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Who faces higher prices?
An empirical analysis based on Japanese homescan data

Naohito Abe

Kyosuke Shiotani

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UTokyo Price Project
702 Faculty of Economics, The University of Tokyo,
7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan
Tel: +81-3-5841-5595
E-mail: watlab@e.u-tokyo.ac.jp
http://www.price.e.u-tokyo.ac.jp/english/

Who faces higher prices?
An empirical analysis based on Japanese homescan data[1]

Naohito Abe[2] (Hitotsubashi Univeristy) and
Kyosuke Shiotani (Bank of Japan[3])

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Abstract

On the basis of household-level scanner data (homescan) for Japan, we construct a household-level price index and investigate the causes of price differences between households. We observe large price differentials between households, as did Aguiar and Hurst (2007). However, the differences between age and income groups are small. In addition, we find that elderly people face higher prices than the younger ones, which is contrary to the results of Aguiar and Hurst (2007). The most important determinant of the price level is reliance on bargain sales; an increase in the purchase of goods at bargain sales by one standard deviation decreases the price level by more than 0.9%, while shopping frequency has only limited effects on the price level.

1. Introduction

Owing to recent technological developments in data creation, numerous commodity price researchers have begun to use not only traditional aggregates, such as the consumer price index, but also micro-level information on commodity prices. To date, commodity-level price information is used in various economic fields, such as macroeconomics (Nakamura and Steinsson, 2007), international economics (Haskel and Wolf, 2001), and industrial economics (Bay et al., 2004, Goldberg and Frank 2005). Recently, on the basis of commodity-level homescan data,[5] Aguiar and Hurst (2007) (hereafter AH) found a violation of the law of one price between different age groups.

[1] We are grateful to comments from Andrew Leicester, Yukiko Abe, Sachiko Kuroda, and seminar participants at Osaka University and the annual meeting of the Japanese Economic Society. This research is an outcome of the JSPS Grants-in-Aid for Young Scientists (S) 21673001.
[2] Naohito Abe: The Institute of Economic Research, Hitotsubashi University. Naka, Kunitachi Tokyo. E-mail: nabe@ier.hit-u.ac.jp. Phone: +81-425-80-8347. b
[3] The views expressed in this paper are those of the authors and are not reflective of those of the Bank of Japan.
[5] Homescan data is a dataset on expenditure based on barcode readers installed in households. Sample households are expected to scan the barcode of every goods they purchased The detailed explanation on homescan data is provided in next section.

More precisely, in the United States, elderly families face lower prices for the same commodities than younger families. AH interpret their results in line with the standard life cycle model of consumption with endogenous decisions about shopping times. The mechanism is straightforward. Because the opportunity costs of shopping for retired people are lower than for younger people, the elderly can spend more time searching for lower prices. AH's findings have provided us with resolutions of several famous puzzles such as the retired-saving puzzle and excess sensitivity of expenditure to predicted income shocks.

Compared to standard consumption panel data such as the Panel Study of Income and Dynamics, the homescan data of AC Nielsen or Kantar provide us with detailed and frequent information about purchases at the household-commodity level. However, most homescan data do not update household characteristics such as income and employment status regularly. In other words, homescan household data on income and employment status does not have within-variation. For this reason, AH did not control for household level fixed-effects, rather, they used age of household head and income as instrumental variables (IV) to deal with endogeneity in determination of shopping frequency. Because IV estimates by AH are about 20 times larger than estimate without IV, careful examination of the effects of unobservable characteristics of households are required.

This study considers the relationship between shopping behaviors and price level on the basis of commodity-level homescan data for Japan. The advantage of using Japanese homescan over those in the US is that Japanese data updates household characteristics every year, which enables us to conduct more robust estimates. It is also worth noting that many previous researches have confirmed the existence of the saving-retirement puzzle, or excess sensitivity, in Japan.[6] Therefore, by investigating the relationship between shopping behaviors and price levels in Japan, we can check whether the mechanisms proposed by AH play significant roles in economies outside the US.

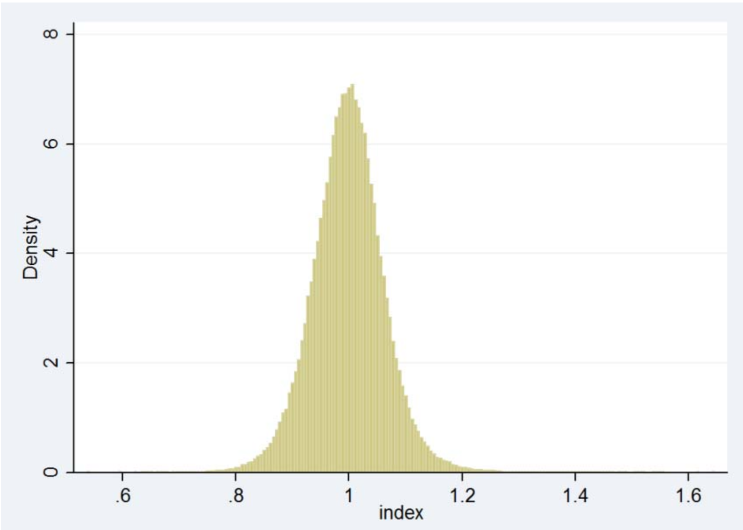
As in the US, we find that commodities are traded at various different prices in Japan. Figure 1 illustrates the distribution of the relative commodity price index following AH.[7] The index takes a value of unity if the recorded price is equal to the regional average price. A value of 1.2 implies that the price is 20% higher than the average. The figure clearly shows that the same products are sold at very different prices. We also found that the price level increases with age, which is in sharp contrast

[6] See Wakabayashi (2008) and Ogawa (1990) for studies on Japanese consumption.
[7] The figure shows the distribution of the household level monthly price index. The definition of the index will be given in the next section.

with the findings by AH. Among several potentially important determinants of the price index, the ratio of purchases at bargain sales is the most important factor. By increasing purchases at bargain sales by one standard deviation, people can enjoy a reduction in their price level of 1.7%, which is consistent with Griffith et al. (2009), who find a significant amount of savings from purchasing at bargain sales in the United Kingdom. Other shopping behaviors, such as frequency of shopping, the degree of mass purchasing or preference for high quality goods, are all statistically significant. However, these behaviors are not quantitatively important.

