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# CPI and Household Income Expenditure under Deflationary Trend

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[1] Opinions expressed in this paper are those of the authors and do not necessarily represent official views of the Statistics Bureau.
In this paper, weights from the Family Income and Expenditure Survey are applied almost in the same way as in the official indices but without detailed arrangements.

**Abstract**

General index of consumer price in Japan fell 0.3% in the year 2003 from the preceding year, showing considerable reduction in declining rate compared with 0.9% in the former year. This result, however, reflects rise in public utilities and does not necessarily reflect supply and demand for commodities and services. Thus, the government and the central bank share recognition that deflation is still continuing, although decline in consumer prices has reduced.

On the other hand, the results by yearly income groups show that declining rate for the first yearly income quintile group[2] with the smallest yearly income is 0.2 percent point smaller than that for the fifth income quintile group with the largest yearly income in the year 2003. This may indicate that income structure changes under the recent deflationary trend.

Examining the results by characteristics of items, index for basic expenditure items, whose expenditure elasticity are less than 1, fell by only 0.1%, while that for selective expenditure items fell by 0.6%. Additionally, index for items in annual purchase frequency classes of less than 0.5 times and over fell by 1.7%, while that of 15 times or more rose by 1.5%.

In argument about the cost-of-living index, in order to compensate for the "upward bias" of the Laspeyres-type fixed basket index, alternative formulae as the geometric mean or the CES type index are proposed, whose models are based on the assumption that a representative household with average income, average expenditure and homothetic preferences exists, in other words all items are common goods having constant elasticity of substitution.

In reality, superior goods and inferior goods coexist in the market and their optimum allocations may change according to incomes.

Discrepancy from homothetic model may emerge and effect differently among social strata especially in the year 2003. The Family Income and Expenditure Survey in Japan supplies us with tools to analyze such issues every month. Here we try, rather than considering theoretical verifications, to examine changes in prices and household expenditures by social strata, and to compare price indices in some formulae.

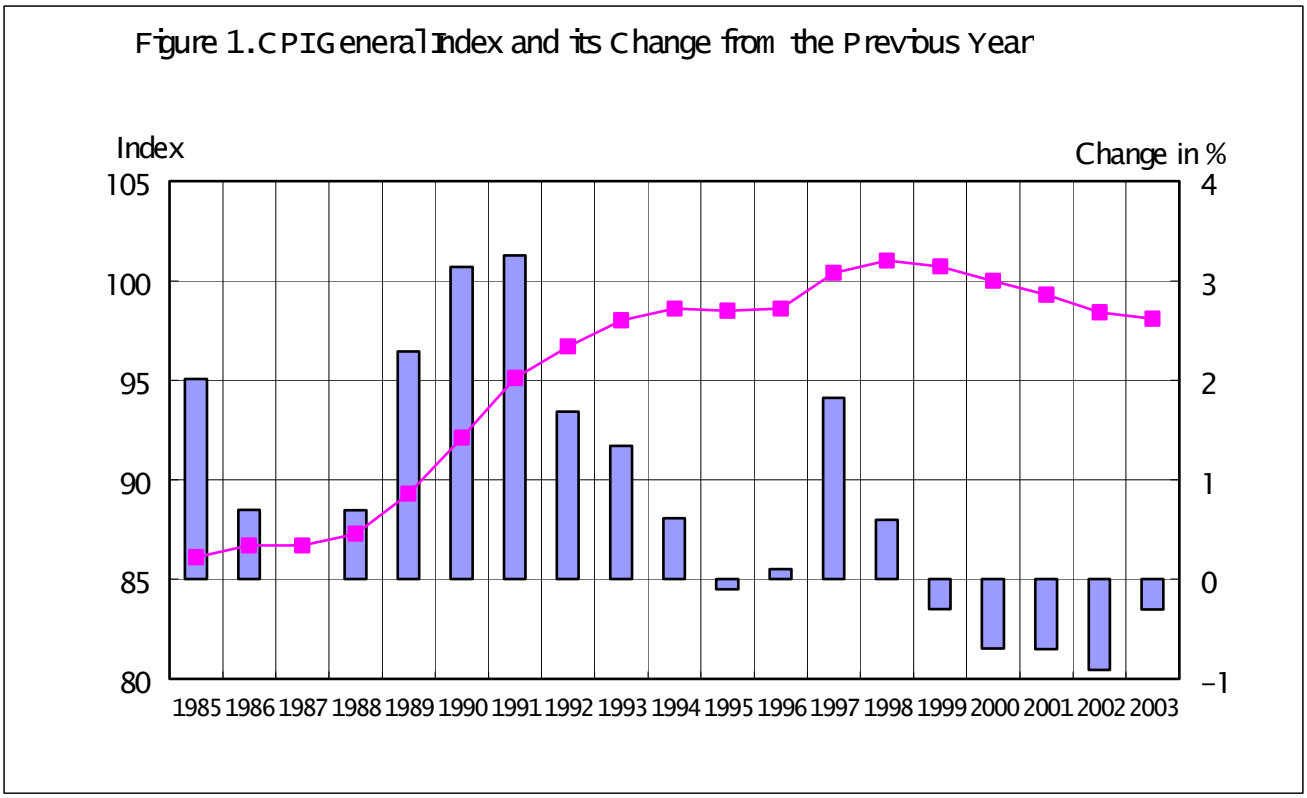
## 1. Outline of Recent CPI in Japan

General index of consumer prices in Japan attained the peak 101.0 in 1998 (2000=100) and stood at 98.1 in 2003, fell 0.3% from the preceding year, recording the fifth year of consecutive decline (Figure 1). Japan has never experienced such a long decline of CPI after World War II. But CPI in 2003 shows considerable reduction in declining rate compared with 0.9% in the former year.

CPI moves quite differently among goods and services. Figure 2 shows changes of CPI during five

[2] Yearly income quintile groups mean the five equally divided groups in terms of the number of households, after arranging them in order of the yearly income.

years, crossing data segmented by the peak year 1998; between in 1993-1998 when CPI rose and in 1998-2003 when CPI declined by ten major groups. Changes in 1998-2003 are lower than in 1993-1998 in nine major groups except for in Transportation & communication. In both periods, CPI rose in Education, Medical care, Housing and Miscellaneous[3], declining in Transportation & communication and Furniture & household utensils. In other four groups including basic consumption as Food, Fuel, light & water charges and Clothes & footwear, CPI rose in 1993-98 and dropped in 1998-2003. This may have reduced differences between the rich and the poor.




Indeed, expenditures differ among income groups. The richest group; the fifth group by yearly Income Quintile Groups spends a lot for Transportation & communication and Reading & recreation as well as Food, while the first group, which consists of those with small yearly income does not spend a lot for those except for Food (Figure 3). Expenditure for Education regarded as typical selective expenditure in the first group is about one eighth for the fifth group in amount, or almost half in weight, and staying low partly because of the price rise even during the deflation period. On the other hand, expenditures for Medical care, Housing and Fuel, light & water charges, regarded as basic expenditures, are similar between these two groups. Comparatively low level of price changes except for Education seems to have reduced the gap as to expenditures between the first and the fifth group. Ratio of total consumption expenditure of the fifth quintile group to the first quintile group tends to drop for recent years (Figure 4). Taking other observations into consideration[4], the gap of expenditures between the rich and the poor seems to have shrunk in

[3] Personal care services, Toilet articles, Cigarettes, etc.

