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EMPIRICAL STUDY OF OUTLET SAMPLING USING SCANNER DATA

Contributed paper submitted by the Management and Coordination Agency of Japan*

Summary

This study aims to clarify bias problem comes from outlet sampling procedures of consumer price indices. Test calculations using scanner data show that a combination of "cut-off" for outlet sampling and "simple arithmetic mean" for aggregation produces fairly good estimates. By exclusion of some small-size shops such as convenience stores, at which prices tend to be invariable, estimates are rather improved unless such small shops have large shares. Bias in certain direction is not observed probably because prices at other types of retail shops tend to change in parallel with each other if leveling out the price bouncing although price level is different among different types of retail shops.

Significant differences are seemingly not observed between "cut-off" based on sales of the relevant category and based on the total sales. It implies that criteria used for "cut-off" can be loose, and survey staff need not grasp so exact data for outlet sampling.

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As to comparison of simple arithmetic mean and simple geometric mean of price indices by sample outlets, differences between them are so small that it is hard to tell which is superior to the other within the scope of this study.

Outlet sampling by the PPS-method might cause upward bias when the price bouncing is strong (that’s the case in Japan as to many daily necessities). In this case, when adopting some appropriate set of weights for the PPS-sampling, and taking geometric mean of price relatives by outlets, there is a possibility that estimates are almost free from bias although further exploration is required to come to the conclusion. However, when sample item is also selected by the PPS-method at each sample outlet – i.e. two-stage PPS-sampling, estimates possibly have upward bias even if taking geometric mean of price relatives because the price bouncing has serious effects on propriety of item selection by the PPS-method.

Introduction

In Japan, sample outlets, where prices are collected for a compilation of consumer price index (CPI), are selected in non-stochastic way. In principle, outlets ranked the highest in sales of each category are selected in each survey area – i.e. cut-off method. Recently, this sampling procedure is criticized for a possible cause of upward bias of price indices for the following reasons.

- It might be difficult to specify the most popular outlets exactly for each category.
- The most popular outlets in the past might lose their positions due to increase of so-called discount stores
- Some small-size retail shops such as convenience stores might be selected less frequently.

Some experts speculate that stochastic outlet sampling such as stochastic selection with probabilities proportionate to sales – i.e. PPS-method - is superior to the present cut-off sampling, which is considered to be acceptable from the past experience. However, clear-cut views on this matter probably do not exist so far, and more researches are required. This paper is an interim report of our recent empirical study of outlet sampling using scanner data.[1)] The results seem to give some insight to the nature of complexity of retail prices although the scope of this study is limited.

Methodology

Available scanner data cover foods except fresh foods, miscellaneous goods for daily use and cosmetics. Among those categories, four categories – instant coffee, chewing gum, toothpaste and toilet tissue - are picked up for the study. The scanner data for instant coffee and chewing gum is provided from about 800 outlets - consisting of about 400 supermarkets including general merchandise stores, about 140 mini-supermarket, which are a type of small-size retail shops similar to convenience stores except for sales of fresh foods, and about 250 convenience stores. As for toothpaste and toilet tissue, the scanner data is provided from about 1700 outlets - consisting of the same outlets with the case of instant coffee and chewing gum plus about 100 home improvement stores and about 700 drug stores. As sales of food categories at home improvement centers and drug stores are negligible, those types of retail shops are excluded from test calculations for instant coffee and chewing gum. Sales at the retail shops are not adjusted according to actual shares of sales by types of retail shops because the exact information is not available. Convenience stores in sample are likely to be fewer. However, its share of household consumption, which contains purchases from department stores, self-employed retailers and mail orders also, seems to be actually as small as its share of sales in the available scanner data. In fact, its share is about 3 percents of household consumption in “coffee and cocoa” including canned coffee, and “cakes and candies”, about 1 percent in “facial tissue and toilet paper”, and “facial soap, shampoo and toothpaste” according to the 1994 National Survey of Family Income and Expenditure, a large-scale family budget survey conducted by Statistics Bureau every five years. (See *Chart 1* below.)

In order to evaluate outlet-sampling methods purely, the superlative price index for each outlet, which is expected to be close to the actual price change at each outlet, is required. Therefore, for each outlet, Fisher’s (ideal) index is computed using unit price indices and sales of all items[2)] within a category as well as Laspeyres’ index, Paasche’s index and geometric-mean index. The reference period for outlet, and price index is fixed in March 1997.

Those price indices by outlets are aggregated using several formulas, and compared with each other in order to evaluate outlet-sampling methods. As this study is mainly focused on bias of price index caused by sampling methods, sampling errors are not estimated.

Chart 1 Percentage of Sales by Types of Retail Shops in the Scanner Data

(Percent)

	Instant coffee	Chewing gum	Tooth paste	Toilet paper
Total	100.0	100.0	100.0	100.0
Super markets	90.9	76.2	38.7	46.8
Mini-supermarkets	8.1	8.6	3.0	4.7
Convenience stores	0.9	15.1	0.9	0.6
Home improvement stores			11.5	12.6
Large-size drug stores[a)]			40.7	29.8
Small-size drug stores[b)]			5.2	5.6

a) Monthly turnover is more than 10
b) Monthly turnover is less than 10

Comparison among aggregates of price index by outlets

Similarly to item sampling, substitution effects possibly cause upward biases of Laspeyres-type aggregates of price indices by outlets using weights proportionate to sales of the relevant category by outlets. In fact, the Laspeyres-type (population) aggregates are higher than the Fisher-type (population) aggregates except for chewing gum, as shown in ***Chart 3*** and ***Chart A-3*** appended, although the differences are smaller than those of item level (see ***Chart 2*** and ***Chart A-2*** appended). Those results indicate that outlet sampling by the PPS-method – stochastic selection with probability proportionate to sales of the relevant category at the reference period - causes upward bias.

