Cabinet Office

ESRI Discussion Paper Series No.364

Inflation Expectations and Household Expenditure: Evidence from Pseudo-Panel Data in Japan

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July 2021

Economic and Social Research Institute
Cabinet Office
Tokyo, Japan

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Abstract

This paper examines to what extent a rise in inflation expectations stimulates current household expenditure in Japan. Using matched household datasets, we find the following. First, quarterly total expenditure increases by 11,930–14,779 yen or 1.0–1.4% in response to a one percentage point rise in the expected inflation rate. Second, the response is largest for durable expenditure, while non-storable non-durable expenditure shows no response. Third, the stimulative effect of a temporary rise in inflation expectations is largely offset by a decline in expenditure a few quarters after inflation expectations have returned to their previous level, resulting in no impact on household expenditure in the long-run.

Keywords: Inflation expectations, household expenditure, zero lower bound, unconventional policies
JEL Classification: D84, E21, E43, E52

[†]This paper forms part of the author's microdata-based research on household consumption at the Economic and Social Research Institute (ESRI), Japan. We would like to thank Naohito Abe, the discussant at the ESRI seminar, and Hibiki Ichiue, the discussant at the 2021 Annual Meeting of Japanese Economic Association for their valuable comments. We am also grateful to Yasuhisa Ino, Minoru Masujima, Hiroshi Nomura, Masahiro Hori, Keiko Murata, Koichiro Iwamoto, Junya Hamaaki, Fumihiko Suga, Kazuhito Higa, Taiyo Fukai, Yoshiyuki Nakazono, and participants of the Aoyama Gakuin University Workshop for their insightful comments, as well as Ralph Paprzycki for his excellent English editing service. Special thanks go to the Ministry of Internal Affairs and Communications and the Cabinet Office for providing me with the microdata employed in this study. This research was supported by a grant-in-aid from the Zengin Foundation for Studies on Economics and Finance, the Nomura Foundation, and JSPS KAKENHI Grant Number 20K13512. The views expressed in this paper are those of the author and do not represent those of the institutions with which we are affiliated.

1 Introduction

There is a growing awareness that a potential policy tool under the zero-lower bound (ZLB) on nominal interest rates is to manage inflation expectations (Coibion et al. 2020). The Fisher equation suggests that, under the ZLB, a central bank can lower real interest rates if it succeeds in raising households' inflation expectations, which in turn potentially stimulates household expenditure. In addition, previous studies show that a rise in households' inflation expectations through the preannouncement of future value added tax (VAT) hikes in combination with a compensatory reduction in other taxes such as income taxes can theoretically stimulate current household expenditure by exploiting intertemporal substitution effects (Feldstein 2002, Hall 2011, Correia et al. 2013, and Hino 2020).

However, whether a rise in inflation expectations does stimulate household expenditure in practice is ambiguous, since several mechanisms work in different directions. The first mechanism is intertemporal substitution. An expected rise in prices, which under the ZLB is equivalent to an expected decline in real interest rates, encourages households to spend more today and less tomorrow. Moreover, this mechanism is expected to operate more strongly with respect to goods with greater durability or storability since households can purchase them at a cheaper price today and consume them later (Cashin and Unayama 2021). That is, the timing of expenditure and consumption can differ, unlike in the case of non-storable non-durable goods such as fresh food as well as services.

The second mechanism is the negative income and wealth effect. An expected rise in prices may not be accompanied by an increase in expected nominal wages (income). For example, households may expect prices to rise by 2% but their nominal wages (income) to grow by only 1%. In this case, they expect their *real* wages (income) to shrink by about 1%, resulting in a negative income effect. For Japan, Ito and Kaihatsu (2016), using a household-level dataset, have shown that over the period 2002–2015, the expected growth rate of nominal wages was almost always lower than the expected inflation rate. Meanwhile, for the United States, Shiller (1997) showed that 42% of respondents to a questionnaire survey expected that their nominal income would never be fully corrected for inflation if the inflation rate unexpectedly doubled in the next year. More recently, using U.S. household-level data, Burke and Ozdagli (2013), focusing on the period April 2009–November 2012, showed that households' mean expected growth rate of real wages was –1.05%. They concluded that this negative income effect may play an important role in explaining their finding that there is no evidence that households increase their expenditure in response to a rise in expected inflation. Meanwhile, for the Netherlands, Coibion et al. (2019) report a *negative* impact of elevated inflation expectations on total expenditure and argue that this is possibly driven by their finding that an increase in inflation expectations does not automatically lead to a commensurate increase in the expected growth rate of nominal household net income. Finally, for the U.K., Nunes and Park (2020) find that higher inflation expectations prompt households to cut back spending and, based on a model they develop, show that

this finding can be explained by the negative income effect.

Along similar lines, increased inflation expectations may have a negative wealth effect. For instance, if households expect the nominal value of their house to remain unchanged when inflation expectations rise, the expected *real* value of their housing wealth will decline. If these kinds of negative income and wealth effects dominate the intertemporal substitution effect, a rise in inflation expectation will dampen household expenditure.

In addition, if a rise in inflation expectations is driven by a preannounced VAT hike, this can be treated as a negative permanent income shock. For instance, in October 2013, the Japanese government announced that the VAT rate would rise from 5% to 8% in April 2014. Given that few goods and services were exempt from VAT and the VAT hike was not compensated for, it is possible that households regarded the announcement of the VAT hike as a negative permanent income shock. Using Japanese household-level data, Cashin and Unayama (2016b) show that non-storable non-durable expenditure declined in response to the announcement of the VAT hike in October 2013, suggesting that households indeed regarded the VAT hike announcement as a negative permanent income shock.

