coalition $S$
  - The “singleton coalition” $S = \{i\}$ is one possibility

- Unanimity required, transfers not possible (due to credibility problems)
1. Transferable Utility vs. Non-Transferable Utility

Outcomes

Let $N = \{1, 2\}$, and $u_i$ be a utility function describing the preferences of player $i$ over coalitions, with

$$u_1(\{1, 2\}) = u_1(\{1\}) + \epsilon_1$$
$$u_2(\{1, 2\}) = u_2(\{2\}) + \epsilon_2$$

Consider $\epsilon_1 > 0$, $\epsilon_2 < 0$, $|\epsilon_1| > |\epsilon_2|$

In TU case stable coalition structure is $\{\{1, 2\}\}$

In NTU case stable coalition structure is $\{\{1\}, \{2\}\}$
2. Japanese National Government Policy

- Historically, transfers $T$ were calculated to equalize quality:

\[
T_i = \tilde{c}(\bar{g}, \text{POP}_i) - 0.75\bar{Y}_i \\
T_S = \tilde{c}(\bar{g}, \text{POP}_S) - 0.75\bar{Y}_S
\]

- During merger period there were at least two policy changes:
  1. Transfers made less generous (model as reduction by $\Delta_c$):

\[
T_{i}^{\text{new}} = \tilde{c}(\bar{g}, \text{POP}_i) - \Delta_c - 0.75\bar{Y}_i
\]

  2. Transfers were not immediately recalculated for mergers:

\[
T_{S}^{\text{new}} = \sum_{i \in S} T_{i}^{\text{new}}
\]

...but recalculation would rather occur after 10 years.
2. Cost of Public Goods

OLS approximation to $c(g, \text{POP})$ fits well:

$$\hat{c}_i(\bar{g}, \text{POP}_i) = \bar{g} \cdot (\beta_0 + \beta_1 \text{POP}_i) + \epsilon_i$$

Assumption:

$$c \simeq \hat{c}$$
"Standard Financial Need" of Japanese Municipalities
('96–'97 fiscal year)

Population (1000s of residents)

(¥100,000,000s ≈ $1,000,000s)
"Standard Financial Need"
(Per capita, log scale)

Population (1000s of residents)

\[ ci \approx P_i \text{ (¥100,000s \approx$1000s per capita)} \]
3. Baseline Estimation Strategy

- Prefecture as unit of observation \((N = 47)\)

- Assume functional form is additively separable in characteristics of coalitions

- Assume error structure is either \(\epsilon_S\) or \(\epsilon_{iS}\)

- Partition \(\pi_0\) is a stable coalition structure if

\[
\forall S' \notin \pi_0, \quad \exists i \in S' \text{ such that } \pi_0 \succ_i S'
\]

- Suppose partition \(\pi_0k\) observed in prefecture \(k\).

- If the set of all \(S'\) is known for each \(k\), then can maximize

\[
\sum_k \log L(\pi_0k \text{ stable } | \theta)
\]
4. Estimation - Simulated Maximum Likelihood

\( V \) is set of all blocking coalitions

\[ \Pi^* = \{ \pi | \forall S' \in V, \exists i \in S' \text{ s.t. } u_i(\pi) > u_i(S')|\theta) \} \]

Restricted preferences:

\[ L(\pi_0|\theta) = P(\pi_0 \in \Pi^*|\theta) \]

(\( \Pi^* \) is guaranteed to contain only a single coalition structure)

Relaxed stability requirements:

\[ L(\pi_0|\theta) \simeq \frac{P(\pi_0 \in \Pi^*|\theta)}{E(\#\Pi^*|\theta, \pi_0 \in \Pi^*)} \]

(\( \Pi^* \) may contain many coalition structures)
4. Estimation - Simulated Maximum Likelihood - Results

**Table 1:** Dependent variable is $u_i(S)$

<table>
<thead>
<tr>
<th></th>
<th>restricted preferences</th>
<th>relaxed stability requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\log(g_s)$</td>
<td>1.00 (0.05)</td>
<td>1.00 (0.001)</td>
</tr>
<tr>
<td>$\log(POPULATION_S)$</td>
<td>-0.17 (0.01)</td>
<td>-0.14 (0.0004)</td>
</tr>
<tr>
<td>$\log(AREA_S)$</td>
<td>-0.26 (0.01)</td>
<td>0.03 (0.0004)</td>
</tr>
<tr>
<td>$\log(INCOME_S)$</td>
<td>0.66 (0.03)</td>
<td>1.61 (0.001)</td>
</tr>
<tr>
<td>IS.MERGER$_S$</td>
<td>0.03 (0.01)</td>
<td>-0.01 (0.001)</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.35</td>
<td>0.05</td>
</tr>
</tbody>
</table>
5. Counterfactual National Policy - Theory

Let $N = \{1, 2\}$, and $u_i$ be a utility function describing the preferences of player $i$ over coalitions, with

\[
\begin{align*}
    u_1(\{1, 2\}) &= u_1(\{1\}) + \epsilon_1 \\
    u_2(\{1, 2\}) &= u_2(\{2\}) + \epsilon_2
\end{align*}
\]

Consider $\epsilon_1 > 0$, $\epsilon_2 < 0$, $|\epsilon_1| > |\epsilon_2|$

In NTU case stable coalition structure is $\{\{1\}, \{2\}\}$

Ex ante both players would be in favour of a social planner offering an incentive for coalition formation. Provided incentives should be proportional to externality
5. Counterfactual National Policy

- Using which set of assumptions?
- What exact policy?
- Conditional on $\pi_0$ being stable or unconditional?
Suppose that residents of a relatively rich municipality received a significant transfer, conditional on merging.