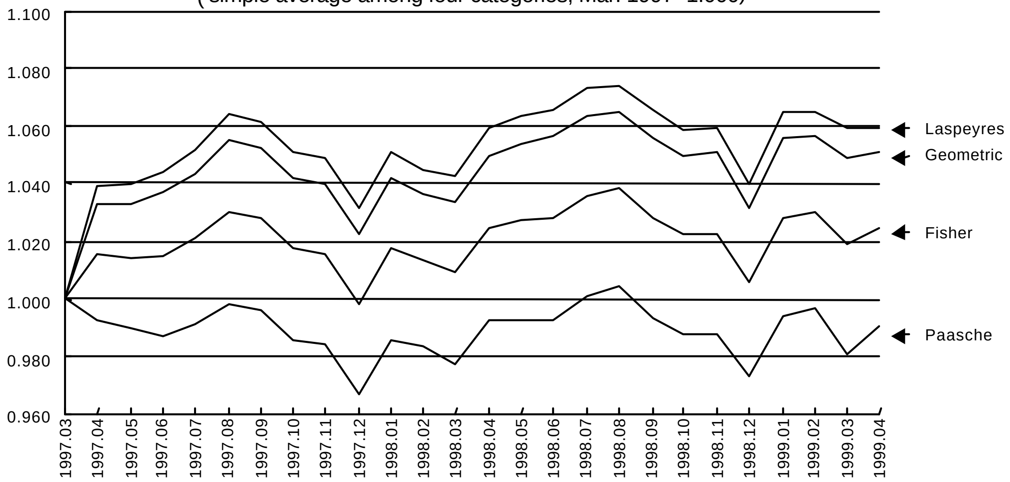
It should be noted that the geometric-mean-type (population) aggregates are also higher than the Fisher-type (population) aggregates except for chewing gum the same as in the case of item selection. That phenomenon is probably attributable to the price “bouncing”. In Japan, retail stores tend to have a bargain sale frequently, and sales at bargain prices are probably larger than sales at non-bargain prices. Chewing gum is sold at bargain prices much less frequently. The results indicate that outlet sampling by the PPS-method is not able to avoid upward bias even if geometric-mean-type aggregates are adopted instead of Laspeyres-type.[3)]

In practice, however, the reference period of outlet sampling usually precedes that of item sampling and price indices. That interval between both reference periods might weaken effects of the price bouncing.

Comparison among aggregates of price indices by outlets using different sets of weights

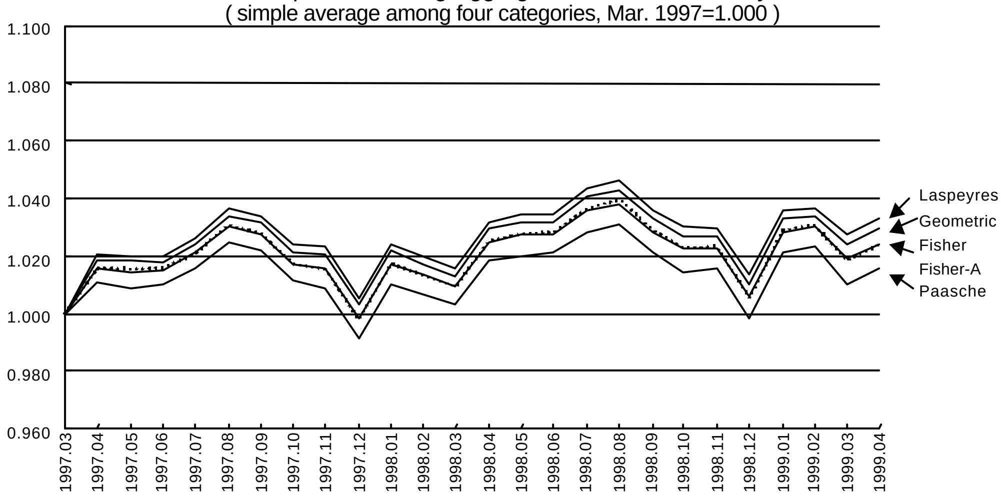
It seems to be more practical to select sample outlets with probability proportionate to the total sales by outlets or sales of some group of categories including the relevant category instead of the detailed category level. Bias of price indices produced from the PPS-sampling with different sets of weights is possible to be estimated by calculations of the (population) aggregates of price indices by outlets with the relevant sets of weights. In this study, sales of all categories of which scanner data is available are used for test calculations because the total sales at each outlet are not available. As a matter of convenience, turnover of all categories available is denoted the “total sales” in this paper.

Chart 2 Comparison among Price Indices by Outlets
(simple average among four categories, Mar. 1997=1.000)



For each category of instant coffee, chewing gum, tooth paste and toilet paper, price indices by outlets computed using four formulas - Laspeyres', Paasche's , Fisher's and geometric mean - are aggregated using Fisher's formula with weights proportionate to sales of the category by outlets. Those four kinds of aggregates are denoted by "Laspeyres", "Paasche", "Fisher" and "Geometric" respectively.
The above chart shows simple averages of those aggeregates among the four categories.

Chart 3 Comparison among Aggregates of Price Indices by Outlets
(simple average among four categories, Mar. 1997=1.000)



For each category of instant coffee, chewing gum, tooth paste and toilet paper, price indices by outlets computed using Fisher's formula are aggregated using four formulas - Laspeyres', Paasche's , Fisher's and geometric mean - with weights proportionate to sales of the category by outlets. Those four kinds of aggregates are denoted by "Laspeyres", "Paasche", "Fisher" and "Geometric" respectively.
The above chart shows simple averages of those aggregates among four categories.