The third mechanism through which a rise in inflation expectations affects household expenditure is via households' balance sheets, as highlighted by Lieb and Schuffels (2020). Inflation affects different household balance sheet items in different ways. For example, if the most important component of household balance sheets is cash and deposits, whose real value is eroded by inflation, households may reduce their expenditure in response to a rise in inflation expectations. On the other hand, if the most important component of household balance sheets is debt, households might increase expenditure in response to a rise in inflation expectations since the real value of this debt would fall as a result of inflation. In addition, the amount of liquid assets can also be an important factor in evaluating the impact of expected inflation on household expenditure. Suppose some households decide to purchase a car today based on the expectation that car prices will rise. If they have sufficient liquid assets, they can purchase their car using those assets. On the other hand, if they do not have sufficient liquid assets, they may decide to take out a car loan. However, in this case, some households may not be approved for a car loan, so that their expenditure is unresponsiveness to the rise in inflation expectations.

Thus, from a theoretical perspective, it is not possible to judge a priori whether a rise in inflation expectations stimulates household expenditure or not. Against this background, this study seeks to empirically examine the impact of a rise in inflation expectations on household expenditure by combining three household-level datasets for Japan.

To identify the causal relationship from inflation expectations to household expenditure, extant studies have relied on three different approaches. The first and most rigorous approach consists of the use of randomized control trials. For instance, Coibion et al. (2019) provide information about the most recent inflation rate in the Netherlands to randomly selected Dutch households and compare their

expenditure response to a control group that were not provided such information. Exploiting the exogenous variation in inflation expectations due to the provision of inflation information, they find that a rise in inflation expectations has a negative impact on durable expenditure and further show that a possible explanation for this negative effect is households' pessimistic outlook regarding their real income and aggregate expenditure triggered by the elevated inflation expectations. Further, conducting a similar experiment to Coibion et al.'s (2019) but focusing on Malaysia, Galashin, Kanz, and Perez-Truglia (2020) find that exogenous variation in inflation expectations does not have a significant effect on actual behavior (as measured in credit card expenditure) and self-reported consumption plans. They interpret the result as indicating that households fail to incorporate revised expectations into their consumption decisions and therefore do not re-optimize their behavior when new information becomes available.

The second approach consists of the use of natural experiments. For instance, D'Acunto, Hoang, and Weber (2021) exploit the unexpected announcement in November 2005 by the German government of a future increase in the VAT rate. Taking advantage of the fact that Germany is the only country in Europe which announced a rise in VAT at that time, they first confirm that inflation expectations in Germany increased more than in the control group (France, Sweden, and the United Kingdom). They then employ difference-in-differences estimation to show that German's probability to say it was a good time to buy durable goods increased by up to 34% in the period between the announcement (November 2005) and the implementation (January 2007) of the VAT hike, implying inflation expectations had a positive effect on durable expenditure.

The third approach consists of the use of household-level microdata. This approach is widely used in this research field and is the one that we also use in the current study. While the use of household microdata makes it more difficult to identify the impact of inflation expectations than the other two approaches, it is possible to include a large number of demographic variables and, if panel data are available, employ fixed effects estimation in order to minimize endogeneity issues that arise when using this approach. Employing household data for the United States, Bachman, Berg, and Sims (2015) show that higher inflation expectations have had a negative impact on the readiness to spend on durables during the ZLB period (while the impact outside the ZLB period was statistically insignificant). Meanwhile, Burke and Ozdagli (2013) focus on the response of expenditure on durable and non-durable goods but find that most of the estimates are statistically insignificant. For Denmark, Vellekoop and Wiederholt (2019) link survey data on inflation expectations to administrative data on income and wealth and show that households with higher inflation expectations save less (i.e., spend more). They also find that households with higher inflation expectations are more likely to acquire a car, especially a higher-value car. Also focusing on Denmark, Lieb and Schuffels (2020) find that households that invest larger parts of their wealth in financial assets (stocks, bonds, etc.) are more likely to purchase a car in response to a rise in inflation expectations. Looking at France, Andrade,

Gautier, and Mengus (2019) employ a monthly panel dataset and show that the probability that households purchased a vehicle over the preceding twelve months increases by 0.19 percentage points if they expected higher inflation over the coming twelve months. For the U.K., Nunes and Park (2020) find that higher inflation expectations lead households to bring durable goods purchases forward but also to cut back spending. They explain this result with the opposing effects of higher inflation expectations. That is, higher inflation expectations tend to boost durable goods expenditure through the intertemporal substitution effect and reduce total expenditure through the erosion of the real value of income.

For Japan, Ichiue and Nishiguchi (2015), using the repeated quarterly cross-section data of the Opinion Survey conducted by the Bank of Japan, show that elevated inflation expectations lead to higher current expenditure, especially among the old and those owning (financial and housing) assets. Meanwhile, Ito and Kaihatsu (2016) construct a pseudo-panel from the repeated cross-section data of the Questionnaire Survey on the Work and Life of Workers conducted by the Japanese Trade Union Confederation Research Institute for Advancement of Living Standards and also report that a rise in inflation expectations increases current expenditure in Japan.