Our empirical results suggest that the price reduction mechanism based on the opportunity costs of shopping provided by AH is not observed in Japan. In contrast to the US, elderly people in Japan who are supposed to have lower opportunity costs for shopping tend not to use bargain sales, which allows them to face higher prices than the young. This suggests that further investigation of shopping strategy, particularly the determinants of purchasing at bargain sales, is necessary to understand the mechanism behind the price level differential between families.

Figure 1: Distribution of the Relative Price Index between Households



Note: The definition of the price index is given in Section 3.

2. Data

Our data are from the "Household Consumer Panel Research" (SCI) data set compiled by Intage, a marketing company in Japan. SCI contains the 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.

Using a barcode reader, households are asked to scan the barcode of every commodity they purchase. In SCI, for every commodity purchased, we can observe the: (1) Japanese Article Number (JAN), a unique commodity identifier,[8] (2) date of purchase, (3) price and quantity, and (4) store name from which the commodity was purchased. Fresh foods (e.g., meat, fish, and vegetables) without barcodes are excluded. This limitation is shared by the homescan data of AC Nielsen in the US. The data we use in this paper cover three years, from 2004 to 2006. Table 1 shows the distribution of family composition and comparisons with the Census and KHPS (Keio Household Panel Survey)[9]. Compared with the Census, the sample households of SCI contain more family members. A similar bias can be found in KHPS. Table 2 shows the age distribution of the sample wife, while Table 3 reports the employment status of the wife. We can observe that a significant number of wives are not in paid employment.

3. Relative Price Index

Following AH, we construct the price index as follows. Let us consider a commodity that belongs to a product category $c \in C$. Denote the price of goods $i \in I_c$ purchased by household $j \in J$ on date $t \in T$ by $p_{i,t}^{j,c}$, and the quantity by $y_{i,t}^{j,c}$. Then, the total expenditure by the household during time interval m can be written as:

$$X_m^j = \sum_{c\in C, i\in I_c, t\in m} p_{i,t}^{j,c} y_{i,t}^{j,c} .$$

If the household purchases each product at the average price, the expenditure would be:

$$\overline{X}_m^j = \sum_{c\in C, i\in I_c, t\in m} \overline{p}^c{}_{i,m} y_{i,t}^{j,c} ,$$

where:

$$\overline{p}^c{}_{i,m} = \sum_{j\in J, t\in m} p_{i,t}^{j,c} \frac{y_{i,t}^{j,c}}{\sum_{j\in J, t\in m} y_{i,t}^{j,c}},$$

[8] JAN (Japanese Article Number) code is managed by The Distribution Systems Research Institute. The code is compatible with the Universal Product Code (UPC). Although the JAN code is supposedly a unique identifier, some companies use the same JAN code for different products. Intage creates its own additional code to deal with the repeated use of JAN code. We use both JAN and Intage codes to identify commodities.

[9] For details of KHPS, see http://www.gcoe-econbus.keio.ac.jp/english/publicdata1.html.

is the weighted average price paid for a good *i* in category c during time interval *m*. Now, we define the price index for the household as the ratio of actual expenditure divided by the expenditure at the average price $\overline{p}^{c}{}_{i,m}$ as follows:

$$\tilde{p}_m^j \equiv \frac{X_m^j}{\overline{X}_m^j}.$$

Finally, we normalize the index by dividing by the average price index within the month to obtain:

$$p_m^j \equiv \frac{\tilde{p}_m^j}{\frac{1}{J}\sum_j \tilde{p}_m^j}.$$

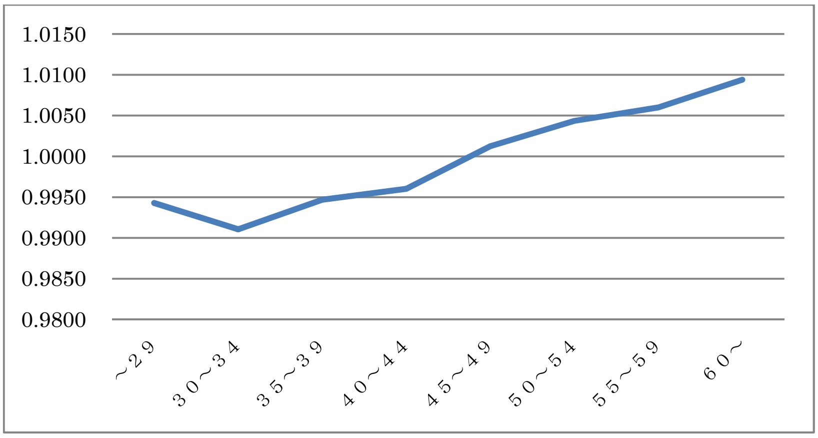
This household-level price index shows the price each household faces relative to the average price.[10] Figure 2 shows the life-cycle profile of this price index. The horizontal axis shows the age of the wife, while the vertical axis indicates the price index. As is clear from the figure, the price index increases with age; it does not decrease, as stated by Aguiar and Hurst (2007). Moreover, the slope is very small, which implies that the differences in prices between age groups are extremely limited; the absolute value of the slope is approximately one-third of that estimated in the US. Figure 3 shows the relationship between the price index and household income. Similar to Figure 2, we observe a slight upward line of price with income, which implies households with greater income face moderately higher prices than poor families.

Table 4 shows the regression coefficients for income and age dummies when the dependent variable is the natural logarithms of the price index. The effects of age and income group dummies on the price index are quite stable and are highly significant. However, the values of the coefficients are generally not very large. According to specification (1) in Table 4, rich households whose income is over 9 million yen face 0.013-point higher prices than the poorest income group.

It is worth noting that this price index cannot capture the movement of prices over time because the average of the price index is always unity.

