Households' Attention to the Central Bank, Inflation Expectations, and Spending

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Introduction

- The literature uses HH-level data to examine:
  - The relationship between inflation expectations and spending (e.g., Bachmann et al. 2015, Ichiue and Nishiguchi 2015)
  - Knowledge of and attention to the CB (e.g., Armantier et al. 2016, Binder and Rodrigue 2018, Coibion et al. 2022)
  - The relationship between inflation expectations and perceptions (e.g., Jonung 1981; Dräger and Nghiem 2021)
- This study examines heterogeneity among HHs at different income levels
  - The empirical part uses two datasets from Japanese HH surveys
  - To explain the empirical findings, we construct a rational inattention model in which HHs face idiosyncratic income risk and borrowing constraints

Preview

	Empirical findings	Theoretical explanations
1	Lower-income HHs' spending is less closely associated with their inflation expectations	Lower-income HHs are more likely to face borrowing constraints
2	Lower-income HHs pay less attention to the CB	Lower-income HHs benefit less from information that helps forecast future inflation, including the central bank's policy stance and outlook
3	Lower-income HHs' inflation expectations are more closely associated with their inflation perceptions	Lower-income HHs have fewer opportunities to correct for the bias in their expectations arising from overextrapolation

- Other reasons (cognitive abilities and asset holdings) can explain the empirical findings, but we can conclude that those who can change their spending more easily pay more attention to the CB

Literature

- The relationship between attention to inflation information and decisions on intertemporal consumption allocation (e.g., Macaulay 2022, D'Acunto et al. 2022)
  - This paper is particularly interested in attention to the CB

- CB communication to the general public (e.g., Haldane and McMahon 2018, Coibion et al. 2023)
  - We examine the type of people on whom the CB should focus

- Rational inattention and inflation volatility (e.g., Cavallo et al. 2017, Dräger and Lamla 2017)
  - We focus on the relationship between attention and an idiosyncratic condition

Outline of the paper

1. Introduction
2. Empirical analysis
3. Theory
4. Conclusion (policy implications)

Datasets

	PPS	Opinion Survey
Observation periods	2004 – 2013 (every Q1)	Sep. 2006 – Sep. 2018
# of samples	Around 4,000/wave	Around 2,000/wave
Data type	Panel	Repeated cross-section
Variables	Inflation expectations Spending change expectations Income levels	Inflation expectations Spending change expectations Income levels the BoJ Inflation perceptions
Question type	Largely quantitative	Qualitative (quantitative too only for inflation)
Note	US, China, and India too	

Distributions of inflation expectations over 1Y in Japan and the US (PPS)

(a) Japan

(b) U.S.

Regression 1

Expected real expenditure changes over the next 1Y

Expected inflation over the next 1Y

$$\overbrace{\widetilde{y^e_{i,t}}} = \beta_1 \overbrace{\widetilde{\pi^e_{i,t}}} + \beta_2 \overbrace{\widetilde{\pi^e_{i,t}}} \underbrace{d_{i,t}} + \beta_3 \underbrace{d_{i,t}} + \cdots$$

(-)   (+)

Dummies for the lowest/middle-income HHs

Note 1: The regression includes HH/time FEs and control variables (expected real income changes, past nominal expenditure changes, and a dummy for planning large expenditure in the near future)

Note 2: We exclude HHs that purchased a house or condo in the previous year and the top 1% HHs in terms of durable goods spending per income

Estimation results

	(1)	(2)
Inflation expectations (1Y from now)	-0.385***	-0.241***
× **Income per HH member (¥1.5-3.0 mil.)**	0.086*	0.096*
× **Income per HH member (< ¥1.5 mil.)**	0.114**	0.112**
Expected real income change		0.171**
Perceived nominal income change		0.093**
# of observations	28,924	27,911
# of HHs	7,467	7,472

Notes: Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Qs about the BoJ in the Opinion Survey

- Do you know that the Bank has been implementing aggressive monetary easing measures to achieve the price stability target of 2% in terms of the YoY rate of change in the CPI?

- How would you describe your level of interest in the Bank's activities?

