How Fast Are Prices in Japan Falling?

Satoshi Imai
Chihiro Shimizu
Tsutomu Watanabe

Japan
AGENDA

- Background
- Findings
- Purposive vs Random
- Methodology1: Purposive Sampling
- Methodology2: Random Sampling
- Sampling error
- Conclusion
- Subsidiary finding
Some argue that rate of deflation was too small in Japan

Rate of deflation in each year (last 15 years) around 1 percent

- Official CPI contains substantial upward bias?
  - Fuhrer et al. (2011)
  - Broda and Weinstein (2007)
Purpose

- Investigate how much estimates of CPI inflation rate depend on the Methodology.
- Especially lower level Sampling Methodology

Approach

- 64 alternative sampling rules (Purposive Sampling)
  - Store sampling
  - Product sampling
  - Price sampling (Survey point, Sale regulation)
  - Region composition
- Purposive Sampling – Random Sampling
Inflation rate has ±0.5% sampling errors at 90% CI (year-on-year based)
Sampling errors is various through items. It shows At the item level sampling errors may cause bias.
SBJ employs Purposive approach

<table>
<thead>
<tr>
<th></th>
<th>Purposive</th>
<th>Random</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>125 items</td>
<td>125 items</td>
</tr>
<tr>
<td>Product</td>
<td>Collect according to sale quantity ranking</td>
<td>Sale quantity waited random sampling</td>
</tr>
<tr>
<td></td>
<td>Only products which matches to defined specification are allowed</td>
<td>All products which belongs to item category are allowed</td>
</tr>
</tbody>
</table>
Example from Table 1: Butter

<table>
<thead>
<tr>
<th>Item code</th>
<th>Description</th>
<th># of JAN codes (A)</th>
<th># of JAN codes that meet the product specifications (B)</th>
<th>(B / A)</th>
<th>Fraction of sales for products that meet the product specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1321</td>
<td>Butter</td>
<td>369</td>
<td>30</td>
<td>0.081</td>
<td>0.458</td>
</tr>
</tbody>
</table>

We conduct this kind of pre-treatment for 125 items.
Methodology 1: Purposive Sampling

- 125 items over 200 outlets

- 64 different sampling simulations
  - Region: single region / six regions
  - Outlet: customer visits (1 or 3 month(s)) quantity sold (1 or 3 month(s))
  - Products: quantity sold (1 or 3 month(s)) (purposive specification pre-treated)
  - Specification: full list / positive only list
  - Sale duration: 3 days / 8 days
  - Sale impute: backward / forward
Methodology 2: Random Sampling

- 125 items over 200 outlets

- Sampling condition
  - Region: six regions
  - Outlet: random sampling waited with customer visits (1 month)
  - Products: random sampling waited with quantity sold (1 month) (all products belonging to the category)
  - Sale duration: 8 days
  - Sale impute: forward
Sampling error

- Sampling error of item $i$
  \[ \delta_i(t) \equiv \sum_r \phi_r \left( n^{-1} \sum_{(o,j) \in A_{r,i}} \pi_{r,i,o,j}^P(t) - n^{-1} \sum_{(o,j) \in B_{r,i}} \pi_{r,i,o,j}^R(t) \right) \]

- Sampling error at the aggregate level
  \[ \delta(t) \equiv \sum_r \omega_i \delta_i(t) \]

- The central limit theorem
  \[ \sum_i \omega_i \delta_i \xrightarrow{d} N \left( \sum_i \omega_i \mu_i, \sum_i \omega_i^2 \sigma_i^2 \right) \]
Conclusion

Inflation rate has ±0.5% sampling errors at 90% CI

(year-on-year based)
Figure 12 shows Sampling error is wide even annual level (time interval 12)

For the future plan, We estimate convergence effect extending up to 500 items.
Outlet substitution and Item substitution should be cared properly.
Thank you for all your attention.

Contact to:

s2.imai@soumu.go.jp
Satoshi Imai

cshimizu@reitaku-u.ac.jp
Chihiro Shimizu

watanabe@e.u-tokyo.ac.jp
Tsutomu Watanabe