Economics Bulletin

Volume 45, Issue 1

Money illusion of interest rates and household decision-making

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Abstract

This paper examines whether Japanese households take the Fisher equation into account when making decisions about saving, borrowing, and spending. To this end, we conduct two experiments in which hypothetical scenarios are randomly assigned. The estimation results show that households generally make decisions without taking the Fisher equation into account. In other words, many decisions are made based on nominal rather than real interest rates. In addition, we find no evidence that the more educated are less likely to suffer from money illusion. These results have important implications for the effectiveness of unconventional monetary policy.

This paper forms part of the author's microdata-based research on household consumption at the Economic and Social Research Institute (ESRI), Japan. I would like to thank Yutaka Murayama, Hiroshi Nomura, Shingo Nakazawa, Kazuki Hiraga, and my colleagues at the ESRI for their helpful comments and iBRIDGE corporation for providing me with the data for this study. This research was supported by a grant-in-aid from JSPS KAKENHI Grant Number 23K01344. The views expressed in this paper are those of the author and do not represent those of the institutions with which we are affiliated.

Citation: Takeshi Niizeki, (2025) "Money illusion of interest rates and household decision-making", *Economics Bulletin*, Volume 45, Issue 1, pages 111-117

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Submitted: September 04, 2024. **Published:** March 30, 2025.

1. Introduction

Monetary policy usually attempts to influence household behavior through changes in *real* interest rates. The Fisher equation states that to change the real interest rates, at least one of the following must change: nominal interest rates or inflation expectations. If households understand the Fisher equation correctly, it does not matter whether the change in the real interest rates is caused by nominal interest rates or by inflation expectations. However, several previous studies note the existence of money illusion in interest rates (Lioui and Tarelli 2022, Todorovic 2022, Darriet et al. 2020, Gemma 2016, Berro, Colman, and Dave 2015, Bruunermeier and Julliard 2008, Wilcox 1990). If household behavior is based on nominal rather than real interest rates, then the monetary policy mechanisms need to be re-examined. In other words, the central bank should work primarily on nominal interest rates, not on inflation expectations, if it wants to influence household behavior. This has particularly important implications for the effectiveness of *unconventional* monetary policy measures that work on inflation expectations.

Against this background, this paper examines whether households' saving, borrowing, and spending decisions are based on nominal or real interest rates. To do so, we conduct two randomized experiments, a saving experiment and a borrowing experiment. In both experiments, the real interest rate increases by five percentage points, and we test whether households' decisions differ when it is caused by a decline in inflation expectations or an increase in nominal interest rates.

This study aims to contribute to the literature in the following aspects. First, to the best of my knowledge, this is the first paper to examine whether Japanese households make decisions in line with the Fisher equation. Unconventional monetary policies that influence the expectations of economic agents can be an important policy tool in Japan, where interest rates remain low despite having escaped the effective lower bound (ZLB) of nominal interest rates. Therefore, it is essential to examine whether Japanese households suffer from monetary illusion of interest rates. Second, this study focuses on three household behaviors: saving, borrowing, and spending. Previous studies mentioned above have focused on only one or two of these.

The structure of the paper is as follows. Section 2 describes the data and experimental design, and Section 3 presents the estimation results. Finally, Section 4 concludes.

2. Data and experimental design

Two types of experiments were conducted in Japan from October 14 to 19, 2023: saving and borrowing experiments. Each experiment consists of three groups (C, T1, and T2), making a total of six groups. We recruited participants for the experiments from individuals registered with iBRIDGE Corporation and randomly assigned them to one of six groups. The hypothetical nominal interest rates (i) and inflation expectations (π^e) presented for each group are shown in Table 1. r represents the real interest rate. The real interest rates are higher in both T1 and

T2 than in the control group, but for different reasons. If households do not suffer from monetary illusion, there should be no difference in their behavior between T1 and T2. In October 2023, when the experiments were conducted, Japan was still under ZLB of nominal interest rates, and according to a survey conducted by the Bank of Japan, the median inflation expectations of households at the time was 10%. Thus, at least the baseline situation in the control group is realistic.

Table 1: Assigned nominal interest rates and inflation expectations

	C	T1	T2
	(Saving experiment)		
i	0%	0%	5%
π^e	10%	5%	10%
r	-10%	-5%	-5%

Questions
Q1. Saving (transfer)
Q2. Satisfaction for r
Q3. Durable

	C	T1	T2
	(Borrowing experiment)		
i	0%	0%	5%
π^e	10%	5%	10%
r	-10%	-5%	-5%

Questions
Q1. Borrowing
Q2. Satisfaction for r
Q3. Durable

Each experiment consists of three questions[1] (see also the bottom of Table 1 for a list of questions) and only Q1 is different for each experiment. Q1 for the saving experiment is as follows.

Q1. Transfer (question only for the saving experiment)
(Hypothetical situation)
- Deposit interest rates at Bank A = x% (annual rate)
- Inflation expectations = y% (annual rate)

"If you could make a deposit at Bank A, how much of your current assets would you transfer to Bank A? Assuming that Bank A is in very good financial condition, please give an approximate figure up to 10 million yen."

