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Inflation Expectations and Survey Design

Junichi Kikuchi

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The Institute of Social and Economic Research
Osaka University
6-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan

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Abstract

We examine whether inflation expectations obtained by open- and closed-ended questions lead to different inflation expectations through a randomized controlled trial. We find that different questionnaires measure significantly different inflation expectations, especially in the short term. We further investigate whether inflation expectations induce consumers to change the intertemporal allocation of consumption via the consumption Euler equation. Our results suggest that actual expenditures are significantly responsive to inflation expectations. The EIS of the sample in the closed-ended questionnaire was higher than that of the open-ended questionnaire.

JEL Classification: D84; E31

Keywords: inflation expectations; measurement; forecast data survey data; survey design

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†Yokohama City University; Institute of Social and Economic Research, Osaka University, m205162g@yokohama-cu.ac.jp

1 Introduction

Expectations matter. Expectations have an important role in macroeconomics. The decisions of economic agents, such as consumption or savings, depend on their expectations for the future. There is growing interest in these expectations. Central banks and researchers collect agents' expectations and study their formation and the relationship between expectations and behavior.

Despite its importance, there is no consensus on how to measure expectations. As we cannot observe expectations directly, we use a proxy variable for expectations. Although there are several proxy variables for expectations, expectations measured using surveys are often used in research. The survey design is important for investigating expectations through questionnaires. Survey questions about expectations come in several forms, such as choosing from options, open-ended questionnaires (percentage changes and levels), and responses to the distribution. As expectations are known to affect the macroeconomy, understanding how to measure them is crucial for macroeconomists and central banks.

This study investigates whether different questionnaires lead to different inflation expectations or not. We randomly assigned two types of questionnaires to survey inflation expectations. We examine the difference in inflation expectations between the open- and closed-ended questions. Our analysis focuses on inflation expectations and response rates. We also investigated whether different questionnaires generated different estimates of the elasticity of intertemporal substitution(EIS).

Three main findings were obtained. First, there is a difference in inflation expectations between the open- and closed-ended questions. We find that inflation expectations are higher in the open-ended question than in the closed-ended question and that inflation expectations increase by 2% if the survey questionnaire changes from a closed-ended question to an open-ended question. We also find that inflation expectations in the open-ended question are more likely to show heterogeneity and that exogenous shocks strongly influence the inflation expectations collected by the open-ended question. Second, we find that the differences between the two questionnaires are big for short-term inflation expectations, while the differences become smaller for long-term inflation expectations. This suggests that special attention should be paid to the impact of different questionnaires

on short-term forecasts. Third, the EIS of the sample in the closed-ended questionnaire was higher than that of the open-ended questionnaire. We interpret the estimated EIS as approaching zero because the inflation expectations obtained by the open-ended questionnaire are subject to greater measurement errors than those obtained by the closed-ended questionnaire.

Our study is linked to two strands of the literature. First, it is related to studies on how to measure expectations. Several discussions have been about measuring expectations, such as wording, rounding, and how to answer. Bruine de Bruinn et al. (2012) shows that question-wording affects responses to surveys. They compare inflation expectations collected by the wordings "prices in general," "inflation," or "prices you pay". Binder (2017) and Ruud et al. (2014) show that rounded inflation expectations relate to the uncertainty of respondents' inflation expectations. Armantier et al. (2013, 2016) summarizes the Survey of Consumer Expectations, which collects households' inflation expectations by a probability distribution. Bruine de Bruinn et al. (2017) compares survey modes, such as face-to-face vs. web. They examined their effects on response rates, reported inflation expectations, and disagreement on expectations.

Second, our study is related to studies that estimate EIS. Beginning with Hall (1978), many studies have attempted to estimate EIS. Hall (1988) concludes that the EIS is unlikely to be much above 0.1 and may well be zero, using time-series data of consumption growth and interest rates. Follow-up studies, however, have yielded mixed results. For example, the EIS Attanasio and Weber (1995) estimated is 0.56, using the Consumer Expenditure Survey, while Cashin and Unayama (2016) finds an EIS of 0.21, using data from the Japanese Family Income and Expenditure Survey. Gourinchas and Parker (2002) estimate the EIS as being between 0.7 to 2.0, using the U.S. American Consumer Expenditure Survey, while Gary and Kumar (2009) estimate the EIS at 0.74 using data about 401(k) participation. Therefore, there is no clear consensus on the magnitude of the elasticity of intertemporal substitution; this arises because of data limitations in relation to inflation expectations, which are usually unobservable and unavailable.

