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Analysis of Price Level Heterogeneity across Households based on the Geary-Khamis Price Index*

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Abstract

We construct a household price index based on household-level scanner data (homescan data). Instead of the conventional Paasche type price index, in this paper, we apply the Geary-Khamis (GK) method that is commonly used to measure the values of different currencies in international trade. The mathematical properties of the GK price index help identify the complex factors behind household-level price differentials. We find that households that buy cereals, manufactured foods, and daily products at weekend bargain rates, reduce their price levels significantly. Further, households with children make purchases at lower prices than households without children through frequent bulk purchases at bargain sales. Certain types of shopping behaviors of the elderly lead them to make purchases at higher prices than the young. Specifically, shopping at specialized stores, not shopping at home improvement stores, spending less on Sundays, and purchasing the same goods repeatedly increase the price levels for the elderly.

1 Introduction

An active monetary policy and prolonged very low inflation rates in many countries have motivated an increasing number of researchers to investigate the determinants of inflation and price levels. While inflation has long been a key topic in the macroeconomic field, recent analyses exhibit a noteworthy feature in that they use large-scale commodity-level price information.[1] Commodity-level price data aids the analysis of various types of heterogeneity such as violation of the law of one price across the region (Haskel and Wolf, 2001) and across retailers (Baye et al., 2004). In their influential paper based on homescan data in the US, Aguiar and Hurst (2007) (hereafter, AH) find a violation of the law of one price across different age groups. In the US, elderly families enjoy lower prices for the same commodities as compared to younger families. AH suggest that this occurs because the elderly can spend more time seeking lower prices as the opportunity costs of shopping are lower for the elderly than for the young. In

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[1] For example, see Nakamura and Steinsson (2008).

contrast, Abe and Shiotani (2014) construct a household price index based on Japanese homescan data and report that price levels are positively correlated with age in Japan. While the price index used by AH is easy to calculate, the Japanese index is subject to serious measurement problems, which makes the detailed investigation of the mechanism behind the heterogeneity very difficult.

In this paper, we apply the Geary-Khamis (GK) method to examine the causes of heterogeneity in prices across households. The GK method is similar to the AH price index in many respects. Both indices allow households to have different weights and prices. The main difference between the two indices is the definition of the average price. In the GK price index, the average price is defined recursively, so that it reflects the information of the household price index. Due to this feature, the GK method is commonly used to compute purchasing power parities (PPPs) for comparing the values of different currencies. The GK price index exhibits higher variation and stronger correlation with household characteristics than the AH price index; this enables us to estimate the contribution of household characteristics that affect the differences in relative prices, such as employment status and family composition.

Our empirical results suggest that bulk buying, the number of children, and participation in weekend sales are important determinants of price levels across households. We believe that households with children can make bulk purchases at weekend bargain sales and, thus, reduce their price levels.

2 Data

In this paper, we use scanner data from the "Household Consumer Panel Research" (hereafter, SCI) data set compiled by INTAGE, a marketing company based in Japan.[2] SCI contains daily shopping information of approximately 12,000 households, randomly selected from all prefectures except Okinawa in Japan. The sample households are restricted to married couples. Households are asked to scan the bar code of every commodity they purchase using a bar code reader. In SCI, the following details are observed for every commodity purchased: (1) the Japanese Article Number (JAN), a unique commodity identifier, (2) the date of purchase, (3) the price and quantity, and (4) the name of the store from which the commodity was purchased. Fresh foods such as meat, fish, and vegetables that do not have bar codes are excluded. The data used in this paper is for the period 2004–2006.

[2] See Abe and Niizeki (2010) or Abe and Shiotani (2014) for details on SCI.

3 Geary-Khamis Price Index

This section compares the AH and GK indices. The GK method, originally proposed by Geary (1958), became widely known through numerous papers by Khamis (1969, 1970, 1972, and 1984). This index is defined by two equations, the PPPs of currencies and the average international commodity prices. It provides a more appropriate measure for comparing the GDPs of various countries instead of that based simply on exchange rates. In our paper, PPP in the GK method corresponds to the relative price index for each household, while the international average price corresponds to the weighted average price of each good purchased by households.