As for an index denoted by "Fisher-A" drawn with a dotted line in the chart, the geometric mean of two kinds of aggregates - Laspeyres' aggregation of price indices by outlets computed using Laspeyres' formula andPaasche's aggregation of price indices by outlets computed using Paasche's formula - is taken for each category, and averaged among four categories.

"Fisher" is almost equal to "Fisher-A" as shown.

The results show that the differences among aggregates – Laspeyres-type, Paasche-type, Fisher-type and geometric-mean-type - clearly become smaller as shown in *Chart 4* and *Chart A-4* appended. Those aggregates computed using a set of weights proportionate to the total sales by outlets are denoted by “Laspeyres-2”, “Paasche-2”, “Fisher-2” and “Geometric-2” respectively in the Charts. Those reductions in bias probably result from weaker effects of the price bouncing. However, Laspeyres-type aggregate still suffers from upward bias while geometric-mean-type aggregate almost equals to Fisher-type notably.

It should be further examined whether the geometric-mean-type (population) aggregates are really free from bias, and simple geometric mean is a good aggregation formula when sample outlets are selected by the PPS-method. The reasons are as follows.

- It is not clear which aggregate level of categories should be used for weighting when outlet sampling is executed locally. Effects of the price bouncing at local level might be much stronger in comparison with the national level.

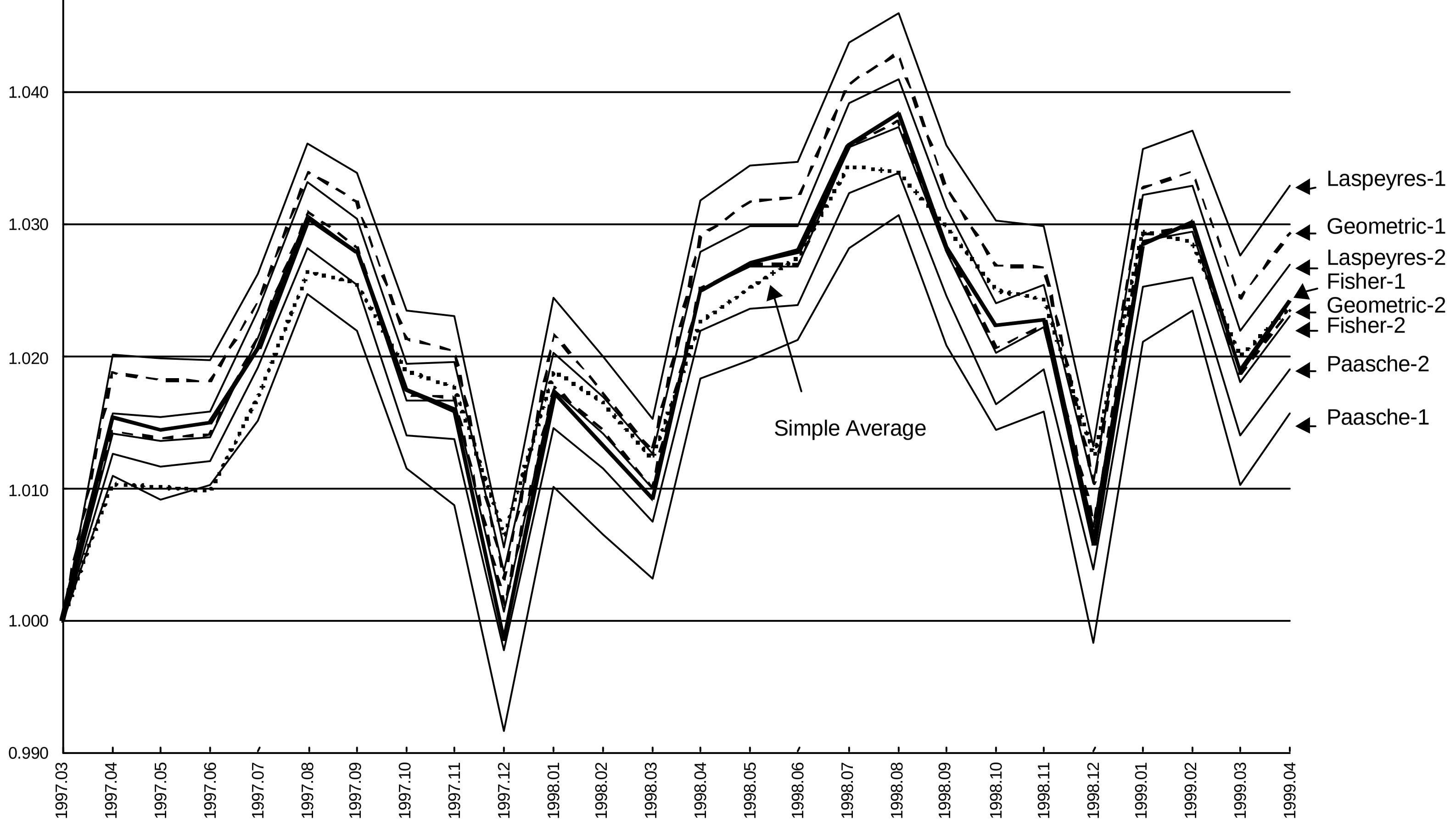
- In practice, the reference period of outlet sampling usually precedes that of item sampling and price indices. That interval between both reference periods might weaken effects of the price bouncing.

- Simple geometric mean of price relatives by sample outlets dose not average to the geometric-mean-type (population) aggregate exactly. When number of sample outlets assigned to each survey area is not enough, the difference might be significant.[3)]

Comparison among cut-off methods for the selection of sample outlets

Aggregation taking simple average of price relatives at sample outlets selected by cut-off method, which is approximate to the present procedures for a compilation of price indices, is also expected to avoid effects of the price bouncing. In this study, two types of cut-off are tested. One is based on sales of the relevant category by outlets, and another is based on the total sales by outlets. In addition, the (population) simple average of price relatives by outlets is also calculated.