The present study seeks to contribute to the literature in the following three respects. First, our datasets allow us to examine the impact of inflation expectations on household expenditure in a quantitative manner since both expenditure and inflation expectations are available in quantitative form. Second, our datasets provide us with detailed information on expenditure collected based on the diary method. We can therefore examine to what extent the degree of durability and storability of goods and services is important for the estimated impact of inflation expectations on expenditure. Third, our pseudo-panel data constructed by combining three micro datasets track the same cohorts over 36 quarters. This allows us to examine the dynamic impact of a rise in inflation expectations on expenditure. If the intertemporal substitution effect is the dominant mechanism, a boost to expenditure in the present period comes at the expense of a reduction in expenditure in the future, so that the impact on the expenditure level in the long-run should be zero. In this case, it is important for both policy makers and economists to know more about the timing of this reversal in expenditure.

The remainder of the study is organized as follows. The next section provides a description of the three datasets we use and explains how we construct pseudo-panel data from them. Section 3 describes our empirical strategy. Section 4 then presents the estimation results in a variety of settings. Finally, Section 5 concludes.

2 Data

To examine the relationship between inflation expectations and household expenditure, we use three micro datasets provided by the Japanese government. The first is the Family Income and Expenditure Survey (FIES), which we use to elicit information on household-level expenditure, income, and wealth.

The second is the Consumer Confidence Survey (CCS), from which we obtain data on inflation expectations as well as data on consumers' perceptions regarding issues such as their household income over the following six months, which are not collected in the FIES. Finally, the third is the Survey of Household Economy (SHE), which focuses on collecting more accurate expenditure information on high-priced goods such as durable goods. Since it is widely known that in the FIES durable expenditure is substantially underreported (Unayama 2018), and since durable expenditure likely is the expenditure category that is the most responsive to changes in inflation expectations (Cashin and Unayama 2021), we also show estimation results in which the durable expenditure reported in the FIES is adjusted based on more reliable durable expenditure information collected by the SHE.

Since all three surveys interview different households, we employ the pseudo-panel technique pioneered by Deaton (1985) and Browning, Deaton, and Irish (1985) to combine these datasets. Further details about the pseudo-panel technique are provided in Section 2.5.

2.1 The FIES

The FIES is a household-level monthly panel dataset provided by the Ministry of Internal Affairs and Communications and is an important source of information for the construction of aggregate data such as the Consumer Price Index (CPI) and private final consumption expenditure in gross domestic product (GDP). The FIES randomly selects 8,000−9,000 households nationwide each month based on three-stage stratified sampling (municipalities, districts, and households) and provides detailed information on household characteristics, income, expenditure, and wealth. While single-person households are surveyed for three consecutive months, multiple-person households are surveyed for six consecutive months. Since data on financial wealth and debt are not available for single-person households, the current analysis focuses on multiple-person households only.

The FIES is a diary-based survey rather than the kind of recall-based survey used in most previous studies. That is, it asks respondents to keep a diary to report monthly expenditure on *all* goods and services they purchased. The wide range of coverage of goods and services makes it possible to decompose the FIES expenditure information into the following three components, as in Cashin and Unayama (2016a, 2016b, 2021): durable goods (automobiles, refrigerators, television sets, beds, personal computers, etc.), storable non-durable goods and services (clothing, gasoline, beverages, rice, tobacco, commuter season tickets (railway), etc.), and non-storable non-durable goods and services (fresh fish and vegetables, electricity, eating out, rent, package tours, telephone services, etc.). A complete list of goods and services contained in each expenditure category is provided in Table A.1. Taking advantage of the detailed expenditure information on goods and services, we examine whether the degree of durability and storability affects the response of expenditure to a rise in inflation expectations.

As for wealth, while the FIES collects information on households' financial wealth and debt (for multiple-person households), the FIES does not contain information on housing wealth. According to Hori and Niizeki (2019), in Japan about 86% of the value of housing wealth derives from the value of the land on which a property sits (while the rest derives from the value of the property itself). We therefore calculate the approximate value of the land each household holds by multiplying the land area the household owns reported in the FIES by the prefectural average residential land price per square meter in the prefecture in which the household resides collected from the Land Market Value Publication provided by the Ministry of Land, Infrastructure, Transport, and Tourism, and use this as a proxy for households' housing wealth.

2.2 The CCS

The CCS is also a household-level monthly panel dataset collected by the Economic and Social Research Institute, Cabinet Office. Each month, 6,700−8,400 households are randomly selected based on three-stage stratified sampling (municipalities, districts, and households), and each household is surveyed for up to fifteen consecutive months.

In addition to household characteristics, the CCS elicits information on inflation expectations over the coming twelve months. Specifically, the respondents are asked:

"By about what percentage do you expect the prices of goods and services that you frequently purchase to change over the next twelve months? (Please select one)"

[1] Go down by 10% or more
[2] Go down by 5% or more but less than 10%
[3] Go down by 2% or more but less than 5%
[4] Go down by less than 2%
[5] Stay about the same (i.e., 0%)
[6] Go up by less than 2%
[7] Go up by 2% or more but less than 5%
[8] Go up by 5% or more but less than 10%
[9] Go up by 10% or more
[10] Don't know

To avoid confusion, the survey also notes: "The prices of goods and services you frequently purchase are the amount of money you actually pay and include a variety of taxes levied when they are purchased."

Following Diamond, Watanabe, and Watanabe (2020), we use the midpoint value of each range

as the expected inflation rate. That is, if a respondent chose [7], we assign a value of 3.5% as their expected inflation rate. For the top and bottom answers ([1] and [9]), we assign −10% and 10%, respectively.[1] We drop individuals from the sample if they chose [10]. Figure 1 depicts the distribution of inflation expectations using 386,873 observations from the CCS covering the period 2009Q2−2018Q1. The distribution is skewed to the left and only 7.4% of respondents expect prices to fall. The mean expected inflation rate is about 2.5%.

