ESRI Discussion Paper Series No.353

Inflation Expectations and Consumer Spending: Micro-data Evidence

Junichi Kikuchi

Yoshiyuki Nakazono

July 2020

Economic and Social Research Institute
Cabinet Office
Tokyo, Japan

Inflation Expectations and Consumer Spending: Micro-data Evidence*

Junichi Kikuchi† Yoshiyuki Nakazono‡

Abstract

This study examines the relationship between inflation expectations and consumer spending. Using a combination of original consumer survey data on inflation expectations and scanner data on the actual expenditure, we examine whether higher inflation expectations generate greater current spending. The linked data also allows us to directly estimate the value of the elasticity of intertemporal substitution (EIS) based on a standard macroeconomic model. We find that higher inflation expectations generate greater current spending compared with one year later and the value of the EIS is significantly positive and approximately 0.1. On the other hand, liquidity-constrained consumers seem to decrease current expenditure in response to higher inflation expectations. This evidence implies that the impact of higher inflation expectations on consumers' intertemporal allocation may vary depending on the type of consumer.

JEL Classification: D84; E21; E31; E52

Keywords: elasticity of intertemporal substitution; Euler equation; forecast data; inflation expectations; survey data

*We thank INTAGE Inc. for the cooperation regarding the online household survey. We also thank the discussant, Naohito Abe, for invaluable inputs and Natsuki Arai, Kengo Nutahara, Rui Ota, Qing-Yuan Sui, Naoki Takayama, and participants in the 2019 Japanese Joint Statistical Meeting and the Japanese Economic Association 2020 Spring Meeting and seminar at the CIGS for their comments and suggestions. Nakazono acknowledges financial support from The Kigawada Foundation (The 21-Seiki Bunka Gakujyutsu Zaidan) and JSPS KAKENHI Grant Number 19K13649.

†Yokohama City University

‡Cabinet Office, Government of Japan; Yokohama City University

1 Introduction

The issue of expectation has been increased interest among policy makers and researchers. While conventional monetary policy cuts nominal interest rates to stimulate the economy, there is no room to reduce short-term nominal interest rates which are virtually zero under the effective lower bound (ELB). As a result, the major central banks such as the Federal Reserve, European Central Bank, and Bank of Japan, have implemented unconventional monetary policies designed to engineer higher inflation expectations and thereby increase current spending. There is a theoretical basis for a relationship between inflation expectations and current spending. Based on the Euler equation, higher inflation expectations lower real interest rates via the Fisher equation; this drop in real interest rates discourages consumer saving and stimulates current spending. Under the ELB, the effect of inflation expectation on the real economy has been the central transmission mechanism for unconventional monetary policies.

However, despite its importance in macroeconomics, the empirical relationship between inflation expectations and consumer spending has not yet been fully uncovered. One of the main reasons is because we do not have concurrent information of consumption growth and inflation expectations. Although panel data on consumers' actual expenditure are often available, there is, as far as we know, no survey data available for the same respondents in relation to inflation expectations.[1] To tackle the issue of the lack of matched data on inflation expectations and consumer expenditure, the literature usually conducts a generalized method of moments to estimate the Euler equation, assuming the choices of instrumental variables (IVs) are valid. However, this approach is often criticized because the correlation between the independent variable and the IVs is very weak.[2] At any attempt to directly estimate the Euler equation which includes expected inflation rates should use matched data on the actual expenditure and inflation expectations.

By using a survey to ask consumers about their subjective inflation expectations

[1]For example, the Michigan Surveys of Consumers includes inflation expectations and readiness to spend on durable goods. However, the surveys do not include data on the respondents' actual spending.

[2]Yogo (2004) point outs the weak-instruments problem that can lead to bias in estimators and size distortion in hypothesis tests and shows that the elasticity of intertemporal substitution (EIS) is less than 1 and not significantly different from 0.

and matching the results of that survey with the actual expenditure, this study directly estimates the Euler equation and examines the relationship between inflation expectations and consumer spending. We focus on whether consumers change the intertemporal allocation of resources in response to changes in their inflation expectations. First, by combining the original consumer survey on inflation expectations and scanner data on the actual expenditure, we examine whether higher inflation expectations generate greater current spending. Second, we structurally estimate the value of the elasticity of intertemporal substitution (EIS). The unique data we combine allows us to directly estimate the deep parameter of the EIS based on a standard model. Third, we identify those who are facing liquidity constraints and investigate how liquidity-constrained consumers respond to changes in inflation expectations. If liquidity-constrained consumers react to higher inflation expectations in a manner that contradicts standard model predictions, the impacts on aggregate spending of unconventional monetary policies aiming to raise inflation expectations may vary among different types of consumer.

This study contributes to the existing literature. First, we find that in response to higher inflation expectations, consumers generate greater current spending compared with one year later. This suggests that the prediction of higher inflation rates induces a change in the intertemporal allocation for the optimal consumption path. In other words, theoretical predictions are consistent with the data. Second, we identify the value of the EIS based on a structural model and show that its estimated value is significantly positive and approximately 0.1. Our results suggest that the EIS may be smaller than those measured in previous studies. Third, we find that consumers who are facing liquidity constraints could not generate greater current spending in response to changes in their expectations. In fact, our result based on the reduced form estimation suggests that liquidity-constrained consumers who live from hand-to-mouth may save more and spend less in response to higher inflation expectations. The result indicates that higher inflation expectations may have varying impacts on consumers' intertemporal allocation. This implies that the macroeconomic effects on current spending of unconventional monetary policies aiming to raise inflation expectations might be ambiguous.