On the other hand, Q1 for the borrowing experiment is as follows.

Q1. Borrow (question only for the borrowing experiment)
(Hypothetical situation)
- Loan interest rates at Bank A = x% (annual rate)

[1] Since the respondent demographics listed in Table 2 are provided free of charge by the research firm, they are not included in the questions.

- Inflation expectations = y% (annual rate)

"Suppose you suddenly need to make a payment of 5 million yen (due to illness, accident, etc.). How much of the 5 million yen would you like to borrow from Bank A?"

Subsequently, in both experiments, we asked about satisfaction with the offered interest rates and the willingness to purchase durable goods as follows (Bachman, Berg, and Sims 2015). Note that the hypothetical situation is always displayed at the top of the response screen (not restated here).

Q2. Satisfaction

"What is your level of satisfaction with the interest rate offered by Bank A? Please answer this question after taking into account the rate of increase in prices given."

Q3. Durable

"Suppose you now have one durable good (refrigerator, car, computer, etc.) that you want to buy. Under the interest rates and price increases offered, do you think now is a good time to buy it?"

Satisfaction with the interest rates is asked after taking into account the inflation rates offered. Thus, if there is no money illusion, there should be no difference between T1 and T2 in terms of satisfaction. The exact wording of the questionnaire is provided in Online Appendix B.

Table 2 summarizes the descriptive statistics of the data. Respondent demographics do not appear to differ significantly on average across groups. The results of the formal balance test are reported in Table A1.

For each experiment, we estimate the following equation:

$$y_i = \beta_0 + \beta_1 T1_i + \beta_2 T2_i + \beta_3 x_i + \varepsilon_i, \quad (1)$$

where i is the respondent index, y_i represents the various outcome variables, $T1_i$ and $T2_i$ are the respective treatment group dummies, x_i is the respondent characteristics listed in Table 2, and ε_i is the error term. Since the control group is excluded from the right-hand side of Equation (1), β_1 and β_2 represent the extent to which the outcome of each treatment group deviates from the control group. By virtue of random assignment, the respondent characteristics (x_i) and each treatment group dummy ($T1_i$ and $T2_i$) are nearly orthogonal. However, since there may be efficiency gains, we estimate β_1 and β_2 after controlling for the respondent characteristics.

Table 2: Descriptive statistics

Group	Saving experiment			Borrowing experiment		
	C	T1 (π^e down)	T2 (i up)	C	T1 (π^e down)	T2 (i up)
Respondent demographics						
Male dummy	0.64	0.65	0.60	0.65	0.65	0.65
Age	48.5	48.0	48.1	48.7	48.4	48.8
No job dummy	0.11	0.10	0.11	0.13	0.10	0.13
Full-time worker dummy	0.57	0.56	0.57	0.59	0.60	0.58
Child dummy	0.54	0.54	0.54	0.54	0.56	0.53
Household pretax income (10,000 yen)	622	624	645	624	633	637
Marriage dummy	0.60	0.62	0.62	0.59	0.61	0.63
College-educated dummy	0.58	0.58	0.59	0.56	0.57	0.57
Decision-making under hypothetical scenarios						
Transfer or borrowing amount (million yen)	1.94	1.92	3.73	2.52	2.27	1.55
Satisfaction with interest rates (0-10)	3.02	2.99	5.51	7.03	6.88	4.81
Durable dummy (good time to buy?)	0.42	0.43	0.45	0.53	0.57	0.36
Number of respondents	672	626	654	535	574	539

Notes: Transfer and borrowing amounts represent the response to Q1 in each experiment. Satisfaction with interest rates and durable dummy represent responses to Q2 and Q3, respectively.

3. Estimation results

Table 3 shows the regression results. In the saving experiment, column (1) shows that the transfer amount is not significantly different between the control group and the T1 group (π^e down), but is significantly higher by 1.75 million yen in the T2 group (i up). This means that the transfer amount for the T2 group (i up) is about 1.9 times the average of the control group (1.94 million yen), which is an economically significant difference. A similar pattern is observed in column (2). Satisfaction with the *real* deposit interest rate increases significantly by 2.44 points on a 10-point scale when the *nominal* deposit interest rate is high, but no significant difference is observed with the control group when inflation expectations are low. There results indicate that respondents refer to *nominal* rather than *real* interest rates when making saving decisions. Finally, there were no significant differences among all groups with respect to willingness to purchase durable goods. Unlike the case of loan interest rates, which we will discuss later, it seems that deposit interest rates do not have a significant impact on people's willingness to buy durable goods.