At least two caveats regarding the expected inflation rates in the CCS should be noted. First, the CCS asks respondents about expected price changes in the goods and services they *frequently* purchase, not *all* goods and services they purchase. Expected price changes in durable goods therefore are likely excluded in the expected inflation rates in the CCS. However, according to a survey used by Diamond, Watanabe, and Watanabe (2020), in answering about their inflation expectations (including expected price changes in durable goods), more than 61% of respondents claim that they base their judgement on what they expect to happen to the prices of items that they purchase *daily* as their most important reason. We therefore believe that the expected inflation rates in the CCS based on goods and services the respondents *frequently* purchase do not greatly deviate from the expected inflation rates based on *all* goods and services they purchase.

The second caveat regards the way the CCS asks about expected inflation rates. As shown above, the CCS provides respondents with a range from +10% to −10%, and the midpoint is 0%. As highlighted by Tourangeau, Couper, and Conrad (2004) for example, this type of presentation may influence the answers respondents provide. For example, the 0% midpoint may make them assume that the mean of the expected inflation rate should be around 0%. In this case, respondents may be more likely to choose the midpoint, resulting in a mean value close to zero.[2]

The CSS also asks respondents about their view regarding their overall livelihood, income growth, employment, and value of assets over the coming six months, summarily referred to as “consumer perceptions” in the survey (the exact wording of the questions is provided in Appendix C). As a robustness check, we include perceptions regarding these items among the explanatory variables to check whether our estimation results suffer from omitted variable bias.

2.3 The SHE

[1] To check the robustness of our main results presented in Table 6 below, we also use –20% and +20% as the values for the top and bottom answers. See Appendix B for more details on the robustness check.

[2] One way to avoid this issue is to simply ask respondents about their expected inflation rate without providing any range. The Opinion Survey conducted quarterly by the Bank of Japan asks respondents about their expected inflation rate over the following twelve months without providing any range. However, this type of questionnaire without any range usually suffers from extreme outliers.

Another way to avoid the issue is the novel approach employed by Kikuchi and Nakazono (2020a, 2020b). They conduct a quarterly online survey in Japan and ask respondents about the future price level assuming that the current price level is 10,000. This makes it possible to avoid the issue (and also alleviate the well-known multiples-of-five problem). However, the approach inevitably also suffers from extreme outliers.

To gain a more accurate understanding of household expenditure, the Japanese government started a new household-level monthly panel survey, the SHE, in 2002 to complement the FIES. About 30,000 households are randomly sampled nationwide based on two-stage stratified sampling (districts and households), and each household is surveyed for 12 months. The SHE focuses on high-priced goods and services that are purchased infrequently (mainly durable goods) and employs a precoded questionnaire. "Precoded" means that, unlike in the FIES, in which respondents report the amount of money they spent on *every* good and service they purchased, the questionnaire contains a list of selected major high-priced items such as automobiles and refrigerators and respondents simply report the amount of money they spent on each item if they purchased one.

As highlighted by Unayama (2018), it is likely that the durable goods expenditure in the pre-coded format used in the SHE is more immune to measurement error than the free-entry diary-based format used in the FIES since it is easier for respondents to understand what they need to report. We therefore believe that the SHE provides more accurate information on durable expenditure. One shortcoming of the durable expenditure data in the SHE is that the coverage of durable goods is limited. Although major durable goods such as automobiles and refrigerators are surveyed, minor durable goods such as rice cookers and microwave ovens are not. We therefore adjust the durable goods data in the FIES based on the data for major durable that are also covered in the SHE (see Table 2). Details on the adjustment of durable goods expenditure are provided in Section 4.2.

2.4 Descriptive statistics

Before turning to the descriptive statistics for the FIES, CCS, and SHE data, it is useful to mention how we weight observations. Although all three surveys are based on random sampling, we find that the distribution of some demographic variables differs across the three surveys, probably due to different response rates.[3] To make observations in the three surveys comparable, we divide observations into 48 groups (= 2 sex groups × 4 age groups × 3 family size groups × 2 region groups), calculate the sampling rates in each group based on the Population Census and use the inverse of the sampling rates as weights.

Table 1 presents descriptive statistics for the three datasets. For the table, all expenditure variables, which are collected monthly, are multiplied by three to make them quarterly variables since we later create a quarterly pseudo-panel dataset. The consumer price index (CPI) for durable goods is used to convert durable expenditure into real terms, while the CPI for non-durable goods is used to convert storable non-durable and non-storable non-durable goods expenditure into real terms. Real total expenditure is then obtained by summing up real durable expenditure, real storable non-durable

[3] For example, while the mean age of the household head in the Population Census conducted in 2010 is about 54.2 years, the mean age of the household head in the FIES data is about 56.7 years, that in the CCS about 60.2 years, and that in the SHE about 60.0 years.

expenditure, and real non-storable non-durable expenditure. Pretax annual household income and net worth are converted into real terms using the CPI for all items. Thus, all monetary variables below are presented in real terms.

Although the (weighted) means and standard deviations of some of the demographic variables still differ slightly across the surveys, they are generally of comparable magnitude. In the FIES, the mean quarterly total expenditure is about 875,000 yen (about 8,750 U.S. dollars), and about 68% of total expenditure consists of non-storable non-durable expenditure (about 593,000 yen), followed by storable non-durable expenditure (about 230,000 yen) and durable expenditure (about 52,000 yen).