First, let us review the price index proposed by AH to clarify the meaning of relative price index. Let $p_{i,t}^j$ and $y_{i,t}^j$ denote the price and quantity, respectively of good $i \in I$ purchased by household $j \in J$ on date $t \in T$. Then, the total expenditure incurred by household j during time interval q is given by

$$X_q^j = \sum_{i \in I, t \in q} p_{i,t}^j y_{i,t}^j. \tag{1}$$

If this household purchases products at their average prices, the expenditure will be

$$\bar{X}_q^j = \sum_{i \in I, t \in q} \bar{p}_{i,q} y_{i,t}^j, \tag{2}$$

where

$$\bar{p}_{i,q} = \sum_{j \in J, t \in q} p_{i,t}^j \frac{y_{i,t}^j}{\sum\limits_{j \in J, t \in q} y_{i,t}^j}, \tag{3}$$

is the weighted average price paid for good i during time interval q. The AH price index for the household is defined as the ratio of the actual expenditure divided by the hypothetical expenditure at the average price $\bar{p}_{i,q}$:

$$\tilde{AH}_q^j \equiv \frac{X_q^j}{\bar{X}_q^j}. \tag{4}$$

Finally, we normalize the index by dividing it by the average price index in the quarter:

$$AH_q^j \equiv \frac{\tilde{AH}_q^j}{\frac{1}{J}\sum_{j \in J} \tilde{AH}_q^j}. \tag{5}$$

Similarly, the GK price index for household j is defined as the ratio of the actual expenditure divided by the expenditure at the hypothetical price $\hat{p}_{i,q}$:

$$GK_q^j \equiv \frac{X_q^j}{\hat{X}_q^j}, \tag{6}$$

where

$$\hat{X}_q^j = \sum_{i \in I, t \in q} \hat{p}_{i,q} y_{i,t}^j, \tag{7}$$

and $\hat{p}_{i,q}$ is the weighted sum of the ratios of good i to the GK price index:

()

$$\hat{p}_{i,q} \equiv \sum_{j \in J, t \in q} \frac{p_{i,t}^j}{GK_q^j} \cdot \frac{y_{i,t}^j}{\sum\limits_{j \in J, t \in q} y_{i,t}^j}. \tag{8}$$

Given the recursive nature of the above equations, the equations for both the GK price index and the average prices have to be solved either by finding the eigenvectors or through iterations.

An important and unique feature of the GK price index is its additivity. In the GK price index, it is possible to add the contribution of a particular purchase of good i by household j at time t to the deviation from the population mean for item categories and household types such as age or income group. Based on Equation (6), the ratio of household j's expenditure at price $\hat{p}_{i,q}$ to the sum of expenditures of all households is given by

$$w_q^j = \frac{\hat{X}_q^j}{\sum\limits_{j \in J} \hat{X}_q^j} = \frac{\hat{X}_q^j}{\sum\limits_{j \in J} X_q^j}. \tag{9}$$

Thus, the GK price index for the whole population is given by

$$GK_q^J = \frac{\sum_{j \in J} \sum_{i \in I, t \in q} p_{i,t}^j y_{i,t}^j}{\sum_{j \in J} \sum_{i \in I, t \in q} \bar{p}_{i,q} y_{i,t}^j} = \sum_{j \in J} \frac{\hat{X}_q^j}{\sum\limits_{j \in J} X_q^j} \cdot \frac{X_q^j}{\hat{X}_q^j} = \sum_{j \in J} w_q^j GK_q^j = 1. \tag{10}$$

Similarly, it is possible to express the deviation of the GK price index from the population mean for the household group G as

$$GK_q^G - 1 = \frac{\sum_{j \in G} \sum_{i \in I, t \in q} p_{i,t}^j y_{i,t}^j}{\sum_{j \in G} \sum_{i \in I, t \in q} \bar{p}_{i,q} y_{i,t}^j} - 1 = \sum_{j \in G} \frac{\hat{X}_q^j}{\sum\limits_{j \in G} X_q^j} \cdot (\frac{X_q^j}{\hat{X}_q^j} - 1) = \sum_{j \in G} \frac{\hat{X}_q^j}{\sum\limits_{j \in G} X_q^j} \sum_{i \in I} c_{i,q}^j, \tag{11}$$

where $c_{i,q}^j = w_{i,q}^j (\frac{p_{i,q}^j}{\hat{p}_{i,q}} - 1)$ is the contribution of good i purchased by household j to the change in the GK price index and $w_{i,q}^j = \frac{\sum_{t \in q} \hat{p}_{i,q} y_{i,t}^j}{\bar{X}_q^j}$ is the share of good i in household j's expenditure. An additional attractive feature of the GK price index is that it can be interpreted as Walrasian equilibrium prices in

a pure exchange economy where each household has a Cobb-Douglas type utility function.[3]

Figure 1 illustrates the distributions of the GK and AH price indices. Both indices exhibit strong product level price differentials. A value of 1.1 for both indices implies that there exist households whose price level is 10% higher than the average. Further, the GK price index has a wider support than the AH price index.

