Graphical Information and Inflation Expectations: Evidence from Japan[1]

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Abstract

This paper examines how central bank communication shapes household inflation expectations. I conduct the first randomized controlled trial (RCT) in Japan that presents households with graphical highlights of the Bank of Japan's (BOJ) outlook for economic activity and prices. Participants were randomly assigned to a control group or to treatment groups that received graphical information on the BOJ's macroeconomic outlook, yield curve control (YCC) policy stance, inflation forecasts, or a combination of outlook and forecasts. The results show that exposure to any type of graphical information significantly lowers household inflation expectations.

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1 Introduction

Understanding how households form inflation expectations is a central question in both macroeconomics and monetary policy. Inflation expectations directly influence consumption, saving, and wage-setting behavior, and they shape the transmission of central bank communication. The literature has documented that households often display systematic biases and inattentiveness when forming expectations. However, prior studies have largely focused on descriptive evidence or measures of expectation formation, and most experimental evidence comes from the United States and Europe. Bholat et al. (2019) analyze how central banks can improve the effectiveness of their communication by presenting information in a simple manner. They show that the use of graphical and narrative devices enhances comprehension among non-expert audiences and influences their perceptions of monetary policy. These findings underscore the importance of designing central bank communication for the general public, rather than relying exclusively on technical reports. However, despite the growing international literature, very few studies, to the best of my knowledge, have implemented an RCT using graphical information provision to investigate household inflation expectations in Japan. This paper addresses this gap by providing causal evidence on the effects of central bank communication in the Japanese setting.

This study investigates how households update their inflation expectations when exposed to highlights of the outlook for economic activity and prices[2]. This is the first information-provision experiment in the form of an RCT to present households with graphical BOJ highlights of the outlook report. I examine whether exposure to different types of information – including macroeconomic outlook, YCC, inflation forecasts, and a combined treatment presenting both macroeconomic outlook and inflation forecasts – significantly lowers household inflation expectations.

The empirical analysis yields two key findings. First, providing information on the macroeconomic outlook through graphical instructions significantly lowered inflation expectations. Even when decomposing the treatment dummies into different types of information – including macroeconomic outlook, YCC, inflation forecasts, and a combined treatment presenting both macroeconomic outlook and inflation forecasts – each type is found to significantly reduce household inflation expectations. Second, the pattern of revisions is consistent with Bayesian updating, whereby the weight given to new information depends on the precision of prior beliefs and signals.

2 RCT design

This study employs data from an information-provision experiment administered through a series of online questionnaires conducted in November 2023 to investigate the formation of individual inflation expectations. The surveys were implemented using the Freeasy online platform operated by iBridge, Inc. In addition to eliciting expectations, each survey collected basic demographic

[2]The highlights of the outlook for economic activity and prices is a short summary document released by the BOJ alongside its full outlook report. It is published in Japanese and English four times a year, and provides non-technical explanations of the Bank's economic and price outlook, policy assessments, and risk factors. The highlights are intended to make the main messages of the outlook report accessible to the general public.

attributes such as gender and age, thereby enabling an analysis of heterogeneity across different population subgroups.

The survey targeted individuals residing in Japan between the ages of 20 and 99, with approximately 100 participants sampled in each wave. Sampling was stratified by gender and age to ensure a balanced composition across demographic categories. A key feature of the design is the randomized assignment of respondents into one control group and several treatment groups.

Participants in the control group were asked about their perception of past price changes, their prior one-year-ahead inflation expectations, and basic demographic information. They received no additional information before providing their posterior expectations. By contrast, participants in the treatment groups were shown graphical excerpts from the BOJ highlights of the outlook for economic activity and prices before answering the same set of questions on their posterior expectations. The graphical information included charts summarizing (i) the Bank's macroeconomic outlook, (ii) its YCC policy stance, (iii) its forecast of future inflation, and (iv) the Bank's macroeconomic outlook and its forecast of future inflation. The design thus allows us to compare how different types of information affect expectations by including dummy variables for each treatment.

Prior inflation expectations were elicited through a discrete choice question asking respondents to select an approximate year-on-year percentage change (in 1% intervals from –12% to +12%). Posterior expectations were elicited using a probability-distribution question, in which respondents allocated 100 percentage points across ten possible inflation intervals (e.g., "0–2% increase," "2–4% decrease"). This approach generates a full distribution of beliefs, permitting a detailed characterization of the mean, dispersion, and shape of individual expectations.

This design enables a causal interpretation of the effect of information provision: by comparing the posterior expectations of the control group with those of the treatment groups, we can isolate the impact of receiving graphical information from the BOJ's highlights of the outlook report.

3 Empirical Analysis

This section describes how I formally tested whether information provisions about the BOJ's highlights of the outlook report affect inflation expectations. To this end, I estimate the following equation using the approach of Coibion et al. (2022):

$$E_{t,j}^{Posterior}[\pi_{t+1}] = \alpha + \beta \times D_j^{Treatment} + \gamma \times E_{t,j}^{Prior}[\pi_{t+1}] + \mathbf{X}\delta + \epsilon_{\mathbf{j}} \tag{1}$$

where $E_{t,j}^{\text{Prior}}[\pi_{t+1}]$ denotes the prior inflation expectation of individual j before receiving information on the BOJ's highlights from the outlook report, while $E_{t,j}^{\text{Posterior}}[\pi_{t+1}]$ represents the posterior inflation expectation after the information is provided. $D_j^{Treatment}$ is a dummy variable that takes 1 when individual j receives the information about the BOJ's highlight. $\mathbf{X}$ is a vector of control variables such as gender, age, income, and educational attainments. My interest is in the coefficient β on the $D_j^{Treatment}$. A negative β suggests that inflation expectations declined based on information from the BOJ's highlights of the outlook report. Table 1 describes the estimation results. In Column (1) and (2), I report regression results obtained by coding individuals in the