The remainder of this paper is organized as follows. Section 2 describes the survey. Section 3 shows the difference in inflation expectations between the two questionnaires. Section 4 shows the difference in the EIS between the two types of questionnaires. Section

5 summarizes the findings and concludes the paper.

2 Data

2.1 Survey of inflation expectations

We conducted a quarterly online survey of Japanese households to collect information on inflation expectations from 2015(Q4). Every quarter, approximately 30,000 households answer questions regarding their outlook for price changes for the next one, three, and ten years. The respondents were asked to answer the following questions:

"What will the levels of CPI be over the next one-, three-, and ten-year periods given that the current level of CPI is 10,000? Provide price level figures over each period, excluding the impact of consumption tax hikes on price levels."

The question asks respondents to estimate the average CPI levels that they forecast over the next 1-, 3-, and 10-year periods. The questionnaire directly measures households' inflation expectations in the short, medium, and long terms.[1] In our survey, we prepared two types of questionnaires. Specifically, open-ended and closed-ended (multiple-choice) questionnaires are available.

2.1.1 Open-ended question

In the open-ended questionnaire, the respondents answered as in the following example: When a respondent answers 10,080, 10,600, and 11,000 as their forecasts for price levels over the following 1-, 3-, and 10-year periods, respectively, their forecasts for annualized inflation rates over the next 1-, 3-, and 10-year periods (or the next 4, 12, and 40 quarters) are calculated as 0.80%, 1.96%, and 0.96%, respectively.

[1] The (annualized) inflation forecasts exclude all forecasts of inflation above 25 and below -5 percent.

Years later	1-year	3-year	10-year
Forecast on price levels	10,080	10,600	11,000

↓

Annualized inflation rates	"Spot" inflation rates			"Forward" inflation rates	
Years later	1-year	3-year	10-year	1- to 3-year	3- to 10-year
Inflation expectations: π^e	0.80%	1.96%	0.96%	2.55%	0.53%

2.1.2 Closed-ended question

In a closed-ended questionnaire, the respondents answered, as shown in Table 1. They chose one option from the 15 options. The appendix presents 3-year and 10-year ahead inflation forecast questionnaires (Table A.1). Because our closed-ended question also surveys inflation expectations in terms of levels, we converted the choices into rates of change for our analysis.

2.2 Data about the consumption expenditure

We use panel data (SCI-personal) on consumption expenditure collected by a marketing company, Intage. We used the data records of day-to-day shopping information collected on an ongoing basis from more than 50,000 consumers aged 15—79 all over Japan. The data captures the profile of these consumers in detail, including aspects such as income, education, and financial assets. We can see who bought what, when, where, how many, and at what prices. These data cover items that households frequently purchase, such as food (except for fresh food, prepared food, and lunch boxes), beverages, miscellaneous daily goods, cosmetics, pharmaceutical products, and cigarettes.[2] We combine the inflation survey with consumption expenditure data from the same respondents and empirically test the theoretical relationship between inflation expectations and consumer spending.

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

3 Differences in inflation expectations between open- and closed-ended questions

First, we find that inflation expectations are higher for open-ended questions than for closed-ended ones. Tables 2 and 3 present the summary statistics for inflation expectations. It shows that the average inflation expectation 1-year ahead is approximately 2% higher in the open-ended question.

Second, we find that the differences between the two questionnaires are big for short-term inflation expectations, while the differences become smaller for long-term inflation expectations. In Table 2, the difference in the average 1-year ahead inflation forecast between the two questionnaires is approximately 2%. In contrast, those of the 3- and 10-year ahead inflation forecasts are approximately 1% and 0.1%, respectively. Figure 5 shows that kernel density becomes more similar as it becomes a long-term inflation forecast. This suggests that the difference between the two questionnaires decreases as the forecast horizon increases.