Chart 4 Comparison among Aggregates of Price Indices by Outlets with Different Sets of Weights
(Simple average among four categories, Mar. 1997=1.000)



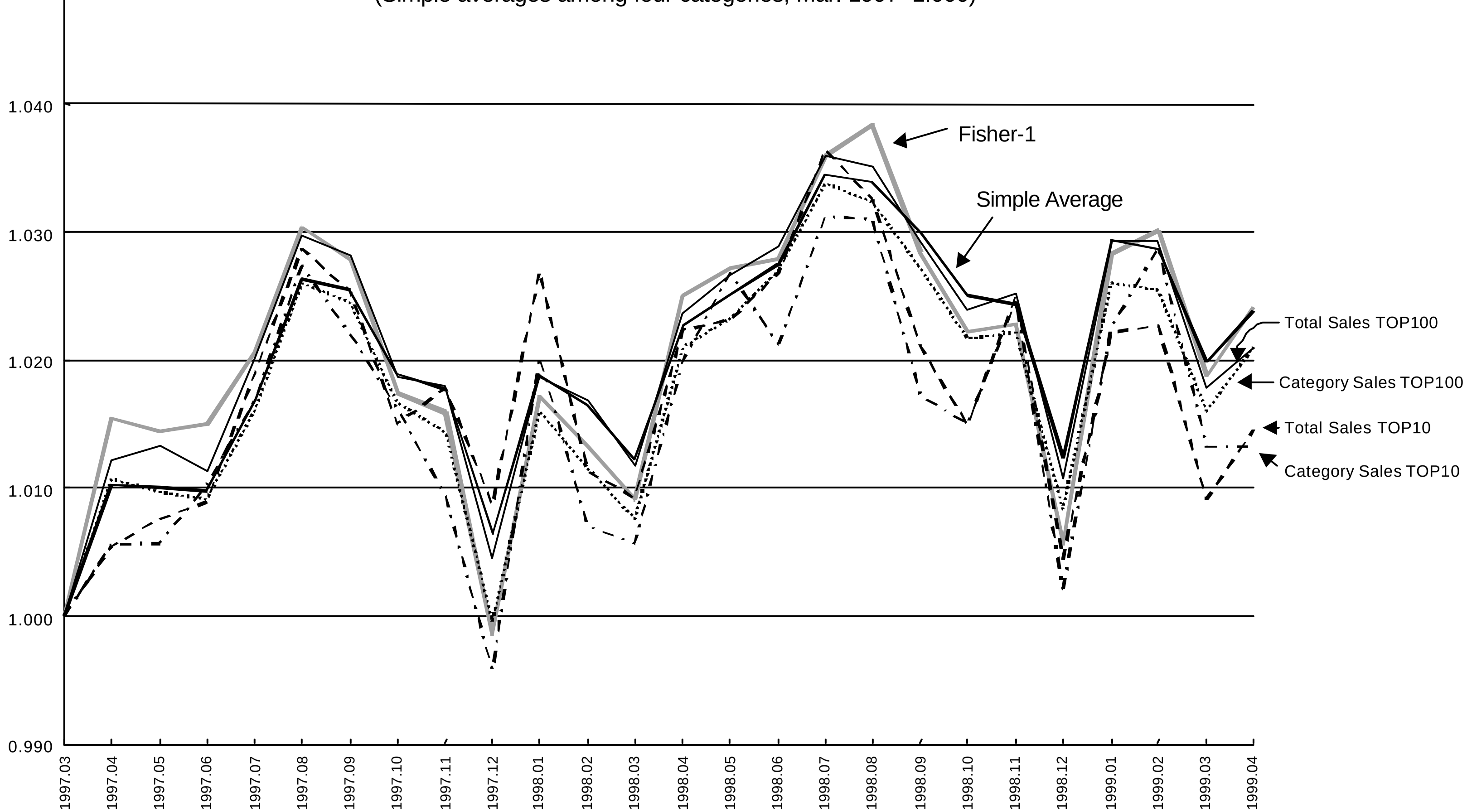
For each category of instant coffee, chewing gum, tooth paste and toilet paper, price indices by outlets computed using Fisher's formula are aggregated using four formulas - Laspeyres' , Paasche's, Fisher's and Geometric mean - with a set of weights proportionate to sales of the category by outlets, and with another set of weights proportionate to total sales (sales of foods except fresh foods, miscellaneous goods for daily use and cosmetics) by outlets. Those aggregates are denoted by "Laspeyres-1", "Paasche-1", "Fisher-1", "Geometric-1", "Laspeyres-2", "Paasche-2", "Fisher-2" and "Geometric-2" respectively. In addition, simple averages are taken (with an equal weight given to outlets) for aggregation of price indices by outlets, and denoted by "Simple Average".
The above chart shows simple averages of those aggregates among the four categories.

As shown in *Chart 5* and *Chart A-4* appended, the results seem to be fairly good, taking account that those aggregates are based on subsets of outlets. Simple averages seem not to have bias in certain direction. Difference between the (population) simple average and the superlative aggregate, which is denoted by “Fisher-1”, is relatively larger as to instant coffee and tooth paste. That is because prices are almost invariable at all convenience stores and many of small-size drug stores (See *Chart 6-1*.). When prices tend to rise at other types of retail shops, the (population) simple average tends to have downward bias, while it tends to have upward bias when prices tend to fall because convenience stores and small drug stores do not have large shares of sales although number of those stores is relatively large (See *Chart 6-2*.). In fact, prices of instant coffee tend to rise from the reference month (up 11.9 percent points in April 1998 from March 1997), and prices of tooth paste tend to fall (down 2.5 percent points in the same period) while prices of chewing gum and toilet paper change little on average (up 0.4 and down 0.1 respectively).

