SRI-Hitotsubashi Consumer Purchase Indices

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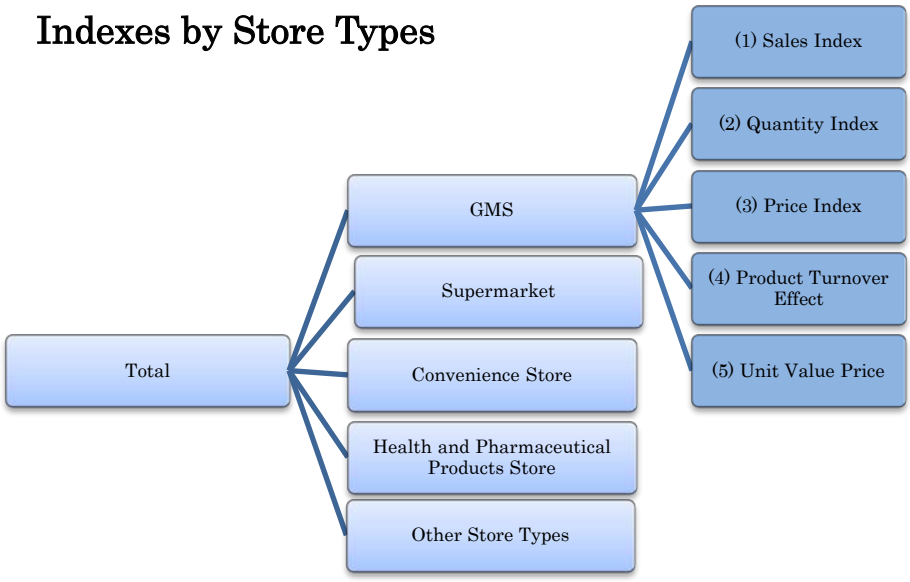
1. Data

Consumer Purchase Indices are calculated based on the SRI, which is a database of point-of sales data collected by INTAGE Inc. from approximately 4,000 retail stores. SRI covers the sales data of processed foods and daily necessities that have JAN (Japanese Article Number) codes, but does not cover fresh foods, packed lunches, served beverages, and so on. The indices are calculated weekly, so we give numbers for weeks beginning from Monday. Our indices show the year-on-year rate of change.

We calculate the indices by store type, and aggregate them using weighted averages, based on the monthly sales estimates, to get the total Index in order to know the movement of all retail sales in Japan.

The store types list consists of 1) GMS (General Merchandise Store which has over 3,000 square meters of store space), 2) Supermarket, 3) Convenience Store, 4) Health and Pharmaceutical Products Store, and 5) Other Store Types.



2. Definitions for Consumer Purchase Indices

The Consumer Purchase Indices consists of four components: 1) Expenditure (Sales) Index, 2) Quantity Index, 3) Price Index, and 4) Product Turnover Effect Index.

(1) Expenditure (Sales) Index

The Expenditure (Sales) Index is expresses the year-on-year rate of change in consumers' purchase amount in retail stores located all over Japan.

(2) Quantity Index

The Quantity Index is the aggregate value of the year-on-year rate of change in quantities purchased by consumers per product from our sample stores; the products are identified by stores and items. We use the Sato-Vartia formula as the aggregator for individual rates of change in quantities of products purchased.[1]

(3) Price Index

The Price Index forms a pair with the Quantity Index, so we can calculate the Index by replacing the quantity information with price information. To be more specific, the Price Index is the aggregate value of the year-on-year rate of change in the price of the products purchased by consumers at our sample stores. The product is identified by stores and items. We use the Sato-Vartia formula as the aggregator for individual rates of change in product prices too.

(4) Product Turnover Effect Index

Since the Quantity Index and Price Index are expressed as aggregates of the year-on-year rates of change, only that product information that exists in both the time points to be compared is included in the calculation. However, in a year, many products enter and leave the retail store. The Product Turnover Effect Index is calculated in order to capture the effect of this movement on consumer purchasing. The method for computing this index is as follows:

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[1] To know more about the Sato-Vartia formula, you can refer to Sato (1976) and Vartia (1976).

