Private Label Brands versus National Brands: Some Implications for the Construction of the CPI

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AGENDA

- Overview of the paper
- Background
- Data and Identifying PLBs
- Aspect of PLB
- Substitution effect
- Quality Adjustment for PLBs
- Conclusion
Overview of the paper

Compare private label brands (PLB) and national brands (NB) using Japanese scanner data.

Compare these two in terms of the following:
(1) the length of product life;
(2) the price change over the entire life;
(3) the frequency of price adjustment;
(4) the average size of price changes;
(5) the frequency of temporary sales;
(6) the size of sale discounts;
Examine to what extent different sampling methodologies regarding the treatment of PLBs would affect the CPI.

Specifically, we construct the CPI using three different product sampling methodologies: (1) sampling only from NBs; (2) sampling only from PLBs; (3) sampling both from NBs and PLBs.
We then compare 11 different quality adjustment methods to evaluate some lessons about the current practice employed by the Statistic Bureau of Japan regarding the PLBs:

1. Unit price method
2. Subcategorized unit price
3. Chained Jevons
4. Existing products mean adjustment (4 branches)
5. Existing products group adjustment (4 branches)
Main findings of the paper:

- **Have PLBs any typical aspects?**
  - Life cycle and life cycle price change are not so different
  - Band of price change is tighter.
  - Frequency of price change is higher.

- **Have PLBs impacts to Japanese CPI?**
  - Yes. Especially substitution effect should be carefully evaluated

- **What kind of quality adjustment is reasonable?**
  - NB and PLBs should be treat as subcategory
  - We suggest “Quality adjustment by unit group”
Background

- Hams (loin, sliced)

![Graph showing the price trends of hams (loin, sliced) from 2000 to 2013. The x-axis represents the years from 2000 to 2013, and the y-axis represents the JPY (100g unit price). The graph includes a legend for different types of hams: PLB, non-PLB, whole, and PLB share(r). The data shows a general trend of increased prices over time.](image-url)
Background

- Index in 2008 indicate the peak due to cost increase and downsizing (Imai, Watanabe, 2014)

- Have PLBs any typical aspects?
- Have PLBs impacts to Japanese CPI?
- What kind of quality adjustment is reasonable?
  - It seems PLB is going to hold an important place in Japanese market
  - Can we treat PLBs as same as NBs?
Some Private brand (PB) commodities that conform to the prescribed basic specifications established by considering their representativeness, marketability, continuity and other factors are surveyed.

(Q&A about the Retail Price Survey, SBJ)

- PLBs possibly are surveyed
  - 66 items (foods and drinks)
  - 9 items (daily needs)
- NBs definitely are specified
  - 36 items (food (not flesh) and drinks)
  - 25 items (daily needs)
※ Evaluable in scanner data, mainly in food (not flesh), drinks (not alcohol) and daily needs
Some Private brand (PB) commodities that conform to the prescribed basic specifications established by considering their representativeness, marketability, continuity and other factors are surveyed. (Q&A about the Retail Price Survey, SBJ)

- If some PLBs comply with basic specifications,
  - SBJ consider those have “same quality”
  - It means those prices are put into the functions directly (except for unit price adjustment)
Background

Ham:
Ham (loin), not Japanese Agricultural Standard (JAS) certified, ordinary quality
# Data and Identifying PLBs