[4] For example, ratio of total consumption expenditure of the fourth quintile group to the second quintile group recorded sixth year of consecutive decline in 2003.

recent years when price hikes have not be seen for most of commodities and services.

**Figure2. Change during Five Years by Ten Major Group (%)**

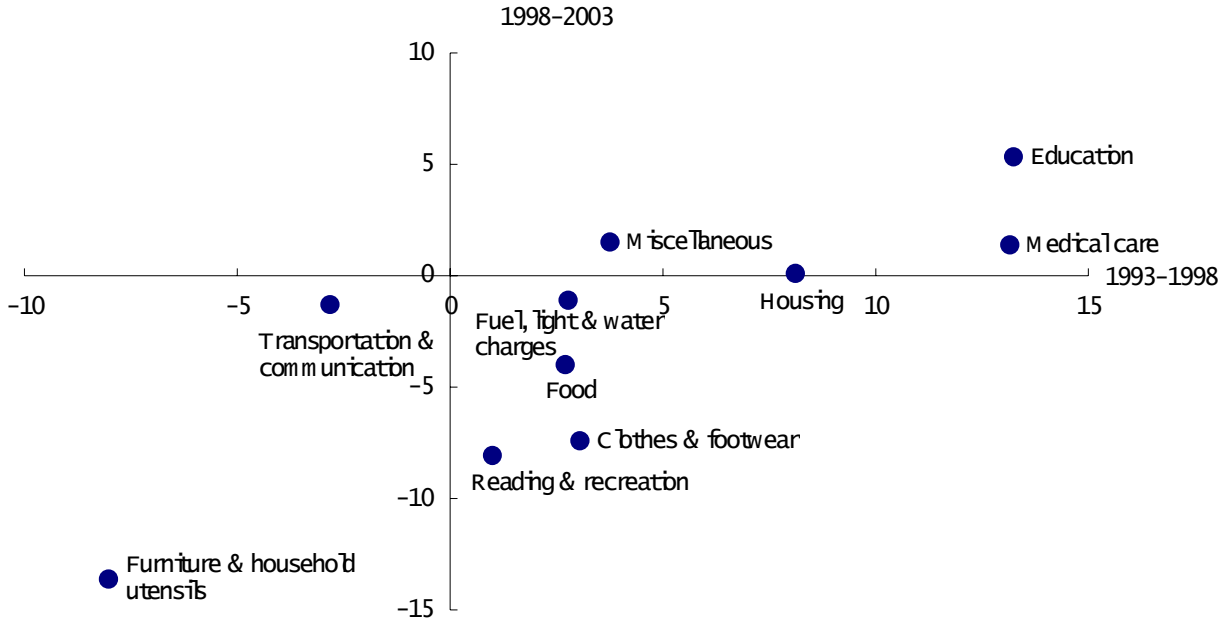



**Figure 3. Expenditures by Income Quintile Group for the Year 2003**

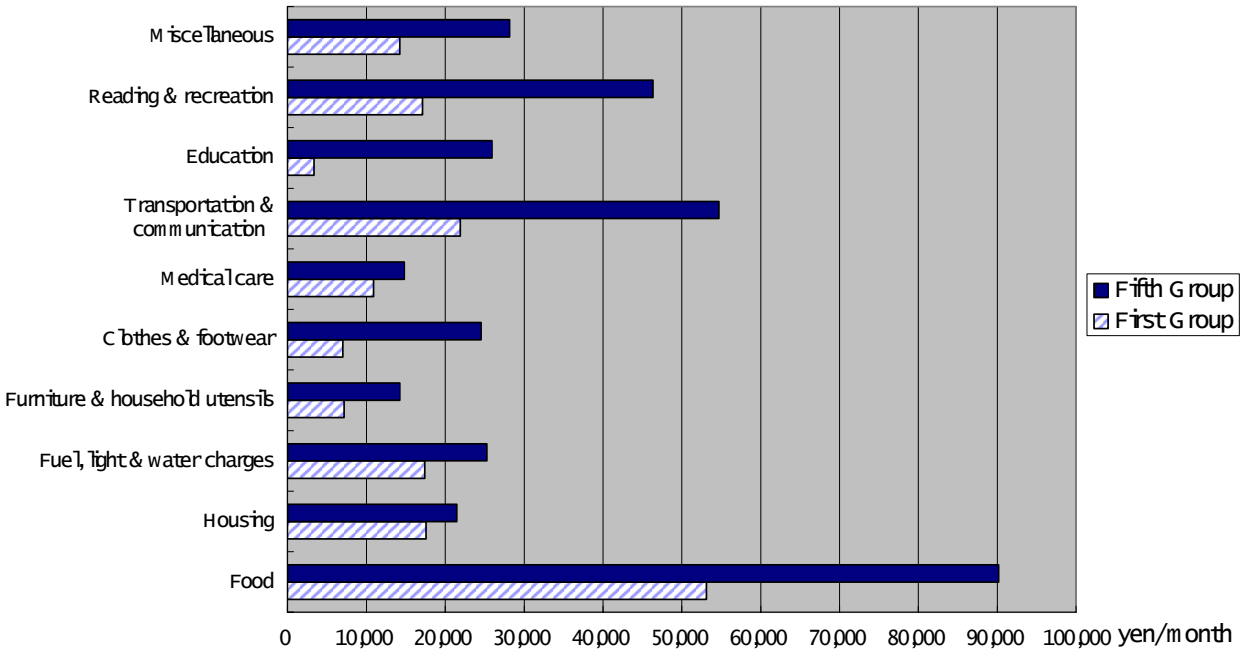
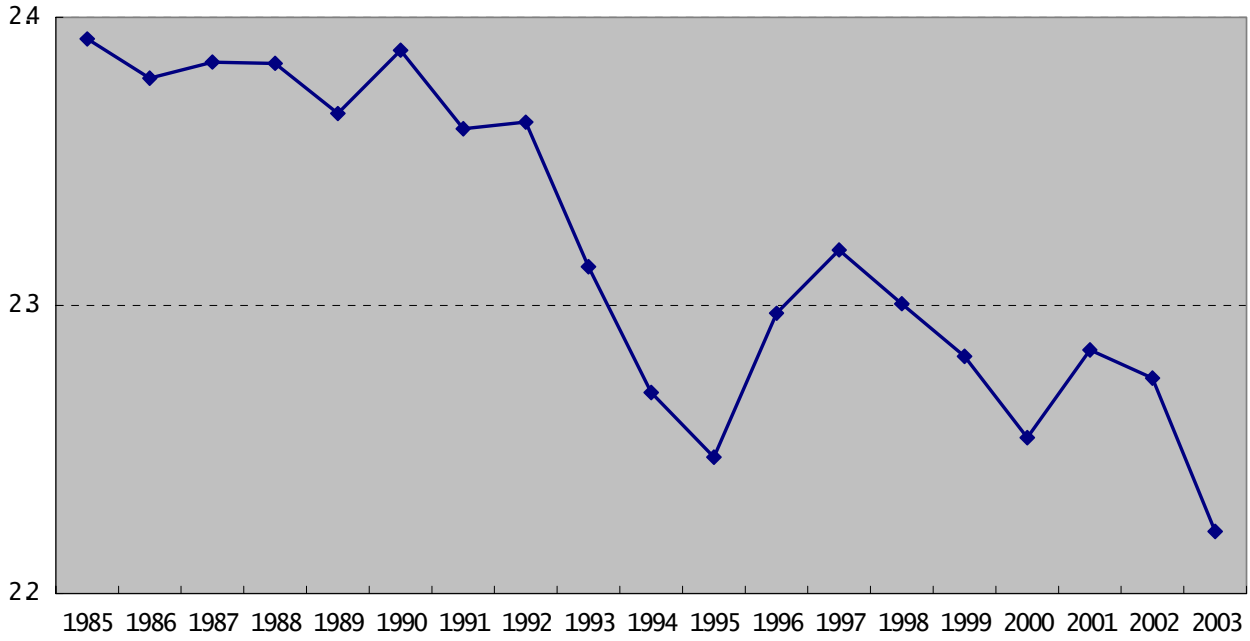