Third, we find that inflation expectations in open-ended questions are more likely to differ between household characteristics. It is widely known that households with several categories, such as females and young people, form higher inflation expectations (Ehrmann et al., 2017; Jonung, 1981; Kikuchi and Nakazono, 2021). Table 5 shows that households with certain characteristics form higher (or lower) inflation expectations if they are in the open-ended question. Specifically, in the open-ended question, females and young people have higher inflation expectations, while highly educated, high-income households form lower inflation expectations.

Fourth, we found that the response rate is approximately 10% higher for closed-ended questions. We also found that household characteristics explained the response rate. Table 4 lists the response rates of the survey. In the entire sample, the response rate for the closed-ended question was approximately 50%, whereas that for the open-ended question was approximately 35%. Table 4 also suggests that some household characteristics have low response rates, such as females, low education, low income, and young age. Table 6 shows that the response rates for these characteristics are low and significant.

Fifth, the inflation expectations collected by the open-ended questions are strongly

influenced by exogenous shocks. In January 2016, the Bank introduced a negative interest rate policy. The introduction of a negative interest rate policy is an exogenous aggregate shock that is expected to negatively impact inflation expectations. Table 7 shows that household inflation expectations are lowered across the board by introducing a negative interest rate policy. Table 7 also shows that the inflation expectations collected by the open-ended questions fall further.

Sixth, inflation expectations increase by 2% when the survey questionnaire changes from a closed-ended to an open-ended question. In 2016Q2, the survey questionnaire was standardized using two types of open-ended questions. We use this change to analyze whether inflation expectations change when the survey questionnaire changes from a closed to an open-ended question. Table 8 shows that households' inflation expectations increase when the questionnaire changes from a closed to an open-ended question.

4 Differences in relationship between inflation expectations and spending between open- and closed-ended questions

4.1 A standard model of consumption

First, we present a theoretical framework to describe the relationship between inflation expectations and consumption growth rate. Suppose the utility function is isoelastic. The consumer ' s objective is:

$$\max \ E_0 \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\gamma} - 1}{1-\gamma},$$

where β is the discount factor and γ^{-1} is the elasticity of intertemporal substitution. We assume that the consumer can borrow and save as much as needed at real interest rate r. In this setting, the first-order conditions lead to the Euler equation:

$$E_t \left[\left(\frac{c_{t+1}}{c_t} \right)^{-\gamma} \beta(1 + r_t) \right] = 1. \tag{1}$$

Taking the logarithm of both sides of Equation (1), we obtain

$$E_t[\Delta \ln c_{t+1}] = \gamma^{-1} (\ln \beta + r_t) . \tag{2}$$

Equation (2) shows the optimal consumption path in the complete market.

Using Euler equations in real and nominal terms, we consider how consumption varies over time, especially under ELB. Because $\Delta \ln c_{t+1} = E_t \Delta \ln c_{t+1} + \varepsilon_{t+1}$ and the (linearized) Fisher equation indicates that $r_t = i_t - E_t[\pi_{t+1}]$, Equation (2) can be written as

$$\Delta \ln c_{t+1} = \gamma^{-1} (i_t - E_t[\pi_{t+1}] + \ln \beta) + \varepsilon_{t+1}, \tag{3}$$

where i_t and $E_t[\pi_{t+1}]$ denote the nominal interest rate and inflation expectations at time t, respectively. Because i_t is almost zero under ELB, Equation (3) can be simply written as

$$\Delta \ln c_{t+1} = -\gamma^{-1} (E_t[\pi_{t+1}] - \ln \beta) + \varepsilon_{t+1}. \tag{4}$$

Equation (4) suggests that for consumers who do not face liquidity constraints, the growth rate of consumption depends only on inflation expectations and the deep parameters γ^{-1} and β.

4.2 Estimation results

Following Kikuchi and Nakazono (2020), the data we use allows us to directly estimate the value of the EIS. Our empirical framework is based on the following equation.

$$\ln(c^i_{t+4}/c^i_t) = \alpha \times E^i_t [\pi_{t \to t+4}] + X\gamma + \varepsilon^i_{t+4}, \tag{5}$$

where $\ln \left(\frac{c^i_{t+4}}{c^i_t} \right)$ and $E^i_t [\pi_{t \to t+k}]$ denote the consumption expenditure growth rates of individual i from t to $t+4$ and the inflation forecasts of individual i over the next k quarters at time t, respectively. A vector X includes control variables, such as time dummies and household demographic variables. We focus on the parameter α in Equation (5). When parameter α is negative, an increase in inflation expectations is associated with greater current consumption. This association follows the prediction of the consumption Euler

equation. In our estimation, EIS(γ^{-1}) is obtained by $1-\alpha$. We show the results from the two types of specifications as benchmark results: (1) pooling regression (OLS) and (2) instrumental variables (IV) regression. The IV instrumental variable is 3-year ahead of inflation expectations.