Table 1 shows the regression coefficients for the income and age dummies when the dependent variables are natural logarithms of the GK and AH price indices. These two indices yield similar results. The effects of age and income group dummies on the price index are stable and highly significant. However, in general the values of the coefficients for the GK price index are higher than those of the AH price index. As seen in Table 1, the GK price index increases with age; this is contrary to the findings of AH in the US. Households with higher incomes face moderately higher prices than low-income households. Based on our estimates, prices for households with income of over 9 million yen are 0.0154 points higher than prices for households in the lowest income category.

This relationship between household income and the price index plays a crucial role in creating greater price level heterogeneity in the GK price index than the AH price index. Generally, high-income families purchase more goods than low-income families. Similarly, rich families tend to face higher prices. It is clear from (6) that the GK price index is the ratio of the actual expenditure to the hypothetical expenditure. The numerator is common for both AH and GK price indices. The difference between the two is in the denominator, the hypothetical expenditure. First, let us consider a commodity that is primarily purchased by rich families. Equation (8) shows that the price faced by a family with a larger GK price index is more discounted than the price faced by a family with a smaller GK price index; this which will lower the average price. Second, if the product purchased by a rich family has a significantly larger share than that for a poor family, the decreasing effects of the price faced by the rich family exceed the increasing effects of the price faced by the poor family; again, this results in lower average prices. Thus, the average prices of commodities primarily purchased by rich families tend to be lower than their average prices in the AH price index. The lower average price results in smaller hypothetical expenditure for the rich, thereby leading to a higher GK price index for the rich. The opposite is true for poor families. Figure 2 shows the scatter plot of the two price indices, which confirms that the difference between the two indices is large for rich and poor families.

Using this GK price index, we investigate the relationship between the price level and family characteristics as well as observed shopping behaviors in the next section.

[3] See Prasada Rao (1985) for the proof.

4 Relationship between Price and Shopping Behaviors

In this section, we decompose the contribution of the effects of (1) the selection of goods and (2) the shopping behaviors on the household price index. When calculating the GK price index, we aggregate the purchase records for three months; thus, we use quarterly data. The sample period is from 2004:1Q to 2006:4Q. We compare the index for elderly households with that for young households; elderly households are defined as families where the wife is aged over 60, while young households are defined as families where the wife is younger than 30 years. We also compare the price indices for the rich (annual income is over 9 million yen) and the poor (annual income is less than 4 million yen).

First, we check the relationship between the price index and several shopping strategies as well as observed household level characteristics. The result is moderately consistent with Abe and Shiotani (2014) who report that the price reduction mechanism based on opportunity costs of shopping provided by AH is not observed in Japan. According to Table 2, it is clear that households where the wives are full-time employees face prices that are higher than the mean price. However, high-income households with full-time homemakers whose opportunity costs are supposed to be lower than the other type of households also face higher prices. Their contribution to the index for high-income households is greater than their expenditure share. This implies that high-income households with full-time homemakers face higher prices than the other type of high-income families. Tables 4 and 5 show the relationship between the number of children and the price index. Further, they illustrate that households with young children who are supposed to be busy face lower prices than households without children. Table 4 shows that the weight of households with no children is higher for the elderly and high-income families as compared to the young or low-income families.

Next, we consider the effect of bargain sales, which is the most important determinant of the price index according to Abe and Shiotani (2014), on the price level. Table 5 suggests that the prices of cereals, manufactured foods, and dairy products play a significant role in this regard. We believe that the lower price level enjoyed by young and low-income households is primarily due to their purchase of such goods at bargain sales. Table 6 shows that price reduction is achieved only through bulk buying; that is, purchases of two or more of the same good at a time. From Table 6, we can infer that even young and low-income households that face low prices do not enjoy lower than average prices if they do not purchase two or more of the same good.

Table 7 shows that large young and low-income families can decrease their price levels through bulk buying. In contrast, the elderly and high-income households do not enjoy price reductions as the number

of family members increases.