Our study is linked to two strands in the literature. First, our study is related to

empirical studies exploring the theoretical relationship between inflation expectations and consumer spending. The literature provides mixed evidence about this relationship. Using survey on the expenditure plan, Ichiue and Nishiguchi (2015) and Duca et al. (2018) show evidence supporting the predictions of the standard models: consumers expecting higher inflation tend to increase current spending. Ehrmann et al. (2017) and Weber et al. (2015) explore the relationship between inflation expectations and consumer attitudes to spending and show also results in line with the predictions of macroeconomic theory. On the other hand, Bachmann et al. (2015) provide contradictory evidence. Using U.S. data, they show that consumers expecting higher inflation tend to decrease current spending when nominal interest rates are virtually zero, while Burke and Ozdagli (2013) report little evidence that consumers respond to changes in inflation expectations. While past studies relied on qualitative data based on expenditure plans or consumers' attitudes to spending, we use the quantitative survey on the actual spending collected by using home scanners and investigate the association between inflation expectations and consumer's actual spending. Furthermore, we identify consumers with liquidity constraints by exploiting the survey information on the levels of income and financial assets and examine how hand-to-mouth consumers react to higher inflation expectations. This study therefore contributes to the existing literature by exploring the varied impacts of higher inflation expectations on consumer spending.

Second, our study is related to the literature on estimating the value of the EIS. Starting with Hall (1978), Hansen and Singleton (1982), Hansen and Singleton (1983), and Hall (1988), many papers have attempted to estimate the 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 papers, however, come up with mixed results.[3] There is therefore no clear consensus on the magnitude of the elasticity of intertemporal substitution; this arises because of the data limitations in

[3]For example, the EIS Attanasio and Weber (1995) estimated is 0.56, using the Consumer Expenditure Survey, while Cashin and Unayama (2016) find 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. Among further studies that estimate the EIS are Basu and Kimball (2002), Barro (2009), and Guvenen (2006), each one of which estimates the EIS differently.

relation to inflation expectations, which are usually unobservable and not available. In the case of our study, we conducted original survey on consumer inflation expectations and believe that we can provide the more accurate value of the EIS.

The structure of this paper proceeds as follows. Section 2 shows the theoretical prediction of the relationship between inflation expectations and consumer spending while Section 3 describes the survey data we use. Section 4 presents our results and Section 5 discuss the intertemporal allocation of liquidity constrained consumers. Section 6 summarizes the findings and presents the conclusions.

2 Theoretical framework and identification strategy

2.1 A standard model of consumption in the complete markets

We first present the theoretical framework to describe the relationship between inflation expectations and the growth rate of consumption. Suppose that the utility function is isoelastic. The objective of the consumer is:

$$\max \; E_t \sum_{\tau=0}^{T-t} (1+\delta)^{-\tau} \frac{c_{t+\tau}^{1-\gamma} - 1}{1-\gamma},$$

subject to the budget constraint:

$$a_{t+\tau+1} = (1 + r_{t+\tau})\, a_{t+\tau} + y_{t+\tau} - c_{t+\tau},$$

and the terminal condition $a_T = 0$. δ is denoted as the rate of time preference and γ^{-1} is the elasticity of intertemporal substitution. In this setting, we assume that the consumer can borrow and save as much as needed. Under the budget constraint, the first order conditions lead to the Euler equation:

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

Rewriting Equation (1) obtains:

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

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

2.2 Identification strategy

Second, we consider how consumption varies over time, especially under the 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:

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

where i_t and $E_t[\pi_{t+1}]$ are denoted as the nominal interest rate and inflation expectations at time t. Because i_t is almost zero under the ELB,[4] Equation (3) can be simply written as:

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

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

Equation (4) simply indicates the theoretical predictions about the relationship between inflation expectations and the growth rate of consumption. When consumers expect a higher inflation rate, they change the intertemporal allocation of consumption and saving; they save less and spend more today. Because higher inflation expectations discourage consumers from saving and encourage them to increase consumption in the current period, the growth rate of consumption $\Delta \ln c_{t+1}$ decreases. Thus, Equation (4) allows us to empirically test the theoretical relationship between inflation expectations and the consumption path.

In order to investigate the theoretical relationship, we use the quarterly survey data

[4]Figure 1 shows the development of the short-term nominal interest rates in Japan since the 1980s. It shows that the short-term nominal interest rates are virtually zero after 2010.

on inflation expectations and the actual expenditure to estimate the following equation:

$$\Delta \ln \left(\frac{c^i_{t+4}}{c^i_t} \right) = -\gamma^{-1} \times E^i_t \left[\pi_{t \to t+4} \right] + X\beta + \varepsilon^i_{t+1}, \tag{5}$$

where c^i_t, $E^i_t \left[\pi_{t \to t+4} \right]$, and X are denoted as individual i's actual expenditure at time t, individual i's inflation expectations over the next four quarters (*i.e.* next year) at time t, and control variables such as time dummies and the constant term. In addition, Equation (4) allows us to directly estimate the deep parameter, γ^{-1}. Recall that γ^{-1} is the EIS. Because the survey linking consumer inflation expectations and their actual expenditure is available, we can simply obtain the structural parameter of γ^{-1} by estimating Equation (5).

