Inflation at the Consumer Level: Evidence from Japan[*]

Daisuke Kanamori[†]   Keisuke Someda[‡]   Kento Tango[§]

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Abstract

Using scanner data on individual expenditure, we estimate inflation rates at the consumer level. We find considerable dispersion in inflation rates across consumers and the level of inflation rates is determined by socio-economic factors. We also find that inflation rates at the consumer level are negatively associated with inflation expectations and the frequency of shopping. This suggests that those who expect inflation to be high go shopping more frequently than before and their bargain-hunting behavior *decreases* inflation rates. Our empirical evidence contribute to building behavioral New Keynesian models *a la* Gabaix (2019; 2020).

JEL Classification:	D12; D30; E31
Keywords:	behavioral New Keynesian model; imperfect information;
	inflation at the consumer level; inflation heterogeneity;

1 Introduction

Global inflation is now one of the most emergent issues faced by both developed and developing countries. Inflation has picked up in an unexpected manner for almost all economists. In fact, the Federal Reserve governor, Jerome Powell, admits "we now understand better how little we understand about inflation" in the European Central Bank Forum in Sintra, Portugal in June 2022. To uncover the dynamics of inflation, the recent literature sheds light on inflation at the micro level. Kaplan and Schulhofer-Wohl (2017) and Strasser et al. (2023) show significant heterogeneity of inflation across consumers. However, there is no evidence on inflation at the consumer level in Japan, which the only country that experienced not only recent inflation after

the COVID-19 pandemic but also long-standing chronic deflation until 2020. Thus, unveiling the inflation dynamics in Japan has been highly interested.

Following the methodology in Kaplan and Schulhofer-Wohl (2017) and Strasser et al. (2023), we estimate inflation rates at the consumer level using a novel data set in Japan. To uncover the inflation dynamics at the micro level, this study examines (1) whether inflation at the consumer level is heterogeneous, (2) what determines inflation at the consumer level, and (3) whether there are any factors other than socio-economic ones that determine inflation at the consumer level.

Using scanner data on individual expenditure, we estimate inflation rates at the consumer level. We find considerable dispersion in inflation rates across consumers and the level of inflation rates is determined by socio-economic factors. We also find that inflation rates at the consumer level are negatively associated with inflation expectations and the frequency of shopping. This suggests that those who expect inflation to be high go shopping more frequently than before and their bargain-hunting behavior *decreases* inflation rates. Our empirical evidence contribute to building behavioral New Keynesian models *a la* Gabaix (2019; 2020).

2 Data

We use panel data (SCI-personal) on consumption expenditure collected by a marketing company, Intage. We use day-to-day shopping information collected on an ongoing basis from consumers aged 15–79 all over Japan. The Family Income and Expenditure Survey (FIES) conducted by the Statistics Bureau of Japan records the consumption expenditure of approximately 6,000 households based on household heads, while the panel data we use records individual expenditure for more than 50,000 consumers. The data capture the profile of these consumers in detail, including aspects such as income, education, and financial assets. Specifically, the data allow us to identify who bought what, when, where, how many, and at what price. Furthermore, the data allow us to estimate the frequency of shopping at the daily basis. These data cover items that households purchase frequently, such as food (except for fresh food, prepared food, and lunch boxes), beverages, daily miscellaneous goods, cosmetics, pharmaceutical products, and cigarettes.[1]

3 Inflation at the consumer level

We estimate inflation rates at the consumer level using the Törnqvist index (PI^T).[2] Inflation is low if a consumer purchases the same good at the cheaper prices at time t than at $t-1$. Thus, consumers who go shopping more frequently for bargain hunting are likely to face lower inflation rates than those who do not.

Figure 1 depicts the histogram of consumer-level inflation rates. The figure suggests considerable heterogeneity of inflation rates. The quartile range is approximately 3.5%, which is similar to those of the U.S. and E.U. (Kaplan and Schulhofer-Wohl, 2017; Strasser et al., 2023).

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[1]Because our scanner data cover daily necessities, they do not cover housing, utilities, durables, clothing, and services.