A: the sales amount of products that exist in the current week and did not exist in the same week last year

B: the sales amount of products that do not exist in the current week and existed in the same week last year

$$\text{Product Turnover Effect Index} = \frac{A - B}{B}$$

The index captures how product turnover contributes to sales at retail stores.

(5) Unit Value Price Index

The Unit Value Price Index is the year-on-year rate of weighted average of unit value price using volume×quantity weight. The unit value price index enablesus to include the information for prices of not only continuing goods, but also new goods and disappeared goods when constructing price indices.

※ Difference between the Price Index (POS-CPI) and the Unit Value Price Index (POS-UVPI)

The POS-CPI is based on the information on the change in prices at item level. When calculating the item-level price changes, we need information on prices at two periods, which forces us to use data on continuing goods. That is, POS-CPI does not reflect information of new goods that appear recently, or disappeared goods that are not sold anymore.

When constructing the POS-UVPI, we utilize information of both f new goods and disappeared goods aas well as continuing goods. This is possible because we use the "unit price" that enables us to compare the prices of different items. Unfortunately, not all the items contain volume information. The sales amount share of categories which have volume information is about 65% in average.

3. Technical Explanation for Decompositions

(1) Decomposition of Expenditure Index

Roughly speaking, the four indices have the following relation each other:

$$\text{Expenditure Index(y/y chg rate)} = \alpha\left(\text{Price Index(y/y chg rate)} + \text{Quantity Index(y/y chg rate)}\right) + \beta\ \text{(Product Turnover Effect Index)}$$

A more detailed development of the numerical formula is as follows:

＜Definition of Variables＞

S_t: sales amount of all products in the current week

S_{t-1}: sales amount of all products in the same week last year

S_t^C: sales amount in the current week of products that exist in both the current week and same week last year

S_{t-1}^C: sales amount in the same week last year of products that exist in both the current week and same week last year

S_t^N: sales amount in the current week of products that exist in the current week and did not exist in the same week last year

S_{t-1}^O: sales amount in the same week last year of products that do not exist in the current week and existed in the same week last year

P_t^C: price in the current week of products that exist in both the current week and same week last year

Q_t^C: quantity in the current week of products that exist in both the current week and same week last year

P_{t-1}^C: price in the same week last year of products that exist in both the current week and same week last year

Q_{t-1}^C: quantity in the same week last year of products that exist in both the current week and same week last year

P_t^N: price in the current week of products that exist in the current week and did not exist in the same week last year

Q_t^N: quantity in the current week of products that exist in the current week and did not exist in the same week last year

P_{t-1}^O: price in the same week last year of products that do not exist in the current week and existed in the same week last year

Q_{t-1}^O: quantity in the same week last year of products that do not exist in the current week and existed in the same week last year

Sales amount in the current period:

$$S_t = S_t^C + S_t^N$$

Sales amount in the same period last year:

$$S_{t-1} = S_{t-1}^{C} + S_{t-1}^{O}$$

The rate of change in the sales amount can be reduced to two factors, as follows:

$$\frac{S_t - S_{t-1}}{S_{t-1}} = \frac{(S_t^C + S_t^N) - (S_{t-1}^C + S_{t-1}^O)}{S_{t-1}}$$

$$= \frac{S_t^C - S_{t-1}^C}{S_{t-1}} + \frac{S_t^N - S_{t-1}^O}{S_{t-1}}$$

$$= \left(\frac{S_{t-1}^C}{S_{t-1}}\right)\frac{\Delta S_t^C}{S_{t-1}^C} + \left(\frac{S_{t-1}^O}{S_{t-1}}\right)\frac{S_t^N - S_{t-1}^O}{S_{t-1}^O}$$

That is,

$$\text{Sales (y/y chg rate)}$$

$$= \text{Weight of continuation product sales} \times \left(\text{Sales of continuation products (y/y chg rate)}\right)$$

$$+ \text{Weight of exit product sales} \times \left(\frac{\text{Sales of entry products} - \text{Sales of exit products}}{\text{Sales of exit products}}\right)$$