As to instant coffee, difference of simple average of price relatives at outlets ranked the highest 10 and 100 in sales of instant coffee (denoted by “Category sales TOP10” and “Category sales TOP100” respectively in *Chart 5* and *Chart A-4* appended) from “Fisher-1” is relatively larger in comparison with aggregate among outlets ranked the highest 10 and 100 in the total sales (denoted by “Total sales TOP10” and “Total sales TOP100” respectively). It might be related with the fact that instant coffee is frequently used as a loss leader at bargains, and prices of instant coffee are discounted substantially at frequent bargains. When amount of annual sales is used as a measure instead, cut-off method based on sales of instant coffee might produce better estimates.

Except for instant coffee, both cut-off by sales of the relevant category and by the total sales are almost equally good. Those results indicate that criteria for outlet selection can be relatively loose. In other words, price collector may go to the second largest shop in sales of the relevant category instead of the top one. However, generally speaking, price collector probably should try to visit the largest shops in sales of the relevant category as far as possible in order to minimizing sampling errors. Price collector should not visit small-size shops such as convenience stores at which prices tend to be invariable in order to avoid bias of price indices unless those shops have fairly large shares in sales of the category, and a stratified sampling method is a better choice.

Chart 5 Comparison among Cut-off Methods for the Selection of Sample Outlets
(Simple averages among four categories, Mar. 1997=1.000)



For each category of instant coffee, chewing gum, tooth paste and toilet paper, price indices by outlets computed using Fisher's formula are averaged with an equal weight in two subsets of outlets respectively - ten outlets and a hundred outlets ranked the highest in sales of the category in the reference month. Simple averages are also taken in another two subsets respectively - ten outlets and a hundred outlets ranked the highest in the total sales (sales of foods except fresh foods, miscellaneous goods for daily use and cosmetics) in the reference month. Those four kinds of aggregates are denoted by "Category Sales TOP10", "Category Sales TOP100", "Total Sales TOP10", and "Total Sales TOP100" respectively. The above chart shows simple averages of those aggregates among the four categories.
As for "Fisher-1" and "Simple Average" in the chart, see footnote on Chart 4.

Comparison between simple arithmetic mean and simple geometric mean in cut-off sampling

It is of great interest which one is better than the other when comparing simple arithmetic mean and simple geometric mean. As shown in ***Chart*** *7*, differences between them seem to be so insignificant that it is impossible to tell which is better in this study.

However, it should be reminded that practically some representative item(s) from a given category is priced at each outlet because the superlative price index for a given category is not available. Representative items that have large shares in sales tend to be used as lose leaders at bargains. As a result, the price bouncing has serious effects on the representative items later than the whole category. Therefore, there is a possibility that differences among simple arithmetic mean and simple geometric mean of price relatives, and relatives of simple arithmetic mean are significant in practice unless bargain prices are not excluded for a compilation of price index.[4)]

Chart 6-1 Histogram of Price Relatives by Outlets
(Tooth paste, Mar. 1998, Mar. 1997=1.000)

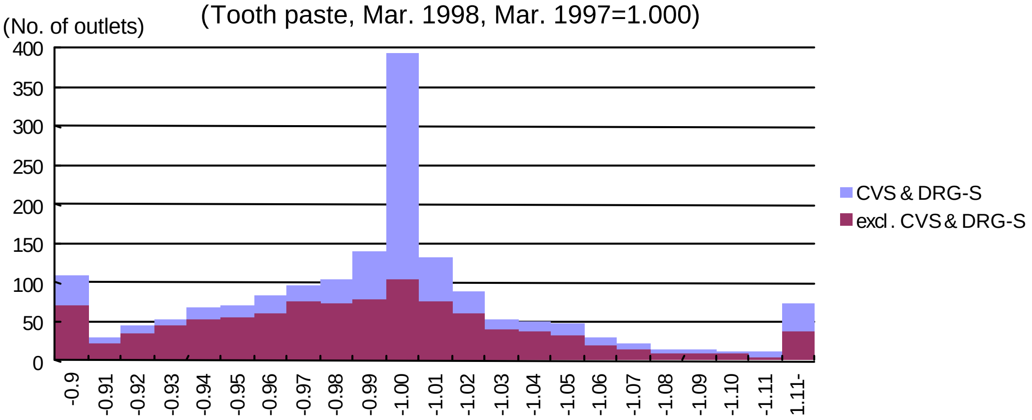
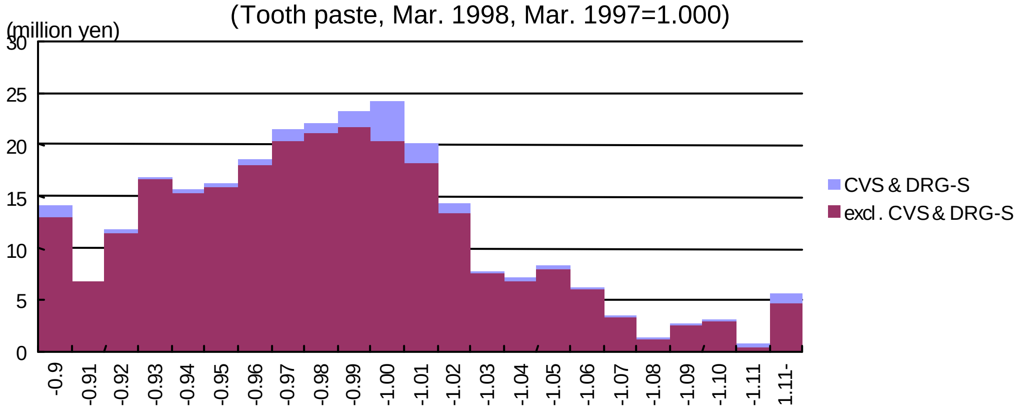


Chart 6-2 Amount of Sales by Level of Price Relatives at Outlets
(Tooth paste, Mar. 1998, Mar. 1997=1.000)



CVS : Convenience stores
DRG-S : Small-size drug stores with monthly turnover less than 10 million yen.