**Figure 4. Ratio of Total Consumption Expenditure of the Fifth Quintile Group to the First Quintile Group**




## 2. Characteristics of CPI in the year 2003

Considering sub-indices by goods and services classification in the year 2003, goods index fell 0.8% mainly due to fall in industrial products such as durable goods and food products (Table 1). While services index rose 0.4% mainly due to 1.3% rise in public services such as medical treatment. This means decline of fall of CPI in 2003 reflects rise in cost for public utilities and does not necessarily reflect supply and demand of commodities and services in the market.

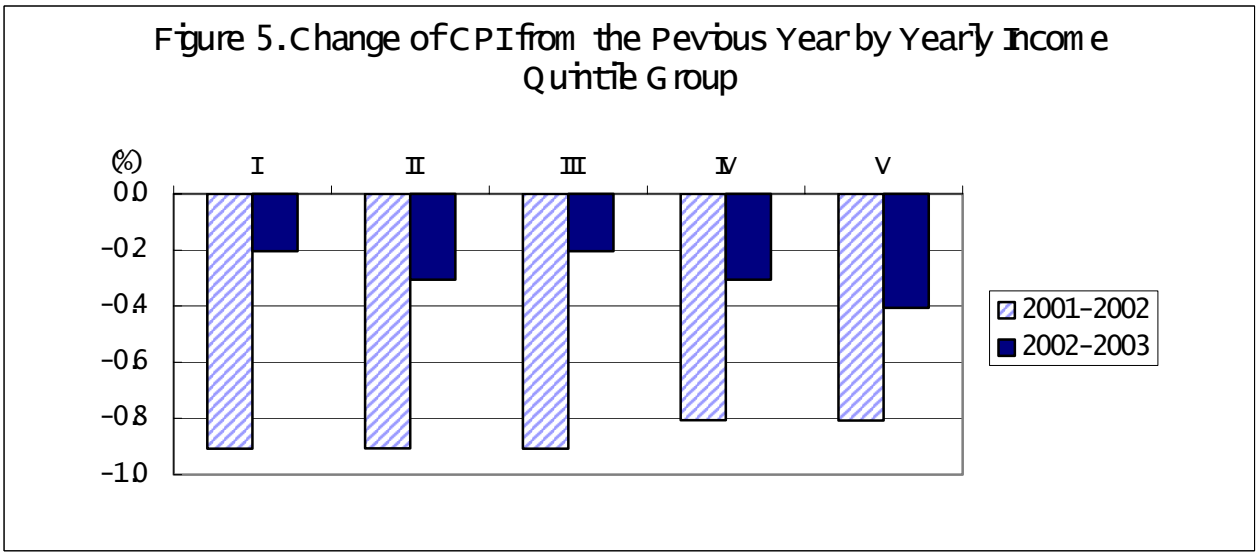
**Table 1. Change of CPI from the Previous Year of Goods and Services**

| | 2001 % | 2002 % | 2003 % | Contribution (2003) |
|---|---|---|---|---|
| Goods | -1.4 | -1.8 | -0.8 | -0.41 |
| Services | -0.1 | 0.0 | 0.4 | 0.20 |
| Public Services | -0.2 | -0.1 | 1.3 | 0.17 |
| General Services | 0.0 | 0.0 | 0.0 | 0.00 |

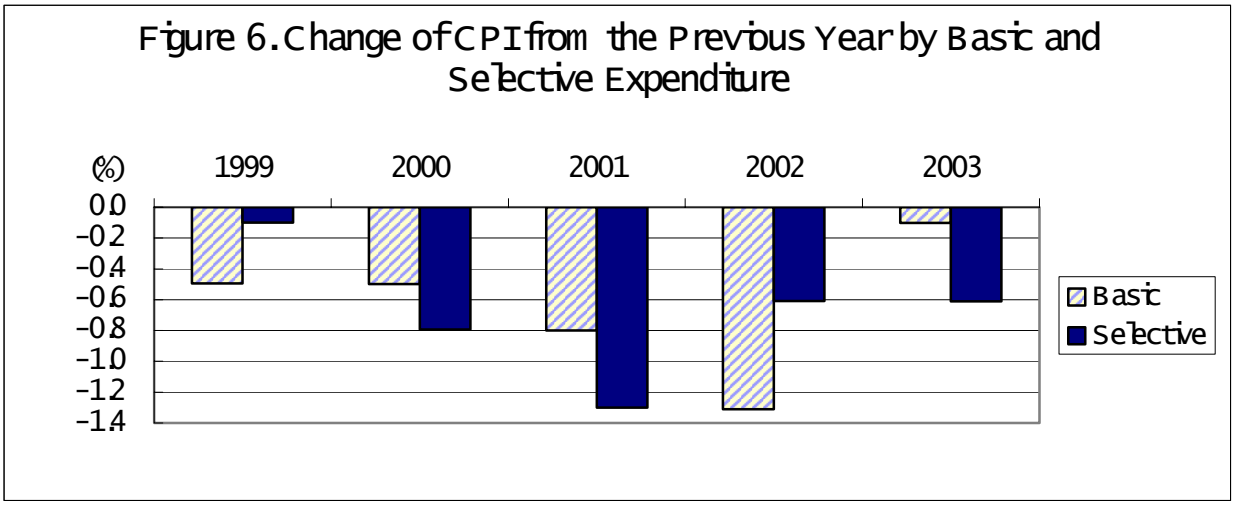
On the other hand, examining the results by yearly income groups[5], declining rate for the first yearly income quintile group is now 0.2 percent point smaller than that for the fifth income quintile