3 Data

3.1 Survey of inflation expectations

We conduct a quarterly online survey for Japanese households to collect inflation expectations from 2015(Q4). Every quarter, approximately 30,000 households answer the questions regarding their outlook for price changes for the next one, three, and ten years. Respondents are 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 the price levels."

The question asks respondents to estimate the CPI levels which they forecast over the next 1-, 3-, and 10-year periods on average. The questionnaire directly measures households' inflation expectations in the short, medium, and long term. The questionnaire is unique because the survey allows us to obtain the quantitative answers and alleviate the "round number" problem which Binder (2017) points out. First, we ask respondents to answer their point estimates by filling out the figures which they forecast as the future levels of CPI. While some surveys ask respondents to choose from options such as "Prices will probably rise" or "Prices will probably fall," we can obtain

the numeric measures to capture consumers' inflation forecasts. For example, when a respondent answers 10,080, 10,600, and 11,000 as her forecasts for the price levels over the following 1-, 3-, and 10-year periods respectively, her 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. We call them "spot" rates and denote $E_t^i[\pi_{t,t+q}]$ as household i's inflation forecasts over the next q-quarter. We can also compute "forward" rates: an annualized forward rate for years n through $n+k$ is calculated from the forecasts of price levels over the next n- and $n+k$-year. When she answers 10,080, 10,600, and 11,000 as the price level forecasts over the next 1-, 3-, and 10-year periods (or the next 4, 12, and 40 quarters), the forward rates $E_t^i[\pi_{t+4,t+12}]$ and $E_t^i[\pi_{t+12,t+40}]$ are 2.55% and 0.53%, respectively. The quantitative measures to capture inflation forecasts make our survey unique.

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%

Second, asking respondents to provide figures for the aggregate price levels can mitigate the "round number" problem which Binder (2017) points out. As Binder (2017) argues, the literature on cognition and communication documents that when a survey asks respondents to answer point predictors, people use round numbers to convey uncertainty. She shows that a large proportion of the respondents to the Michigan Surveys of Consumers and the Federal Reserve Bank of New York Survey of Consumer Expectations report inflation forecasts that are a multiple of five. Our survey could also include a-multiple-of-five forecasts. However, because our measures to capture inflation expectations are calculated by point predictors of particular price levels, the measures we compute are not always a multiple of five. In fact, Binder (2017) reports that approximate half of the forecasts were a multiple of five in the case of the University of

Michigan Surveys of Consumers, while our survey shows that only approximately one-fifth of forecasts are a multiple of five. Thus, our survey can alleviate the problem that arises as a result of rounding behavior.

Tables 1 and 2 show "spot" and "forward" inflation forecasts of households, respectively.[5] Based on the simple average, Table 1 shows that inflation expectations for the 1-year and 3-year horizons are above 2.0%, while 10-year-ahead forecasts are at 1.5%. Table 2 shows that the average of inflation forecasts for the 1- to 3-year horizons is almost 2.0%, and those for the 3- to 10-year horizons are almost 1.0%. Our measure to capture households' inflation expectations is reasonable in sense that respondents' covariates explain the level of forecasts. The average forecasts of female, lowly qualified, and lower-income respondents are higher than those of male, highly qualified, and higher-income earners. These evidences are similar in both Tables 1 and 2.

3.2 Data about the consumption expenditure

The data we use is the panel data (SCI-personal) on the consumption expenditure, collected by a marketing company, Intage. We use the data that records day-to-day shopping information collected on an ongoing basis from 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 price. This data covers items which 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.[6] We combine the inflation survey with the consumption expenditure from the same respondents and empirically test the theoretical relationship with inflation expectations and consumer spending.

[5]The (annualized) inflation forecasts exclude all forecasts of inflation above 25 and below -2 percent.
[6]Table 3 shows the basic statistics of the data.

4 Estimation results

4.1 Testing the theoretical prediction and estimating the structural parameter of the EIS

As presented in Section 2, the data we use allows us to directly estimate the value of the EIS. We regress the growth rate of consumption on inflation expectations for not only shorter-term but also longer-term horizons. Our empirical framework is based on the following equation:

$$\ln\left(\frac{c^i_{t+q}}{c^i_t}\right) = -\gamma^{-1} \times E^i_t\left[\pi_{t\to t+k}\right] + X\beta + \varepsilon^i_{t+q}, \tag{6}$$

where $\ln\left(\frac{c^i_{t+q}}{c^i_t}\right)$ and $E^i_t\left[\pi_{t\to t+k}\right]$ are denoted as the consumption expenditure growth rates by individual i from t to $t+q$ and inflation forecasts by individual i over the next k quarters at time t, respectively. A vector X includes the control variables such as the fixed effects, time dummies, and aggregate inflation rates.[7] Because we use the quarterly data, when $q = 4$ and $k = 12$, $\ln\left(\frac{c^i_{t+4}}{c^i_t}\right)$ is the annual growth rate of individual i's expenditure and $E^i_t\left[\pi_{t\to t+12}\right]$ is the inflation forecast for the next 12 quarters ($i.e.$ the next 3 years) at time t.[8] We focus on the parameter γ^{-1} in Equation (6).