Table 9 summarizes the estimation results of the EIS. The top panel of Table 9 presents the results for the entire sample. This shows that the estimated EIS of the sample, which is the subject of the open-ended questionnaire, is approximately 1.0, and that of the sample, which is the subject of the closed-ended questionnaire, is approximately 1.4. The results showed that the EIS of the sample in the closed-ended questionnaire was higher than that in the open-ended questionnaire. The result that the EIS of the sample in the closed-ended questionnaire was higher than that in the open-ended questionnaire was also found in the high-income (middle panel of Table 9) and highly educated groups (bottom panel of Table 9). These results suggest that inflation expectations collected in an open-ended questionnaire have a larger measurement error than those collected in a closed-ended questionnaire. If a variable has a measurement error, the coefficients of that variable include an attenuation bias. Attenuation bias is a phenomenon in which the coefficient approaches zero when a variable has a measurement error. We interpret the estimated coefficients as approaching zero because the inflation expectations obtained by the open-ended questionnaire are subject to greater measurement errors than those obtained by the closed-ended questionnaire.

5 Conclusion

We investigate whether different questionnaires lead to different inflation expectations. We randomly assigned two types of questionnaires to survey inflation expectations. We examine the difference in inflation expectations between the open- and closed-ended questions. We also investigated whether different questionnaires generated different estimates of EIS.

Three main findings were obtained. First, there is a difference in inflation expectations between the open- and closed-ended questions. We find that inflation expectations

are higher in the open-ended question than in the closed-ended question and that inflation expectations increase by 2% if the survey questionnaire changes from a closed-ended question to an open-ended question. We also find that inflation expectations in the open-ended question are more likely to show heterogeneity and that exogenous shocks strongly influence the inflation expectations collected by the open-ended question. Second, we find that the differences between the two questionnaires are big for short-term inflation expectations, while the differences become smaller for long-term inflation expectations. This suggests that special attention should be paid to the impact of different questionnaires on short-term forecasts. Third, the EIS of the sample in the closed-ended questionnaire was higher than that of the open-ended questionnaire. We interpret the estimated EIS as approaching zero because the inflation expectations obtained by the open-ended questionnaire are subject to greater measurement errors than those obtained by the closed-ended questionnaire.