Turning to the borrowing amount in column (4), the T1 group (π^e down) borrows less than the control group, but the difference is limited to 0.25 million yen. On the other hand, the borrowing amount by the T2 group (i up) is about 1 million yen less than that of the control group. As reported in the lower part of Table 3, the coefficients for the T1 and T2 groups are significantly different. A similar pattern is observed for satisfaction with the *real* loan interest rates, with satisfaction decreasing only as the *nominal* interest rates increase (column 5). Thus, it appears that respondents are making decisions based primarily on *nominal* rather than *real* interest rates, not only for saving but also borrowing.

Table 3: Regression results

	Saving experiment			Borrowing experiment		
	(1) Transfer (million yen)	(2) Satisfaction (0-10 scale)	(3) Durable (1=Yes, 0=No)	(4) Borrow (million yen)	(5) Satisfaction (0-10 scale)	(6) Durable (1=Yes, 0=No)
T1 (π^e down)	-0.04	-0.08	0.02	-0.25*	-0.15	0.04
	(0.17)	(0.15)	(0.03)	(0.13)	(0.15)	(0.03)
T2 (i up)	1.75***	2.44***	0.04	-0.97***	-2.22***	-0.17***
	(0.18)	(0.15)	(0.03)	(0.13)	(0.16)	(0.03)
Mean of outcome for control group	1.94	3.02	0.42	2.52	7.03	0.53
p-values for T1=T2	0.00	0.00	0.57	0.00	0.00	0.00
Control variables	YES	YES	YES	YES	YES	YES
N	1,952	1,952	1,952	1,648	1,648	1,648

Notes: The table summarizes estimation results based on Equation (1). Since the control group is excluded, the coefficients on T1 and T2 are the number of units by which the outcome variable differs from the control group, other things being constant. Robust standard errors are shown in parentheses. ***, **, * indicate statistical significance level at 1%, 5%, and 10%, respectively.

With respect to the willingness to purchase durable goods (column 6), only the T2 group (i up) shows a significant drop in willingness to purchase. Compared to the control group, the T2 group, which faces a higher nominal borrowing rate, is 17 percentage points less likely to say that now is a good time to buy durable goods. This is a reasonable result since about 40% of Japanese purchase automobiles (major durable goods) with a loan (Japan Automobile Manufacturers Association 2021), but again, it is the nominal interest rate, not the real one, that matters here.

Finally, we examine whether the money illusion about interest rates observed in Table 3 is mitigated for more educated respondents. To this end, we add an additional explanatory variable, a college-educated dummy that takes one if the respondent has a college degree and zero otherwise, interacted with each treatment dummy. Table 4 shows the estimation results. No significant differences in average treatment effects are observed across educational backgrounds for all dependent variables. This suggests that the money illusion may not be alleviated through education (Cipriani, Lubian, and Zago 2008).

Table 4: Regression results interacted with the college-educated dummy

	Saving experiment			Borrowing experiment		
	(1) Transfer (million yen)	(2) Satisfaction (0-10 scale)	(3) Durable (1=Yes, 0=No)	(4) Borrow (million yen)	(5) Satisfaction (0-10 scale)	(6) Durable (1=Yes, 0=No)
T1 (π^e down)	-0.03	-0.18	0.02	-0.14	0.03	0.08*
	(0.25)	(0.23)	(0.04)	(0.19)	(0.22)	(0.04)
T2 (i up)	1.70***	2.36***	0.08*	-0.96***	-2.13***	-0.15***
	(0.27)	(0.21)	(0.04)	(0.19)	(0.23)	(0.04)
T1 (π^e down)	-0.02	0.16	-0.00	-0.19	-0.31	-0.08
× College-educated	(0.31)	(0.28)	(0.05)	(0.24)	(0.28)	(0.05)
T2 (i up)	0.09	0.15	-0.07	-0.01	-0.14	-0.02
× College-educated	(0.34)	(0.27)	(0.05)	(0.23)	(0.30)	(0.05)
Mean of outcome for control group	1.94	3.02	0.42	2.52	7.03	0.53
p-values						
for T1=T2	0.00	0.00	0.20	0.00	0.00	0.00
for T1+T1×Univ =T2+T2×Univ	0.00	0.00	0.75	0.00	0.00	0.00
Control variables	YES	YES	YES	YES	YES	YES
N	1,952	1,952	1,952	1,648	1,648	1,648

Notes: See notes in Table 3.

4. Conclusions

In this study, we examined whether Japanese households save, borrow, and spend based on the Fisher equation, i.e., real rather than nominal interest rates. To do so, we conducted two randomized experiments. We found that households make decisions primarily based on nominal rather than real interest rates. In other words, households did not take the Fisher equation into account when making decisions. This was also true even for those with higher education.

The above results have an important implication for the effectiveness of unconventional monetary policy in Japan. That is, policies that work on inflation expectations may be less effective under the ZLB. In fact, according to columns 3 and 6 of Table 3, inflation expectations have no significant impact on the willingness to purchase durable goods. In addition, since the money illusion of interest rates is observed even among well-educated, it may be difficult to raise the effectiveness of policy through education.

With one caveat, our findings are based on hypothetical scenarios and may differ from those

based on actual changes in circumstances. Further research in this area is needed in the future.

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