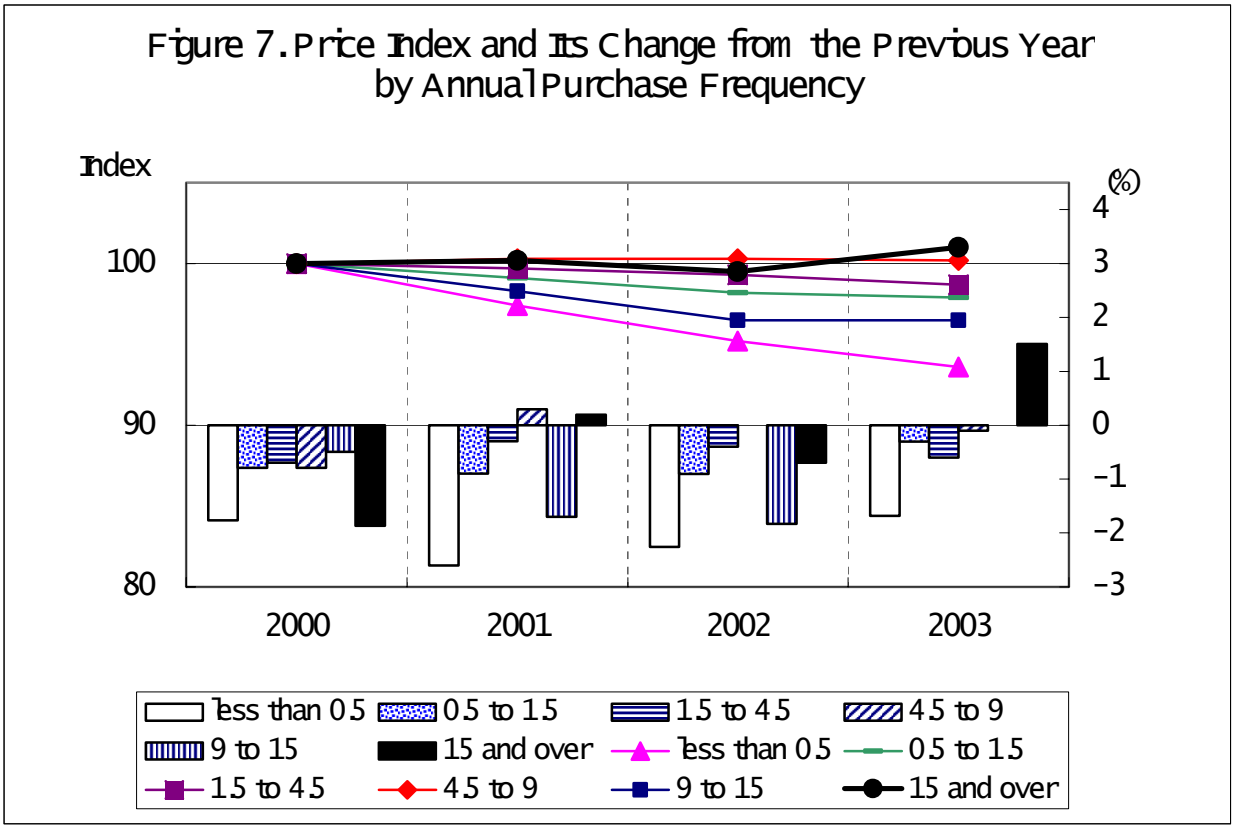
[5] In chapter 2, 3 and 4 in this paper, target population for weight by yearly income quintile group excludes agricultural, forestry and fisheries households.

group (Figure 5). This may indicate that income structure changes under the recent deflationary trend.




Examining the results by characteristics of items, index for basic expenditure items, whose expenditure elasticity are less than 1, fell by only 0.1%, while that for selective expenditures fell by 0.6% (Figure 6). Additionally, index for items in annual purchase frequency classes of "less than 0.5 times" fell by 1.7%, while that of "15 times or more" rose by 1.5% (Figure 7). The difference of price changes between essential expenditures and nonessential expenditures may have affected structures of expenditures by income groups.






### 3. Comparison among Types of Indices

Dividing households into yearly income quintile groups, we compare the Laspeyres-type index with the Paasche-type index for each quintile group as yearly average index for all Japan. The result is shown in table 2.1. The fact that discrepancy between the Laspeyres-type index and the Paasche-type Index is comparatively large in the group V, with large selective expenditures, they can enjoy benefits of decline in prices. The group with the smallest discrepancy is, however, the group II – not the group I – with more than 0.4 percent point smaller than the group V, while the discrepancy of the group I is larger than average, being closer to that of the group V.

**Table 2.1. Laspeyres and Paasche Indices by Yearly Income Quintile Group for the Year 2003 (2000□100)**

| | All | I | II | III | IV | V |
|---|---|---|---|---|---|---|
| Laspeyres | 97.8 | 98.0 | 97.9 | 97.8 | 97.8 | 97.6 |
| Paasche | 97.3 | 97.4 | 97.7 | 97.2 | 97.3 | 96.9 |
| (P-L)┻100/L | -0.5 | -0.6 | -0.2 | -0.6 | -0.5 | -0.7 |

As characteristics in each year after the year 2000, Tables 2.2 to 2.4 show the Laspeyres-type

indices and the Paasche-type indices for each year by income groups based on and in reference to the previous year as 100.

**Table 2.2. Laspeyres and Paasche Indices by Yearly Income Quintile Group for the Year 2001 (2000□100)**

| | All | I | II | III | IV | V |
|---|---|---|---|---|---|---|
| Laspeyres | 99.1 | 99.2 | 99.2 | 99.1 | 99.1 | 99.0 |
| Paasche | 98.9 | 99.1 | 99.1 | 98.9 | 98.9 | 98.8 |
| (P-L)┻100/L | -0.2 | -0.1 | -0.1 | -0.2 | -0.2 | -0.2 |

**Table 2.3. Laspeyres and Paasche Indices by Yearly Income Quintile Group for the Year 2002 (2001□100)**

| | All | I | II | III | IV | V |
|---|---|---|---|---|---|---|
| Laspeyres | 98.9 | 99.0 | 99.0 | 98.9 | 98.9 | 98.9 |
| Paasche | 98.9 | 99.0 | 99.0 | 98.8 | 98.9 | 98.8 |
| (P-L)┻100/L | -0.0 | -0.0 | -0.0 | -0.1 | 0.0 | -0.0 |

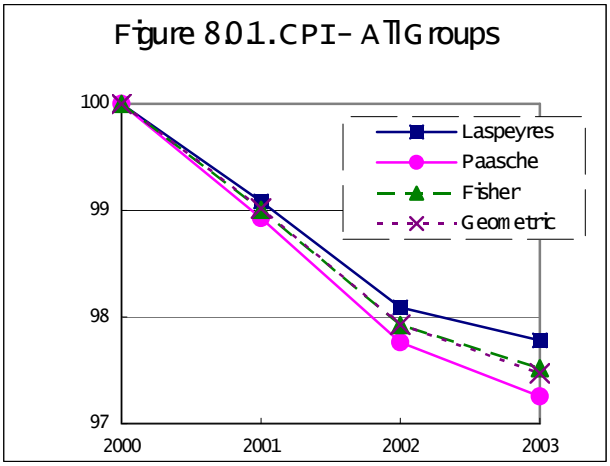
**Table2.4. Laspeyres and Paasche Indices by Yearly Income Quintile Group for the Year 2003 (2002□100)**

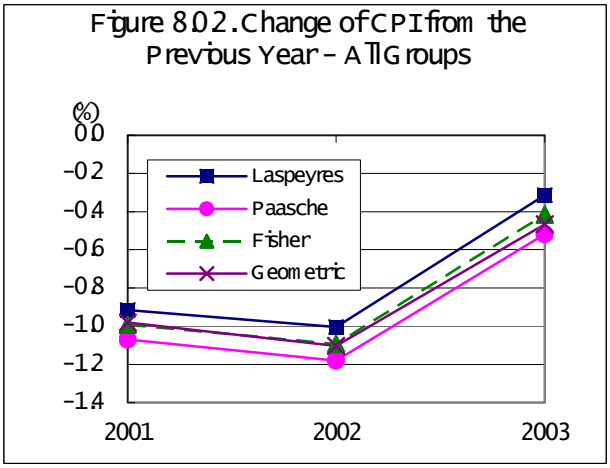
| | All | I | II | III | IV | V |
|---|---|---|---|---|---|---|
| Laspeyres | 99.6 | 99.7 | 99.7 | 99.6 | 99.6 | 99.5 |
| Paasche | 99.6 | 99.6 | 99.7 | 99.6 | 99.6 | 99.5 |
| (P-L)┻100/L | -0.0 | -0.1 | 0.0 | 0.0 | -0.0 | -0.0 |