If we break the sales down to price and quantity, we arrive at the following expression:

$$\frac{P_t Q_t - P_{t-1} Q_{t-1}}{P_{t-1} Q_{t-1}} \approx \left(\frac{S_{t-1}^C}{S_{t-1}}\right)\left(\frac{\Delta P_t^C}{P_{t-1}^C} + \frac{\Delta Q_t^C}{Q_{t-1}^C}\right) + \left(\frac{S_{t-1}^O}{S_{t-1}}\right)\frac{P_t^N Q_t^N - P_{t-1}^O Q_{t-1}^O}{P_{t-1}^O Q_{t-1}^O}$$

$\frac{P_t Q_t - P_{t-1} Q_{t-1}}{P_{t-1} Q_{t-1}}$: Expenditure (Sales) Index (y/y change rate)

$\frac{\Delta P_t^C}{P_{t-1}^C}$: Price Index (y/y change rate)

$\frac{\Delta Q_t^C}{Q_{t-1}^C}$: Quantity Index (y/y change rate)

$\frac{P_t^N Q_t^N - P_{t-1}^O Q_{t-1}^O}{P_{t-1}^O Q_{t-1}^O}$: Product Turnover Effect Index

$\left(\frac{S_{t-1}^C}{S_{t-1}}\right)$, $\left(\frac{S_{t-1}^O}{S_{t-1}}\right)$: Weights (α and β)

Therefore, we can arrive at the formula

$$\text{Expenditure Index(y/y chg rate)}$$

$$= \alpha \left(\text{Price Index(y/y chg rate)} + \text{Quantity Index(y/y chg rate)}\right)$$

$$+ \beta \text{ (Product Turnover Effect Index)}$$

(2) Decomposition of Unit Value Price Index

Unit Value Price Index, π_t^{Θ}, can be decomposed into the four factors as following,

$$\pi_t^{\Theta} = \left(\frac{P_{t-y}^{C}}{P_{t-y}^{\Theta}}\right) w_{t-y}^{C} \pi_t^{CL} + \left(\frac{P_{t-y}^{C}}{P_{t-y}^{\Theta}}\right) w_{t-y}^{C} \phi_t^{C} + \frac{w_{t-y}^{O}\left(P_t^{C} - P_{t-y}^{O}\right) + w_t^{N}(P_t^{N} - P_t^{C})}{P_{t-y}^{\Theta}} + \left(\frac{P_{t-y}^{C}}{P_{t-y}^{\Theta}}\right) w_{t-y}^{C} \phi_t^{C} \pi_t^{C}$$

where,

P_t^C: weighted average unit value price of continuing goods using the volume-quantity weight in category Θ in the period t,

P_{t-y}^C: weighted average unit value price of continuing goods using the volume-quantity weight in category Θ in the period $t-y$,

P_t^N: weighted average unit value price of new goods using the volume-quantity weight in category Θ in the period t,

P_{t-y}^O: weighted average unit value price of disappearing goods using the volume-quantity weight in category Θ in the period $t-y$,

w_{t-y}^C: volume-quantity share of continuing goods in category Θ in the period $t-y$,

w_t^{N}: volume-quantity share of new goods in category Θ in the period t,

w_{t-y}^{O}: volume-quantity share of continuing goods in category Θ in the period $t-y$,

π_t^{CL}: growth rate of price index with Laspeyres formula of continuing goods in category Θ,

ϕ_t^C: the substitution effect among continuing goods in category Θ,

and,

$\pi_t^C = (P_t^C - P_{t-y}^C)/P_{t-y}^C$.

In the decomposition formula, the first term shows contribution of the price change effect of continuing goods, the second term shows contribution of the substitution effect among continuing goods, the third term shows contribution of the product turnover effect, and the fourth term shows the contribution of the cross term.[2]

[2] To know more about the decomposition of unit value index, you can see Abe, Enda, Inakura and Tonogi (2015).

<Reference>

- Sato, Kazuo. "The ideal log-change index number." *The Review of Economics and Statistics* (1976): 223-228.
- Vartia, Yrjö O. "Ideal log-change index numbers." Scandinavian Journal of Statistics (1976): 121-126.
- Abe, Enda, Inakura, and Tonogi. (2015). “Effects of New Goods and Product Turnover on Price Indexes”. RCESR Discussion Paper Series No. DP15-2.