[2]The logarithm of the index is computed as follows: $\ln(PI_j^T) = \sum_{i=1}^{N} \frac{\omega_{0i,j}+\omega_{1i,j}}{2}\left(\ln p_{1i,j} - \ln p_{0i,j}\right)$, where $\omega_{ti,j}$ and $p_{ti,j}$ is denoted as the weight of a consumption basket for good i of consumer j at time t and good i's price at which consumer j purchased at time t.

What determines heterogeneity of inflation? Figure 2 depicts the relationship between ages and inflation. The figure suggests that ages are positively associated with inflation. The clear relationship implies that socio-economic factor may affect inflation at the consumer level. To formally test the relationship, we regress inflation on socio-economic factors:

$$\pi_t^j = \beta_1 \times Gender_t^j + \beta_2 \times Age_t^j + \beta_3 \times Education_t^j + \beta_4 \times Income_t^j + \delta_t + \epsilon_t^j, \tag{1}$$

where π_t^j is denoted as inflation for consumer j and $Gender_t^j$, Age_t^j, $Education_t^j$, and $Income_t^j$ are socio-economic factors: gender, age, educational attainment, and income level for consumer j. While we do not report the estimation results from Equation (1) and robustness checks to save space, the results suggest that gender, sex, education, and income level predict heterogeneity of inflation; women, old people, and those with low educational attainment or high income face significantly higher inflation than others.

4 Frequency of shopping and inflation at the consumer level

Are there any factors other than socio-economic ones that determine inflation at the consumer level? Sudo et al. (2018) show that the decline in hours worked explains the rise in the frequency of sales by retailers. The finding suggests that consumers with more leisure time do more shopping than busy consumers. In this case, consumers with more leisure time are likely to be bargain hunters, who may face *lower* inflation than busy consumers.

To test the hypothesis, we regress inflation on the (logarithm of) frequency of shopping:

$$\pi_t^j = c_j + \gamma \times \ln(visit_t^j) + \beta_2 \times Age_t^j + \beta_3 \times Education_t^j + \beta_4 \times Income_t^j + \delta_t + \epsilon_t^j, \tag{2}$$

where $\ln(visit_t^j)$ is denoted as the frequency of shopping at quarter t by consumer i. To alleviate endogenous issues, we instrument the (logarithm of) frequency of shopping ($\ln(visit_t^j)$) with the lagged one ($\ln(visit_t^j)$). Our focus is on the coefficient γ: a negative γ suggests that more frequent shopping entails *more* chances to buy goods at cheaper prices for those with more leisure time than busy consumers.

Table 1 shows the estimation results. The significantly negative γ in the table supports our hypothesis: more frequent shopping is associated with low inflation. This implies that frequent shopping entails *more* chances to buy goods at cheap prices. The table supports the evidence in the previous section: socio-economic factors predict inflation at the consumer level. In fact, inflation are positively associated with age, educational attainment, and income level in Specification (2).

5 Conclusion

Using a novel data set, we estimate consumer-level inflation rates. There are two findings. First, heterogeneous inflation rates at the consumer level are predicted by socio-economic factors. We also find that inflation at the consumer level negatively associated with the frequency of shopping. The finding suggests that more

frequent shopping entails *more* chances to buy goods at cheaper prices for those with more leisure time than busy consumers. Our empirical evidence may pave the new avenue for a behavioral New Keynesian model.

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Table 1: Does frequency of shopping affect inflation at the consumer level?

Dependent variable: π_t^j	(1)	(2)
Frequency of shopping	-0.672***	-0.543***
	(0.0706)	(0.0980)
Age		0.688***
		(0.0270)
Educational attainment		0.274**
		(0.109)
Income level		0.0564**
		(0.0227)
Constant	3.481***	-1.190**
	(0.283)	(0.557)
Individual fixed effect	YES	YES
Time fixed effect	YES	YES
Observations	633,783	350,708