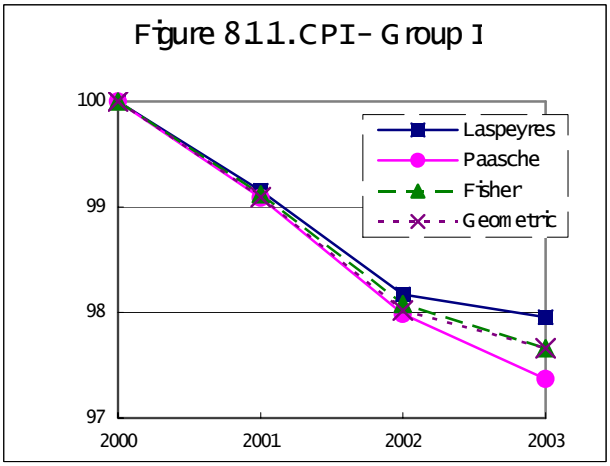
The results show that from the year 2000 to 2001, in line with the popular theory, the Paasche-type indices are lower than the Laspeyres-type indices. And discrepancies for lower-income groups tend to be smaller than those for higher-income groups, because, in general terms, lower-income groups have tight supplies and demands, and they benefit less from substitution.

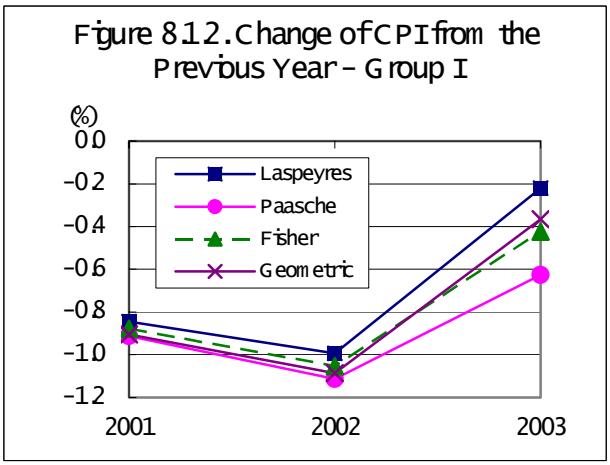
Small discrepancies from the year 2001 may underpin small movements of prices and household consumption. Meanwhile, The group IV in 2001 to 2002 and the group II and III in 2002 to 2003 show, however slightly, reversal of the Laspeyres-type and the Paasche-type indices. Reversal of these indices in not-so-small income group is against the common view described above.

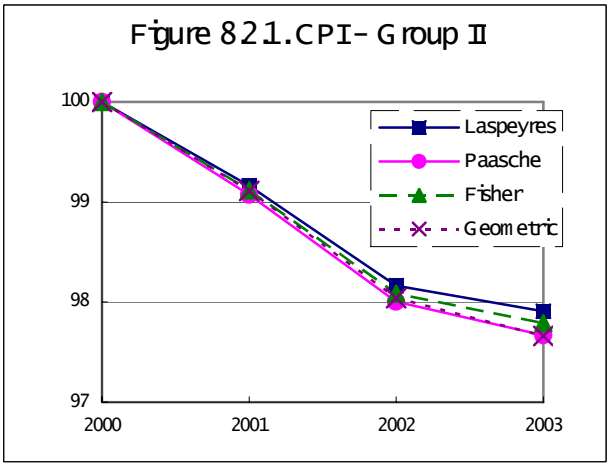
Since this phenomenon may affect approximation of the cost-of-living index under certain assumptions for substitution, we compare the Laspeyres-type, the Paasche-type, the Fisher-type and the geometric mean indices since the year 2000 for each income group (Figures 8.0.1-8.5.2).