- Do you know that one of the Bank's objectives is to achieve price stability?

- How would you describe the Bank's relationships with your lives?

Answers to Qs about the BoJ

(a) Knowledge of Aggressive Policy for 2%

(b) Interest in the BoJ's Activities

Regression 2

$$a_{i,t} = \begin{cases} \text{Know about the inflation target} & \text{if} & \alpha_2 < a_{i,t}^* \\ \text{Do not know much about it} & \text{if} & \alpha_1 < a_{i,t}^* \leq \alpha_2 \\ \text{Have never heard of it} & \text{if} & a_{i,t}^* \leq \alpha_1 \end{cases}$$

Dummies for low/middle income
and high financial literacy

$$a_{i,t}^* = \beta \, \overbrace{d_{i,t}} + \gamma \, \underbrace{x_{i,t}} + \tau_t + \epsilon_{i,t}$$

(-)

Controls (gender, age, work status)

Estimation results

	(1) Aggressive policy for 2%	(2) Interest in the activities	(3) Price stability	(4) Relationship to our lives
Income (¥1.5-3.0 mil.)	-0.268***	-0.152***	-0.232***	-0.144***
Income (< ¥1.5 mil.)	-0.435***	-0.268***	-0.451***	-0.279***
High financial literacy	0.536***	0.497***	0.383***	0.263***
Estimation period	Sep. 2013-	Sep. 2006-	Sep. 2006-	Sep. 2006-
# of observations	42,568	62,648	62,700	62,658

Notes: Robust standard errors in parentheses. *** indicates significance at the 1% level.

Proxy for financial literacy

Q1: How do you think economic conditions have changed compared with 1Y ago?

(a) Have improved

(b) Have remained the same

(c) Have worsened

Q2: With regard to Q1, what makes you think so?

(Choose up to two answers.)

(a) Media reports

(b) Economic indicators and statistics

(c) Business performance of the company I work for, or of my own company

(d) Income level for myself or other family members

(e) Bustle of shopping streets and amusement quarters

(f) Other

Overview of theory

- HHs face idiosyncratic income risk and borrowing constraints (Mckay et al. 2016, 2017)

- HHs determine the degree of attention to information on future inflation, taking losses from imprecise information into account (e.g., Sims 2003; Mackowiak and Wiederhold 2015; Dräger and Lamla 2017)

- HHs overextrapolate the past when forming inflation expectations

Conclusion (1): summary

- This study finds that:
  - Lower-income HHs' spending is less closely associated with inflation expectations
  - They pay less attention to the BoJ
  - Their inflation expectations are more closely associated with inflation perceptions
- To explain them, a rational inattention model is constructed
- Other reasons (cognitive abilities and asset holdings) can explain the empirical findings
- We conclude that those who can change their spending more easily pay more attention to the CB

Conclusion (2): policy implications

- Even if attention to the CB is weak on average, this does not necessarily imply weak effectiveness of CB communication
- Do not aim to enhance communication equally with the general public
- Do not deal with those who complain about inflation too much
- Facilitating access to CB information by those who are interested in it may be more efficient than proactive access from the CB
- Improving HHs' ability of intertemporal consumption allocation, for example, by reducing the probability that they face liquidity constraints, may improve communication efficiency

Conclusion (3): note

- We are not opposed to efforts to educate those who pay little attention to CB information
  - If it is relatively easy to improve communication with those people, such efforts are likely to be rewarded
  - Our results suggest that easiness to improve communication is not the sole determinant of optimal communication strategy, and that the CB needs to take HHs' ability to change their spending into account
- The policy implications above are only in terms of influencing aggregate spending
  - E.g., communication with a broad audience may be crucial to maintain political support for CB independence

Conclusion (4): future work

- Adding the rational attention framework to the HANK
  - The HANK model suggests that the direct effect of monetary policy is weak since only a limited share of HHs can change spending strongly in response to changes in real interest rates, but the general equilibrium effect is large (e.g., Kaplan et al. 2018)
  - As such, even if the direct effect of communication on spending is small, the general equilibrium effect could be large
  - Endogenous inflation would allow us to analyze an additional channel
- Studying firms' behavior
  - E.g., the more sticky the price of its product, the more incentive a firm may have to pay attention to information about future inflation when setting it
  - If this is the case, the CB should focus more on firms that pay more attention to its communication since the prices of their products are more likely to be set based on information obtained through communication

Thank you for your attention!