Note: The data are from January 2015 to December 2020. We instrument the logarithm of frequency of shopping ($\ln(visit_t^j)$) with the lagged variable ($\ln(visit_{t-1}^j)$).
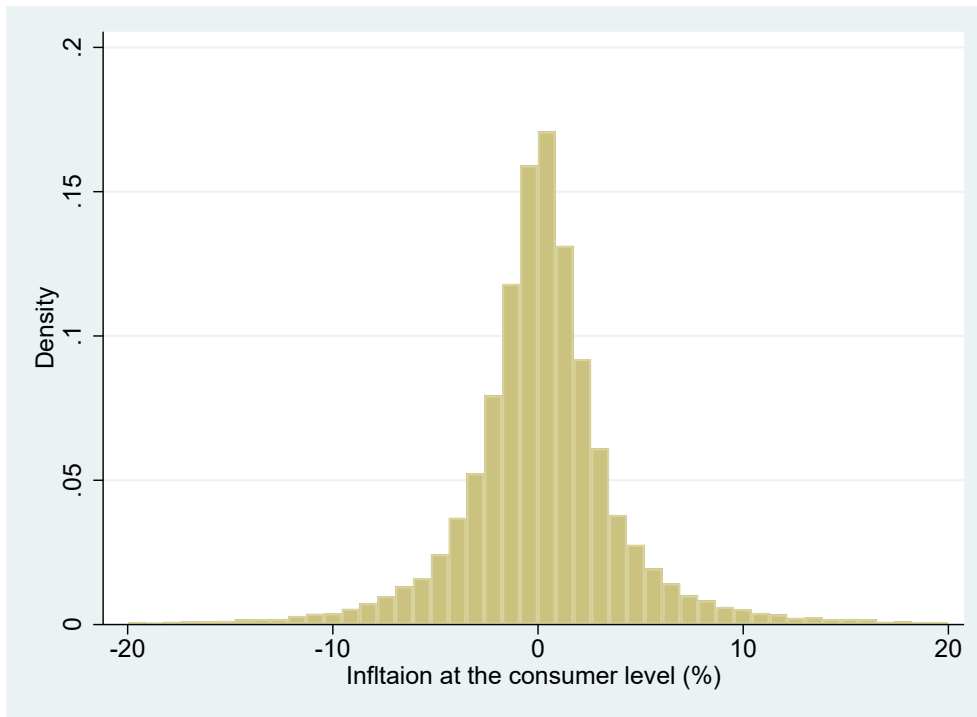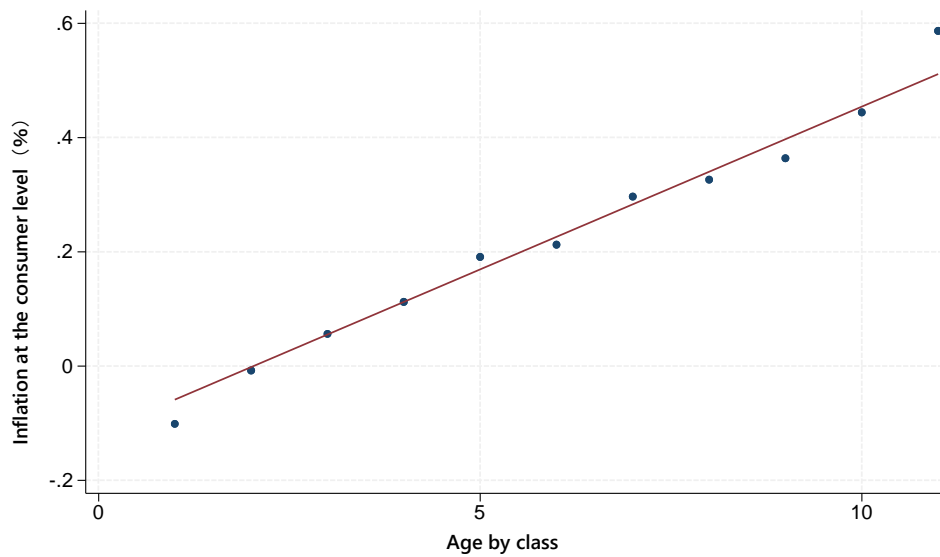
Figure 1: Histogram of consumer-level inflation rates

Figure 2: Relationship between ages and inflation at the consumer level