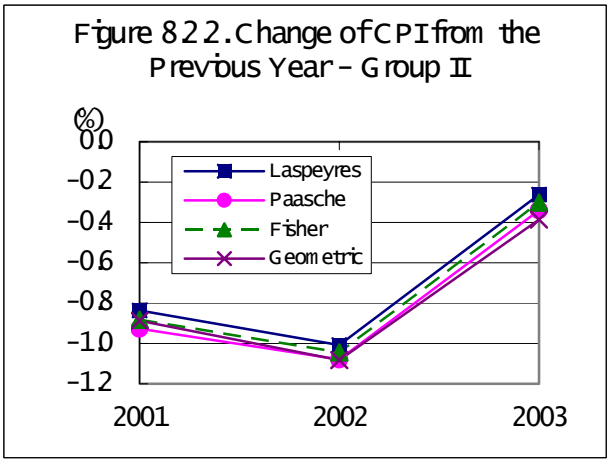


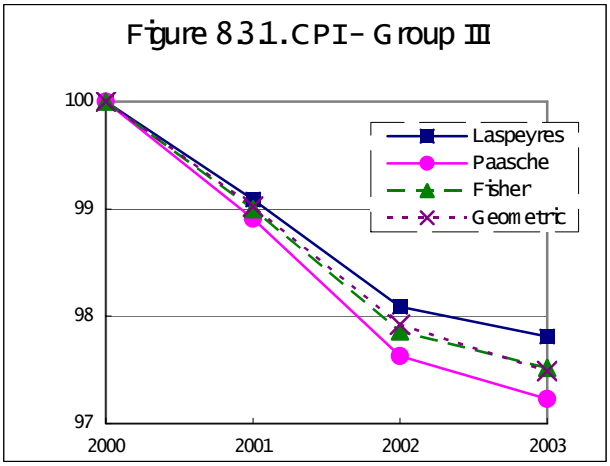



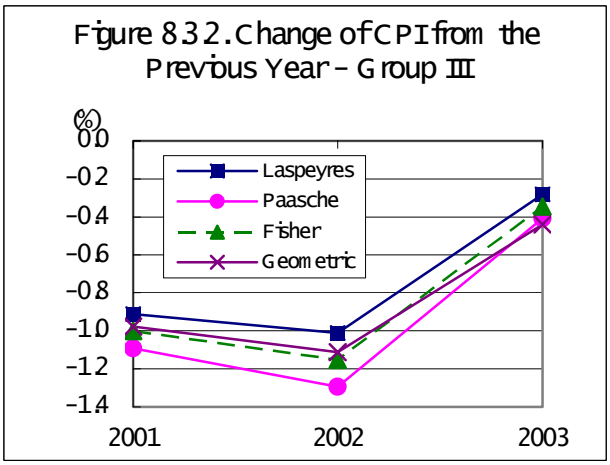



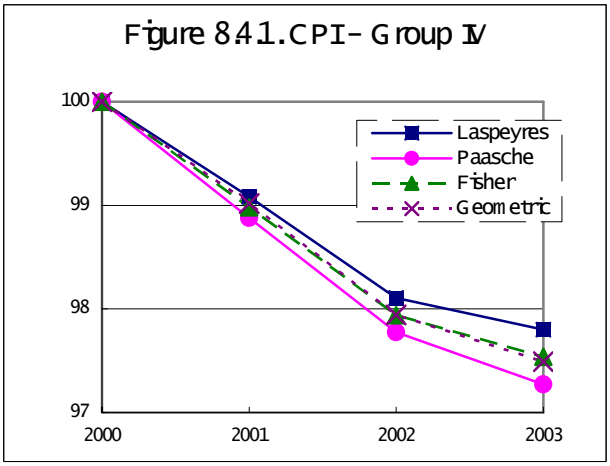



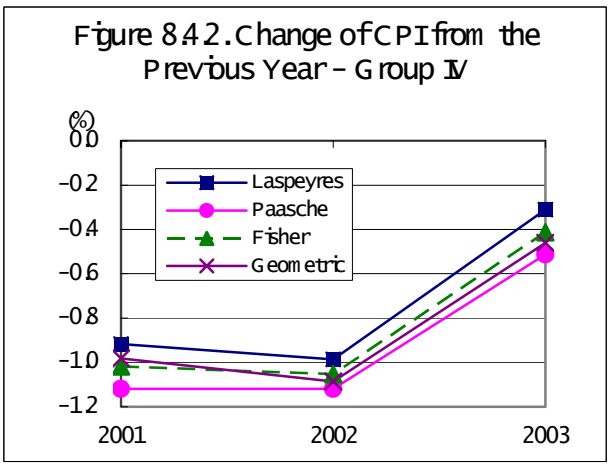



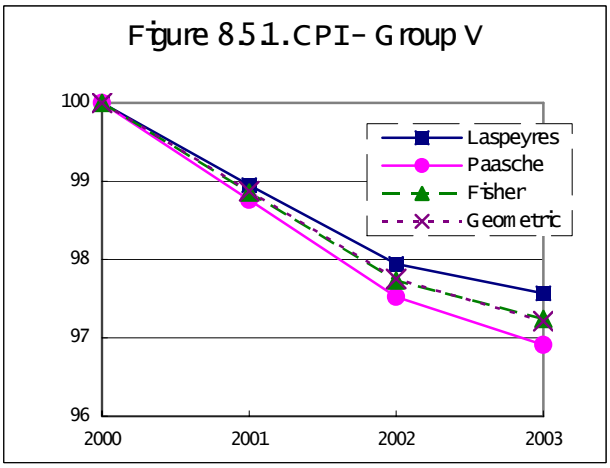



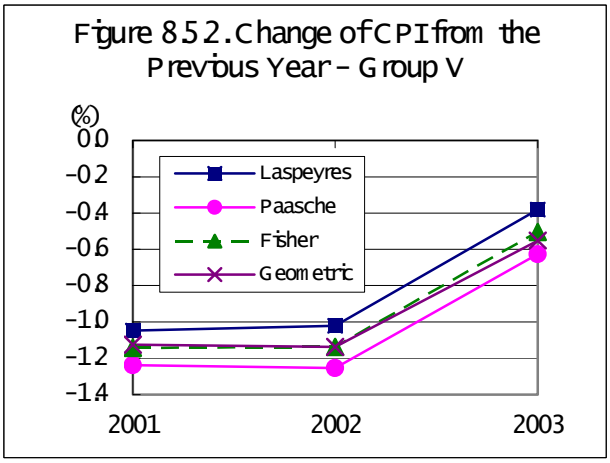



These results show that in indices for all, the geometric mean indices show quite similar movements to those of the Fisher-type indices (the ideal formula), located between the Laspeyres-type indices and the Paasche-type indices. In indices for each group, however, the geometric mean indices sometimes show discrepancies from the Fisher-type indices, and in the year 2003, changes from the previous year of the geometric mean indices are lower than those of the Paasche-type indices for the group II and the group III and the level of the geometric mean index is lower than the Paasche-type indices for the group II. This phenomenon is easily understood considering that the geometric mean indices are designed to show good performance with high elasticity of substitution, that is, in case

prices and quantity fluctuate in the same directions, they may weaken adequacy.

**4. Contribution Factors**

Table 3 shows contributions for each subgroup of items to both the Laspeyres-type and the Paasche-type index of the year 2003 based on the year 2002 (shown in table 2.4) and their discrepancies to measure contribution by each subgroup to overall discrepancy as to the two types of indices. If price and quantity move in the opposite direction, as in usual substitution behavior, the contribution of the subgroup is negative, while if they move in the same direction, as in special goods like the Giffen good, the contribution is positive. The sum of the contributions is equal to the overall discrepancy. Comparatively high contributions mark in Medical service in the group II, III and V, and Recreational durables in the group III.

Medical service, whose price rose by the hike of self-pay ratio for health insurance in April 2003, may be a basic and significant service to households for which no other products and services can substitute. And, in this field, change of the target population as well as change of prices influence on macro-level purchase behavior.

As for Recreational durables, contributions differ significantly among income groups. This subgroup includes PCs with rapid quality improvement and price down. Demand for these products also depends on their diffusion in each social group.

## Table 3. Contribution to the Annual Changes by Yearly Income Quintile Group of Laspeyres and Paasche Indices □2002-2003□