However, as mentioned, durable expenditure is likely underreported in the FIES. To examine how severe the underreporting problem in the FIES is, we focus on expenditure on twelve durable goods in the FIES and compare the results to durable expenditure in the SHE. As shown in Table 2, expenditure on the twelve items in the FIES amounts to only 31% to 67% of the expenditure reported in the SHE. The mean durable expenditure in the FIES is only about 45% of the durable expenditure in the SHE.[4] To the best of our knowledge, the reasons why many households do not report durable goods purchases in the FIES has not yet been explored. One possible explanation, as mentioned by Unayama (2018), is that many respondents misunderstand what they are asked to report and think that they should only report purchases of daily items since the FIES employs a diary format. In contrast, such misunderstanding is unlikely in the SHE, since the questionnaire explicitly lists the items to be reported. Thus, the SHE likely provides more accurate information on durable expenditure than the FIES, and we therefore use the total expenditure in the FIES adjusted based on the durable expenditure in the SHE for our analysis.

2.5 The pseudo-panel technique

Since the three micro datasets mentioned above do not survey the same households, we combine the datasets using the pseudo-panel technique pioneered by Deaton (1985) and Browning, Deaton, and Irish (1985) and employed in many other studies (e.g., Attanasio, Kovacs, and Molnar, 2019; Duca-Radu, Kenny, and Reuter, 2021, to name a few). We start by creating 17 cohorts based on year-of-birth intervals of three years (−1932, 1933−1935,…, 1975−1977, 1978−) and replace the household-level observations with the cohort means. Cohort means are calculated on a quarterly basis (not on a monthly basis) since we need a sufficiently large sample size for each cell to make the estimation reliable. In our current analysis, we use observations covering the period 2009Q2−2018Q1 since satisfactory data on quantitative inflation expectations in the CSS are available only from 2009Q2 onward.

[4] Unayama (2015) decomposes durable expenditures in the FIES and the SHE into the contribution of those who report non-zero expenditures (extensive margin) and the unit price of durable goods paid by those that purchased durable goods (intensive margin). He finds that the extensive margin explains the majority of the difference in durable expenditure between the FIES and the SHE. That is, respondents in the FIES provide accurate information on the unit price of durable goods when they do report such expenditure.

Figure 2 provides an illustration of the way we track a cohort over time. The figure focuses on those belonging to the cohort born between 1963 and 1965 (cohort 12) as an example. Since we track the same cohort for 36 quarters, each cohort consists of 36 cells. Among all households surveyed in 2009Q2 by the FIES, 1,174 households had a household head born between 1963 and 1965. The average quarterly total expenditure of these households is about 1,063,338 yen. Similarly, among all households surveyed in 2009Q2 by the CCS, 441 households had a household head born between 1963 and 1965. The average expected inflation rate of these households is 1.06%. Thus, provided that the observations are randomly selected and the sample size in each cell is sufficiently large, we can assume that if the FIES had asked households in this cohort about their inflation expectations, the average expected inflation rate would have been close to 1.06%. Continuing this exercise until 2018Q1 for both the FIES and the CCS (as well as the SHE, which is not shown in Figure 2), we can obtain 36-quarterly panel data points for this cohort *as if* we had tracked the same household over time. Since we construct the pseudo-panel dataset for 17 cohorts over 36 quarters, the sample size for our analysis is 612 (=17×36), and we have a balanced panel.

As highlighted by Verbeek (2008), there are at least two caveats with regard to the use of the pseudo-panel approach. The first is that there need to be a sufficient number of households in each cell to ensure that the sample cell mean is close to the population cell mean.[5] However, with a given number of observations, there is a tradeoff in the construction of cells: on the one hand, to ensure consistency of the sample cell means, it is desirable to construct cells such that each contains as many households as possible; on the other hand, constructing cells with a large number of households reduces the number of cells that can be constructed, which makes estimators less precise.

The second caveat concerns the way in which the cohorts are constructed. Suppose cohorts are constructed on the basis of geographical regions (say, 47 prefectures). In this case, households may move from one cohort (say, Okinawa) to another cohort (say, Tokyo) over time. If preferences such as risk aversion differ across regions, cohort fixed effects do not control for different preferences. We therefore need to construct cohorts on the basis of variables that do not vary over time. In our current analysis, we employ the most commonly used variable, the year of birth, to construct cohorts.

Table 3 provides descriptive statistics for the cell size (the number of households contained in each cell) in the three surveys. As mentioned, we construct 612 cells (=17 cohorts×36 quarters). The average cell size for the different surveys is 1,109 households for the FIES, 632 for the CCS, and 3,115 for the SHE. Moreover, the minimum cell sizes are 379 households (FIES), 197 households (CCS), and 763 households (SHE). These cell sizes should be sufficiently large to ensure that the sample means of variables in each cell are close enough to the population means of the variables in each cell.

[5] For this reason, Attanasio, Kovacs, and Molnar (2019), for example, use only cells containing more than 100 households.

