Product Downsizing and Hidden Price Increases
Evidence from Japanese Deflationary Period

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AGENDA

- Overview of the paper
- Background
- Data and Empirical Method
- Identifying the Generation
- Product Turnover
- Responsiveness of Size Change
- Estimating Demand Equation
- Conclusion
CPI inflation in Japan has been below zero over the last 15 years. Given this, it is quite difficult for firms to raise prices even when they face a higher marginal cost.

One strategy they have taken is to reduce the size/weight of a product without reducing prices that much, thereby raising effective prices.

Statistics Bureau of Japan has been trying to detect such “hidden price increases” and successfully detected some incidences. However, they may be only a small part of the entire incidences.
Octopus Fritters (*Takoyaki*)

500 yen for **6 pieces**
since August 2012

500 yen for **8 pieces**
before August 2012
Three research questions:
- To what extent product downsizing occurs?
- To what extent product downsizing affects prices?
- To what extent product downsizing affects quantities sold?

The novelty of our methodology:
- We develop an algorithm to identify the sequence of “product generations” (i.e. which product is a successor to which product)
- We identify 15,000 pairs of retiring products and their successors
- For each pair, we calculate the percentage change of size/weight, the percentage change of nominal and per-unit prices, and the percentage change of quantities sold.
Main findings of the paper:

- **To what extent product downsizing occurs?**
  - Among the 15,000 product replacement events, the size/weight was reduced in 5,000 cases, while it increased in 1,500 cases and remained unchanged in 8,500 cases. The number of product replacements involving downsizing increased significantly in 2007 and 2008, when firms faced substantial cost increases due to the price hike in imported raw materials and grain.

- **To what extent product downsizing affects prices?**
  - We find that product downsizing by 1 percent is associated with a price decline only by 0.45 percent.

- **To what extent product downsizing affects quantities sold?**
  - We find that product downsizing by 1 percent leads to a decline in quantities sold by 0.55 percent, suggesting that most consumers are smart enough to make consumption decision based on effective prices rather than nominal prices.
Recent CPI

- CPI in Japan indicates deflation nearly 15 years.
Official CPI indicate the peak in 2008.

- Firms faced cost increase due to the price hike of oil and raw materials.
- Firms find it quite difficult to raise price.
- Firms reduce the size or the weight with considerable products to adjust effective price.

- What extent product downsizing prevails in these periods?
- How firms decide the price?
- How markets treat such downsizing?
Data and Empirical Method

- Scanner data
  - About 200 outlets
  - Cover 125 items of CPI

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of outlets</th>
<th>No. of products</th>
<th>No. of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>189</td>
<td>251,053</td>
<td>242,357,320</td>
</tr>
<tr>
<td>2001</td>
<td>187</td>
<td>265,629</td>
<td>274,319,027</td>
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<td>2002</td>
<td>198</td>
<td>276,504</td>
<td>283,433,216</td>
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<tr>
<td>2003</td>
<td>188</td>
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<td>242,425,055</td>
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<td>2004</td>
<td>202</td>
<td>279,753</td>
<td>282,074,675</td>
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<td>2005</td>
<td>187</td>
<td>288,634</td>
<td>309,888,190</td>
</tr>
<tr>
<td>2006</td>
<td>189</td>
<td>315,152</td>
<td>329,139,639</td>
</tr>
<tr>
<td>2007</td>
<td>274</td>
<td>359,207</td>
<td>386,389,129</td>
</tr>
<tr>
<td>2008</td>
<td>261</td>
<td>375,287</td>
<td>419,941,109</td>
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<td>2009</td>
<td>264</td>
<td>364,106</td>
<td>422,389,029</td>
</tr>
<tr>
<td>2010</td>
<td>259</td>
<td>363,379</td>
<td>420,708,540</td>
</tr>
<tr>
<td>2011</td>
<td>249</td>
<td>363,208</td>
<td>408,357,242</td>
</tr>
<tr>
<td>2012</td>
<td>261</td>
<td>339,170</td>
<td>372,087,471</td>
</tr>
</tbody>
</table>
Data and Empirical Method

- Extracting size/weight information

Ex)
“Snow Brand Hokkaido Butter” 200g
“Snow Brand cheese” 1 piece

- 1,234 six digit categories evaluable
  (1,788 six digit categories in data)
Data and Empirical Method

- Products evaluable ratio is over 75%
  - The coverage ratio slightly decreased through the time.