Table 4 summarizes the estimation results using the entire sample. Panels (A) and (B) use the annual and the semiannual growth rates of consumption as the dependent variable, respectively. First of all, we confirm that higher inflation expectations are negatively associated with the growth rate of consumption, that is, higher inflation expectations generate greater current spending compared to future spending. In fact, the sign of the relationship between the growth rate of consumption and inflation expectations are negative in all cases.[9] While the model we present in Section 2 predicts the nexus only between the annual growth rate of consumption and inflation expectations

[7]The growth rate of consumption on the left-hand side is deflated by the inflation rate which is computed by the change in the CPI (excluding perishables).

[8]The combination of $(q, k) = (4, 4)$ exactly matches the model in Section 2; the annual growth rate of consumption expenditure from t to $t+4$ is influenced by inflation expectations for the next one year from t to $t+4$.

[9]Note that the estimated coefficient is $-\gamma^{-1}$, but γ^{-1} (that is, EIS) is reported in Tables 4 to 8.

for the next one year, the table suggests that higher inflation expectations for the next three year significantly generate greater current expenditure compared to future expenditure. The evidence shows that our benchmark results are robust and are consistent with the theoretical prediction of the standard macroeconomic model, that higher inflation expectations induces consumers to change their intertemporal allocation and to save less and spend more.

Second, Table 4 also shows the value of the EIS (γ^{-1}). The value of the coefficient is our primary focus. The estimate in the first column in Panel (A) is approximately 0.1. The results are similar to those in Panel (B), using the semiannual growth rate of consumption as the dependent variable. The value of the coefficient is approximately 0.1. The values in Panel (A) and (B) are much smaller to those suggested by previous studies.[10]

4.2 Robustness check

We check the robustness of our benchmark results using the subsamples. While we show the estimate results of the EIS in Table 4, the sample covers all the respondents. We reestimate the values of the EIS using the subsamples from consumers who seem not to face liquidity constraints, specifically, the subsample of wealthy or highly educated consumers. Table 5 shows the results. Wealthy and highly educated consumers are defined as those whose household income is 9 million yen a year or more or have financial assets over 10 million yen, and have a bachelor's degree or higher, respectively. Panels (A) and (B) use the annual and the semiannual growth rates of consumption as the dependent variable, respectively. The results in both panels show that higher inflation expectations are negatively associated with current expenditure, that is, higher inflation expectations *increase* the growth rate of consumption. The relationship is significant: the growth rate of consumption is related to inflation expectations for the next one and three years. The evidence supports our benchmark results. Furthermore, the value of γ^{-1} is approximately 0.2, which is slightly higher than those which our estimation results suggest in the previous section. The results imply that the EIS for consumers who

[10] Jappelli and Pistaferri (2017) summarize that the estimated EIS in the literature ranges from 0.2 to 2.0.

can access credit more easily becomes slightly higher than that of those who cannot.

We also check the robustness of our benchmark results by taking the first difference of Equation (6) and using the lag of the inflation expectations as the instrumental variable (IV: $E^i_{t-1}[\pi_{t-1\to t+k-1}]$). Taking the first difference of Equation (6) can omit the consumer i's specific effects. Using the first lag of the independent variable as the IV can alleviate the endogenous problem in the estimating equation when inflation expectations in the right-hand side might be correlated with the error term (ε) due to the omitted variable(s). Table 6 shows the robustness of our benchmark results. Panels (A) and (B) use the first difference and the IV as the dependent variable, respectively. The estimated EIS is below 0.1, but significantly positive, when we use inflation expectations for the next one year. The results in both panels support the above results: higher inflation expectations generate greater current consumption and the EIS is much lower than those in the previous studies.[11]

5 How do consumers with liquidity constraints respond to a change in their inflation expectations?

Consumption theories do not predict that liquidity-constrained consumers can always smooth their consumption path. Zeldes (1989) shows that consumers who are not constrained can more easily choose the timing of their spending, while those who are constrained may not be able to increase current spending in response to a higher inflation expectation. In fact, Bachmann et al. (2015) find that higher inflation expectations induce consumers with liquidity constraints reduce current expenditure compared to future expenditure.

Before moving on to estimation, how should we identify consumers facing liquidity constraints? While there are many studies that suggest ways to carry out such an identification, including Jappelli et al. (1998), Carroll (2001), Kohara and Horioka (2006), and Ludvigson (1999), we follow Zeldes (1989) and Jappelli (1990) and use the data on

[11] We further check the robustness of our benchmark results by excluding liquidity-constrained consumers from the sample as reported in Table 7. We define liquidity-constrained consumers in Section 5.

income and financial assets to identify consumers with liquidity constraints. We assume that consumers with a household income below 4 million yen and financial assets worth 3 million yen or less are facing liquidity constraints.