- **Scanner data**

## Number of Outlets, Products and Observations

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of outlets</th>
<th>Entries</th>
<th>Exits</th>
<th>No. of products</th>
<th>No. of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>189</td>
<td>21</td>
<td>4</td>
<td>251,053</td>
<td>242,357,320</td>
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<tr>
<td>2001</td>
<td>187</td>
<td>2</td>
<td>4</td>
<td>265,628</td>
<td>274,319,003</td>
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<td>2002</td>
<td>198</td>
<td>13</td>
<td>2</td>
<td>276,503</td>
<td>283,432,923</td>
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<tr>
<td>2003</td>
<td>189</td>
<td>3</td>
<td>12</td>
<td>274,479</td>
<td>257,525,219</td>
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<tr>
<td>2004</td>
<td>202</td>
<td>17</td>
<td>4</td>
<td>279,753</td>
<td>282,074,675</td>
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<tr>
<td>2005</td>
<td>187</td>
<td>15</td>
<td>30</td>
<td>288,634</td>
<td>309,888,190</td>
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<tr>
<td>2006</td>
<td>189</td>
<td>7</td>
<td>5</td>
<td>306,166</td>
<td>323,722,317</td>
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<tr>
<td>2007</td>
<td>274</td>
<td>93</td>
<td>8</td>
<td>348,134</td>
<td>379,329,705</td>
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<tr>
<td>2008</td>
<td>261</td>
<td>4</td>
<td>17</td>
<td>367,079</td>
<td>412,843,270</td>
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<tr>
<td>2009</td>
<td>264</td>
<td>7</td>
<td>4</td>
<td>357,950</td>
<td>416,297,894</td>
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<tr>
<td>2010</td>
<td>259</td>
<td>0</td>
<td>5</td>
<td>358,305</td>
<td>415,354,684</td>
</tr>
<tr>
<td>2011</td>
<td>249</td>
<td>0</td>
<td>10</td>
<td>358,837</td>
<td>403,651,608</td>
</tr>
<tr>
<td>2012</td>
<td>261</td>
<td>21</td>
<td>9</td>
<td>358,250</td>
<td>445,600,351</td>
</tr>
<tr>
<td>2013</td>
<td>334</td>
<td>78</td>
<td>5</td>
<td>366,233</td>
<td>401,856,201</td>
</tr>
</tbody>
</table>

- 2003: 11.2003 and 12.2003 weekly observation only
- 2013: 1.2013 to 10.2013 only
Data and Identifying PLBs

- Identifying PLBs

**Ex)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Maker</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>49 03050</td>
<td>155</td>
<td>“Snow Brand Hokkaido Butter” 200g</td>
</tr>
<tr>
<td>49 01810</td>
<td></td>
<td>“AEON TopValu Hokkaido Butter” 200g</td>
</tr>
</tbody>
</table>

- Products having retailer maker code are PLBs

- 570 six digit categories evaluable
  (1,797 six digit categories in data)
Data and Identifying PLBs

PLB related basic information

<table>
<thead>
<tr>
<th>[PBbase] Number of Outlets, Products and Turnover of Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of outlets</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>2000</td>
</tr>
<tr>
<td>2001</td>
</tr>
<tr>
<td>2002</td>
</tr>
<tr>
<td>2003 *</td>
</tr>
<tr>
<td>2004</td>
</tr>
<tr>
<td>2005</td>
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<tr>
<td>2006</td>
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<td>2010</td>
</tr>
<tr>
<td>2011</td>
</tr>
<tr>
<td>2012</td>
</tr>
<tr>
<td>2013 *</td>
</tr>
</tbody>
</table>

!! Only outlets providing one PLB product at least
2003: 11.2003 and 12.2003 are weekly data
2013: 1.2013 to 10.2013 Only
Data and Identifying PLBs

- Aggregated geometric mean of unit price (lower weight: quantity)
## Aspect of PLB