| | Laspeyres | | | | | | _ aasche | | | | | | _ aasche-Laspeyres | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All | | | | | | All | | | | | | All | | | | | |
| General | -0.41 | -0.28 | -0.32 | -0.44 | -0.39 | -0.50 | -0.43 | -0.37 | -0.29 | -0.43 | -0.43 | -0.51 | -0.02 | -0.09 | 0.02 | 0.01 | -0.04 | -0.01 |
| Cereals | 0.04 | 0.04 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | -0.00 | -0.00 | 0.00 | -0.00 | 0.00 | 0.00 |
| Fresh fish & shellfish | -0.04 | -0.04 | -0.04 | -0.05 | -0.05 | -0.04 | -0.04 | -0.04 | -0.04 | -0.04 | -0.05 | -0.04 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| Meat | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 | -0.00 | -0.00 | 0.00 | -0.00 | -0.00 | -0.00 |
| Dairy products & eggs | -0.01 | -0.02 | -0.02 | -0.01 | -0.01 | -0.01 | -0.01 | -0.02 | -0.02 | -0.01 | -0.01 | -0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Fresh vegetables | 0.08 | 0.09 | 0.08 | 0.09 | 0.08 | 0.07 | 0.08 | 0.09 | 0.08 | 0.08 | 0.08 | 0.07 | -0.00 | -0.00 | -0.00 | -0.01 | -0.00 | -0.00 |
| Fresh fruits | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 |
| Oils, fats & seasonings | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 | -0.02 | -0.00 | -0.00 | -0.00 | 0.00 | 0.00 | 0.00 |
| Cakes & candies | -0.01 | -0.01 | -0.00 | -0.01 | -0.00 | -0.01 | -0.01 | -0.01 | -0.00 | -0.01 | -0.00 | -0.01 | 0.00 | 0.00 | 0.00 | 0.00 | -0.00 | -0.00 |
| Cooked food | -0.02 | -0.03 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.03 | -0.02 | -0.02 | -0.02 | -0.02 | -0.00 | -0.00 | -0.00 | 0.00 | -0.00 | -0.00 |
| Beverages | -0.04 | -0.05 | -0.04 | -0.04 | -0.04 | -0.03 | -0.04 | -0.05 | -0.04 | -0.04 | -0.04 | -0.03 | -0.00 | 0.00 | -0.00 | 0.00 | -0.00 | -0.00 |
| Alcoholic beverages | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | 0.00 | -0.00 | 0.00 | 0.00 | 0.00 | -0.00 |
| Eating out | -0.01 | -0.00 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.00 | -0.01 | -0.01 | -0.01 | -0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rent, excluding imputed rent | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Repairs & maintenance | -0.02 | -0.01 | -0.02 | -0.02 | -0.03 | -0.04 | -0.03 | -0.02 | -0.01 | -0.02 | -0.02 | -0.05 | -0.00 | -0.00 | 0.01 | -0.01 | 0.00 | -0.01 |
| Electricity | -0.07 | -0.08 | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 | -0.08 | -0.07 | -0.07 | -0.07 | -0.06 | 0.00 | -0.00 | -0.00 | 0.00 | -0.00 | 0.00 |
| Gas | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.00 | -0.00 | 0.00 |
| Other fuel & light | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | -0.00 | -0.00 | 0.00 | -0.00 | -0.00 | -0.00 |
| Water & sewerage charges | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | -0.00 | 0.00 | -0.00 | 0.00 | 0.00 |
| Household durables | -0.10 | -0.08 | -0.10 | -0.11 | -0.09 | -0.11 | -0.11 | -0.09 | -0.10 | -0.12 | -0.11 | -0.11 | -0.00 | -0.01 | 0.01 | -0.01 | -0.02 | 0.00 |
| Interior furnishings | -0.01 | -0.01 | -0.01 | -0.01 | -0.02 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.02 | 0.00 | 0.00 | 0.00 | -0.00 | 0.00 | -0.00 |
| Bedding | -0.01 | -0.01 | -0.00 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.00 | -0.01 | -0.01 | -0.01 | -0.00 | -0.00 | 0.00 | -0.00 | -0.00 | 0.00 |
| Domestic utensils | -0.01 | -0.02 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Domestic non-durables | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | -0.00 | 0.00 | 0.00 |
| Domestic services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.00 | 0.00 | -0.00 | -0.00 | -0.00 | -0.00 |
| Clothes | -0.06 | -0.05 | -0.05 | -0.06 | -0.06 | -0.08 | -0.06 | -0.05 | -0.06 | -0.06 | -0.07 | -0.08 | -0.00 | 0.00 | -0.00 | -0.00 | -0.00 | 0.00 |
| Shirts, sweaters & underwear | -0.03 | -0.03 | -0.03 | -0.03 | -0.04 | -0.04 | -0.03 | -0.02 | -0.03 | -0.03 | -0.04 | -0.04 | -0.00 | 0.00 | -0.00 | -0.00 | -0.00 | -0.00 |
| Footwear | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cloth & other clothing | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | 0.00 | -0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Medicines & health fortification | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 |
| Medical supplies & appliances | -0.02 | -0.04 | -0.03 | -0.02 | -0.02 | -0.02 | -0.03 | -0.04 | -0.03 | -0.03 | -0.02 | -0.02 | -0.00 | -0.01 | -0.00 | -0.00 | 0.00 | -0.00 |
| Medical services | 0.17 | 0.19 | 0.19 | 0.17 | 0.18 | 0.14 | 0.18 | 0.17 | 0.20 | 0.19 | 0.16 | 0.17 | 0.01 | -0.01 | 0.01 | 0.02 | -0.01 | 0.03 |
| Public transportation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.00 | -0.00 | 0.00 | -0.00 | -0.00 | 0.00 |
| Private transportation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Communication | -0.01 | -0.01 | -0.01 | -0.01 | -0.00 | -0.00 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 |
| School fees | 0.04 | 0.03 | 0.04 | 0.05 | 0.06 | 0.05 | 0.05 | 0.03 | 0.04 | 0.04 | 0.06 | 0.06 | 0.00 | 0.00 | 0.00 | -0.00 | 0.00 | 0.00 |
| School textbooks & reference books | -0.00 | 0.00 | 0.00 | 0.00 | -0.00 | -0.00 | -0.00 | 0.00 | 0.00 | 0.00 | -0.00 | -0.00 | 0.00 | -0.00 | -0.00 | -0.00 | 0.00 | 0.00 |
| Tutorial fees | -0.00 | -0.00 | -0.00 | -0.00 | -0.01 | -0.01 | -0.00 | -0.00 | -0.00 | -0.00 | -0.01 | -0.01 | 0.00 | -0.00 | -0.00 | 0.00 | -0.00 | 0.00 |
| Recreational durables | -0.21 | -0.15 | -0.16 | -0.24 | -0.23 | -0.25 | -0.23 | -0.20 | -0.16 | -0.22 | -0.24 | -0.28 | -0.01 | -0.06 | 0.00 | 0.02 | -0.01 | -0.02 |
| Recreational goods | -0.06 | -0.05 | -0.05 | -0.06 | -0.06 | -0.05 | -0.06 | -0.05 | -0.06 | -0.06 | -0.05 | -0.05 | 0.00 | -0.00 | -0.00 | 0.00 | 0.00 | 0.00 |
| Books & other reading materials | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | -0.00 | -0.00 | 0.00 | -0.00 | -0.00 | -0.00 |
| Recreational services | -0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Personal care services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Toilet articles | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.03 | -0.00 | 0.00 | 0.00 | 0.00 | -0.00 | -0.00 |
| Personal effects | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 | 0.04 | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 | 0.04 | -0.00 | -0.00 | 0.00 | 0.00 | -0.00 | -0.01 |
| Cigarettes | 0.02 | 0.03 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | 0.03 | 0.02 | 0.02 | 0.01 | 0.01 | -0.00 | 0.00 | 0.00 | -0.00 | -0.00 | -0.00 |
| Other | -0.01 | -0.00 | -0.00 | -0.01 | -0.01 | -0.03 | -0.01 | -0.00 | -0.00 | -0.01 | -0.01 | -0.02 | 0.00 | 0.00 | 0.00 | -0.00 | -0.00 | 0.00 |

## 5. Comparisons among Items

Effects of Substitution tend to be larger among Items than among subgroups. The Laspeyres-type index became larger than the Paasche-type index in most cases among Items. But some exceptional cases exist. For example, quantity for beef in Fresh meat decreased though the price also decreased from 2000 to 2003, and in the end, the Laspeyres-type index for Fresh meat became lower than the Paasche-type index for the year 2003 (Table 4.1 & 4.2). This case was caused mainly for fear of the BSE (Bovine Spongiform Encephalopathy). Firstly consumers on demand sides departed from the market, and stock farmers or companies on supply sides were forced to lower the price. Similar things happened in Charges for practicing golf. Popularity of playing golf diminished and managers for golf practice lowered the charges to keep customers.