Table 8 shows the results of the reduced form estimation using the sample from liquidity-constrained consumers. Panels (A) and (B) in the table use the annual and the semiannual growth rates of consumption as the dependent variable, respectively. Panel (A) shows the significantly *positive* relation between the growth rate of consumption and inflation expectations; higher inflation expectations seem to generate lower current expenditure compared to one year later. Panel (B) in the table also shows that the relationship between inflation expectations and the growth rate of consumption is positive. These results suggest that in contrast to the predictions of standard macroeconomic theory, higher inflation expectations may induce liquidity-constrained consumers to increase current saving and decrease current spending. The evidence that consumers with liquidity constraints may fail to smooth their consumption in response to higher inflation expectations under the ELB is consistent with Bachmann et al. (2015), which documents the negative correlation between inflation expectations and the readiness to spend on durables inside the ELB using the Michigan Survey of Consumers.

6 Conclusion

This study examines the relationship between inflation expectations and consumer spending, focusing on whether consumers change the intertemporal allocation of resources in response to changes in their inflation expectations. First, using a combination of original consumer survey on inflation expectations and scanner data on the actual expenditure, we examine whether higher inflation expectations generate greater current spending. Second, we structurally estimate the value of the EIS. It is hard for researchers to identify the value of the EIS via the Euler equation mainly due to the lack of the linked data on consumer inflation expectations and the consumption expenditure. The unique data we combine allows us to directly estimate the deep parameter of the EIS based on a standard model. Third, we identify those who are facing liquidity constraints and

investigate how liquidity-constrained consumers respond to changes in inflation expectations. If liquidity-constrained consumers react to higher inflation expectations in a manner that contradicts standard model predictions, the impacts on aggregate spending of unconventional monetary policy aiming to raise inflation expectations may vary among different types of consumer.

There are three contribution of our study. First, we find that in response to higher inflation expectations, consumers generate greater current spending compared with one year later. This suggests that the prediction of higher inflation expectations induces a change in the intertemporal allocation for the optimal consumption path. In other words, theoretical predictions are consistent with the data. Second, we identify the value of the EIS based on a structural model and show that its estimated value is significantly positive and approximately 0.1. Our results suggest that the EIS may be smaller than those measured in previous studies. Third, we find that consumers who are facing liquidity constraints could not generate greater current spending in response to higher inflation expectations. The evidence indicates that higher inflation expectations may have varying impacts on consumers' intertemporal allocation.

References

Attanasio, O., and Weber, G. (1995). Is Consumption Growth Consistent with Intertemporal Optimization? Evidence from the Consumer Expenditure Survey. *Journal of Political Economy*, 103(6), 1121–1157.

Bachmann, R., Berg, T. O., and Sims, E. R. (2015). Inflation Expectations and Readiness to Spend: Cross-Sectional Evidence. *American Economic Journal: Economic Policy*, 7(1), 1–35.

Barro, R. J. (2009). Rare Disasters, Asset Prices, and Welfare Costs. *American Economic Review*, 99(1), 243–264.

Basu, S., and Kimball, M. S. (2002). Long-Run Labor Supply and the Elasticity of Intertemporal Substitution for Consumption. *Working Paper*.

Binder, C. C. (2017). Measuring Uncertainty Based on Rounding: New Method and Application to Inflation Expectations. *Journal of Monetary Economics*, 90, 1–12.

Burke, M. A., and Ozdagli, A. (2013). Household Inflation Expectations and Consumer Spending: Evidence from Panel Data. *Working Papers* 13–25, Federal Reserve Bank of Boston.

Carroll, C. D. (2001). A Theory of the Consumption Function, With and Without Liquidity Constraints. *The Journal of Economic Perspectives*, 15(3), 23–45.

Cashin, D., and Unayama, T. (2016). Measuring Intertemporal Substitution in Consumption: Evidence from a VAT Increase in Japan. *The Review of Economics and Statistics*, 98(2), 285–297.

Duca, L. A., Kenny, G., and Reuter, A. (2018). Inflation Expectations, Consumption and the Lower Bound: Micro Evidence from a Large Euro Area Survey. *Working Paper Series*, 2196, European Central Bank.

Ehrmann, M., Pfajfar, D., and Santoro, E. (2017). Consumers' Attitudes and Their Inflation Expectations. *International Journal of Central Banking*, 13(1), 225–259.

Gary, V. E., and Kumar, A. (2009). The Elasticity of Intertemporal Substitution: New Evidence from 401(k) Participation. *Economic Letters*, 103, 15–17.

Gourinchas, P. O., and Parker, J. A. (2002). Consumption over the Life Cycle. *Econometrica*, 70(1), 47–89.

Guvenen, F. (2006). Reconciling Conflicting Evidence on the Elasticity of Intertemporal Substitution: A Macroeconomic Perspective. *Journal of Monetary Economics*, 53, 1451–1472.

Hall, R. E. (1978). Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence. *Journal of Political Economy*, 86(6), 971–987.