Table 1: Number of Outlets, Products, and Observations

<table>
<thead>
<tr>
<th></th>
<th>All Products in Dataset</th>
<th>Products with information on size/weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of outlets</td>
<td>No. of products</td>
</tr>
<tr>
<td>2000</td>
<td>189</td>
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<tr>
<td>2012</td>
<td>261</td>
<td>339,170</td>
</tr>
</tbody>
</table>
Data and Empirical Method

- Figure 1 Size/Weight index
Data and Empirical Method

- Figure 2 Price and Per-Unit Price index
Data and Empirical Method

Figure 3  Changes in size/weight by product category
Data and Empirical Method

- Figure 4 Changes in price and per-unit price by product category
Identifying the sequence of generation

- Exit month
  Quantity decrease 50% more than 3 month average preceding the month
- Entry month
  entry month of candidate: m-5 ~ m+5
  m: exit month of base product
- Quantity

\[
\begin{pmatrix}
\end{pmatrix}
\]

- Size/weight
- Product name evaluation
Identifying the Generation

- Number of Product Turnover Events by Product Category

<table>
<thead>
<tr>
<th>Product Category</th>
<th>No. of events</th>
<th>Size/weight unchanged</th>
<th>Size/weight decrease</th>
<th>Size/weight increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bean curd and fermented soybeans</td>
<td>138</td>
<td>60</td>
<td>55</td>
<td>23</td>
</tr>
<tr>
<td>Pickled food and prepared food</td>
<td>763</td>
<td>167</td>
<td>487</td>
<td>100</td>
</tr>
<tr>
<td>Fish-paste</td>
<td>575</td>
<td>212</td>
<td>273</td>
<td>90</td>
</tr>
<tr>
<td>Meat processed products</td>
<td>332</td>
<td>97</td>
<td>189</td>
<td>46</td>
</tr>
<tr>
<td>Ice cream and ice</td>
<td>260</td>
<td>170</td>
<td>70</td>
<td>20</td>
</tr>
<tr>
<td>Body care product</td>
<td>631</td>
<td>470</td>
<td>142</td>
<td>19</td>
</tr>
<tr>
<td>Oral care product</td>
<td>68</td>
<td>44</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>Hygiene product</td>
<td>110</td>
<td>76</td>
<td>31</td>
<td>3</td>
</tr>
<tr>
<td>Detergent</td>
<td>201</td>
<td>130</td>
<td>61</td>
<td>13</td>
</tr>
<tr>
<td>Kitchen supplies</td>
<td>76</td>
<td>65</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Cosmetics and stationery</td>
<td>591</td>
<td>508</td>
<td>30</td>
<td>53</td>
</tr>
<tr>
<td>Pet food and sanitary</td>
<td>419</td>
<td>205</td>
<td>190</td>
<td>24</td>
</tr>
</tbody>
</table>

Total: 15,000 case
- Unchanged: 8,462
- Decrease: 5,173
- Increase: 1,365
Identifying the Generation

- Example of downsizing margarine
  - Meiji Brand Soft 450g
  - Meiji Brand Soft 400g
  - Meiji Brand Soft 360g
Identifying the Generation

- Example of size unchanged margarine
  - Corp Half 180g
  - Corp Half 180g
  - Corp Half 180g
  - Corp Half 180g

[Graph showing trends of margarine and fat spread with labels Product D, Product E, Product F, and Product G]
Product Turnover

- Figure 5: Cumulative distribution of changes in size/weight at the time of product turnover
Product Turnover

- Figure 6: Number of product turnover events by year

![Graph showing the number of product turnover events by year, categorized into size/weight increase, size/weight unchanged, and size/weight decrease. The graph highlights a significant increase in turnover events in 2008.]
Responsiveness of Size Change

- Figure 7: Cumulative distributions of price changes at the time of product turnover
Figure 9: Cumulative distributions of sales changes at the time of product turnover
Responsiveness of Size Change

- Table 3: Responsiveness of Prices to Changes in Size/Weight at the Time of Product Turnover

<table>
<thead>
<tr>
<th>Size/Weight reduction</th>
<th>Price decline</th>
<th>All</th>
<th>Food</th>
<th>Chilled food</th>
<th>Normal temperature</th>
<th>Frozen food</th>
<th>Daily</th>
<th>Necessaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>0.45%</td>
<td>0.445 (0.028)</td>
<td>0.454 (0.029)</td>
<td>0.645 (0.057)</td>
<td>0.369 (0.034)</td>
<td>0.354 (0.111)</td>
<td>0.290 (0.106)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 8: Responsiveness of prices to changes in size/weight

Responsiveness measure 1.1

Ex) Size/Weight reduction 20%
Price decline only 12%
Per-unit price rises 8%
Estimating Demand Equation

\[
\begin{pmatrix}
\alpha_1 & \alpha_2 & 1 - \alpha_1 - \alpha_2 \\
0.000 & 0.764 & 0.236 \\
0.100 & 0.803 & 0.097 \\
0.200 & 0.842 & -0.042 \\
0.300 & 0.881 & -0.181 \\
0.400 & 0.919 & -0.319 \\
0.500 & 0.958 & -0.458 \\
0.600 & 0.997 & -0.597 \\
0.700 & 1.036 & -0.736 \\
0.800 & 1.075 & -0.875 \\
0.900 & 1.114 & -1.014 \\
1.000 & 1.153 & -1.153 \\
\end{pmatrix}
\] (5)

is very small
Estimating Demand Equation

- ( )
  - Percentage change in quantity sold
  - Percentage change in nominal price
  - Percentage change in product size/weight

- ( )

- 76% of consumers is wise.
Conclusion

- Evidence showing that consumers determine consumption based on the per-unit price rather than the price itself.

- Quality Adjustment should be treated carefully. Especially to downsizing product in Japanese markets.
Thank you for all your attention.

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