3 Empirical strategy

We estimate the following equation using ordinary least squares (where subscript i denotes the cohort and t denotes the quarter and runs from 2009Q2 to 2018Q1):

$$\bar{c}_{i,t} = \beta_0 + \beta_1 \bar{\pi}^e_{i,t} + \boldsymbol{\beta'_2}\bar{\boldsymbol{x}}_{\boldsymbol{i,t}} + \boldsymbol{\beta'_3 year_t} + \boldsymbol{\beta'_4 quarter_t} + \boldsymbol{\beta'_5 cohort_i} + \varepsilon_{it}, \quad (1)$$

where $\bar{c}_{i,t}$ is the cell average of quarterly household expenditure, $\bar{\pi}^e_{i,t}$ is the cell average of the expected inflation rate over the next twelve months, $\bar{\boldsymbol{x}}_{\boldsymbol{i,t}}$ is a vector of the cell averages of control variables, $\boldsymbol{year_t}$ is a vector of nine year dummies, $\boldsymbol{quarter_t}$ is a vector of three quarter dummies, $\boldsymbol{cohort_i}$ is a vector of sixteen cohort dummies, and ε_{it} is the error term, which is assumed to be uncorrelated with the explanatory variables. $\bar{\boldsymbol{x}}_{\boldsymbol{i,t}}$ includes the cell average of the male dummy, which takes one if the household head is male and zero if female, the cell average of the age of the household head and of the square of the household head age, the cell average of the household size, the cell average of the number of working household members, the cell average of the pretax annual household income, and the cell average of household net worth (the sum of financial wealth and the value of land owned less debt). $\boldsymbol{year_t}$ and $\boldsymbol{quarter_t}$ are added to capture aggregate and seasonal effects, respectively. Since time-invariant cohort effects are captured by $\boldsymbol{cohort_i}$, we employ the fixed-effects approach to estimate Equation (1). Standard errors are clustered at the cohort level.

When running our regressions, we use the cohort size (the number of households contained in a cohort) as weights to place a higher weight on cohorts consisting of a larger number of households than others. As highlighted by Solon, Haider, and Wooldridge (2015), this type of weighting is important for two reasons. First, if the error term in Equation (1) suffers from heteroskedasticity in the sense that its variance decreases as the cohort size increases, weighting should provide a certain degree of efficiency gain. Second, and more importantly, if the impact of inflation expectations on household expenditure is heterogeneous across cohorts, regressions unweighted by cohort size will fail to produce consistent estimates of the key parameter β_1.

As described in Section 2.2, the CCS elicits information on households' perceptions about their overall livelihood and income, the employment situation, and the value of their assets over the coming six months. Respondents answer these questions by choosing one from five options. In the question about households' income for example, the options are: "It will increase," "It will increase slightly," "It will remain unchanged," "It will decrease slightly," and "It will decrease" (see Appendix C for the exact wording of the questions and answer options for the other consumer perceptions variables).

To control for these consumer perceptions over the next six months, we first create a dummy for each option for all four consumer perceptions variables at the household level, calculate the cell mean for all 612 cells, and then add them as explanatory variables to Equation (1). Note that since we take the cell mean, the dummy represents, for example, what percentage of households chose "It will

increase" in response to the question about household income. Since the sum of the percentages is one (100%), we drop "It will remain unchanged" from all four consumer perception variables to avoid perfect multicollinearity.

There are arguments both for and against controlling for consumer perceptions over the coming six months in Equation (1). On the one hand, it is necessary to avoid omitted variable bias. For instance, a positive comovement between inflation expectations and current expenditure may simply be driven by households' optimism about future macroeconomic conditions (Bachman, Berg, and Sims 2015). In this case, failure to control for consumer perceptions about the future would generate an upward bias in estimates of β_1.

On the other hand, adding consumer perceptions to the right-hand side of Equation (1) may result in too many control variables. That is, while an increase in inflation expectations may stimulate current expenditure through the intertemporal substitution effect, it may also lead to pessimistic household expectations about their income and wealth in real terms, in turn leading them to lower their expenditure, as explained in detail in Section 1. In this case, controlling for consumer perceptions might cancel out the negative income and/or wealth effect of higher inflation expectations on estimates of β_1, resulting in an upward bias in estimates of β_1.

Thus, there are arguments for and against controlling for consumer perceptions. We therefore conduct our estimations both with and without consumer perceptions included as control variables and compare the results.

4 Estimation results

4.1 Baseline results

Table 4 shows our baseline results. In Table 4(a), the level of quarterly expenditure is used as the dependent variable, while in Table 4(b) the log of quarterly expenditure is used.[6] In each table, Panel A shows the estimation results without controlling for consumer perceptions for the coming six months, while Panel B shows the estimation results controlling for consumer perceptions. Column (1) in Panel A of Table 4(a) shows that a one percentage point increase in the expected inflation rate stimulates quarterly total expenditure by 10,373 yen (about 103.73 U.S. dollars). However, the estimate falls to 6,572 yen and is no longer statistically significant once we control for consumer perceptions for the coming six months. As discussed in Section 3, controlling for consumer perceptions is expected to lower estimates of the expenditure response. However, unfortunately we cannot determine the reason behind this. That is, we do not know whether the reason is that adding consumer perceptions reduces

[6] Note that when we use the logarithm of quarterly expenditure as the dependent variable, explanatory variables in yen (household annual income and net worth) are also in logarithmic form. In addition, we first calculate the cell averages and then take the logarithm rather than taking the logarithm at the household level first and then calculating the cell average. The reason is that we focus on cohorts' response to changes in inflation expectations, not on households' response.

the omitted variable bias, that it results in overcontrolling or some other factor is at play.

Next, column (2) focuses on durable rather than total consumption expenditure. The result shows that a one percentage point increase in the expected inflation rate boosts quarterly durable expenditure and that the impact is still statistically significant even after controlling for consumer perceptions. One caveat is that the (within) adjusted R-squared in the estimation for durable expenditure is substantially lower than in the estimations for the other expenditure categories. While this lower (within) adjusted R-squared may simply stem from the fact that durable goods expenditure differs from other expenditure in that the timing of purchases is occasionally random – a household electrical item or a car has to be replaced because it broke and no longer works –, it is also consistent with the argument that durable expenditure in the FIES is substantially underreported. We deal with the second possibility in Section 4.2.