Chart 7 Comparison between Simple Arithmetic mean and Simple Geometric Mean of Price Indices by Outlets

Mar. 1998 (Mar. 1997 = 1.000)

	aggregation of price indices by outlets 1)			
	simple geometric mean	simple average	difference	Fisher-1 2)
Instant coffee	1.100	1.103	-0.004	1.120
Chewing gum	0.998	0.999	0.000	1.000
Tooth paste	0.988	0.990	-0.002	0.979
Toilet paper	0.954	0.957	-0.003	0.938
Simple average among four categories	1.010	1.012	-0.002	1.009

Mar. 1999 (Mar. 1998 = 1.000)

	aggregation of price indices by outlets 1)			
	simple geometric mean	simple average	difference	Fisher-1 2)
Instant coffee	1.009	1.012	-0.004	1.006
Chewing gum	0.999	0.999	0.000	1.001
Tooth paste	0.994	0.995	-0.002	0.984
Toilet paper	1.041	1.044	-0.003	1.057
Simple average among four categories	1.011	1.013	-0.002	1.013

1) Aggregates of price indices by outlets computed using Fisher's formula.
2) As for "Fisher-1", see footnote on Chart 4.

Consideration to two-stage stochastic sampling

When sample outlets are selected with the PPS-method then a sample item is selected with the PPS-method at each sample outlet – i.e. two-stage PPS-sampling, a simple arithmetic mean of price relatives by sample outlets averages to the Laspeyres-type (population) aggregate of price indices by outlets computed using Laspeyres' formula. While a simple geometric mean of price relatives averages to some approximate to the geometric-mean-type (population) aggregate of geometric-mean-type price indices by outlets.[5)]

Test calculations show that both types of the (population) aggregates suffer from substantial upward bias as shown in *Chart 8*. That is probably because the price bouncing has serious effects on propriety of item selection procedures. It seems to be a good speculation that usage of traditional cut-off for item selection produces better results as to unbiasedness.

Conclusion

Our study shows that a combination of "cut-off" for outlet sampling and "simple arithmetic mean" for aggregation produces fairly good estimates. By exclusion of some small-size shops such as convenience stores, at which prices tend to be invariable, estimates are rather improved unless such small shops have large shares. Bias in certain direction is not observed probably because prices at other types of retail shops tend to change in parallel with each other if leveling out the price bouncing (as shown in *Chart A-1* appended) although price level is different among different types of retail shops. It implies that so-called discounters newly opened do not cause significant bias of price indices.

Significant differences are seemingly not observed between "cut-off" based on sales of the relevant category and based on the total sales. It implies that criteria used for "cut-off" can be loose, and survey staff need not grasp so exact data for outlet sampling.

Thus, some naive doubts concerning the traditional cut-off method described in *Introduction* to this paper seem to be off the point.

As to the comparison of simple arithmetic mean and simple geometric mean, differences between them are so small that it is hard to tell which is superior to the other within the scope of this study.

Chart 8 Bias in Two-Stage Laspeyres' and Geometric-Mean Aggregation
(Simple average among four categories, Mar. 1997=1.000)

For each category of instant Coffee, chewing gum, tooth paste and toilet paper, price index by outlets computed using Laspeyres' formula are aggregated using Laspeyres' formula, and price index by outlets computed using geometric-mean formula are aggregated using geometric-mean formula with a set of weights proportionate to sales of the category by outlets, and with another set of weights proportionate to the total sales by outlets. Those aggregates are denoted by "Laspeyres-1L", "Geometric-1G", "Laspeyres-2L" and "Geometric-2G" respectively. In addition, simple averages are taken (with an equal weight given to outlets) for aggregation of price indices by outlets computed using Laspeyres' formula, and denoted by "Simple Average-L".
The above chart shows simple averages of those aggregates among the four categories.
As for "Fisher-1" and "Simple Average", see footnote on Chart 4.

Outlet sampling by the PPS-method might cause upward bias when the price bouncing is strong (that's the case in Japan as to many daily necessities). In this case, when adopting some appropriate set of weights for the PPS-sampling, and taking geometric mean of price relatives, there is a possibility that estimates are almost free from bias although further exploration is required to come to the conclusion. However, when sample item is also selected by the PPS-method at each sample outlet – i.e. two-stage PPS-sampling, estimates possibly have upward bias even if taking geometric mean of price relatives because the price bouncing possibly has serious effects on propriety of item selection by the PPS-method.

Needless to say, it is desirable to make similar studies covering wider varieties of categories. In addition, the same test calculations might be desirable using annual averages as the reference for outlet selection instead of monthly averages in order to confirm the results shown in this paper although new outlets have to be excluded from calculations.

Note.

1) This research was conducted with the collaboration of Marketing Intelligence Corporation (Japan). The author is very grateful to Mr. Ikuo Takahashi, Mr. Hitoshi Abe and other staff members in Marketing Intelligence Corporation (Japan) for a very large contribution. However, views expressed in this paper are those of the author and do not necessarily reflect those of Statistics Bureau or Marketing Intelligence Corporation (Japan).

2) In Japan, scan able products are uniquely defined by Japanese Article Number (JAN). In this paper, products that have different JANs are regarded as different items basically.

3) Probably a simple geometric mean of price indices by sample outlets, which selected by the PPS-method, is expected to lies between the Laspeyres-type and the geometric-mean-type (population) aggregate on average.