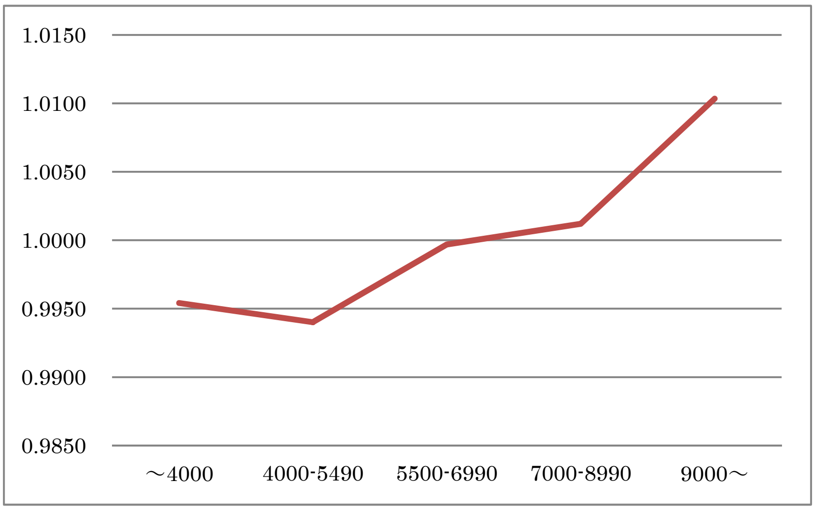
Figure 2: Life-Cycle Profile of Price Index

[10] When calculating the average price for each commodity, we use the regional average that divides the whole of Japan into 10 different regions.



Note: The horizontal axis is the age of wife.

Figure 3: Household Income and Price Index



Note: The horizontal axis is household income whose unit is 1,000 yen.

4. Shopping Behaviors

One of the main results of AH is that elderly people can lower their prices by increasing their shopping frequency. In this section, in addition to the shopping frequency, we introduce other shopping behaviors that might affect the relative price index introduced in the previous section.

<u>Shopping frequency: (ln trip)</u>

As our measure of shopping frequency, we use the number of stores households use. More precisely, we first count the number of different stores a sample household visits each day. Next, we calculate the sum of the number for each month, which gives the index for the degree of shopping frequency.

The number of different stores: (ln stores)

This measure captures the variety of shops each household uses. Note that this variable does not include information regarding frequent shopping at the same store. This variable can be used to find the people who use more stores in search of better prices, thus as a proxy for search intensity, because high search intensity might lead to a lower price index.

Herfindahl–Hirschman index: (ln HHI)

Next, we construct the Herfindahl–Hirschman index (HHI) to capture the concentration of spending. HHI is a measure of the amount of competition in the industry. We use it as an indicator for the degree of concentration of stores where the households purchase goods. For example, consider two households. Both families go to three stores in a month. One of the families relies on a large supermarket and spends 90% of its monthly expenditure at the supermarket, while the other family spends evenly between the three stores. Our HHI captures the difference between such shopping behaviors.

HHI is defined as follows:

$$HHI_m^j \equiv \sum_{k=1}^{K} {S_{k,m}^j}^2,$$

where $S_{k,m}^j$ is the share of store $k \in \mathrm{K}$ in monthly total purchases of household j. In regression analyses, we use the natural log of HHI (ln_HHI).

The total number of goods bought by a household: (ln quantity)

We consider the monthly total number of goods a household buys:

$$Quantity_m^j = \sum_{c\in C, i\in I_c, t\in m} y_{i,t}^{j,c}$$

It is reasonable to suppose that a family buying many goods can enjoy volume discounts more, thus decreasing the price level.

Bargain index: (bargain)

To observe the effect of buying at bargain sales, we construct a measure for bargains. As might be expected, a household can decrease their price index by purchasing more goods at bargain sales.

Because of the lack of store-level flags for bargain sales in our dataset, it is necessary to define the price at bargain sales based on information regarding the movements of store-level prices. In this paper, we adopt the store-level monthly minimum price for each good, $min\, P_{i,t}^{c}$, as the price at bargain sales. Then, the following index is used:

$$bargain_m^j = \frac{\sum_{c\in C, i\in I_c, t\in m} I\left(P_{i,t}^{j,c}\right) p_{i,t}^{j,c} y_{i,t}^{j,c}}{\sum_{c\in C, i\in I_c, t\in m} p_{i,t}^{j,c} y_{i,t}^{j,c}},$$

where:

$$I\left(P_{i,t}^{j,c}\right) = \begin{cases} 1, & P_{i,t}^{j,c} = min\ P_{i,t}^{c}\ and\ min\ P_{i,t}^{c} \neq max\ P_{i,t}^{c} \\ 0, & Otherwise \end{cases}$$

shows the ratio of expenditure at bargain prices. A household with a large bargain index is purchasing products at lower prices than regular prices, which lowers the relative price index. It is worth noting that this measure captures the importance of temporal reduction within a month. If prices are stable for several months, or if bargain sales last more than one month, this index fails to capture the importance of bargain sales.[11]

Store choice index: (ln store_choice)

Generally, most products can be purchased at both luxury stores and discount stores. The movement of prices differs between stores to a great extent. Abe and Tonogi (2009) show that prices move very differently between stores based on a large point-of-sale database of Japanese stores. Suppose a rich family has a higher opportunity cost of shopping than poor families. Also, suppose that a rich family tends to use luxury stores. Then, it is probable that luxury stores sell commodities at higher prices than standard supermarkets because customers can reduce their shopping costs by buying goods at one shop even if they know other stores have set lower prices for exactly the same goods. However, discount shops cannot set higher prices for common goods because common goods are the main products of discount shops, which expect that customers will change their favorite shops if they increase the prices of commonly used goods. Thus, it is worth examining the effects of store quality on the price index.