Column (3) presents the results for storable non-durable expenditure. They indicate that the impact of inflation expectations is positive and significant even after controlling for consumer perceptions, although the magnitude is smaller than that observed for durable goods. Finally, column (4) shows the results for non-storable non-durable expenditure, which suggest that such expenditure is not influenced by changes in inflation expectations. This is consistent with studies such as those by Cashin and Unayama (2016a), who find that the elasticity of intertemporal substitution (EIS) for non-storable non-durable expenditure data in Japan is small and not significantly different from zero, and Kikuchi and Nakazono (2020a), who, using household-level scanner data on non-durable expenditure, find that the EIS is close to zero (about 0.1).

Table 4(b) shows the estimation results when we use the dependent variable in logarithmic form. Note that in these specifications, the estimates of β_1 can be interpreted as elasticities. We find that the estimation results are similar to those in the level specifications. Starting with column (1), total quarterly expenditure increases by 1.0% in response to a one percentage point increase in the expected inflation rate, but again the estimate becomes insignificant once we control for consumer perceptions. The largest elasticity is observed in the response of durable expenditure. As shown in column (2), quarterly durable expenditure increases by 6.3–8.4% in response to a one percentage point increase in the expected inflation rate. Next, column (3) indicates that quarterly storable non-durable expenditure also increases – by 0.9–1.0%. In contrast, column (4) again suggests that non-storable non-durable expenditure is not affected by a rise in inflation expectations. These findings in Table 4(b) are consistent with the theoretical prediction that the response of durable and storable non-durable goods consumption is larger than that of non-storable non-durable goods consumption, since in the case of the former the timing of expenditure and consumption can differ (Cashin and Unayama 2021). That is, it is possible to purchase such goods now at a cheaper price and consume them later.

4.2 Estimation results with adjusted durable expenditure

While the estimation results in Table 4 provide certain insights, they are unsatisfactory, since durable expenditure in the FIES is highly likely underreported, as highlighted in Section 2.4. In this subsection, we therefore use the durable expenditure data from the SHE, which are likely more reliable, and examine to what extent (i) the response of durable expenditure differs between the FIES and the SHE, and (ii) the response of total expenditure changes when we adjust durable expenditure in the FIES based on the SHE data.

Table 5 compares the response of durable expenditure using the FIES and the SHE data. Note that we restrict durable goods in the FIES to those also covered in the SHE (the twelve items shown in Table 2), so that the coverage of durable goods in our estimations based on the two surveys is identical. Columns (1) and (3) present the results using the FIES data and indicate that quarterly durable expenditure increases by 4,490−4,641 yen in response to a one percentage point increase in the expected inflation rate. On the other hand, columns (2) and (4), using the SHE data, suggest that quarterly durable expenditure increases by 9,047−9,847 yen. Thus, the measured response using the FIES data is only about 46−51% of that based on the SHE data. Given Unayama's (2015) finding that most of the underreporting of durable expenditure in the FIES is due to the extensive margin, the estimation results in Table 5 imply that in the FIES a considerable number of households do not report their purchases of durable goods.

To examine to what extent the estimated response of total expenditure changes when we take this underreporting into account, we adjust the durable expenditure in the FIES as shown in Figure 3. Specifically, we inflate the expenditure on the twelve items included in both the FIES and the SHE by a factor of 2.23, which is the average expenditure on the twelve durable items in the SHE (69,183 yen) divided by the average expenditure on the twelve items in the FIES (31,023 yen). However, we do not make any adjustments with regard to durable goods not surveyed in the SHE, represented by "Other durables" in Figure 3, since we are not sure to what extent the expenditure on these durable goods is underreported in the FIES.

The estimation results using the adjusted FIES figures are presented in Table 6. Note that the estimations underlying Table 6 are identical to those in Table 4 except that the total expenditure and durable expenditure are adjusted as just explained, so that the results for storable non-durable and non-storable non-durable expenditures are identical to those in Table 4. In the level specification with the adjustment of durable expenditure, the response of quarterly durable expenditure increases from 4,468−5,735 yen in column (2) of Table 4(a) to 9,826–10,141 yen in column (2) of Table 6(a). As a result, the response of total quarterly expenditure increases from 6,572–10,373 yen in column (1) of Table 4(a) to 11,930–14,779 yen in column (1) of Table 6(a). Furthermore, the response of total quarterly total expenditure is now statistically significant at the 5% level when controlling for consumer perceptions (panel B).

Similar results are obtained when we use the logarithm of expenditure as dependent variable.

That is, using the adjusted durable expenditure, the estimated response of durable expenditure increases from 6.3–8.4% in column (2) of Table 4(b) to 8.8%–9.1% in column (2) of Table 6(b). As a result, the estimated response of total expenditure increases from 0.5–1.0% in column (1) of Table 4(b) to 1.0–1.4% in column (1) of Table 6(b).[7]

In sum, the estimation results in Table 6 suggest that the estimated response of durable and total expenditure to a rise in inflation expectations is downward-biased if we rely on the durable expenditure data in the FIES. Another important conclusion from Table 6 is that most of the total expenditure response is driven by durable expenditure. Specifically, given that in the level specification the sum of the estimates in columns (2), (3), and (4) adds up to the estimate in column (1), we can calculate the percentage contribution of the durable expenditure response to the total expenditure response. Doing so suggests that about 69–82% of the total expenditure response is due to the response of durable expenditure.