When *n* outlets are sampled with replacement by the PPS-method, a simple geometric mean of price relatives by sample outlets is expected to average a CES-type aggregate.

$$I_{CES} = \left\{ \sum w_0 \left(\frac{p_t}{p_0} \right)^{1/n} \right\}^n$$

w_0 : weight proportionate to sales at each outlet in the reference period

$\frac{p_t}{p_0}$: price relative at each outlet

n : number of sample outlets

When the population is divided into *n* groups taking a share of sales almost equally, and an outlet is selected by the PPS-method from each group, a simple geometric mean of price relatives by sample outlets is expected to average in-between, geometric-mean index and CES index.

$$I_{PCES} = \prod_{k} \left\{ \sum_{i_k}^{i_{k+1}-1} \frac{w_{0i}}{W_{0k}} \left(\frac{p_{ti}}{p_{0i}} \right)^{W_{0k}} \right\} \approx \prod_{k} \left\{ \sum_{i_k}^{i_{k+1}-1} n w_{0i} \left(\frac{p_{ti}}{p_{0i}} \right)^{1/n} \right\}$$

w_{0i} : weight assigned to *i*-th outlet proportionate to sales at the outlet in the reference period

W_{0k} : sum of weights among outlets belong to group *k*

$\frac{p_{ti}}{p_{0i}}$: price relative at *i*-th outlet

n :

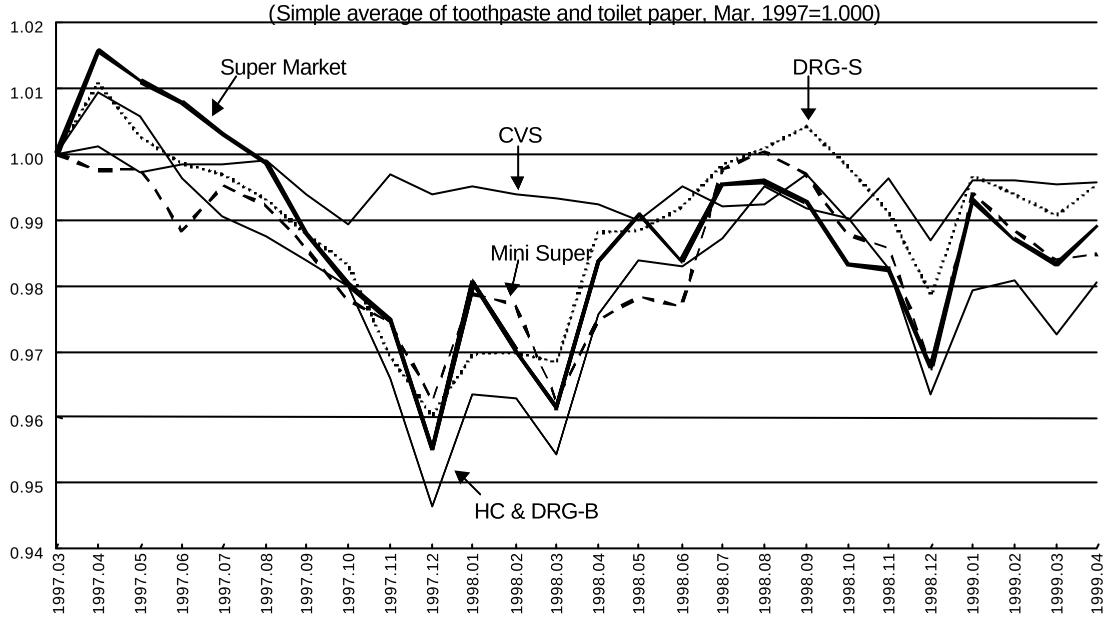
hich are selected by a two-stage PPS-
nean-type (population) aggregate on

4) In Japan, prices at short-term bargains within a week are excluded.

5) Similarly to outlet sampling, a simple geometric mean of price relatives, which are selected by a two-stage PPS-method, is expected to lies between the Laspeyres-type and the geometric-mean-type (population) aggregate on average. See Note 3).

Appendix

Chart A-1 Price Indices by types of outlets
(Simple average of toothpaste and toilet paper, Mar. 1997=1.000)



Price indices are calculated in the same way as "Fisher-1" in Chart 4.
CVS : Convenience stores
Mini Super : small-size retail shops similar to convenience stores except for sales of fresh foods
HC : Home improvement stores
DRG-B : Large-size drug stores with monthly turnover more than 10 million yen
DRG-S : Small-size drug stores with monthly turnover less than 10 million yen

Chart A-2 Comparison among Price Indices by Outlets (Mar. 1997 = 1.000)

Simple averages among four categories

Formula	difference from "Fisher" average of difference	difference from "Fisher" average of absolute difference
Laspeyres	0.034	0.034
Geometric	0.025	0.025
Paasche	-0.032	0.032
Fisher	0.000	0.000

Instant coffee

Formula	difference from "Fisher" average of difference	difference from "Fisher" average of absolute difference
Laspeyres	0.075	0.075
Geometric	0.058	0.058
Paasche	-0.070	0.070
Fisher	0.000	0.000

Tooth paste

Formula	difference from "Fisher" average of difference	difference from "Fisher" average of absolute difference
Laspeyres	0.041	0.041
Geometric	0.027	0.027
Paasche	-0.039	0.039
Fisher	0.000	0.000

Chewing gum

Formula	difference from "Fisher" average of difference	difference from "Fisher" average of absolute difference
Laspeyres	0.003	0.003
Geometric	0.001	0.001
Paasche	-0.003	0.003
Fisher	0.000	0.000

Toilet paper

Formula	difference from "Fisher" average of difference	difference from "Fisher" average of absolute difference
Laspeyres	0.018	0.018
Geometric	0.014	0.014
Paasche	-0.017	0.017
Fisher	0.000	0.000

Averages of difference from "Fisher" in each month from 1997/04 - 1999/04 are shown in the chart.
As for formulas in the chart, see footnote on Chart 2.
In the table for "Simple averages among four categories", simple averages of aggregates among the four categories are compared with simple averages of "Fisher" among the four categories.