We define the index for the quality of each store, $k \in K$, by following the procedure for the relative price index. The store quality index is the ratio of hypothetical sales if the store sells the goods at their average price $\bar{P}_{i,m}^{c}$ relative to sales if the store sells the goods at their categorical average prices. More precisely, first, we obtain the average price for a given good in category $c \in C$ as:

[11] When a household purchases very rare items that are sold only one item per month in each store, we cannot identify whether this price is a bargain price or a regular price. Our variable regards this purchase as not a bargain sale. To check the importance of the rarely traded goods, we try several different definitions for bargain sales and find that our main results in later sections do not depend on rarely traded goods.

$$\bar{P}_m^c = \sum_{i \in I_c, k \in K, t \in m} p_{i,t}^{k,c} \frac{y_{i,t}^{k,c}}{\sum_{i \in I_c, k \in K, t \in m} y_{i,t}^{k,c}}$$

Next, assuming that the stores sell the average goods in each category at the average price, we obtain the total sale as:

$$\bar{Z}_m^k = \sum_{c \in C, i \in I_c, t \in m} \bar{p}_m^c y_{i,t}^{k,c}.$$

Then, we calculate the total sales of store *k* if it sells the goods at their average prices

$$\bar{p}_{i,m}^c = \sum_{k \in K, t \in m} p_{i,t}^{k,c} \frac{y_{i,t}^{k,c}}{\sum_{k \in K, t \in m} y_{i,t}^{k,c}},$$

$$Z_m^k = \sum_{c \in C, i \in I_c, t \in m} \bar{p}_{i,m}^c y_{i,t}^{k,c}.$$

Now, the index for the quality of goods sold at store *k* is defined as:

$$\tilde{q}_m^k \equiv \frac{Z_m^k}{\bar{Z}_m^k}.$$

Finally, we normalize the index by dividing by the average monthly quality index as follows:

$$q_m^{\mathrm{k}} \equiv \frac{\tilde{q}_m^k}{\sum_{k \in K} \tilde{q}_m^k} \ ,$$

which gives us the quality index of a store *k* during the time interval *m*.

We employ the average of the store quality index weighted by the share of each store in monthly total purchases of a household *j*.

$$Store\ \mathrm{choice}_m^j \equiv \sum_{k \in K} S_{k,m}^j q_m^k$$

The greater the store choice index, the higher the likelihood of using luxury stores, which leads to a higher price index.

Quality index: (ln quality)

By changing "store" to "household" in the previous index, we can create the household level monthly average quality index. The quality index for households is defined as the ratio of the hypothetical expenditure were the household to purchase the goods at their average price, $\bar{p}_{i,m}^c$, to the expenditure if the household were to purchase the goods at their category average prices, $\bar{p}_m^c$. Formally, define the total expenditure of household j when assuming the household purchases goods at the category average price:

$$\bar{Z}_m^j = \sum_{c \in C, i \in I_c, t \in m} \bar{p}_m^c y_{i,t}^{j,c}.$$

Next, define the hypothetical expenditure if the household purchases the goods at their commodity level average price as:

$$Z_m^j = \sum_{c \in C, i \in I_c, t \in m} \bar{p}_{i,m}^c y_{i,t}^{j,c}.$$

The index for quality of goods bought by household j is defined as:

$$\tilde{q}_m^j \equiv \frac{Z_m^j}{\bar{Z}_m^j}.$$

We normalize the index by dividing by the average monthly quality index as follows:

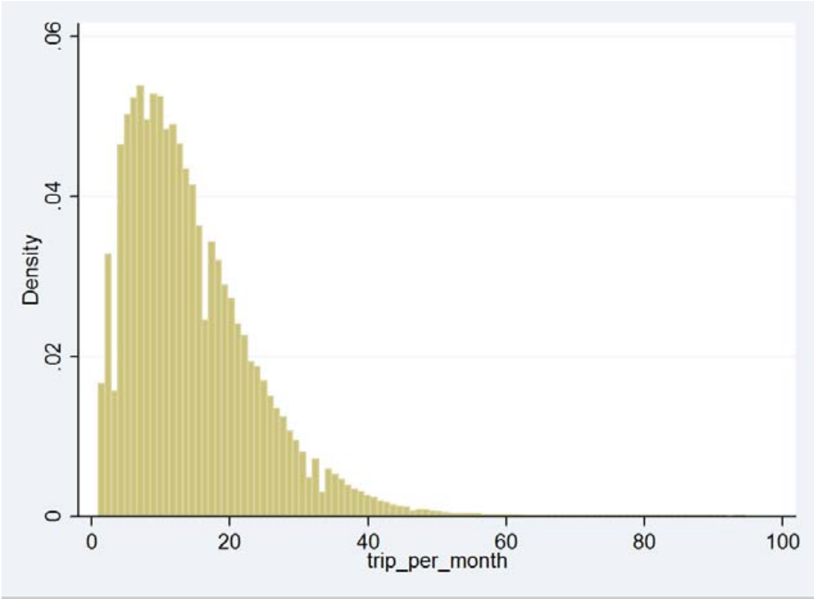
$$q_m^j \equiv \frac{\tilde{q}_m^j}{\sum_{j \in J} \tilde{q}_m^j}.$$

It is expected that the greater this quality index, the higher the price index.

As noted previously, this measure is not affected by other household shopping strategies, such as buying at sales, because it uses the average price of each good. In this index, we assume all households encounter the same prices for specific goods, so the higher index does not imply a household buys goods at higher prices than another household.

Table 5 reports the descriptive statistics of these shopping behavior variables and the relative price index between different age and income groups. On average, Japanese families shop 14.4 times a month. The standard deviation of the number of trips is large, i.e., 9.5, which implies families have highly heterogeneous shopping frequencies. Figure 4 confirms this heterogeneity. Some families shop more than 100 times a month. It is important to note that this index counts multiple trips to the same store within the same day as only one trip. Therefore, the number of trips in this table is the lower bound of the actual number of trips.

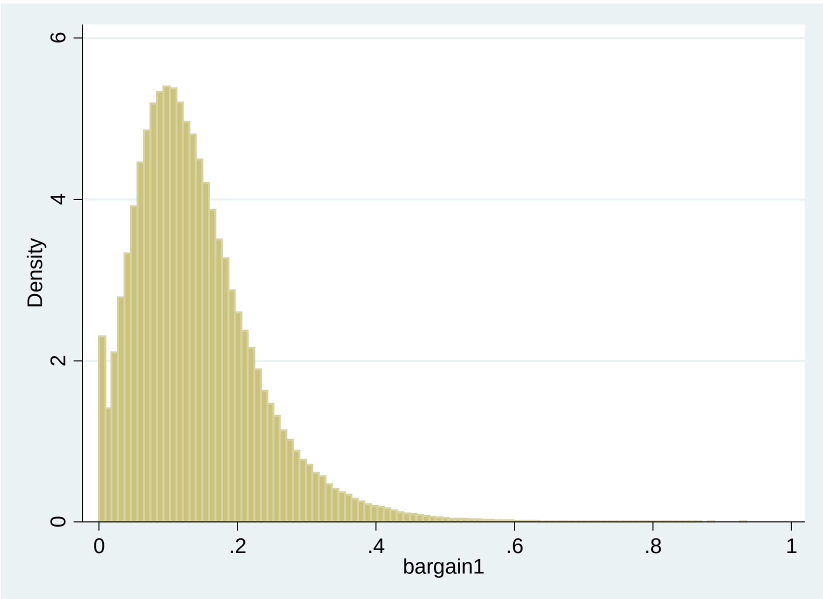
Figure 4: Distribution of the Frequency of Shopping Trips per Month



According to Table 5, households with the wife between 50 and 54 years old shop more frequently than younger households, which is consistent with AH. We also observe that shopping frequency increases with income.