We also identify certain characteristics of the shopping behavior of the elderly that affect the price index. Table 8 reports that the day of the week is an important factor that determines the price level. Shopping on Saturdays and Sundays can significantly reduce the price level for the young or poor families. Over 50% of the low-income households and over 40% of the young households shop on these days. This means that the price level on weekends is lower than that on weekdays. Thus, shopping at weekend bargain sales is a crucial factor that affects the heterogeneity in the household price index for the young or poor families. In contrast, the elderly buy less than the young on Sundays; this explains the difference in their respective price levels to an extent.

Table 9 reports the contribution of purchases at different types of stores. We observe that the elderly spend more at specialized stores and less at home improvement stores than the young; this contributes to the higher price levels among the elderly than the young. Finally, Table 10 shows that the elderly purchase more of the same goods as compared to the young. It is likely that the elderly have stronger loyalty towards some specific brands and may buy the same goods at non-discounted prices even if alternative goods are available at bargain prices.

5 Conclusion

This study investigates the determinants of price differentials across households based on a household price index constructed using the GK method. The GK method reveals that households that buy cereals, manufactured foods, and daily products at weekend bargain sales face significantly lower prices than the others. Our empirical results suggest that the number of children is an important determinant of purchases at bargain sales. Households with young children can enjoy bulk purchases at bargain sales as compared to households without children. We also find that certain types of shopping behaviors among the elderly such as spending more at specialized stores, spending less at home improvement stores, spending less on Sundays, and buying the same goods repeatedly contribute to their higher price levels.

This paper illustrates the relationship between the household price index and several household-specific characteristics as well as certain patterns of shopping behaviors. In this paper, we were unable to investigate the causality in detail due to the lack of a structural model. This gap will be addressed in our future works.

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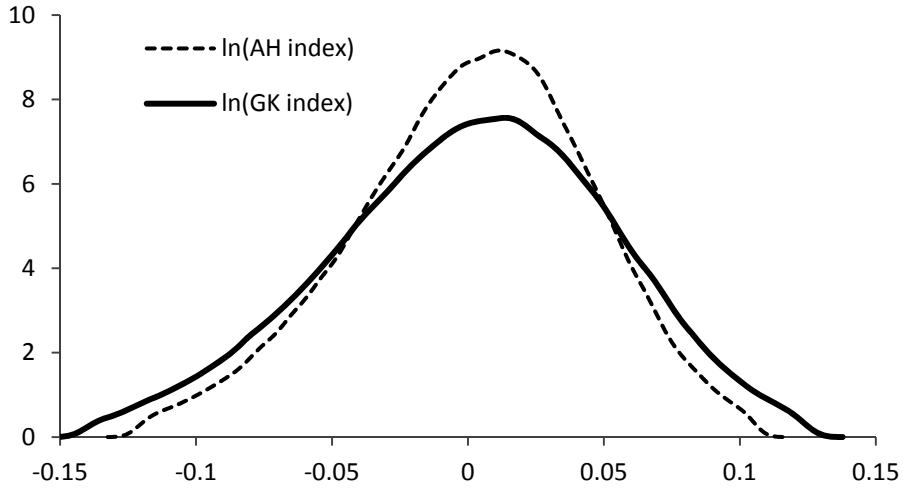
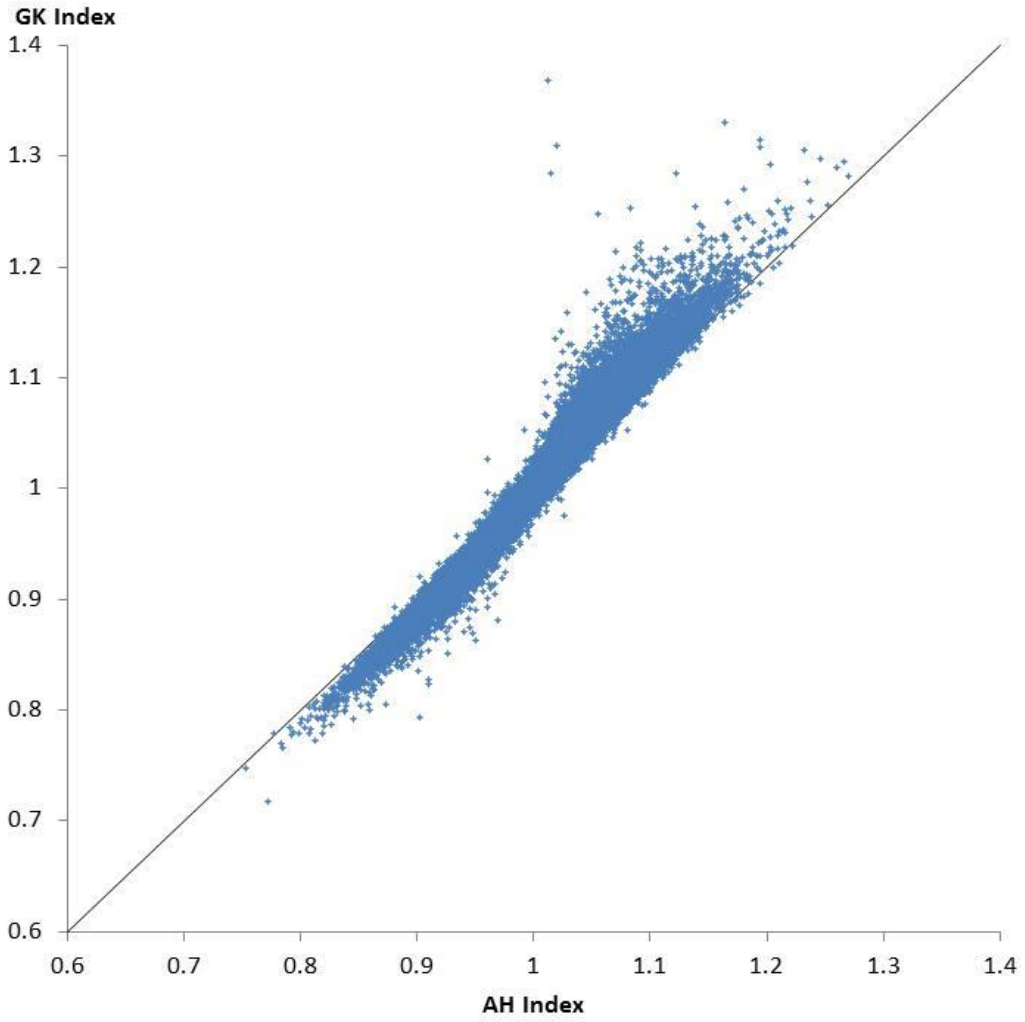
Figure 1: Distribution of Relative Price Index across Households