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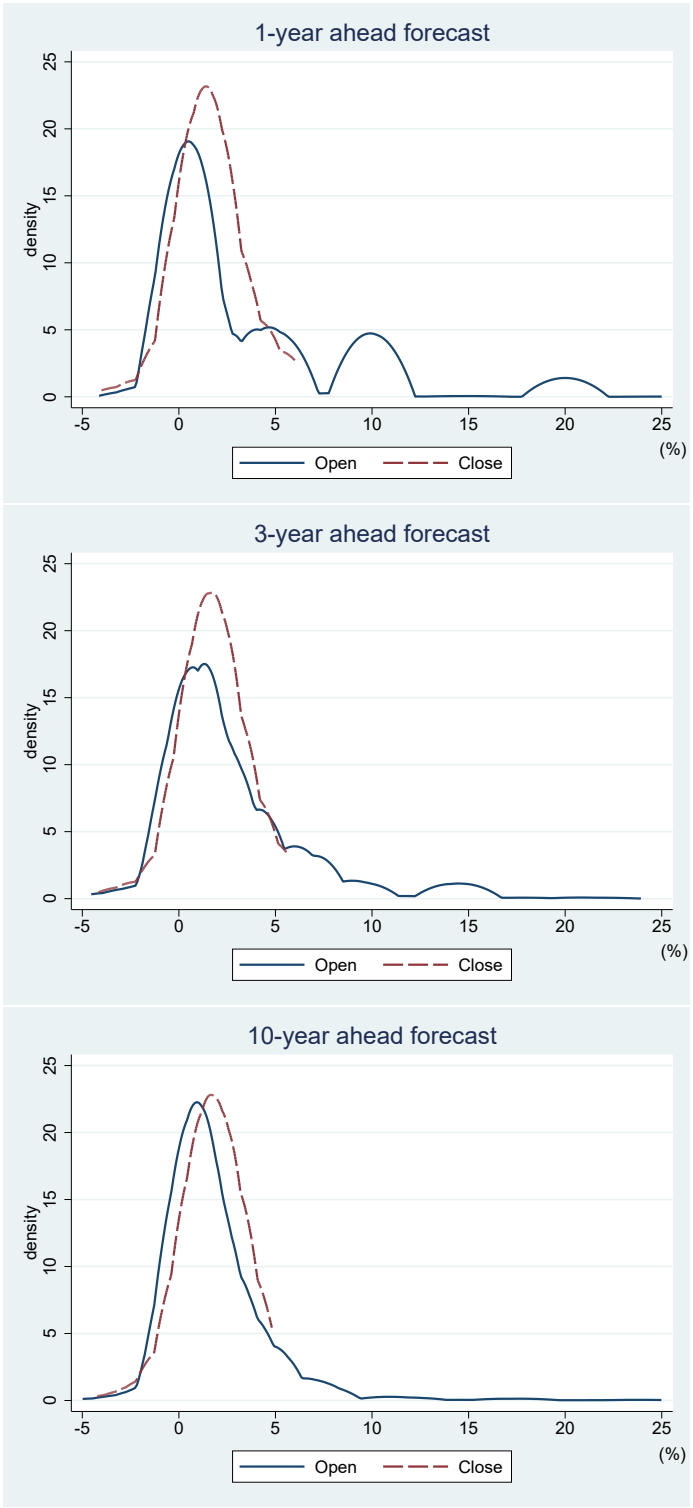

Figure 1: Kernel density estimates of inflation expectations for 1-year (top panel), 3-year (middle panel), and 10-year (bottom panel) horizons. We use an Epanechnikov kernel as a kernel function. The bandwidth of kernel is set to be 0.01.

Table 1: Questionnaire of closed-ended question (1-year ahead inflation forecast)

1-year ahead inflation expectations		
	Questionnaire	Inflation expectations
1	Less than 10,050	0%
2	More than 10,050 and less than 10,150	1%
3	More than 10,150 and less than 10,250	2%
4	More than 10,250 and less than 10,350	3%
5	More than 10,350 and less than 10,450	4%
6	More than 10,450 and less than 10,550	5%
7	More than 10,550	6%
8	More than 9,850	-1%
9	More than 9,750 and less than 9,850	-2%
10	More than 9,650 and less than 9,750	-3%
11	More than 9,550 and less than 9,650	-4%
12	More than 9,450 and less than 9,550	-5%
13	More than 9,350 and less than 9,450	-6%
14	Less than 9,350	-7%
15	I have no idea.	

Table 2: Basic statistic (%)

	Open				Close			
	Mean	Median	S.D.	Obs.	Mean	Median	S.D.	Obs.
All								
1-year	3.78	1.00	5.16	14,768	1.69	1.00	1.71	18,120
3-year	2.95	1.64	3.74	14,864	1.83	1.96	1.65	20,278
10-year	1.93	0.96	2.65	14,840	1.81	1.84	1.53	19,913
Male								
1-year	3.22	1.00	4.73	7,238	1.67	1.00	1.82	8,282
3-year	2.51	1.64	3.39	7,355	1.78	1.96	1.77	9,486
10-year	1.65	0.96	2.43	7,356	1.71	1.84	1.62	9,524
Female								
1-year	4.32	1.00	5.49	7,440	1.71	1.00	1.62	9,838
3-year	3.39	2.28	4.00	7,509	1.87	1.96	1.54	10,792
10-year	2.21	1.41	2.83	7,484	1.89	1.84	1.43	10,389
Higher education								
1-year	3.39	1.00	4.86	7,394	1.64	1.00	1.69	8,207
3-year	2.68	1.64	3.51	7,473	1.79	1.96	1.63	9,341
10-year	1.76	0.96	2.45	7,440	1.78	1.84	1.50	9,296
Lower education								
1-year	4.11	1.00	5.39	3,156	1.75	1.00	1.73	4,422
3-year	3.18	1.64	3.91	3,199	1.88	1.96	1.68	4,868
10-year	2.10	1.14	2.79	3,209	1.80	1.84	1.58	4,655
High income								
1-year	3.27	1.00	4.65	2,950	1.62	1.00	1.69	3,245
3-year	2.53	1.64	3.24	2,978	1.79	1.96	1.64	3,717
10-year	1.70	0.96	2.26	2,967	1.75	1.84	1.48	3,729
Low income								
1-year	4.24	1.00	5.51	3,748	1.76	1.00	1.78	5,200
3-year	3.33	1.64	4.17	3,794	1.88	1.96	1.72	5,759
10-year	2.25	1.41	3.17	3,793	1.83	1.84	1.65	5,540