Hall, R. E. (1988). Intertemporal Substitution in Consumption. *Journal of Political Economy*, 96(2), 339–357.

Hansen, L. P., and Singleton, K. J. (1982). Generalized Instrumental Variables Estimation of Nonlinear Rational Expectations Models. *Econometrica*, 50(5), 1269–1286.

Hansen, L. P., and Singleton, K. J. (1983). Stochastic Consumption, Risk Aversion, and the Temporal Behavior of Asset Returns. *Journal of Political Economy*, 91(2), 249–265.

Ichiue, H., and Nishiguchi, S. (2015). Inflation Expectations and Consumer Spending at the Zero Bound: Micro Evidence. *Economic Inquiry*, 53(2), 1086–1107.

Jappelli, T. (1990). Who is Credit Constrained in the U.S. Economy? *The Quarterly Journal of Economics*, 105(1), 219–234.

Jappelli, T., Pischke, J. S., and Souleles, N. S. (1998). Testing for Liquidity Constraints in Euler Equations with Complementary Data Sources. *The Review of Economics and Statistics*, 80(2), 251–262.

Jappelli, T., and Pistaferri, L. (2017). The Economics of Consumption: Theory and Evidence. *Oxford University Press*.

Kohara, M., and Horioka, C. Y. (2006). Do Borrowing Constraints Matter? An Analysis of Why the Permanent Income Hypothesis does not Apply in Japan. *Japan and the World Economy*, 18(4), 358–377.

Ludvigson, S. (1999). Consumption and Credit: A Model of Time-Varying Liquidity Constraints. *The Review of Economics and Statistics*, 81(3), 434–447.

Yogo, M. (2004). Estimating the Elasticity of Intertemporal Substitution When Instruments Are Weak, *The Review of Economics and Statistics*, 86(3), 797–810.

Weber, M., Hoang, D., and D'Acunto, F. (2015). Inflation Expectations and Consumption Expenditure. *Meeting Papers*, 1266, Society for Economic Dynamics.

Zeldes, S. P. (1989). Consumption and Liquidity Constraints: An Empirical Investigation. *Journal of Political Economy*, 97(2), 305–346.

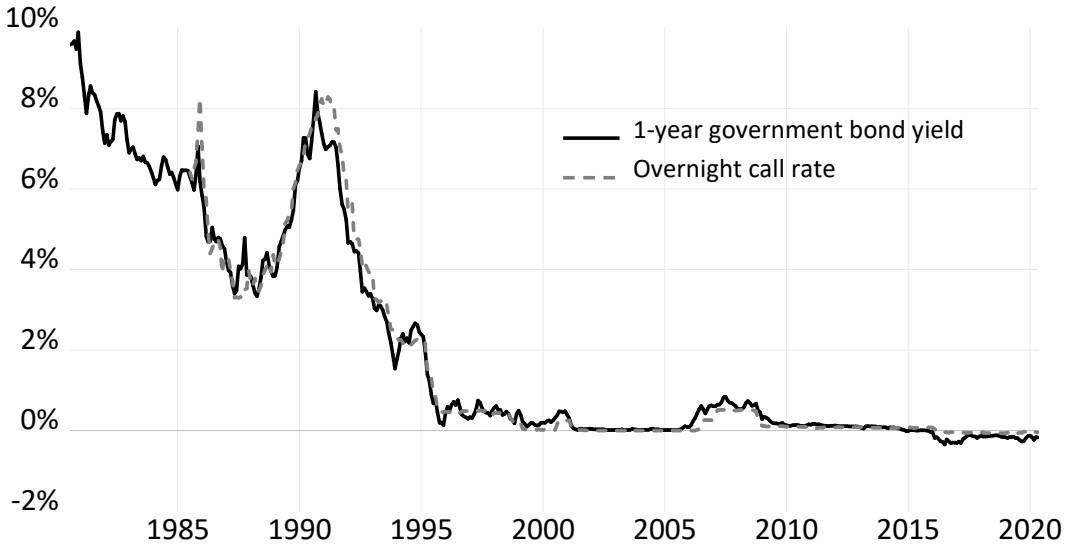

Figure 1: Development of the short-term nominal interest rates (Source: Ministry of Finance, Japan and Bank of Japan)

Table 1: Basic statistics of households' inflation forecasts: "Spot" forecasts

	1-year average			3-year average			10-year average		
	Mean	Median	Obs.	Mean	Median	Obs.	Mean	Median	Obs.
All	2.5%	0.5%	143,612	2.1%	0.9%	144,806	1.5%	1.0%	144,835
Female	2.8%	0.8%	69,474	2.4%	1.0%	69,843	1.6%	1.0%	69,802
Male	2.2%	0.5%	73,694	1.8%	0.6%	74,517	1.3%	1.0%	74,589
High school graduate or below	2.8%	1.0%	64,212	2.3%	1.0%	64,650	1.6%	1.0%	64,671
Four-year college graduate or above	2.2%	0.5%	73,706	1.8%	0.6%	74,340	1.3%	1.0%	74,159
Annual income below 4 million yen	2.7%	0.9%	63,077	2.3%	1.0%	63,570	1.6%	1.0%	63,625
Annual income 9 million yen and above	2.1%	0.5%	32,429	1.7%	0.7%	32,665	1.2%	1.0%	32,638

Note: The forecasts of inflation above 25 and below -2 percent are trimmed. The data cover from 2015Q4.