Note: The kernel density estimation of the price indicies defined in Section 3.

Figure 2: Scatter Plots of GD and AH Indices



Note: The covariance matrix is as follow, where the diagonal elements are variances, and its upper right element is correlation.

	AH	GK
AH	0.0022	0.9886
GK	0.0026	0.0031

Table 1: The Relation between Relative Price and Household Characteristics

	(1) lnGKindex	(2) lnAHindex	(3) lnGKindex	(4) lnAHindex
Dummy for Income (1)				
4,000-5,490	0.0014	0.0009	0.0017	0.0011
	(3.052)	(2.243)	(3.857)	(2.955)
5,500-6,990	0.0054	0.0038	0.0047	0.0033
	(11.235)	(9.303)	(9.888)	(8.130)
7,000-8,990	0.0066	0.0044	0.006	0.004
	(13.355)	(10.545)	(12.071)	(9.486)
9,000-	0.0154	0.0111	0.014	0.0101
	(30.452)	(26.184)	(26.757)	(23.027)
Dummy for Age (2)				
30-34	-0.0048	-0.0041	-0.0034	-0.0033
	(-7.537)	(-7.504)	(-5.363)	(-5.895)
35-39	-0.0022	-0.0022	-0.0012	-0.0018
	(-3.658)	(-4.153)	(-1.771)	(-3.052)
40-44	-0.0019	-0.0022	-0.0028	-0.0034
	(-3.019)	(-4.060)	(-3.850)	(-5.361)
45-49	0.0019	0.0003	-0.0017	-0.0028
	(2.852)	(0.513)	(-2.120)	(-4.153)
50-54	0.0043	0.0015	-0.0019	-0.0031
	(6.480)	(2.681)	(-2.340)	(-4.432)
55-59	0.008	0.0041	0.0006	-0.0011
	(12.276)	(7.436)	(0.773)	(-1.579)
60-	0.0145	0.0092	0.0058	0.0032
	(22.032)	(16.640)	(7.103)	(4.579)
Constant	-0.0068	-0.0035	-0.0121	-0.0069
	(-12.689)	(7.514)	(-11.140)	(-7.472)
Observations	126,834	126,895	126,834	126,895
R-squared	0.025	0.017	0.067	0.050