1. Assume that $\theta = \hat{\theta}$.
2. Draw $\epsilon$ via Gibbs sampling such that $\pi_0$ is the stable partition.
3. Given $\epsilon$, calculate the stable partition under the new policy.
Effect of Alternative Policy by Quantile (Population Weighted)

Utility quantile

Difference in utility at quantile (alternative − actual)

0.0
0.2
0.4
0.6
0.8

0
20
40
60
80
100

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Effect of Alternative Policy by Quantile (Population Weighted)
Change in utility under alternative policy

$u_{\text{new}} - u_{\text{original}}$

-0.04
-0.02
0.00
0.02
0.04

100 150 200
6. Conclusions

- SML estimates using coalition formation model give plausible signs and magnitudes

- Counterfactual estimates support incentive scheme suggested by theory

- Depending on degree of inequality aversion, government may not want to allow decentralized transfer negotiations
  - Further work: tax on negotiated transfers may be most efficient
5. Counterfactual - Transferable Utility

Relaxed Stability Requirements Approach

Assume that transfers will be small relative to total income. Then for municipalities $i, j$ the “transfer rate” would be

$$\lambda_{ij} = \frac{\text{POP}_j}{\text{POP}_i} \cdot \frac{\partial u_i}{\partial y_i} \cdot \frac{\partial u_j}{\partial y_j}$$

and

$$\lambda_{ij} = \frac{\lambda_i}{\lambda_j}$$

with

$$\lambda_i = \frac{\partial u_i}{\partial y_i} \cdot \frac{\text{POP}_i}{\text{POP}_i}$$

then define $\tilde{u}_i$ as a rescaling of $u_i$:

$$\tilde{u}_i = \frac{1}{\lambda_i} u_i$$

Then the $\tilde{u}$ create a transferable utility game that is a local approximation to the more complicated transfer rates on $u$.
5. Counterfactual - Transferable Utility - Bargaining (I)

Relaxed Stability Requirements Approach

\( V(S) = \sum_{i \in S} \tilde{u}(S) \) is the “value” for coalition \( S \)

\( \forall S \in \pi \in \Pi^*, \exists x \) such that

1. \( \sum_{i \in S} x_i = V(S) \)
2. \( \sum_{i \in S'} x_i \geq V(S') \quad \forall S' \subset S \)

\( \quad \) In general, many such \( x \) exist. Which is selected?
The “nucleolus” is often proposed as an equitable solution concept. Take it as the best case scenario.

Worst case scenario would be that richest municipalities get all the surplus

Nucleolus:

\[
\arg\min_{x} \max_{S' \subset S} E(S')
\]

where

\[
E(S') = V(S') - \sum_{i \in S'} x_i
\]

note that if $S$ is part of a stable partition, $E(S') < 0 \quad \forall S' \subset S$

Since there may be more than one $x$ that leads to the same maximum above, continue lexicographically

Resulting $x$ is unique
Utility change from allowing transfers

\[ \log(\text{Income per capita}) \]

\[ U(\text{with transfers}) - U(\text{no transfers}) \]

\(-40\)  
\(-20\)  
\(0\)  
\(20\)  

\(-1.0\)  
\(-0.5\)  
\(0.0\)  
\(0.5\)
Utility change from incentive scheme

$log(\text{Income per capita})$

$U(\text{with incentives}) - U(\text{original policy})$

-5
0
5
10

-1.0
-0.5
0.0
0.5

Utility change from incentive scheme

$log(\text{Income per capita})$

$U(\text{with incentives}) - U(\text{original policy})$

-5
0
5
10

-1.0
-0.5
0.0
0.5
3. Non-existence

“Roommates Problem” [Gale-Shapley, 1962]
3. Non-existence - Solutions

“Roommates Problem” [Gale-Shapley, 1962]

\[
\begin{align*}
\{1, 2\} & \succ_1 \{1, 3\} \succ_1 \{1\} \succ_1 \{1, 2, 3\} \\
\{2, 3\} & \succ_2 \{1, 2\} \succ_2 \{2\} \succ_2 \{1, 2, 3\} \\
\{1, 3\} & \succ_3 \{2, 3\} \succ_3 \{3\} \succ_3 \{1, 2, 3\}
\end{align*}
\]

- Restricted preferences
- Relaxed stability requirements
3a. Restricted Utility Function

\[ u_i(S) = \theta_2 \log g_S + \theta_3 \log POP_S + \theta_4 \log AREA_S + \theta_5 \log y_S + \epsilon_S \]

Stable coalition structure guaranteed to exist and is generically unique (Farrell and Scotchmer, 1988)
3a. Restricted Utility Function

\[ u_i(S) = \theta_2 \log g_S + \theta_3 \log POP_S \\
+ \theta_4 \log AREA_S + \theta_5 \log y_S + \epsilon_S \]

\[ = u(S) \]

Stable coalition structure guaranteed to exist and is generically unique (Farrell and Scotchmer, 1988)
3b. Relaxed Stability Requirements

[Ray and Vohra 1997]

- Restrict \( V \) to only refinements and coarsenings of existing coalition structure

- Existence of solution set \( \Pi^* \) is guaranteed, but an equilibrium selection assumption is necessary.

- Equilibrium selection assumption: \( \frac{1}{|\Pi^*|} \)
Coalition Sizes: Actual

Coalition Size

\[\sqrt{\text{Frequency}}\]
Coalition Sizes: Actual and "Restricted Preferences"
Coalition Sizes: Actual and "Relaxed Stability Requirements"