**Table 4.1 Laspeyres and Paasche Indices by Yearly Income Quintile Group for Fresh meat for the Year 2003 (2000=100)**

| | All | I | II | III | IV | V |
|---|---|---|---|---|---|---|
| Laspeyres | 101.7 | 101.8 | 101.8 | 101.8 | 101.7 | 101.5 |
| Paasche | 101.9 | 102.0 | 101.9 | 102.0 | 101.9 | 101.6 |
| (P-L)㸃100/L | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 |

**Table 4.2 Change of Price and Quantity by Yearly Income Quintile Group for Fresh meat for the Year 2003 (2000=100)**

| | | Change from 2000 to 2003 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Expenditure in 2000 | Price | Quantity | | | | | |
| | | | All | I | II | III | IV | V |
| | thousand yen | % | % | % | % | % | % | % |
| All | 63 | 1.7 | -9.3 | -7.5 | -7.7 | -10.5 | -10.7 | -9.4 |
| Beef | 28 | -1.1 | -17.2 | -15.9 | -15.3 | -19.7 | -19.9 | -15.1 |
| Pork | 23 | 2.7 | -1.7 | -0.0 | -1.8 | -1.4 | -2.8 | -1.8 |
| Chiken | 11 | 6.5 | -5.3 | -3.1 | -1.7 | -7.7 | -3.8 | -8.4 |
| Others | 0 | 4.0 | -15.4 | -13.7 | -8.9 | -18.3 | -20.6 | -14.7 |

Then we compared these Laspeyres Indices with geometric mean indices. From natures of the formulae, fixed weights at the base period would value more excessively price down in the geometric formula than in arithmetic formula, if both of the price and the quantity decrease. In this case, the Laspeyres type geometric indices with fixed weight at the base period are less than the Laspeyres type arithmetic indices. Conversely, the Paasche type geometric indices with fixed

weights at the reference period are less than the Paasche type arithmetic indices. In the end, Both of geometric indices depart from ideal indices like the Fisher indices or the Tronqvist indices with wider distances than arithmetic indices, what we call in general, the Laspeyres indices and the Paasche indices.

Table 4.3 illustrates the result. Geometric mean indices record lower than arithmetic mean indices if weights are fixed at the base period. On the other hand, geometric mean indices record higher than arithmetic mean indices if weights are fixed at the reference period.

**Table 4.3 Comparisons with Indices by Yearly Income Quintile Group for Fresh Meat for the Year 2003 (2000=100)**

| | | All | I | II | III | IV | V |
|---|---|---|---|---|---|---|---|
| Arithmetic Mean | Laspeyres | 101.7 | 101.8 | 101.8 | 101.8 | 101.7 | 101.5 |
| | Paasche | 101.9 | 102.0 | 101.9 | 102.0 | 101.9 | 101.6 |
| | Fisher | 101.8 | 101.9 | 101.8 | 101.9 | 101.8 | 101.6 |
| | (P-L)÷100/L | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 |
| Geometric Mean | Laspeyres | 101.7 | 101.8 | 101.7 | 101.8 | 101.7 | 101.5 |
| | Paasche | 101.9 | 102.0 | 102.0 | 102.0 | 102.0 | 101.7 |
| | Tronqvist | 101.8 | 101.9 | 101.8 | 101.9 | 101.8 | 101.6 |
| | (P-L)÷100/L | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 |

Though the Laspeyres-type index became larger than the Paasche-type index for all, reverse results can be seen for some groups. Table 5.1 & 5.2 show that decrease of price and quantity for Fruit or vegetable juice is comparatively large and the Laspeyres-type index is smaller than the Paasche-type index for the subgroup, Other beverages[6] in the group III in the year 2003.

**Table 5.1 Laspeyres and Paasche Indices by Yearly Income Quintile Group for Other beverages for the Year 2003 (2000=100)**

| | All | I | II | III | IV | V |
|---|---|---|---|---|---|---|
| Laspeyres | 94.4 | 94.5 | 94.5 | 94.4 | 94.4 | 94.4 |
| Paasche | 94.4 | 94.5 | 94.4 | 94.5 | 94.3 | 94.4 |
| (P-L)×100/L | -0.0 | -0.0 | -0.1 | 0.1 | -0.1 | -0.1 |

**Table 5.2 Change of Price and Quantity by Yearly Income Quintile Group for Other beverages**

[6] Beverages are composed of Tea, Coffee & cocoa and Other beverages while Alcoholic beverages represents another independent subgroup.

**for the Year 2003 (2000=100)**

| | | Change from 2000 to 2003 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Expenditure in 2000 | Price | Quantity | | | | | |
| | | | All | I | II | III | IV | V |
| | thousand yen | % | % | % | % | % | % | % |
| All | 24 | -5.6 | 4.5 | 4.9 | 6.6 | 2.3 | 2.6 | 6.4 |
| Fruit or vegetable juice | 14 | -5.8 | -2.3 | 2.2 | -1.0 | -7.2 | -0.7 | -2.9 |
| Carbonated beverages | 3 | -8.3 | 8.4 | -1.6 | 10.6 | 8.5 | 4.4 | 19.7 |
| Fermented lactic drinks | 4 | -1.4 | 5.1 | 2.4 | 6.1 | 19.1 | -7.4 | 6.5 |
| Others | 3 | -7.1 | 30.9 | 30.0 | 41.2 | 19.0 | 30.2 | 34.8 |

In this case, differences among indices are trivial. But the geometric mean index with fixed weight at the year 2000 records 94.36, slightly smaller than the arithmetic mean index recording 94.38. And difference between the Laspeyres type and the Paasche type is 0.13 numerated by geometric mean indices, slightly larger than 0.08 of that by arithmetic mean indices.

**Table 5.3 Coparisons with Iindexes by Yearly Income Quintile Group for Other Beverages for the Year 2003 (2000=100)**

| | | All | I | II | III | IV | V |
|---|---|---|---|---|---|---|---|
| Arithmetic Mean | Laspeyres | 94.4 | 94.5 | 94.5 | 94.4 | 94.4 | 94.4 |
| | Paasche | 94.4 | 94.5 | 94.4 | 94.5 | 94.3 | 94.4 |
| | Fisher | 94.4 | 94.5 | 94.5 | 94.4 | 94.4 | 94.4 |
| | (P-L)☂100/L | -0.0 | -0.0 | -0.1 | 0.1 | -0.1 | -0.1 |
| Geometric Mean | Laspeyres | 94.4 | 94.5 | 94.5 | 94.4 | 94.4 | 94.4 |
| | Paasche | 94.4 | 94.5 | 94.5 | 94.5 | 94.3 | 94.4 |
| | Tronqvist | 94.4 | 94.5 | 94.5 | 94.4 | 94.4 | 94.4 |
| | (P-L)☂100/L | 0.0 | 0.0 | -0.0 | 0.1 | -0.1 | -0.0 |

**6. Tentative Conclusion**

Above analyses through real CPI in Japan underpin various substitution behaviors such as non-substitution based on institutional factors like medical care and those by economic or social trend sometimes due to specific phenomena like the BSE other than general reversible movement of quantity to prices. The geometric index does not perform well enough as cost-of-living index under uncommon phenomena where substitution rarely take place.

Especially uncommon substitutions tend to happen more in smaller groups like in an income group, because the more similar members within a group are, the more special characteristics as to consumption they tend to have. The situation can be observed in, for instance, expenditures for recreational durables and other beverages for the third income group around the year 2003.

These results suggest that approximation of cost-of-living index, theoretically defined as to keep certain level of utility, from existing data, needs enough care when dealing with prices or expenditures with such characteristics, especially when segmented by household types such as income groups.

The observations however may have been produced under the “moderate deflation”, when subtle movements of both prices and expenditures induce much concerns. Further study would be required to judge whether they are special characteristics only under the present circumstances or will also happen under inflationary trend.