- 570 categories aggregated indicators

<table>
<thead>
<tr>
<th>Ratio (PLB / non PLB)</th>
<th>PLB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>mean</strong></td>
<td><strong>stdev.</strong></td>
</tr>
<tr>
<td>Variety</td>
<td>0.113</td>
</tr>
<tr>
<td>Life Cycle length (days)</td>
<td>1.237</td>
</tr>
<tr>
<td>ΔP (entry – exit)</td>
<td>1.164</td>
</tr>
<tr>
<td>ΔP (max – min)</td>
<td>1.021</td>
</tr>
<tr>
<td>ΔP (entry – exit) / Life Cycle length</td>
<td>0.610</td>
</tr>
<tr>
<td>Price change count (per 30 days)</td>
<td>2.477</td>
</tr>
<tr>
<td>Price decline count (per 30 days)</td>
<td>2.391</td>
</tr>
<tr>
<td>Price change interval (days)</td>
<td>0.788</td>
</tr>
<tr>
<td>Price decline interval (days)</td>
<td>0.827</td>
</tr>
<tr>
<td>Price change ratio</td>
<td>0.762</td>
</tr>
<tr>
<td>Price decline ratio</td>
<td>0.746</td>
</tr>
</tbody>
</table>

* This data calculated by only products which already exit from the market
## Aspect of PLB

### Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety</td>
<td># of products</td>
</tr>
<tr>
<td>Life Cycle length (days)</td>
<td>Duration from the start date of sale to disappear date</td>
</tr>
<tr>
<td>$\Delta P$ (entry – exit)</td>
<td>(exit price – entry price) / entry price</td>
</tr>
<tr>
<td>$\Delta P$ (max – min)</td>
<td>(max price – min price) / max price</td>
</tr>
<tr>
<td>$\Delta P$ (entry – exit) / Life Cycle length</td>
<td>(exit price – entry price) / entry price / Life Cycle length</td>
</tr>
<tr>
<td>Price change count (per 30 days)</td>
<td>Price change count per 30 days</td>
</tr>
<tr>
<td>Price decline count (per 30 days)</td>
<td>Price decline count per 30 days</td>
</tr>
<tr>
<td>Price change interval (days)</td>
<td>Duration from last price change to next change</td>
</tr>
<tr>
<td>Price decline interval (days)</td>
<td>Duration from last price decline to next decline</td>
</tr>
<tr>
<td>Price change ratio</td>
<td>$</td>
</tr>
<tr>
<td>Price decline ratio</td>
<td>$</td>
</tr>
</tbody>
</table>
Aspect of PLB

- Life cycle length and life cycle rate of price decline are not so different

- Price change is more frequent
  More than two times frequency for sale and price back

- Price change band is narrower
  PLB move within ±10%
  non PLB move within ±15%
Aspect of PLB

- CDF over 570 categories

Price decline ratio mean - 570 categories

Price change ratio mean - 570 categories

6 digits categories

Ratio

PLB  non PLB

0  0.05  0.1  0.15  0.2  0.25  0.3  0.35  0.4  0.45  0.5

6 digits categories

0  0.05  0.1  0.15  0.2  0.25  0.3  0.35  0.4  0.45  0.5

PLB  non PLB
Substitution Effect

- Price mean change is divided to three factors

\[
\Delta \ln P = \alpha_{t-1} \cdot \Delta \ln P_{PLB} + (1 - \alpha_{t-1}) \cdot \Delta \ln P_{nonPLB} \\
+ (\alpha_t - \alpha_{t-1}) \cdot \ln P_{PLB t} + (\alpha_{t-1} - \alpha_t) \cdot \Delta \ln P_{nonPLB t}
\]

- PLB factor
- non PLB factor
- substitution factor

\( \alpha: \) share of PLB
Variance ratio for substitution effect

Variance ratio mean: 0.0573
Variance ratio stdev.: 0.104

Substitution PLB ⇔ non PLB is not so small
Substitution Effect

- Time line of substitution effect

Substitution effect is important as same as Price change of PLBs

Consumers move to PLBs
Quality Adjustment for PLBs

- Hams (loin, sliced)
Quality Adjustment for PLBs

Points
- PLBs’ price level are generally quite different from non PLB’s one

To consider COGI

- PLBs needs proper adjustment
  - There is difference in quality between PLBs and non PLBs
Quality Adjustment for PLBs