Not surprisingly, the ratio of bargain purchases decreases with age and income. The standard deviation is also large. Figure 5 shows the distribution of the bargain ratio. We observe a mass point at zero, which implies that some families always purchase goods at higher prices rather than the monthly minimum price.

Figure 5: Distribution of the Bargain Ratio



The shopping concentration measure, ln_HHI, decreases with age and income, implying that elderly and rich families tend to disperse their expenditures between different stores.

5. The Relationships between the Relative Price Index and Shopping Behaviors

Table 6 reports our ordinary least squares results. Because of the endogeneity in shopping behaviors, we should be careful in our interpretation of the shopping behavior coefficients, such as the frequency of trips. Because of the large sample size, some of the t-values exceed fifty. Except for the ln_HHI and the number of different stores (ln_store), the signs of the shopping behaviors are generally consistent with the casual hypotheses raised in the previous section. For example, the coefficient of the frequency of trips (ln_trip) is negative, which implies that households that purchase more frequently face lower prices. Moreover, the size of the coefficient, −0.0137 in Spec (1), is similar to AH's OLS results.

The effects of income dummies are exceptionally stable. Controlling for shopping behaviors does not change the coefficients or their statistical significance, which implies that a positive relationship between the relative price index and income level reflects other mechanisms from those considered in Section 4, that we have not captured. The effects of age dummies, however, are very unstable. Depending on the choice of shopping strategies, the sign and magnitude of the coefficients of age dummies vary to a great extent, which suggests that the relationship between age and relative prices is related to the shopping behavior considered in Section 4. In other words, shopping strategy is an endogenous variable that is related to household characteristics.

AH used dummies for income and age as instrumental variables to control for the endogeneity of shopping behavior. Unfortunately, in our dataset, the two-stage least square estimates with these instrumental variables cannot pass either the over-identification tests or the weak instrumental tests. Thus, rather than relying on instrumental variables, we adopt a fixed effects model, which enables us to omit the biases due to unobservable family level effects.

Table 7 presents our estimation results. Robust and stable relationships are found between the shopping behaviors ln_quantity, bargain ratio, ln_store_choice, and ln_quality and the relative price index. The effects of age and income become much smaller than those reported in Table 6 probably because the fixed effects absorb the age effects. Table 8 reports the effects on the relative price index of an increase in each dependent variable by one standard deviation, based on Table 7. The effects of the bargain ratio have the greatest impact on the prices. The second greatest effect on the relative price index comes from mass purchasing (ln_quantity). With an increase in purchase quantity of one standard deviation, households can enjoy a 0.6% decrease in their relative price index. Households can also reduce their price level by choosing goods of lower quality or by shopping at discount shops. These effects, however, are smaller than the effects through purchasing at bargain sales. The effects of frequency of shopping are only 15% of the effects of purchasing at bargain sales.

It is worth noting that the R-squared of Spec (1) in Table 6 is approximately 20%, which implies that approximately 80% of the differences in the relative price index cannot be explained by the observed variables. As shown in Figure 1 and Table 4, there is a significant amount of heterogeneity in the relative price index between households. We need more information on the households' shopping behaviors and preferences to study the cause of the heterogeneity in more detail.

6. Conclusion

This paper investigated household-level price and inflation rate differences based on Japanese scanner data. The data reveal that the law of one price is violated to a great extent. Differences in prices between households exist for the same commodity, which is consistent with previous studies based on US data. The price level is negatively correlated with shopping frequency and positively correlated with income and age, both of which results are inconsistent with the results in the US. The ratio of purchases at bargain sales is a declining function of age. After controlling for purchases at bargain sales, the age effects on price level become very small, suggesting that elderly households face higher prices than young because elderly people use bargain sales less. The fixed effects estimates show very small significant effects of the shopping frequency on the price level, which is inconsistent with previous studies based on data in the US.

Many tasks remain. In this paper, the product-level information is not fully utilized. Variation in household characteristics, such as employment status and family composition, may also be important in explaining the differences in the prices paid by households. Finally, following Broda and Romalis (2009), heterogeneity in price level change, that is, heterogeneity in household-level inflation, needs to be investigated.

References

Abe, N., and A. Tonogi, (2010) "Micro and Macro Price Dynamics in Daily Data," *Journal of Monetary Economics*, Vol. 57, pp.716-728.

Aguiar, M. and E. Hurst (2007) "Life-Cycle Prices and Production," *American*

Economic Review, Vol. 97(5), pp.1533-59.

Baye, M., J. Morgan, and P. Scholten, (2004) "Price Dispersion in the Small and in the Large: Evidence from an Internet Price Comparison Site," *Journal of Industrial Economics*, 52, pp. 463.496

Broda, C. and J. Romalis, (2009) "The Welfare Implications of Rising Price Dispersion," mimeo.

Goldberg,P.K. and V. Frank, (2005) "Market integration and convergence to the Law of One Price: evidence from the European car market," *Journal of International Economics*, vol. 65(1), pages 49-73, January.

Haskel, J. and H. Wolf, "The Law of One Price - A Case Study", S*candinavian Journal of Economics,* 2001, vol. 103, pp. 545-558.

Griffith, R., E. Leibtag, A. Leicester, and A. Nevo (2009) "Consumer Shopping Behavior: How Much Do Consumers Save?" *Journal of Economic Perspectives*, Vol.23(2), pp. 99-120.

Ogawa,K. (1990) "Cyclical Variations in Liquidity Constrained Consumers: Evidence from Macrodata in Japan," Journal of Japanese and International Economies, Vol.4., pp. 173-193.

