The Determinants of the Municipality's Decision to Implement Recycling in Japan: Socio-Economic and Technological Factors

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Introduction
In Japan, a recycling-based society has been promoted owing to the shortage of landfill sites for waste disposal during the past decade. The Japanese government has encouraged reduction, reuse, and recycling of waste with the slogan “3R” under the Basic Law for Establishing a Recycling-based Society.

Along with this slogan, several recycling laws have been enacted and various policies implemented in Japan. Among them, the Contaminants and Packaging Recycling Law enacted in 1997 seems to be the most important, because containers and packaging waste accounts for a large share of the emitted waste with respect to cubic capacity. The types of containers and packaging designated by this law include glass containers, PET bottles, paper containers and wrapping, and plastic containers and wrapping. According to the law, municipalities are required to collect and store recyclable containers and packaging material that households have separated from solid waste.

However, the law is non-binding in nature; thus, the collection of each type of recyclable containers and packaging is done at the discretion of the municipalities. Some municipalities do not provide collection services for these recyclables.

Why do some municipalities recycle while others do not? Few studies have investigated the determinants of the municipality’s decision to collect recyclables.

Models
The following model, applying the random-effects probit model proposed by Giulkey and Murphy (1993), estimates the determinants of the municipality’s decision to implement recycling in Japan: 

\[ \Pr(y = 1 | X) = \Phi(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k) \]

where \( Y \) : a latent variable;
\( X \): technology vector;
\( \Phi \): the normal cumulative distribution function

\( \Phi \) \( Y \) indicates:
- A municipality shares landfill sites or jointly
- Ownership types of landfill sites: self or joint?

Dependent Variables
- Dummy variables: if municipalities collect a certain type of recyclable or collect commingled recyclables and then sort them according to their type, or not otherwise.
- 6 types of recyclables:
  - PET bottles
  - Paper containers
  - White trays

Independent Variables
- Waste generation per capita per year (w)
- Rate for under 15 years of age (Ratio of under 15)
- Rate for over 65 years of age (Rate of over 65)
- Average taxable gain per capita (million yen) (Income)
- Average household size (HHsize)
- Population density (person per km²) (Popd)
- Year dummy

Data
- Balanced panel
- 2000 - 2002 (Three years) (To avoid the influence of large-scale merging of municipalities in 2003)
- 2508 municipalities

Waste technological factors
- Landfill
- Remaining landfill capacity per capita (ln(landfill))
- A municipality possesses landfill sites (Dlandfill)
- A municipality shares landfill sites with regional affairs association? (Decommissioning?)

Types of incineration facilities
- Stoker furnaces (DStoker)
- Fluidized bed furnaces (DFluid)
- Waste power generation (DFDF)
- Ratio of waste generation collected by entities directly run by municipalities (Ratio of public sector)

RDF (Refuse Derived Fuel) facilities (DRDF)

Waste power generation per capita per year (w)

Ownership types of landfill sites: self or joint?

Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>z-Value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.656**</td>
<td>0.129</td>
<td>4.07</td>
<td>0.000</td>
</tr>
<tr>
<td>Dstoker</td>
<td>-0.155**</td>
<td>0.051</td>
<td>-3.09</td>
<td>0.002</td>
</tr>
<tr>
<td>Dfluid</td>
<td>-0.532***</td>
<td>0.033</td>
<td>-16.03</td>
<td>0.000</td>
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<tr>
<td>DRDF</td>
<td>0.0410*</td>
<td>0.121***</td>
<td>0.34</td>
<td>0.733</td>
</tr>
<tr>
<td>ln(landfill)</td>
<td>0.490*</td>
<td>0.374***</td>
<td>1.31</td>
<td>0.191</td>
</tr>
<tr>
<td>Decommision(?)</td>
<td>0.212***</td>
<td>0.057***</td>
<td>3.70</td>
<td>0.000</td>
</tr>
<tr>
<td>Income</td>
<td>0.830**</td>
<td>0.106</td>
<td>7.88</td>
<td>0.000</td>
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<tr>
<td>HHsize</td>
<td>-0.311</td>
<td>0.1</td>
<td>-3.11</td>
<td>0.002</td>
</tr>
<tr>
<td>Popd</td>
<td>-0.106</td>
<td>0.049</td>
<td>-2.16</td>
<td>0.031</td>
</tr>
<tr>
<td>Year</td>
<td>0.006</td>
<td>0.006</td>
<td>0.93</td>
<td>0.353</td>
</tr>
</tbody>
</table>

Discussion and Conclusions
Whether or not municipalities recycle containers and packaging is likely to depend on if they own incineration facilities, and how scarce the remaining landfill capacity is.

Random effects prob vs. Pooled prob
- The Log Likelihood tests showed that the random-effects probit model was more effective.
- We could control unobservable and time-invariant individual effects by municipalities, which provided an accurate estimation using the available panel data.

Incentive and power generation
- Municipalities using waste power generation did not show a high probability of collecting and separating recyclable containers.
- Municipalities with stoker furnaces were less likely to collect and separate recyclable containers.

RDF (Refuse Derived Fuel) facilities
- Municipalities having RDF facilities showed a lower possibility of collecting and separating plastic containers. This seems to be because plastic containers are particularly suitable materials for RDF, and municipalities would rather use them to maintain their RDF facilities than collect and separate them.

Landfill
- Municipalities that had their own landfill sites showed a higher probability of collection and separation than those that did not possess landfills.
- Municipalities that shared landfills with other municipalities showed a lower probability of collection and separation.

The scarcity signal of remaining landfill capacity could encourage municipalities with their own landfill sites to reduce landfill waste by keeping recyclables out of landfills. However, even with the scarcity signal, municipalities sharing landfills with other regional association might take no countermeasures.

For further information
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References