Note:
Ordinary least squares estimates based on Japanese homescan provided by INTAGE.
The dependent variable is the Household Level AH & GK Price Index
Clustering t-statistics are in parentheses.
The data is converted to household level quarterly data.
(1) The unit is 1000yen. The base is the income below 4,000.
(2) The age of wife. The base is the dummy for below 30.
Spec (3)&(4) controlled for the number of family members, the age of lastchildren, city size and prefecture .
All the explanatory variables in spec (1) & (2) are shown in this table.

Table 2: Contribution of Wife's job for GK index

	-29			60-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.767	100.0%	100.0%	1.377	100.0%	100.0%
Full-time employee	0.052	-7.4%	11.3%	0.181	13.1%	8.4%
Part-time employee	-0.151	20.0%	20.5%	0.224	16.3%	18.6%
Independent business	0.023	-3.3%	1.0%	0.105	7.5%	5.5%
Side job	-0.027	3.4%	1.4%	0.056	4.1%	2.3%
Without job	-0.664	87.4%	65.9%	0.812	59.0%	65.2%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

	-4 mil yen			9 mil yen-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.539	100.0%	100.0%	1.169	100.0%	100.0%
Full-time employee	0.077	-14.5%	8.9%	0.353	30.4%	20.8%
Part-time employee	-0.191	36.0%	29.9%	0.176	14.9%	33.6%
Independent business	-0.000	-0.1%	3.1%	0.077	6.6%	4.0%
Side job	-0.018	3.2%	3.2%	0.013	1.2%	1.7%
Without job	-0.407	75.3%	54.8%	0.549	46.9%	39.9%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

Table 3: Contribution for GK index by children's age

	-29			60-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.789	100.0%	100.0%	1.374	100.0%	100.0%
No children under 20	0.075	-10.0%	11.3%	1.279	93.3%	90.3%
0-6	-0.611	76.7%	70.3%	0.002	0.1%	1.7%
7-12	-0.038	5.0%	3.3%	0.046	3.3%	2.8%
13-19	-0.019	2.8%	1.0%	0.021	1.4%	2.6%
0-6 & 7-12	-0.191	24.9%	13.4%	0.012	0.9%	1.2%
0-6 & 13-19	0.015	-1.9%	0.4%	0.007	0.5%	0.2%
7-12 & 13-19	-0.017	2.4%	0.2%	-0.003	-0.3%	1.0%
0-6, 7-12 & 13-19	-	0.0%	0.0%	0.009	0.7%	0.2%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

	-4 mil yen			9 mil yen-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.557	100.0%	100.0%	1.192	100.0%	100.0%
No children under 20	0.200	-38.0%	38.3%	0.752	63.4%	50.4%
0-6	-0.313	56.1%	22.0%	0.027	2.2%	3.9%
7-12	-0.108	19.9%	9.7%	0.057	4.8%	6.1%
13-19	-0.018	3.5%	10.9%	0.248	20.5%	26.5%
0-6 & 7-12	-0.237	43.9%	11.6%	0.028	2.4%	3.6%
0-6 & 13-19	0.005	-0.8%	0.4%	0.004	0.3%	0.4%
7-12 & 13-19	-0.071	12.7%	6.5%	0.081	6.7%	8.5%
0-6, 7-12 & 13-19	-0.015	2.8%	0.8%	-0.005	-0.4%	0.6%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

Table 4: Contribution of Children for GK index

	-29			60-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.789	100.0%	100.0%	1.328	100.0%	100.0%
No children	0.078	-10.5%	11.8%	1.251	94.2%	91.5%
1	-0.186	23.9%	36.0%	0.015	1.0%	3.6%
2	-0.514	66.2%	42.1%	0.031	2.4%	3.7%
over 3	-0.154	20.3%	10.1%	0.031	2.4%	1.2%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

	-4 mil yen			9 mil yen-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.557	100.0%	100.0%	1.192	100.0%	100.0%
No children	0.180	-33.0%	43.6%	0.904	76.2%	65.3%
1	-0.167	29.5%	20.5%	0.148	12.6%	17.1%
2	-0.409	72.6%	26.4%	0.099	8.3%	13.1%
over 3	-0.175	31.0%	9.5%	0.035	2.9%	4.5%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