Chart A-3 Comparison among Aggregates of Price Indices by Outlets (Mar. 1997 = 1.000)

Simple averages among four categories

Formula	difference from "Fisher" average of difference	difference from "Fisher" average of absolute difference
Laspeyres	0.007	0.007
Geometric	0.004	0.004
Paasche	-0.007	0.007
Fisher	0.000	0.000
Fisher-A	0.000	0.001

Instant coffee

Formula	difference from "Fisher" average of difference	difference from "Fisher" average of absolute difference
Laspeyres	0.017	0.017
Geometric	0.011	0.011
Paasche	-0.016	0.016
Fisher	0.000	0.000
Fisher-A	0.001	0.002

Tooth paste

Formula	difference from "Fisher" average of difference	difference from "Fisher" average of absolute difference
Laspeyres	0.004	0.004
Geometric	0.002	0.002
Paasche	-0.004	0.004
Fisher	0.000	0.000
Fisher-A	0.000	0.000

Chewing gum

Formula	difference from "Fisher" average of difference	difference from "Fisher" average of absolute difference
Laspeyres	0.000	0.000
Geometric	0.000	0.000
Paasche	0.000	0.000
Fisher	0.000	0.000
Fisher-A	0.000	0.000

Toilet paper

Formula	difference from "Fisher" average of difference	difference from "Fisher" average of absolute difference
Laspeyres	0.006	0.006
Geometric	0.003	0.003
Paasche	-0.006	0.006
Fisher	0.000	0.000
Fisher-A	0.000	0.000

Averages of difference from "Fisher" in each month from 1997/04 - 1999/04 are shown in the chart.
As for formulas in the chart, see footnote on Chart 3.
In the table for "Simple averages among four categories", simple averages of aggregates among the four categories are compared

Chart A-4 Comparison among Different Sets of Weights and Cut-off Methods (Mar. 1997 = 1.000)

Simple averages among four categories

Aggregation formula		difference from "Fisher-1"	
		average of difference	average of absolute difference
Category sales weights	Laspeyres-1	0.007	0.007
	Geometric-1	0.004	0.004
	Paasche-1	-0.007	0.007
	Fisher-1	0.000	0.000
Total sales weights	Laspeyres-2	0.003	0.003
	Geometric-2	0.000	0.001
	Paasche-2	-0.003	0.003
	Fisher-2	0.000	0.001
Equal weight	Simple Average	0.000	0.003
	Category Sales TOP10	-0.005	0.005
	Category Sales TOP100	-0.003	0.003
	Total Sales TOP10	-0.003	0.005
	Total Sales TOP100	0.000	0.002

Instant coffee

Aggregation formula		difference from "Fisher-1"	
		average of difference	average of absolute difference
Category sales weights	Laspeyres-1	0.017	0.017
	Geometric-1	0.011	0.011
	Paasche-1	-0.016	0.016
	Fisher-1	0.000	0.000
Total sales weights	Laspeyres-2	0.002	0.002
	Geometric-2	-0.003	0.003
	Paasche-2	-0.010	0.010
	Fisher-2	-0.004	0.004
Equal weight	Simple Average	-0.012	0.013
	Category Sales TOP10	-0.021	0.021
	Category Sales TOP100	-0.011	0.011
	Total Sales TOP10	-0.011	0.017
	Total Sales TOP100	-0.003	0.005

Tooth paste

Aggregation formula		difference from "Fisher-1"	
		average of difference	average of absolute difference
Category sales weights	Laspeyres-1	0.004	0.004
	Geometric-1	0.002	0.002
	Paasche-1	-0.004	0.004
	Fisher-1	0.000	0.000
Total sales weights	Laspeyres-2	0.004	0.004
	Geometric-2	0.002	0.002
	Paasche-2	-0.001	0.002
	Fisher-2	0.002	0.002
Equal weight	Simple Average	0.011	0.012
	Category Sales TOP10	-0.001	0.005
	Category Sales TOP100	0.001	0.003
	Total Sales TOP10	-0.002	0.005
	Total Sales TOP100	0.003	0.004

Chewing gum

Aggregation formula		difference from "Fisher-1"	
		average of difference	average of absolute difference
Category sales weights	Laspeyres-1	0.000	0.000
	Geometric-1	0.000	0.000
	Paasche-1	0.000	0.000
	Fisher-1	0.000	0.000
Total sales weights	Laspeyres-2	0.001	0.001
	Geometric-2	0.001	0.001
	Paasche-2	0.000	0.001
	Fisher-2	0.001	0.001
Equal weight	Simple Average	-0.002	0.002
	Category Sales TOP10	-0.002	0.002
	Category Sales TOP100	-0.001	0.001
	Total Sales TOP10	0.000	0.002
	Total Sales TOP100	0.000	0.001

Toilet paper

Aggregation formula		difference from "Fisher-1"	
		average of difference	average of absolute difference
Category sales weights	Laspeyres-1	0.006	0.006
	Geometric-1	0.003	0.003
	Paasche-1	-0.006	0.006
	Fisher-1	0.000	0.000
Total sales weights	Laspeyres-2	0.004	0.004
	Geometric-2	0.001	0.002
	Paasche-2	-0.003	0.003
	Fisher-2	0.000	0.002
Equal weight	Simple Average	0.002	0.006
	Category Sales TOP10	0.004	0.006
	Category Sales TOP100	0.000	0.003
	Total Sales TOP10	0.002	0.006
	Total Sales TOP100	0.001	0.004

Averages of difference from "Fisher-1" in each month from 1997/04 - 1999/04 are shown in the chart.
As for aggregation formula in the chart, see footnotes on Chart 4 and 5.
In the table for "Simple averages among four categories", simple averages of aggregates among the four categories are compared with simple averages of "Fisher-1" among the four categories.