treatment group as 1 and those in the control group as 0. Each of the coefficients on the treatment dummy is negative and statistically significant. In Column (3) and (4), I extend the specification by including dummies for the type of information provided–namely D^{Macro}, D^{YCC}, $D^{Forecast}$, and $D^{Macro\_and\_Forecast}$[3]. All of these coefficients are negative and statistically significant, indicating that exposure to each type of information reduced respondents' inflation expectations relative to the control group. These results indicate that the BOJ's communication plays a crucial role in shaping household inflation expectations. The statistically significant effects across all treatment types provide robust evidence that presenting information in a graphical format is an effective means of influencing households' inflation expectations.

4 Theoretical framework

To interpret the empirical findings presented in the previous section, I develop a simple information acquisition framework that builds on Baley and Veldkamp (2021) while adapting it to the context of inflation expectation formation. Importantly, this framework is not merely a Bayesian learning model; it is designed to capture the role of graphical information provision and to rationalize why different types of information may have effects on expectations, as observed in the data.

Let θ denote the underlying (true) inflation rate. This fundamental is modeled as a normally distributed random variable with mean $\mu_\theta(i)$ and variance $\sigma^2_\theta(i)$. The subscript i indicates heterogeneity across individuals in both the central tendency and the degree of uncertainty of prior beliefs. Individuals receive external information in the form of a noisy signal about the fundamental. Specifically, the signal observed by individual i is given by

$$s(i) = \theta + \epsilon_i, \tag{2}$$

where ϵ_i is a normally distributed noise term with mean zero and variance $\sigma^2_\epsilon(i)$. A smaller variance $\sigma^2_\epsilon(i)$ implies higher precision of the observed signal. Individual i forms posterior expectations by combining prior beliefs with the observed signal through Bayesian updating. The posterior mean of θ is

$$E[\theta \mid s(i)] = \frac{\sigma^2_\epsilon(i)}{\sigma^2_\theta(i) + \sigma^2_\epsilon(i)}\mu_\theta(i) + \frac{\sigma^2_\theta(i)}{\sigma^2_\theta(i) + \sigma^2_\epsilon(i)}s(i). \tag{3}$$

This expression highlights that the relative weight assigned to the signal versus the prior depends on their respective precisions. More precise signals (smaller $\sigma^2_\epsilon(i)$) receive greater weight in posterior updating, which provides a theoretical explanation for why graphical information – by reducing noise and enhancing comprehension – leads to belief revision in the empirical analysis. The posterior uncertainty is given by

$$\sigma^2_{\theta|s}(i) = \left(\frac{1}{\sigma^2_\theta(i)} + \frac{1}{\sigma^2_\epsilon(i)}\right)^{-1}. \tag{4}$$

[3] D^{Macro} indicates respondents exposed to the macroeconomic outlook highlights; D^{YCC} indicates respondents exposed to the YCC information; $D^{Forecast}$ indicates respondents exposed to the inflation forecasts; and $D^{Macro\_and\_Forecast}$ indicates respondents exposed to a combined treatment presenting both macroeconomic outlook and inflation forecasts.

Here, $\sigma^2_{\theta|s}(i)$ measures the residual imprecision of posterior expectations. Posterior variance decreases when prior beliefs are highly imprecise or when the signal itself is highly accurate, which is consistent with the observed finding that graphical presentations are particularly effective for individuals with diffuse prior beliefs. Thus, this framework provides a theoretical foundation that links the precision of graphical communication to the magnitude of expectation updating, clarifying why the empirical results differ across information types.

5 Conclusions

This paper provides new evidence on how central bank communication affects household inflation expectations in Japan. Using the first RCT to present households with graphical highlights of the BOJ's outlook report, I show that exposure to the information significantly lowered expected inflation. Regression results further reveal that this effect is robust across different types of information – macroeconomic outlook, YCC, inflation forecasts, and a combined treatment presenting both macroeconomic outlook and inflation forecasts. Each of these individually leads to a statistically significant decline in expectations.

To interpret these findings, I develop a simple Bayesian updating framework that links the precision of external information to the extent of belief revision. The model clarifies why more informative signals, such as graphical presentations, induce stronger updating, and explains the observed heterogeneity in responses across individuals with different prior uncertainties. Empirical evidence is consistent with these theoretical predictions: individuals with higher prior expectations revise their beliefs more strongly in the direction of the signal.

References

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Table 1: Regression of posterior inflation expectations on treatment dummies

	(1)	(2)	(3)	(4)
$E_{t,j}^{Prior}[\pi_{t+1}]$	0.711***	0.706***	0.713***	0.706***
	(0.028)	(0.029)	(0.028)	(0.029)
$D^{Treatment}$	−0.995***	−1.017***		
	(0.283)	(0.283)		
D^{Macro}			−0.821**	−0.813**
			(0.358)	(0.358)
D^{YCC}			−1.322***	−1.356***
			(0.361)	(0.361)
$D^{Forecast}$			−0.971**	−1.008**
			(0.360)	(0.366)
$D^{Macro\_and\_Forecast}$			−0.843**	−0.883**
			(0.360)	(0.360)
Constant	1.739***	0.826	1.726***	0.787
	(0.292)	(0.582)	(0.293)	(0.585)
age dummy	No	Yes	No	Yes
female dummy	No	Yes	No	Yes
income dummy	No	Yes	No	Yes
education dummy	No	Yes	No	Yes
Observations	530	530	530	530

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.