Table 5: Contfibution for GK index by Goods Type

	-29			60-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.777	100.0%	100.0%	1.346	100.0%	100.0%
Cereals	-0.148	19.2%	11.5%	0.142	10.4%	11.7%
Seasonings	-0.039	4.9%	12.7%	0.205	15.3%	15.3%
Manufactured Food	-0.179	23.4%	15.6%	0.245	18.3%	16.2%
Cakes & Candies	-0.078	9.9%	12.1%	0.135	10.0%	7.4%
Dairy Products	-0.126	16.5%	7.7%	0.082	6.1%	9.1%
Beverages	-0.064	8.5%	18.0%	0.253	18.8%	24.7%
Soap & Toothbrushes	-0.035	4.7%	5.7%	0.095	7.1%	4.9%
Detergent	-0.021	2.7%	4.9%	0.083	6.2%	4.7%
Facial Tissue & Food Wrap	-0.094	11.5%	10.6%	0.055	4.0%	3.5%
Others	0.008	-1.1%	1.3%	0.051	3.8%	2.5%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

	-4 mil yen			9 mil yen-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.565	100.0%	100.0%	1.172	100.0%	100.0%
Cereals	-0.127	22.8%	12.9%	0.139	11.8%	11.5%
Seasonings	-0.061	10.6%	13.7%	0.201	17.2%	13.8%
Manufactured Food	-0.122	21.6%	16.6%	0.221	18.8%	16.8%
Cakes & Candies	-0.084	14.7%	10.2%	0.094	8.0%	8.9%
Dairy Products	-0.080	14.3%	8.6%	0.065	5.5%	8.8%
Beverages	-0.047	8.3%	20.6%	0.189	16.2%	22.8%
Soap & Toothbrushes	-0.002	0.3%	5.1%	0.070	6.0%	5.8%
Detergent	-0.001	0.2%	4.6%	0.067	5.7%	4.5%
Facial Tissue & Food Wrap	-0.044	7.6%	6.0%	0.067	5.7%	4.2%
Others	0.002	-0.3%	1.7%	0.059	5.1%	2.9%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

Table 6: Contribution of Bulk buying for GK index

	-29			60-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.773	100.0%	100.0%	1.354	100.0%	100.0%
Not bulk buying	0.376	-51.5%	70.1%	1.701	126.2%	60.5%
Bulk buying	-1.149	151.5%	29.9%	-0.347	-26.2%	39.5%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

	-4 mil yen			9 mil yen-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.558	100.0%	100.0%	1.196	100.0%	100.0%
Not bulk buying	0.481	-88.7%	66.0%	1.601	134.2%	63.2%
Bulk buying	-1.039	188.7%	34.0%	-0.405	-34.2%	36.8%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

Table 7: Contribution for GK index by Family size

	-29			60-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.777	100.0%	100.0%	1.335	100.0%	100.0%
2	0.070	-9.4%	8.8%	0.627	46.8%	50.1%
3	-0.248	32.0%	30.8%	0.451	34.0%	29.7%
4	-0.485	62.9%	39.1%	0.166	12.3%	11.2%
5	-0.122	15.5%	12.5%	0.043	3.2%	4.2%
over 6	0.008	-1.0%	8.8%	0.050	3.7%	4.8%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

	-4 mil yen			9 mil yen-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.573	100.0%	100.0%	1.187	100.0%	100.0%
2	0.134	-24.8%	27.8%	0.138	11.7%	9.9%
3	-0.021	3.2%	26.3%	0.337	28.5%	24.7%
4	-0.501	88.9%	30.8%	0.417	34.8%	36.1%
5	-0.183	32.2%	12.3%	0.159	13.4%	17.3%
over 6	-0.002	0.5%	2.8%	0.137	11.5%	11.9%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

Table 8: Contribution for GK index by Day of Week

	-29			60-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.777	100.0%	100.0%	1.346	100.0%	100.0%
Sunday	-0.201	26.1%	18.4%	0.093	6.9%	16.4%
Monday	0.001	-0.1%	13.4%	0.291	21.7%	12.8%
Tuesday	-0.130	16.5%	15.2%	0.219	16.4%	14.7%
Wednesday	-0.103	12.9%	14.2%	0.199	14.8%	13.8%
Thursday	-0.116	14.9%	13.3%	0.192	14.3%	14.0%
Friday	-0.110	14.6%	12.3%	0.209	15.5%	14.3%
Saturday	-0.117	15.1%	13.2%	0.143	10.6%	14.1%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