Kitamura, Y., (2008) "Kakeibetsu Bukkashisu no Kouchiku to Bunseki (in Japanese)," *Kinyukennkyux*, Vol.27(3), pp.91-150.

Kuroda, S., and I. Yamanoto, (2010) "Kakeibetsu Infle Ritsu No Bonpu To Sono Jizokusei (in Japanese)," in Seko et al. ed., *Nihon Kakei Kodo no Dainamizumu*, Keio University Press, pp. 217-244.

Nakamura, E. and J. Steinsson, (2008) "Five Facts about Prices: A Reevaluation of Menu Cost Model," *Quarterly Journal of Economics,* 123 (4), 1415-1464.

Wakabayashi, M. (2008) "The Retirement Consumption Puzzle in Japan," Journal of Population Economics, Vol. 21, pp. 983-1005.

Table 1: Family Composition

Family members		2	3	4	5	6
	2004	0.16	0.24	0.38	0.15	0.07
SCI	2005	0.16	0.24	0.38	0.15	0.07
	2006	0.17	0.24	0.38	0.14	0.07
Census	2005	0.38	0.27	0.22	0.08	0.05
KHPS	2004−2009	0.22	0.24	0.29	0.14	0.11

SCI is homescan data by Intage. KHPS is a panel data provided by Keio University.

Table 2: Wife Age Distribution

	Wife Age	～29	30～34	35～39	40～44
	2004	0.08	0.11	0.16	0.16
SCI	2005	0.08	0.12	0.14	0.16
	2006	0.08	0.12	0.14	0.15
Census	2005	0.068	0.107	0.111	0.11
	Wife Age	45～49	50～54	55～59	60～
	2004	0.12	0.14	0.11	0.12
SCI	2005	0.12	0.13	0.13	0.11
	2006	0.12	0.12	0.14	0.11
Census	2005	0.111	0.128	0.148	0.218

Table 3: Wife's job status

Age	SCI						Census 2005
	Full Time	Part Time	Self Employed	Agriculture	Sideline	Non Working	Non Working
～29	0.13	0.23	0.01	0.00	0.02	0.61	0.55
30～34	0.10	0.33	0.02	0.00	0.04	0.52	0.54
35～39	0.14	0.41	0.02	0.00	0.03	0.40	0.47
40～44	0.14	0.50	0.03	0.00	0.04	0.29	0.35
45～49	0.20	0.47	0.04	0.00	0.03	0.27	0.30
50～54	0.19	0.44	0.04	0.00	0.02	0.31	0.34
55～59	0.18	0.33	0.04	0.00	0.02	0.42	0.41
60～	0.09	0.19	0.06	0.00	0.02	0.64	0.50

Table 4: Basic Regression

	(1) lnprice	(2) lnprice	(3) lnprice	(4) lnprice
Dummy for Income (1)				
4,000–5,490	0.0016	0.0016	0.0011	0.0008
	(5.556)	(5.531)	(3.587)	(2.645)
5,500–6,990	0.0055	0.0055	0.0050	0.0049
	(17.462)	(17.424)	(15.962)	(15.606)
7,000–8,990	0.0069	0.0068	0.0060	0.0060
	(20.911)	(20.857)	(18.431)	(18.546)
9,000–	0.0130	0.0130	0.0119	0.0121
	(37.898)	(37.831)	(35.121)	(36.789)
Dummy for Age (2)				
30–34	−0.0025	−0.0025	−0.0024	−0.0035
	(−5.822)	(−5.809)	(−5.566)	(−8.283)
35–39	−0.0005	−0.0005	−0.0003	−0.0011
	(−1.177)	(−1.203)	(−0.723)	(−2.778)
40–44	−0.0021	−0.0021	−0.0019	−0.0011
	(−4.338)	(−4.354)	(−3.896)	(−2.647)
45–49	−0.0001	−0.0001	0.0002	0.0032
	(−0.241)	(−0.248)	(0.399)	(7.449)
50–54	0.0001	0.0001	0.0006	0.0051
	(0.234)	(0.206)	(1.050)	(11.861)
55–59	0.0023	0.0023	0.0028	0.0080
	(4.228)	(4.267)	(5.044)	(18.802)
60–	0.0078	0.0078	0.0080	0.0138
	(14.172)	(14.158)	(14.555)	(31.895)
Constant	−0.0042	−0.0036	−0.0031	−0.0096
	(−4.809)	(−5.419)	(−5.893)	(−27.102)
Observations	371,367	371,367	371,367	371,367
R-squared	0.031	0.031	0.018	0.015

Note:
Ordinary least squares estimates based on Japanese homescan provided by Intage.
The dependent variable is the Household Level Price Index
The data is converted to household level monthly 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 (1) controlled for time dummies, locational dummies, and household characteristics.
Spec (2) controlled for locational dummies and household characteristics.
Spec (3) controlled for household characteristics.
All the explanatory variables in spec (4) are shown in this table.

Table 5: Descriptive Statistics of Shopping Behaviors

		lnprice		Price Index (Level)		ln_trip		Number of Trips		Number of Stores (ln)	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
age of wife	～29	−0.0075	0.0595	0.9943	0.0590	2.0662	0.7512	10.1810	7.3054	1.2776	0.6075
	30～34	−0.0106	0.0572	0.9911	0.0566	2.1968	0.7486	11.4913	7.7730	1.3448	0.6102
	35～39	−0.0070	0.0572	0.9947	0.0567	2.3254	0.7387	12.9688	8.5863	1.4037	0.5978
	40～44	−0.0056	0.0571	0.9960	0.0567	2.4589	0.7505	14.8864	9.8937	1.4556	0.6031
	45～49	−0.0003	0.0564	1.0013	0.0563	2.5284	0.7340	15.7767	10.1449	1.4748	0.5982
	50～54	0.0027	0.0571	1.0044	0.0571	2.6112	0.6869	16.7191	10.3619	1.5572	0.5727
	55～59	0.0044	0.0573	1.0060	0.0573	2.5979	0.6526	16.1623	9.4398	1.5627	0.5759
	60～	0.0076	0.0584	1.0094	0.0587	2.5977	0.6516	16.1627	9.4465	1.5291	0.5787
	Total	−0.0021	0.0577	0.9995	0.0575	2.4349	0.7381	14.4381	9.5046	1.4565	0.5997
income	～4000	−0.0062	0.0594	0.9954	0.0669	2.3426	0.7376	13.1376	8.8552	1.3692	0.6015
	4000-5490	−0.0070	0.0577	0.9940	0.0638	2.3895	0.7294	13.6798	8.9383	1.4247	0.5914
	5500-6990	−0.0026	0.0573	0.9997	0.0636	2.4217	0.7432	14.2156	9.4528	1.4552	0.5980
	7000-8990	−0.0007	0.0567	1.0012	0.0619	2.4921	0.7453	15.2501	10.1186	1.4998	0.5989
	9000～	0.0073	0.0563	1.0104	0.0625	2.5430	0.7184	15.7681	10.0189	1.5428	0.5963
	Total	−0.0021	0.0577	0.9998	0.0640	2.4349	0.7381	14.3654	9.5090	1.4565	0.5997