Table 2: Basic statistics of households' inflation forecasts: "Forward" forecasts

	1 to 3-year average			3 to 10-year average		
	Mean	Median	Observation	Mean	Median	Observation
All	1.8%	0.4%	141,686	1.1%	0.6%	141,667
Female	2.0%	0.7%	68,192	1.1%	0.6%	68,131
Male	1.7%	0.4%	73,058	1.0%	0.6%	73,107
High school graduate or below	2.0%	0.9%	63,139	1.1%	0.6%	63,061
Four-year college graduate or above	1.6%	0.4%	73,062	1.0%	0.5%	72,975
Annual income below 4 million yen	1.6%	0.4%	53,782	0.9%	0.6%	53,822
Annual income 9 million yen and above	1.6%	0.5%	32,135	1.0%	0.6%	32,157

Note: The forecasts of inflation above 25 and below -2 percent are trimmed. The data covers the range from 2015Q4.

Table 3: Basic statistics of household expenditure

	Purchase amount (yen)		
	Mean	Median	Obs.
All	20,499	17,153	1,242,452
Female	24,182	21,537	754,335
Male	14,822	11,593	486,236
High school graduate or below	22,987	20,161	684,242
Four-year college graduate or above	18,518	14,930	503,353
Households' annual income below 4 million yen	18,915	15,850	621,072
Households' annual income 9 million yen and above	22,357	18,502	226,564
Households with liquidity constraints	18,649	15,779	36,766
Households without liquidity constraints	22,485	18,857	270,681

Table 4: Do consumers increase current spending in response to changes in their expectations?

$$\ln(c^i_{t+4}/c^i_t) = -\gamma_1^{-1} \times E^i_t[\pi_{t\to t+k}] + X\beta + \varepsilon^i_{t+4}$$

Panel (A)	1 year $E^i_t[\pi_{t\to t+4}]$	3 year $E^i_t[\pi_{t\to t+12}]$	10 year $E^i_t[\pi_{t\to t+40}]$
γ_1^{-1}	0.102***	0.111***	0.053
	(0.021)	(0.009)	(0.072)
Random effect	YES	YES	YES
Time fixed effect	YES	YES	YES
Observations	84,625	85,422	85,191

$$\ln(c^i_{t+2}/c^i_t) = -\gamma_2^{-1} \times E^i_t[\pi_{t\to t+k}] + X\beta + \varepsilon^i_{t+2}$$

Panel (B)	1 year $E^i_t[\pi_{t\to t+4}]$	3 year $E^i_t[\pi_{t\to t+12}]$	10 year $E^i_t[\pi_{t\to t+40}]$
γ_2^{-1}	0.064***	0.134***	0.087
	(0.021)	(0.024)	(0.063)
Random effect	YES	YES	YES
Time fixed effect	YES	YES	YES
Observations	110,792	111,696	111,480

Note: Standard errors in parentheses are clustered at individual levels, and ***, **, and * indicate 1%, 5%, and 10% significance, respectively. Time dummy and constant term are included as the control variables.

Table 5: Do the wealthy or the highly educated consumers increase current spending in response to changes in their expectations?

$$\ln(c^i_{t+4}/c^i_t) = -\gamma_1^{-1} \times E^i_t[\pi_{t\to t+k}] + X\beta + \varepsilon^i_{t+4}$$

Panel (A)	1 year ($k=4$)	3 year ($k=12$)	10 year ($k=40$)
Wealthy consumers	$E^i_t[\pi_{t\to t+4}]$	$E^i_t[\pi_{t\to t+12}]$	$E^i_t[\pi_{t\to t+40}]$
γ_1^{-1}	0.196***	0.277***	0.280
	(0.042)	(0.032)	(0.170)
Random effect	YES	YES	YES
Time fixed effect	YES	YES	YES
Observations	29,676	29,872	29,661

$$\ln(c^i_{t+4}/c^i_t) = -\gamma_2^{-1} \times E^i_t[\pi_{t\to t+k}] + X\beta + \varepsilon^i_{t+4}$$

Panel (B)	1 year ($k=4$)	3 year ($k=12$)	10 year ($k=40$)
Consumers with a higher degree	$E^i_t[\pi_{t\to t+4}]$	$E^i_t[\pi_{t\to t+12}]$	$E^i_t[\pi_{t\to t+40}]$
γ_2^{-1}	0.152***	0.199**	0.045
	(0.045)	(0.082)	(0.135)
Random effect	YES	YES	YES
Time fixed effect	YES	YES	YES
Observations	43,800	44,265	44,130

Note: Panel (A) uses the subsample from consumers with more than 9 million yen a year as household's income or financial assets over 10 million yen. Panel (B) uses the subsample from consumers with a bachelor's degree or higher. Standard errors in parentheses are clustered at individual levels, and ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

Table 6: Do consumers increase current spending in response to changes in their expectations? Robustness check by taking the first differences (Panel (A)) and using the IV (Panel (B)).