Benefits of CB communication about future inflation

- When nominal interest rates are stuck at the ELB, the CB may be able to stimulate spending by making people believe in higher future inflation

- CB communication still matters away from the ELB
  - Higher inflation expectations can lead to higher or lower real rate expectations
  - The CB may be able to avoid or mitigate adverse consequences by credibly communicating its ability and willingness of controlling inflation

Is CB communication effective?

- The literature often conducts RCTs in which the treatment groups are informed of the CB's inflation target, its outlook for inflation, and so forth (e.g., Armantier et al. 2016, Binder and Rodrigue 2018, Coibion et al. 2022).

- The results of such RCTs suggest

  – Information from CBs can alter inflation expectations

  – Many people do not pay serious attention to such information until informed through RCTs

- These results are consistent with much survey-based evidence that knowledge about MP and inflation is limited, particularly among HHs with certain sociodemographic factors, such as low-income HHs

Examples of Qs of the PPS

- By what percentage do you expect consumer prices will change in 2013, compared with the previous year?
    - 11 choices, such as
        - Decrease by at least 4.5%
        - Decrease by at least 3.5% but less than 4.5%
        - Change by less than 0.5% in either direction
    - We assign [-5%, -4%,…, 5%] to these choices.
- In 2013 what will be the approximate percentage change in your family's total annual expenditures compared with 2012?
    - 11 choices, such as
        - Decrease by at least 9%
        - Decrease by at least 7% but less than 9%
    - We assign [-10%, -8%,…, 10%] to these choices.

Inflation Qs in the Opinion Survey

- How do you think prices have changed compared with one year ago? (Note: Prices are defined as overall prices of goods and services you purchase.)
  - (a) Have gone up significantly
  - (b) Have gone up slightly
  - (c) Have remained almost unchanged
  - (d) Have gone down slightly
  - (e) Have gone down significantly
- What is your outlook for prices one year from now?
  - (a) Will go up significantly
  - (b) Will go up slightly
  - (c) Will remain almost unchanged
  - (d) Will go down slightly
  - (e) Will go down significantly

Estimation results for regression 2 (Cont.)

	Aggressive policy for 2%	Price stability	Interest in the activities	Relationship to our lives
Female	-0.593***	-0.334***	-0.212***	-0.033***
Age 30-39	0.152***	0.095***	0.116***	-0.069***
Age 40-49	0.378***	0.326***	0.251***	-0.077***
Age 50-59	0.593***	0.488***	0.365***	-0.060***
Age 60-69	0.875***	0.604***	0.569***	-0.006
Age 70+	0.954***	0.547***	0.675***	-0.066***
Agriculture, forestry,...	-0041	-0.165***	0.015	-0.010
Self-employed...	0.075***	-0.035**	0.090***	0.059***
Non-regular employee	-0.128***	-0.189***	-0.105***	-0.067***
Student, pensioner,...	0.069***	-0.034**	-0.002	0.044***

Regression 3: OLS regressions with quantitative answers of the Opinion Survey

Inflation perceptions compared with 1Y ago

Controls (gender, age, work status)

$$\pi_{i,t}^e = \beta_1 \overbrace{\pi_{i,t}^p} + \beta_2 \overbrace{\pi_{i,t}^p} \underbrace{d_{i,t}} + \beta_3 \underbrace{d_{i,t}} + \gamma \overbrace{x_{i,t}} + \tau_t + \epsilon_{i,t}$$

(+)   (+)

Dummies for the lowest/middle income and high financial literacy

Note: Inflation variables are winsorized at the 1 and 99% levels

Estimation results for regression 3

	1Y	5Y
Inflation perceptions (from 1Y ago)	0.446***	0.273***
× Income per HH member (¥1.5-3.0 mil.)	0.014	0.021**
× Income per HH member (< ¥1.5 mil.)	0.048***	0.046***
× High financial literacy	-0.008	-0.014
# of observations	89,974	89,974

Note: Robust standard errors in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

How to Measure Income per HH Member in the Opinion Survey?