		Bargain		ln_quantity		ln_HHI		ln_store_choice		ln_quality	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
age of wife (1)	～29	0.1394	0.0967	4.0852	0.6789	8.4072	0.4752	−0.1816	0.0753	−0.0518	0.1751
	30～34	0.1433	0.0924	4.2796	0.6544	8.3691	0.4848	−0.1784	0.0739	−0.0355	0.1753
	35～39	0.1433	0.0859	4.4645	0.6417	8.3649	0.4791	−0.1748	0.0768	−0.0244	0.1605
	40～44	0.1441	0.0830	4.6017	0.6465	8.3466	0.4837	−0.1714	0.0730	−0.0157	0.1548
	45～49	0.1402	0.0825	4.6544	0.6393	8.3459	0.4851	−0.1664	0.0779	−0.0008	0.1599
	50～54	0.1371	0.0861	4.6235	0.6232	8.2837	0.4829	−0.1584	0.0841	0.0005	0.1749
	55～59	0.1364	0.0908	4.5536	0.5903	8.2729	0.4854	−0.1541	0.0917	0.0016	0.1854
	60～	0.1364	0.0937	4.5348	0.5836	8.2979	0.4912	−0.1501	0.1133	−0.0034	0.1842
	Total	0.1403	0.0884	4.4945	0.6539	8.3344	0.4853	−0.1668	0.0841	−0.0150	0.1713
income (2)	～4000	0.1436	0.0951	4.3503	0.6523	8.3812	0.4816	−0.1745	0.0839	−0.0494	0.1730
	4000-5490	0.1443	0.0916	4.4441	0.6405	8.3507	0.4774	−0.1729	0.0808	−0.0305	0.1685
	5500-6990	0.1407	0.0876	4.5026	0.6582	8.3399	0.4824	−0.1682	0.0766	−0.0130	0.1640
	7000-8990	0.1412	0.0879	4.5772	0.6418	8.3129	0.4878	−0.1618	0.0903	0.0006	0.1670
	9000～	0.1333	0.0857	4.6117	0.6462	8.2818	0.4938	−0.1548	0.0883	0.0218	0.1762
	Total	0.1403	0.0884	4.4945	0.6539	8.3344	0.4853	−0.1668	0.0841	−0.0150	0.1713

Note

(1) The age of wife. The base is the dummy for below 30.

(2) The unit is 1000yen. The base is the income below 4,000 thousand yen.

Table 6: Ordinary Least Squares

	(1) lnprice	(2) lnprice	(3) lnprice	(4) lnprice	(5) lnprice	(6) lnprice	(7) lnprice	(8) lnprice
ln_trip	−0.0081	−0.0126						
	(−36.144)	(−92.771)						
ln_store	−0.0016		−0.0087					
	(−5.277)		(−52.931)					
ln_HHI	0.0037			0.0067				
	(12.409)			(34.013)				
ln_quantity	0.0001				−0.0140			
	(0.271)				(−87.747)			
bargain	−0.2425					−0.2540		
	(−248.359)					(−258.591)		
ln_store_choice	0.0273						0.0594	
	(−24.355)						(52.549)	
ln_quality	0.0394							0.0557
	(−72.150)							(101.984)
Dummy for Income (1)								
4,000−5,490	0.0008	0.0018	0.0020	0.0018	0.0019	0.0013	0.0013	0.0006
	(3.084)	(6.266)	(6.806)	(6.255)	(6.535)	(4.789)	(4.447)	(2.182)
5,500−6,990	0.0030	0.0054	0.0059	0.0057	0.0057	0.0041	0.0049	0.0037
	(10.410)	(17.500)	(18.919)	(18.272)	(18.331)	(14.147)	(15.670)	(11.854)
7,000−8,990	0.0039	0.0070	0.0075	0.0072	0.0073	0.0054	0.0059	0.0044
	(13.132)	(21.535)	(22.894)	(22.101)	(22.514)	(17.808)	(18.066)	(13.599)
9,000−	0.0076	0.0129	0.0137	0.0135	0.0134	0.0097	0.0118	0.0097
	(24.029)	(38.060)	(39.877)	(39.273)	(39.404)	(30.312)	(34.394)	(28.547)
Dummy for Age (2)								
30−34	−0.0013	−0.0011	−0.0019	−0.0022	−0.0007	−0.0019	−0.0029	−0.0033
	(−3.418)	(−2.531)	(−4.483)	(−5.056)	(−1.678)	(−4.682)	(−6.606)	(−7.733)
35−39	0.0014	0.0024	0.0007	−0.0000	0.0031	0.0001	−0.0011	−0.0017
	(3.512)	(5.297)	(1.491)	(−0.097)	(6.764)	(0.244)	(−2.463)	(−3.704)
40−44	0.0012	0.0023	−0.0004	−0.0014	0.0029	−0.0010	−0.0030	−0.0036
	(2.688)	(4.702)	(−0.776)	(−2.937)	(5.868)	(−2.156)	(−6.067)	(−7.487)
45−49	0.0031	0.0049	0.0018	0.0005	0.0057	0.0009	−0.0011	−0.0022
	(6.339)	(9.309)	(3.307)	(0.965)	(10.720)	(1.914)	(−2.047)	(−4.211)
50−54	0.0047	0.0061	0.0025	0.0010	0.0067	0.0016	−0.0009	−0.0014
	(9.392)	(11.296)	(4.632)	(1.813)	(12.256)	(3.106)	(−1.604)	(−2.695)
55−59	0.0070	0.0085	0.0048	0.0032	0.0091	0.0042	0.0011	0.0004
	(14.099)	(15.601)	(8.816)	(5.889)	(16.642)	(8.338)	(2.084)	(0.765)
60−	0.0115	0.0141	0.0100	0.0085	0.0150	0.0092	0.0062	0.0055
	(22.631)	(25.785)	(18.288)	(15.528)	(27.302)	(18.082)	(11.373)	(10.084)
Constant	0.0259	0.0221	0.0070	−0.0606	0.0509	−0.0319	0.0069	−0.0004
	(9.007)	(24.560)	(7.871)	(−32.397)	(47.972)	(−35.969)	(7.766)	(−0.509)
Observations	371,367	371,367	371,367	371,367	371,367	371,367	371,367	371,367
R−squared	0.211	0.053	0.038	0.034	0.050	0.179	0.038	0.057