Note: Higher education, lower education, high income, and low income indicates four-year college graduate or above, high school graduate or below, households' annual income 9 million yen and above and households' annual income below 4 million yen, respectively.

Table 3: Basic statistics (%)

	Open				Close			
	Mean	Median	S.D.	Obs.	Mean	Median	S.D.	Obs.
20s								
1-year	4.25	1.00	5.58	1,928	1.88	2.00	1.83	2,386
3-year	3.58	1.64	4.36	1,971	1.94	1.96	1.80	2,745
10-year	2.37	1.41	3.48	2,019	1.87	1.84	1.64	2,759
30s								
1-year	3.66	1.00	5.14	3,332	1.67	1.00	1.72	3,737
3-year	2.97	1.64	3.85	3,406	1.81	1.96	1.63	4,330
10-year	1.99	0.96	2.8	3,433	1.78	1.84	1.52	4,428
40s								
1-year	3.69	1.00	5.06	4,065	1.66	1.00	1.70	4,652
3-year	2.87	1.64	3.58	4,108	1.80	1.96	1.65	5,216
10-year	1.85	0.96	2.35	4,119	1.77	1.84	1.51	5,188
50s								
1-year	3.76	1.00	5.14	3,056	1.69	1.00	1.71	4,003
3-year	2.82	1.64	3.53	3,078	1.83	1.96	1.63	4,375
10-year	1.79	0.96	2.35	3,056	1.83	1.84	1.51	4,203
60s and over								
1-year	2.67	1.00	3.88	5,558	2.32	1.00	3.32	5,058
3-year	2.26	1.96	2.69	5,773	2.10	1.96	2.38	5,329
10-year	1.78	1.84	1.98	5,479	1.82	1.84	1.88	5,000

Table 4: Response rate

		Open	Close			Open	Close
All	1-year	36%	44%	20s	1-year	28%	35%
	3-year	36%	49%		3-year	29%	40%
	10-year	36%	48%		10-year	29%	39%
Male	1-year	42%	48%	30s	1-year	35%	39%
	3-year	43%	55%		3-year	36%	45%
	10-year	43%	55%		10-year	36%	45%
Female	1-year	32%	41%	40s	1-year	39%	44%
	3-year	32%	45%		3-year	39%	49%
	10-year	32%	43%		10-year	39%	48%
Higher education	1-year	44%	49%	50s	1-year	38%	49%
	3-year	44%	56%		3-year	38%	53%
	10-year	44%	55%		10-year	38%	51%
Lower education	1-year	30%	42%	60s and over	1-year	46%	48%
	3-year	30%	45%		3-year	48%	51%
	10-year	30%	43%		10-year	45%	48%
High income	1-year	44%	48%				
	3-year	44%	54%				
	10-year	44%	54%				
Low income	1-year	30%	42%				
	3-year	31%	46%				
	10-year	30%	44%				

Note: Higher education, lower education, high income, and low income indicates four-year college graduate or above, high school graduate or below, households' annual income 9 million yen and above and households' annual income below 4 million yen, respectively.