$$\Delta \ln(c^i_{t+4}/c^i_t) = -\gamma_1^{-1} \times \Delta E^i_t[\pi_{t\to t+k}] + X\beta + \varepsilon^i_{t+4}$$

Panel (A)	1 year ($k=4$)	3 year ($k=12$)	10 year ($k=40$)
First difference	$\Delta E^i_t[\pi_{t\to t+4}]$	$\Delta E^i_t[\pi_{t\to t+12}]$	$\Delta E^i_t[\pi_{t\to t+40}]$
γ_1^{-1}	0.086**	0.170***	0.028
	(0.031)	(0.021)	(0.028)
Time fixed effect	YES	YES	YES
Observations	37,880	38,546	38,199

$$\ln(c^i_{t+4}/c^i_t) = -\gamma_1^{-1} \times E^i_{t-1}[\pi_{t-1\to t+k-1}] + X\beta + \varepsilon^i_{t+4}$$

Panel (B)	1 year ($k=4$)	3 year ($k=12$)	10 year ($k=40$)
IV	$E^i_{t-1}[\pi_{t-1\to t+3}]$	$E^i_{t-1}[\pi_{t-1\to t+11}]$	$E^i_{t-1}[\pi_{t-1\to t+39}]$
γ_1^{-1}	0.036**	0.103***	0.061*
	(0.012)	(0.029)	(0.029)
Random effect	YES	YES	YES
Time fixed effect	YES	YES	YES
Observations	71,050	25,286	36,958

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

Table 7: Do consumers increase current spending in response to changes in their expectations? Robustness check without liquidity constrained consumers.

$$\ln(c^i_{t+4}/c^i_t) = -\gamma_1^{-1} \times E^i_t[\pi_{t\to t+k}] + X\beta + \varepsilon^i_{t+4}$$

Panel (A)	1 year ($k=4$)	3 year ($k=12$)	10 year ($k=40$)
	$E^i_t[\pi_{t\to t+4}]$	$E^i_t[\pi_{t\to t+12}]$	$E^i_t[\pi_{t\to t+40}]$
γ_1^{-1}	0.158***	0.298***	0.295***
	(0.017)	(0.033)	(0.060)
Random effect	YES	YES	YES
Time fixed effect	YES	YES	YES
Observations	52,157	51,538	50,723

$$\ln(c^i_{t+2}/c^i_t) = -\gamma_2^{-1} \times E^i_t[\pi_{t\to t+k}] + X\beta + \varepsilon^i_{t+2}$$

Panel (B)	1 year ($k=4$)	3 year ($k=12$)	10 year ($k=40$)
	$E^i_t[\pi_{t\to t+4}]$	$E^i_t[\pi_{t\to t+12}]$	$E^i_t[\pi_{t\to t+40}]$
γ_2^{-1}	0.102***	0.187***	0.196**
	(0.019)	(0.034)	(0.078)
Random effect	YES	YES	YES
Time fixed effect	YES	YES	YES
Observations	69,844	68,993	67,992

$$\Delta\ln(c^i_{t+4}/c^i_t) = -\gamma_3^{-1} \times \Delta E^i_t[\pi_{t\to t+k}] + X\beta + \varepsilon^i_{t+4}$$

Panel (C)	1 year ($k=4$)	3 year ($k=12$)	10 year ($k=40$)
	$\Delta E^i_t[\pi_{t\to t+4}]$	$\Delta E^i_t[\pi_{t\to t+12}]$	$\Delta E^i_t[\pi_{t\to t+40}]$
γ_3^{-1}	0.181***	0.315***	0.003
	(0.036)	(0.064)	(0.065)
Time fixed effect	YES	YES	YES
Observations	23,616	23,616	23,192

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

Table 8: Do consumers with liquidity constraints increase current spending in response to changes in their expectations?

$$\ln(c^i_{t+4}/c^i_t) = \alpha_1 \times E^i_t[\pi_{t\to t+k}] + X\beta + \varepsilon^i_{t+4}$$

Panel (A)	1 year ($k=4$)	3 year ($k=12$)	10 year ($k=40$)
	$E^i_t[\pi_{t\to t+4}]$	$E^i_t[\pi_{t\to t+12}]$	$E^i_t[\pi_{t\to t+40}]$
α_1	0.155**	0.415***	0.507*
	(0.064)	(0.098)	(0.229)
Fixed effect	YES	YES	YES
Time fixed effect	YES	YES	YES
Observations	5,487	5,577	5,605

$$\ln(c^i_{t+2}/c^i_t) = \alpha_2 \times E^i_t[\pi_{t\to t+k}] + X\beta + \varepsilon^i_{t+2}$$

Panel (B)	1 year ($k=4$)	3 year ($k=12$)	10 year ($k=40$)
	$E^i_t[\pi_{t\to t+4}]$	$E^i_t[\pi_{t\to t+12}]$	$E^i_t[\pi_{t\to t+40}]$
α_2	0.116**	0.0801	0.491*
	(0.050)	(0.080)	(0.231)
Fixed effect	YES	YES	YES
Time fixed effect	YES	YES	YES
Observations	6,303	6,397	6,427

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