Note:
Ordinary least squares estimates based on Japanese homescan provided by Intage.
The dependent variable is the Household Level Price Index
Time dummies are included in all the specifications. T statistics are in parentheses.
Household level characteristics such as the number of family members as well as locational information are also controlled.
The data is converted to household level monthly 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.

Table 7: Fixed Effects

	(1) lnprice	(2) lnprice	(3) lnprice	(4) lnprice	(5) lnprice	(6) lnprice	(7) lnprice	(8)
ln_trip	0.0053	−0.0024						
	(17078)	(−12.230)						
ln_store	−0.0004		−0.0008					
	(−1.302)		(−4.196)					
ln_HHI	0.0041			0.0012				
	(14.224)			(5.105)				
ln_quantity	−0.0103				−0.0098			
	(−36.375)				(−45.968)			
bargain	−0.1302					−0.1322		
	(−159.827)					(−162.27)		
ln_store_choice	0.0108						0.0205	
	(9.120)						(17.452)	
ln_quality	0.0140							0.0236
	(25.690)							(44.338)
Dummy for Income (1)								
4,000−5,490	0.0001	−0.0001	−0.0001	−0.0001	−0.0001	0.0001	−0.0001	−0.0001
	(0.185)	(−0.111)	(−0.103)	(−0.098)	(−0.096)	(0.151)	(−0.085)	(−0.128)
5,500−6,990	0.0002	0.0001	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002
	(0.322)	(0.191)	(0.240)	(0.229)	(0.111)	(0.354)	(0.270)	(0.257)
7,000−8,990	0.0007	0.0006	0.0006	0.0006	0.0005	0.0008	0.0007	0.0005
	(0.932)	(0.687)	(0.751)	(0.749)	(0.565)	(1.065)	(0.817)	(0.676)
9,000−	0.0003	0.0000	0.0001	0.0001	−0.0001	0.0004	0.0001	0.0001
	(0.377)	(0.036)	(0.121)	(0.118)	(−0.055)	(0.450)	(0.142)	(0.056)
Dummy for Age (2)								
30−34	0.0013	0.0011	0.0012	0.0013	0.0013	0.0011	0.0012	0.0013
	(1.891)	(1.636)	(1.776)	(1.784)	(1.814)	(1.690)	(1.759)	(1.804)
35−39	0.0016	0.0018	0.0019	0.0020	0.0020	0.0014	0.0019	0.0018
	(1.617)	(1.762)	(1.889)	(1.907)	(1.933)	(1.437)	(1.830)	(1.778)
40−44	0.0021	0.0021	0.0022	0.0022	0.0024	0.0018	0.0021	0.0020
	(1.805)	(1.729)	(1.809)	(1.828)	(2.001)	(1.542)	(1.722)	(1.640)
45−49	0.0025	0.0029	0.0030	0.0030	0.0031	0.0022	0.0029	0.0028
	(1.836)	(2.092)	(2.158)	(2.181)	(2.243)	(1.661)	(2.068)	(1.998)
50−54	0.0025	0.0030	0.0031	0.0031	0.0032	0.0023	0.0030	0.0029
	(1.614)	(1.862)	(1.912)	(1.938)	(1.958)	(1.452)	(1.825)	(1.819)
55−59	0.0019	0.0025	0.0025	0.0026	0.0027	0.0017	0.0023	0.0023
	(1.126)	(1.410)	(1.421)	(1.446)	(1.517)	(1.000)	(1.277)	(1.293)
60−	0.0028	0.0035	0.0035	0.0035	0.0036	0.0026	0.0032	0.0032
	(1.418)	(1.716)	(1.706)	(1.731)	(1.806)	(1.339)	(1.578)	(1.595)
Constant	0.0121	0.0004	−0.0045	−0.0153	0.0376	0.0116	−0.0021	−0.0047
	(3.958)	(0.278)	(−3.140)	(−6.520)	(22.468)	(8.632)	(−1.510)	(−3.374)
Observations	371,367	371,367	371,367	371,367	371,367	371,367	371,367	371,367
R−squared	0.077	0.001	0.001	0.001	0.006	0.069	0.001	0.006
Number of monitor_c	14,442	14,442	14,442	14,442	14,442	14,442	14,442	14,442

Note:
Fixed Effects Model
The dependent variable is the Household Level Price Index
Time dummies are included in all the specifications. T statistics are in parentheses.
Household level characteristics such as the number of family members as well as locational
The data is converted to household level monthly data.
(1) The unit is 1000yen. The base is the income below 4,000 thousand yen.
(2) The age of wife. The base is the dummy for below 30.

Table 8: The effects of an increase by one standard deviation of each variable on ln (Prices)

	ln_trip	ln_store	ln_HHI	ln_quantity
SD	0.73807	0.60218	0.48529	0.65390
Coefficients	−0.0024	−0.0008	0.0012	−0.0098
Effects on ln Prices	−0.00177	−0.00048	0.00058	−0.00641

	bargain	ln_store_choice	ln_quality
SD	0.08840	0.08413	0.17129
Coefficients	−0.1322	0.0205	0.0236
Effects on ln Prices	−0.01169	0.00172	0.00404