- The Opinion Survey asks to choose from five categories about HH composition.

Choice	Assumed # of HH members
(a) Single-person HH	1
(b) Married-couple HH	2
(c) Two-generation HH	3
(d) Three-generation HH	3
(e) Other	3

- We divide income of the respondent and spouse by the assumed number of HH members.

- We check the robustness to using only samples with answers (a) and (b).

Robustness

- Focusing on HHs with relatively high data quality (i.e. single-person and married- couple HHs only)

- An alternative measure of financial literacy

- Winsorized at the 1 and 99% levels

- Using qualitative answers to inflation questions

Regression 3': ordered probit models with qualitative answers of the Opinion Survey

$$\pi_{i,t}^e = \begin{cases} \text{Price level will go up significantly} & \text{if} \quad \alpha_4 < \pi_{i,t}^{e*} \\ \quad\quad\quad\quad\quad \vdots & \quad\quad\quad \vdots \\ \text{Price level will go down signifiantly} & \text{if} \quad \pi_{i,t}^{e*} \leq \alpha_1 \end{cases}$$

Inflation perceptions compared
with 1Y ago (-2,-1,0,1, or 2)

Controls
(gender, age, work status)

$$\pi_{i,t}^{e*} = \beta_1 \overbrace{\pi_{i,t}^p} + \beta_2 \overbrace{\pi_{i,t}^p} \underbrace{d_{i,t}} + \beta_3 \underbrace{d_{i,t}} + \gamma \overbrace{x_{i,t}} + \tau_t + \epsilon_{i,t}$$

(+)   (+)

Dummies for the lowest/middle
income and high financial literacy

Estimation Results for Inflation Expectations Formation

	1Y	5Y
Inflation perceptions (from 1Y ago)	0.588***	0.342***
× Income per HH member (¥1.5-3.0 mil.)	-0.003	0.020
× Income per HH member (< ¥1.5 mil.)	0.033***	0.049***
× High financial literacy	-0.005	-0.048***
# of observations	104,342	103,144

Notes: Robust standard errors in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

HHs' income status

- Income status: $z_{h,t} = 0$ (high income) and $z_{h,t} = 1$ (low income)
- The status follows a Markov chain:

$$\begin{bmatrix} \Pr(z_{h,t+1} = 0) \\ \Pr(z_{h,t+1} = 1) \end{bmatrix} = \begin{bmatrix} 1 - \omega_H & 1 - \omega_L \\ \omega_H & \omega_L \end{bmatrix} \begin{bmatrix} \Pr(z_{h,t} = 0) \\ \Pr(z_{h,t} = 1) \end{bmatrix}$$

where $0 < \omega_H < \omega_L < 1$

- Then, the steady state probability of low income is

$$\omega \equiv \Pr(z_{h,t} = 1) = \frac{\omega_H}{1 - \omega_L + \omega_H}$$

HHs' problem

- Expected utility

$$E_{h,t} \sum_{s=0}^{\infty} \beta^s U_{h,t+s} = E_{h,t} \sum_{s=0}^{\infty} \beta^s \left(\ln c_{h,t} - l_{h,t} \right)$$

- Budget constraint

$$P_t c_{h,t} + b_{h,t+1} = P_t I_{h,t} + R_t b_{h,t}$$

where

$$I_{h,t} = \begin{cases} w_{h,t} l_{h,t} + \dfrac{D_t}{1-\omega} - \dfrac{\omega m}{1-\omega} & \text{if } z_{h,t} = 0 \text{ or income is high} \\ m & \text{if } z_{h,t} = 1 \text{ or income is low} \end{cases}$$