Points detail

- There are two types of PLB
  - Same product without brand label
    ⇒ Its spec is considerable as same with non PLB
  - Proprietary planed product for Reasonability
    ⇒ Some spec is depressed to cut cost

Second PLBs needs adjustment
Quality Adjustment for PLBs

Strategies

- Impute mean price
  - Impute new PLB with PLB mean
  - Impute new PLB with non PLB mean
- Impute grouped mean price
  - Impute with weight/size grouped mean
- Intermediate index
  - Divide PLBs and non PLB to sub category index
Quality Adjustment for PLBs

Strategies detail

- Impute mean price
  - Impute mean price on existing PLB
    \[ P_{PLB,t}^{Adjusted} = P_{PLB,t} \cdot \frac{\text{mean}_{i\in PLB}(P_{ti})}{P_{PLB,t}} \]
  - Impute mean price on existing non PLB
    \[ P_{PLB,t}^{Adjusted} = P_{PLB,t} \cdot \frac{\text{mean}_{i\in \text{non PLB}}(P_{ti})}{P_{PLB,t}} \]
  - Independently of way for PLB, non PLB products are imputed by own existing mean price
Strategies detail

- Impute grouped mean price
  - Impute types with PLB/non PLB are same
  - To calculate impute ratio, use same weight/size group’s existing mean

If new PLB has 400g weight

\[ P_{PLB,t}^{G\text{Adjusted}} = P_{PLB,t} \cdot \frac{\text{mean}_{i \in PLB, Group400\text{g}}(P_{ti})}{P_{PLB,t}} \]

Use mean price with same weight group

If no same group exists on t,

Liner adjusted mean price with group having most product variation

\[ P_{PLB,t}^{Adjusted} = P_{PLB,t} \cdot \frac{\text{mean}_{i \in PLB, Group350\text{g}}(P_{ti}) \cdot 400}{350 \cdot P_{PLB,t}} \]
Quality Adjustment for PLBs

Strategies detail

- Intermediate index
  - PLB and non PLB as subcategory index
  - Aggregate PLB index and non PLB index to its category level index with amount of sale share
Quality Adjustment for PLBs

- 6 digits category index
  - Weighted geometric mean of (unit price, quantity)
  - Laspeyres index based on 01.2000
  - Chained Jevons index
  - Chained Tronqvist index
    - Element as PLB index and non PLB index with amount of sale share

- Upper level aggregate
  - Aggregate with annual amount of share weight in 2000
Quality Adjustment for PLBs

- Results with lower weight

These index contains Substitution effect to cheap PLB prices
Quality Adjustment for PLBs

- Results with lower weight

Using non grouped mean fails
Using grouped mean and intermediate follows chained Jevons
Quality Adjustment for PLBs

Results without lower weight

Non weighted geometric mean of (unit price, product, outlet)

Factual statistics faces to these index due to difficulty getting real-time weight
Both of lower weighted and non weighted has about 3.0 points difference at the max at final reach in our case.
Conclusions

Findings

PLBs have tricky aspects

- **Have PLBs any typical aspects?**
  - Life cycle and life cycle price change are not so different
  - Band of price change is tighter; PLB move within ±10% non PLB move within ±15%
  - Frequency of price change is higher; More than two times frequency for sale and price back

- **Have PLBs impacts to Japanese CPI?**
  - Some consumers move to cheep PLBs. Especially substitution effect should be carefully evaluated
  - It's means how PLBs get market share and how PLBs are different from non PLBs on quality are important

- **What kind of quality adjustment is reasonable?**
  - NB and PLBs should be treat as subcategory
  - We suggest “Quality adjustment by unit group”
Conclusion

- We face to needs getting real-time weight much more before
  - Except for grouped mean method, we need real-time weight
  - Without information how PLB's hold share in the market, we can get only imperfect price change
  - PLBs is going to be typical property which needs proper quality adjustment way
Thank you for all your attention.

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