	-4 mil yen			9 mil yen-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.565	100.0%	100.0%	1.172	100.0%	100.0%
Sunday	-0.201	35.7%	17.7%	0.142	12.1%	18.5%
Monday	0.035	-6.4%	12.7%	0.242	20.7%	12.7%
Tuesday	-0.084	15.0%	15.0%	0.178	15.2%	14.3%
Wednesday	-0.062	10.8%	14.0%	0.165	14.0%	13.4%
Thursday	-0.081	14.2%	13.4%	0.174	14.9%	13.6%
Friday	-0.062	10.9%	13.3%	0.156	13.2%	13.0%
Saturday	-0.111	19.8%	13.9%	0.116	9.8%	14.4%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

Table 9: Contribution for GK index by Store type

	-29			60-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.777	100.0%	100.0%	1.317	100.0%	100.0%
Convenience store	0.110	-14.3%	0.9%	0.084	6.4%	0.8%
Specialized store	-0.092	12.1%	6.6%	0.166	12.5%	10.5%
Pharmacy	-0.174	22.1%	17.8%	0.033	2.4%	8.0%
Home improvement store	-0.176	23.2%	6.3%	-0.023	-1.8%	4.6%
Home delivery & door to door sales	0.027	-3.5%	4.8%	0.138	10.6%	5.8%
Supermarket	-0.460	59.0%	62.5%	0.852	64.7%	68.2%
Others	-0.011	1.3%	1.1%	0.068	5.2%	2.1%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

	-4 mil yen			9 mil yen-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.586	100.0%	100.0%	1.141	100.0%	100.0%
Convenience store	0.094	-16.2%	0.8%	0.100	8.8%	0.9%
Specialized store	-0.012	2.2%	6.9%	0.028	2.5%	7.5%
Pharmacy	-0.157	26.7%	11.5%	0.005	0.5%	9.8%
Home improvement store	-0.145	25.1%	5.8%	-0.053	-4.7%	5.6%
Home delivery & door to door sales	0.041	-7.3%	5.6%	0.179	15.7%	8.5%
Supermarket	-0.405	69.3%	68.0%	0.859	75.2%	66.7%
Others	-0.001	0.2%	1.3%	0.023	2.0%	1.2%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

Table 10: Contribution of Repeat purchasing for GK index

	-29			60-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.777	100.0%	100.0%	1.346	100.0%	100.0%
1	-0.552	71.4%	64.7%	0.619	46.1%	55.2%
2	-0.145	18.7%	17.0%	0.209	15.5%	17.7%
3	-0.041	5.3%	7.3%	0.135	10.1%	9.0%
4	-0.020	2.5%	3.7%	0.069	5.1%	4.8%
5	-0.006	0.8%	2.1%	0.049	3.6%	3.0%
6	-0.005	0.6%	1.3%	0.035	2.6%	2.1%
7	-0.007	0.9%	0.9%	0.028	2.0%	1.5%
8	-0.001	0.2%	0.7%	0.026	2.0%	1.1%
9	0.001	-0.2%	0.5%	0.021	1.6%	1.0%
over 10	0.000	-0.1%	1.6%	0.154	11.5%	4.8%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.

	-4 mil yen			9 mil yen-		
	Contribution for Index	Weight in contribution	Weight in expenditure	Contribution for Index	Weight in contribution	Weight in expenditure
Sum	-0.565	100.0%	100.0%	1.165	100.0%	100.0%
1	-0.474	83.7%	59.3%	0.537	45.9%	57.5%
2	-0.118	20.9%	17.2%	0.197	17.0%	17.7%
3	-0.016	2.7%	8.2%	0.112	9.7%	8.5%
4	-0.004	0.8%	4.2%	0.069	5.9%	4.6%
5	0.006	-0.9%	2.6%	0.046	4.0%	2.8%
6	0.003	-0.5%	1.8%	0.037	3.2%	1.9%
7	0.002	-0.3%	1.3%	0.026	2.2%	1.3%
8	0.003	-0.4%	1.0%	0.023	2.0%	1.0%
9	0.001	-0.1%	0.8%	0.018	1.6%	0.8%
over 10	0.033	-5.8%	3.6%	0.099	8.6%	3.9%

Note: The figures are average for the sample period: 2004:1Q-2006:4Q.