- HHs set their wages
- Borrowing constraints

$$b_{h,t+1} \geq 0$$

- The net supply of bonds is zero

Firms' problem

- Production function

$$Y_t = AL_t = A \left[\frac{1}{1-\omega} \int_0^{1-\omega} l_{h,t}^{\frac{\eta-1}{\eta}} dh \right]^{\frac{\eta}{\eta-1}} \quad \text{where } \eta > 1$$

- Firms minimize the labor costs, given Y_t and $w_{h,t}$

$$l_{h,t} = \left(\frac{w_{h,t}}{W_t} \right)^{-\eta} L_t, \text{ where } W_t = \left[\frac{1}{1-\omega} \int_0^{1-\omega} w_{h,t}^{-(\eta-1)} dh \right]^{-\frac{1}{\eta-1}}$$

- Real dividend

$$D_t = Y_t - \int_0^{1-\omega} w_{h,t} l_{h,t} dh$$

- Goods market clearing

$$Y_t = C_t = \int_0^{1-\omega} c_{h,t} dh + \omega m$$

Euler equation

- Euler equation for high income HHs

$$c_{h,t}^{-1} = \beta \mathrm{E}_{h,t}\left[R_{t+1}\frac{P_t}{P_{t+1}}\{(1-\omega_H)c_{h,t+1}^{-1} + \omega_H m^{-1}\}\right]$$

- The first-order approximation at the ZLB

$$\hat{c}_{h,t} = \mathrm{E}_{h,t}[\pi_{t+1}] + \zeta\mathrm{E}_{h,t}\left[\hat{c}_{h,t+1}\right]$$

where

$$\zeta = \frac{(1-\omega_H)\bar{c}_{H,t}^{-1}}{(1-\omega_H)\bar{c}_{H,t}^{-1}+\omega m^{-1}} < 1$$

- Thus,

$$\hat{c}_{h,t} = \sum_{s=1}^{\infty}\zeta^{s-1}\mathrm{E}_{h,t}[\pi_{t+s}]$$

- Explanation 1: lower-income HHs' spending is less sensitive to their inflation expectations.

Information structure

- Perceived law of motion for inflation

$$\pi_{t+1} = \rho\pi_t + \epsilon_{t+1}, \text{ where } \epsilon_{t+1} \sim i.i.d. N(0, \sigma^2)$$

- Signal

$$s_{h,t} = \epsilon_{t+1} + \nu_{h,t}, \text{ where } \nu_{h,t} \sim i.i.d. N(0, \left[\sigma_{h,t}^{-2} - \sigma^{-2}\right]^{-1})$$

- Inflation expectations

$$\mathrm{E}_{h,t}[\pi_{t+1}] = \rho\pi_t + \frac{\sigma_{h,t}^{-2} - \sigma^{-2}}{\sigma_{h,t}^{-2}} s_{h,t}$$

$$= \rho\pi_t + \frac{\sigma_{h,t}^{-2} - \sigma^{-2}}{\sigma_{h,t}^{-2}} \epsilon_{t+1} + \frac{\sigma_{h,t}^{-2} - \sigma^{-2}}{\sigma_{h,t}^{-2}} \nu_{h,t}$$

$$\mathrm{E}_{h,t}[\pi_{t+s}] = \rho^{s-1} \mathrm{E}_{h,t}[\pi_{t+1}]$$

- Thus,

$$\hat{c}_{h,t} = \frac{1}{1-\zeta\rho}\left(\rho\pi_t + \frac{\sigma_{h,t}^{-2} - \sigma^{-2}}{\sigma_{h,t}^{-2}} \epsilon_{t+1} + \frac{\sigma_{h,t}^{-2} - \sigma^{-2}}{\sigma_{h,t}^{-2}} \nu_{h,t}\right)$$

Optimal degree of attention

- Loss function for high-income HHs

$$\mathrm{E}_{h,t'}\left[U_{h,t}^{**} - U_{h,t}\right] = \theta\sigma_{h,t}^2, \text{ where } \theta = \frac{\eta\bar{L}(1+\eta\bar{L})}{2(1-\zeta\rho)^2}$$