Table 5: Inflation expectations and households' characteristics

	1-year	3-year	10-year
D^{open}	1.950***	0.978***	0.040
	(0.101)	(0.074)	(0.056)
D^{female}	0.001	0.062**	0.171***
	(0.027)	(0.024)	(0.023)
$D^{female} \times D^{open}$	0.942***	0.709***	0.301***
	(0.092)	(0.068)	(0.051)
$D^{under29}$	0.207***	0.112***	0.048
	(0.040)	(0.037)	(0.033)
$D^{under29} \times D^{open}$	0.160	0.373***	0.373***
	(0.141)	(0.109)	(0.087)
$D^{highly-educated}$	−0.074***	−0.049**	−0.005
	(0.027)	(0.024)	(0.023)
$D^{highly-educated} \times D^{open}$	−0.395***	−0.234***	−0.191***
	(0.093)	(0.068)	(0.051)
$D^{high-income}$	−0.061*	−0.035	−0.063**
	(0.033)	(0.030)	(0.028)
$D^{high-income} \times D^{open}$	−0.396***	−0.350***	−0.150***
	(0.105)	(0.076)	(0.056)
Constant	1.693***	1.794***	1.716***
	(0.030)	(0.027)	(0.026)
Observations	32,798	35,142	34,753

Note: Standard errors in parentheses are clustered at individual levels, and ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

Table 6: Response rate and households' characteristics

	1-year	3-year	10-year
D^{open}	−9.106***	−14.65***	−13.85***
	(0.792)	(0.792)	(0.793)
D^{female}	−4.817***	−7.161***	−8.440***
	(0.509)	(0.510)	(0.509)
$D^{female} \times D^{open}$	−1.888***	0.050	1.110
	(0.710)	(0.711)	(0.711)
$D^{under29}$	−9.560***	−8.962***	−7.386***
	(0.630)	(0.643)	(0.641)
$D^{under29} \times D^{open}$	2.318***	1.984**	1.349
	(0.868)	(0.879)	(0.880)
$D^{highly-educated}$	6.308***	7.968***	8.513***
	(0.516)	(0.517)	(0.516)
$D^{highly-educated} \times D^{open}$	4.168***	2.432***	1.626**
	(0.720)	(0.721)	(0.720)
$D^{high-income}$	3.137***	5.132***	6.365***
	(0.663)	(0.660)	(0.659)
$D^{high-income} \times D^{open}$	4.142***	2.136**	0.908
	(0.933)	(0.931)	(0.931)
Constant	48.59***	54.98***	54.43***
	(0.568)	(0.567)	(0.566)
Observations	82,592	82,592	82,592

Note: Standard errors in parentheses are clustered at individual levels, and ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

Table 7: Impact of negative interest rate policy

$E_t^i[\pi_{t\to t+4}] - E_{t-1}^i[\pi_{t-1\to t+3}] = \alpha + \beta \times D_i^{open} + \varepsilon_i$

	1-year	3-year	10-year
D_i^{open}	−0.237***	−0.194***	−0.058
	(0.091)	(0.063)	(0.047)
α	−0.215***	−0.239***	−0.208***
	(0.028)	(0.024)	(0.023)
Observations	9,151	10,303	10,123

Note: Standard errors in parentheses are clustered at individual levels, and ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

Table 8: Impact of changes in the questionnaire

$E_t^i[\pi_{t\to t+4}] - E_{t-1}^i[\pi_{t-1\to t+3}] = \alpha + \beta \times D_i^{close} + \varepsilon_i$

	1-year	3-year	10-year
D_i^{close}	2.182***	1.098***	0.079
	(0.109)	(0.073)	(0.051)
α	−0.671***	−0.456***	−0.191***
	(0.080)	(0.053)	(0.036)
Observations	7,693	8,336	8,230

Note: Standard errors in parentheses are clustered at individual levels, and ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

Table 9: Estimating the EIS

$$\ln(c^i_{t+4}/c^i_t) = \alpha \times E^i_t[\pi_{t\to t+4}] + X\gamma + \varepsilon^i_{t+4}$$