- Optimization problem

$$\min_{\sigma_{h,t}^{-2}}\left[\theta\sigma_{h,t}^2 + \mu\frac{1}{2}\log_2\left(\frac{\sigma_{h,t}^{-2}}{\sigma^{-2}}\right)\right]$$

- The optimal precision of information for high-income HHs

$$\sigma_{h,t}^{*-2} = 2\ln(2)\frac{\theta}{\mu} > \sigma^{-2}$$

- Explanation 2: lower-income HHs pay less attention to information on future inflation, including information from the CB
  - HHs may improve their inflation forecasts by using information about the CB's policy stance, outlook, and so forth

Optimal communication strategy

- An improvement in CB communication is represented by $\mu \downarrow$

- An extended model with μ being different between different income levels suggests that the CB should aim to lower μ for high-income HHs but not for low-income ones

- More generally, improved communication about future inflation with HHs whose spending is more responsive to inflation expectations is more likely to pay off.

- When it is difficult to detect HH types, just facilitating access to CB information by those interested could be a solution

- If low-income HHs can change their consumption to some extent and if it is easier to improve communication with them than with high-income HHs, the CB may have to prioritize improving communication with low-income HHs

- Our results suggest that easiness to improve communication is not the only determinant of optimal strategy

Overextrapolation

- Actual law of motion for inflation

$$\pi_{t+1} = \rho\pi_t + \epsilon_{t+1}, \text{ where } \epsilon_{t+1} \sim i.i.d.\, N(-\delta\pi_t, \sigma^2)$$

- Inflation expectations

$$E_{h,t}[\pi_{t+1}] = \rho\pi_t + \frac{\sigma_{h,t}^{*-2} - \sigma^{-2}}{\sigma_{h,t}^{*-2}}\epsilon_{t+1} + \frac{\sigma_{h,t}^{*-2} - \sigma^{-2}}{\sigma_{h,t}^{*-2}}v_{h,t}$$

- The slope coefficient

$$\frac{E[E_{h,t}[\pi_{t+1}]\pi_t]}{\text{Var}(\pi_t)} = \rho - \frac{\sigma_{h,t}^{*-2} - \sigma^{-2}}{\sigma_{h,t}^{*-2}}\delta$$

- Remember that $\sigma_{s,h,t}^{*-2} > \sigma^{-2}$ for high-income HHs but $\sigma_{h,t}^{*-2} = \sigma^{-2}$ for low-income HHs

- Explanation 3: Lower-income HHs' inflation expectations depend more on inflation perceptions

Analysis without the ZLB

- The Euler equation:

$$\hat{c}_{h,t} = -\mathrm{E}_{h,t}[r_{t+1}] + \zeta \mathrm{E}_{h,t}[\hat{c}_{h,t+1}]$$

- HHs' perceived law of motion for the real interest rate:

$$r_{t+1} = \rho r_t + \epsilon_{t+1}, \text{ where } \epsilon_{t+1} \sim N(0, \sigma^2)$$

- Then,

$$\hat{c}_{h,t} = -\frac{1}{1-\zeta\rho}\left(\rho r_t + \frac{\sigma_{h,t}^{-2}-\sigma^{-2}}{\sigma_{h,t}^{-2}}\epsilon_{t+1} + \frac{\sigma_{h,t}^{-2}-\sigma^{-2}}{\sigma_{h,t}^{-2}}v_{h,t}\right)$$

- Even with these modifications, the loss function and the optimal precision of information for high-income HHs are unchanged

- Suppose that the CB follows the Taylor principle

$$r_t = \phi\pi_t, \text{ where } \phi > 0$$

- Then, higher inflation expectations have the opposite effect as with the ZLB

Two other potential explanations

- Cognitive abilities
  - Controlling for financial literacy may not be enough
  - D'Acunto et al. (2022) find that inflation expectations of higher-IQ individuals are more sensitive to news, and their spending decisions are more in line with the Euler equation
  - Their results are consistent with ours if lower-IQ individuals tend to earn lower incomes and pay less attention to news about the CB

- Asset holdings
  - Households with higher asset holdings may pay higher attention to the CB since its policy may impact on asset values
  - They are more able to change their spending