All	Open				Close			
	OLS		IV		OLS		IV	
α	−0.094	−0.088	−0.051	−0.043	−0.344*	−0.349*	−0.463*	−0.467*
	(0.066)	(0.067)	(0.083)	(0.084)	(0.180)	(0.181)	(0.265)	(0.265)
Implied EIS	1.094	1.088	1.051	1.043	1.344	1.349	1.463	1.467
Constant	−0.004	−0.002	−0.006	−0.005	−0.004	0.005	−0.003	0.003
	(0.005)	(0.014)	(0.006)	(0.014)	(0.005)	(0.013)	(0.006)	(0.014)
Control		✓		✓		✓		✓
Time dummy	✓	✓	✓	✓	✓	✓	✓	✓
Observations	10,390	10,390	10,214	10,214	12,717	12,717	11,555	11,555
High income	Open				Close			
	OLS		IV		OLS		IV	
α	−0.164	-0.132	−0.069	−0.022	−0.784*	−0.763*	−0.597	−0.561
	(0.175)	(0.178)	(0.204)	(0.208)	(0.454)	(0.457)	(0.704)	(0.705)
Implied EIS	1.164	1.132	1.069	1.022	1.784	1.763	1.597	1.561
Constant	0.005	−0.006	0.001	−0.010	−0.002	−0.053	0.001	−0.041
	(0.012)	(0.036)	(0.012)	(0.037)	(0.012)	(0.033)	(0.015)	(0.035)
Control		✓		✓		✓		✓
Time dummy	✓	✓	✓	✓	✓	✓	✓	✓
Observations	2,148	2,148	2,122	2,122	2,350	2,350	2,134	2,134
Highly educated	Open				Close			
	OLS		IV		OLS		IV	
α	−0.108	−0.120	−0.137	−0.161	−0.485	−0.494*	−0.902**	−0.911**
	(0.102)	(0.103)	(0.124)	(0.125)	(0.296)	(0.297)	(0.443)	(0.444)
Implied EIS	1.108	1.12	1.137	1.161	1.485	1.494	1.902	1.911
Constant	−0.006	−0.027	−0.005	−0.027	0.004	0.009	0.009	0.011
	(0.008)	(0.020)	(0.008)	(0.021)	(0.008)	(0.019)	(0.010)	(0.021)
Control		✓		✓		✓		✓
Time dummy	✓	✓	✓	✓	✓	✓	✓	✓
Observations	5,221	5,221	5,143	5,143	5,788	5,788	5,279	5,279

Note: Standard errors in parentheses are clustered at individual levels, and ***, **, and * indicate 1%, 5%, and 10% significance, respectively. The instrumental variable in IV is 3-year ahead inflation expectations. The high-income and highly educated groups are the subsamples of consumers with more than 9 million yen a year and those with a bachelor's degree or higher, respectively.

Table A.1: Questionnaire of closed-ended question (3- and 10-year ahead inflation forecast)

3-year ahead inflation expectations			
Questionnaire			Inflation expectations
1	[UP]	Less than 10,150	0%
2	[UP]	More than 10,150 and less than 10,450	1%
3	[UP]	More than 10,450 and less than 10,750	2%
4	[UP]	More than 10,750 and less than 11,050	3%
5	[UP]	More than 11,050 and less than 11,350	4%
6	[UP]	More than 11,350 and less than 11,650	5%
7	[UP]	More than 11,650	6%
8	[DOWN]	More than 9,550	-1%
9	[DOWN]	More than 9,250 and less than 9,550	-2%
10	[DOWN]	More than 8,950 and less than 9,250	-3%
11	[DOWN]	More than 8,650 and less than 8,950	-4%
12	[DOWN]	More than 8,350 and less than 8,650	-5%
13	[DOWN]	More than 8,050 and less than 8,350	-6%
14	[DOWN]	Less than 8,050	-7%
15	I have no idea.		

10-year ahead inflation expectations			
Questionnaire			Inflation expectations
1	[UP]	Less than 10,150	0%
2	[UP]	More than 10,150 and less than 10,450	1%
3	[UP]	More than 10,450 and less than 10,750	2%
4	[UP]	More than 10,750 and less than 11,050	3%
5	[UP]	More than 11,050 and less than 11,350	4%
6	[UP]	More than 11,350 and less than 11,650	5%
7	[UP]	More than 11,650	6%
8	[DOWN]	More than 9,550	-1%
9	[DOWN]	More than 9,250 and less than 9,550	-2%
10	[DOWN]	More than 8,950 and less than 9,250	-3%
11	[DOWN]	More than 8,650 and less than 8,950	-4%
12	[DOWN]	More than 8,350 and less than 8,650	-5%
13	[DOWN]	More than 8,050 and less than 8,350	-6%
14	[DOWN]	Less than 8,050	-7%
15	I have no idea.		