4.3 Estimation results using inflation expectation categories

The analysis so far employed cell averages to examine the effects of inflation expectations on household expenditure. One shortcoming of this approach is that, as a result, the variation of inflation expectations in our data is limited: although, as shown in Figure 1, expected inflation rates at the household-level range from −10% to +10%, the cell averages of expected inflation rates range only from 0.11% to 4.56%. Our results in Table 6 therefore potentially do not sufficiently take into account that extreme inflation expectations such as expectations of falling prices or of inflation rates of 10% or more may have a substantially different impact on household expenditure.

To examine whether this is the case, we create a dummy for each category of inflation expectations at the household-level, calculate the cell means of the dummies, and then replace the expected inflation rate with the inflation expectations category in Equation (1). Note that since we take the cell means of the dummies, they represent what percentage of households chose a specific category regarding their expectation for prices – such as “Go up by less than 2%” – in the cell. Moreover, since the sum of the percentages add up to 100%, we drop “Stay about the same (i.e., 0%)” to avoid perfect multicollinearity. Finally, we consolidate the dummies for deflationary expectations for the price level into a single dummy, since only 7.4% of households indicated they expected prices to fall.

Figure 4 depicts the estimation results, with panel (a) showing those for the specification in levels and panel (b) those in logarithm. Since the results are very similar, we focus on those in Figure 4(b), where the dependent variable is the logarithm of total quarterly expenditure (with durable expenditure adjusted as described above). The figure yields three major findings. First, the response of total

[7] Further, we ran additional estimations in which we further adjusted the FIES data by also multiplying the figures for expenditure on “Other durables” in Figure 3 by a factor of 2.23. While not shown to conserve space, the results were very similar to those in Table 6 since the response of expenditure on these goods is limited.

expenditure monotonically increases as the expected inflation rate rises from around 0% to 5–10%. Specifically, the results suggest that if households' expected inflation rate changes from around 0% to 5–10%, their total expenditure increases by 8.2% or 15.5%, depending on whether we control for consumer perceptions. Second, once the expected inflation rate reaches 10% or more, the response of total expenditure is no longer significantly different from the response when the expected inflation rate is around 0%. One possible explanation for this phenomenon is that those who expect the price level to go up by 10% or more are more pessimistic about their future. In fact, once we control for consumer perceptions regarding the coming six months, the negative impact of inflation expectations is partly alleviated, but the estimate is still statistically insignificant. Third, even if households' inflation expectations change from around 0% to deflation, their total expenditure does not change significantly. We therefore do not find any evidence for the so-called "deflationary spiral hypothesis," which suggests that deflationary expectations lead people to postpone purchases, resulting in a decline in aggregate demand.

4.4 Heterogenous responses by cohort characteristics

Next, we examine whether the impact of inflation expectations on expenditure differs by cohort characteristics such as asset portfolios and past inflation experience. However, we do not obtain any significant results (the estimation results are omitted to conserve space). This is probably because we use cell averages, which results in limited variation in the explanatory variables and a small sample size.

For instance, as mentioned in the introduction, the impact of inflation expectations on expenditure may be influenced through the so-called balance sheet channel. We therefore examine whether households' assets and liabilities play a role by adding three interaction terms (inflation expectations interacted with households' financial wealth, debt, and value of their land). However, the estimates for all three interaction terms are not statistically significant.

Given the findings by Malmendier and Nagel (2016) and Diamond, Watanabe, and Watanabe (2020) that past inflation experience affects inflation expectations, we also examine whether households' past inflation experience affects their expenditure response to changes in inflation expectations. For instance, those who experienced high inflation right after World War II or the first oil crisis in 1973 may be more concerned about (the consequences of) inflation than those who have never experienced inflation, and their expenditure may therefore be more sensitive to changes in inflation expectations. We therefore examine whether the expenditure response differs across year-of-birth cohorts. However, we do not find any significant differences.

4.5 Dynamic effects on total expenditure

So far, our findings indicate that a rise in inflation expectations stimulates *current* expenditure,

providing evidence that unconventional fiscal and monetary policies should help to boost expenditure and hence the economy. However, assuming that the standard life-cycle/permanent income hypothesis (LC/PIH) holds and changes in inflation expectations do not alter households' expected lifetime resources, an increase in expenditure in the current period means that households will have to cut their expenditure sometime in the future to balance their budget.

To examine the dynamic impact of inflation expectations on households' total expenditure, we take advantage of the fact that our pseudo-panel data track the same cohort for 36 quarters and estimate the following finite distributed lag model of order twelve:

$$\bar{c}_{i,t} = \beta_0 + \sum_{j=0}^{12} \gamma_j \, \bar{\pi}^{e}_{i,t-j} + \boldsymbol{\beta'_1 \bar{x}_{i,t}} + \boldsymbol{\beta'_2 year_t} + \boldsymbol{\beta'_3 quarter_t} + \boldsymbol{\beta'_4 cohort_i} + \varepsilon_{it}, \qquad (2)$$

That is, we add twelve lags of the expected inflation rate to capture the dynamic impact of inflation expectations on household expenditure.[8]

To understand the intuition underlying our approach, consider the case of a temporary increase in inflation expectations at time t. That is, the expected inflation rate temporally rises by one percentage point at time t and then returns to its original lower level at time $t+1$ and all future periods. In this case, the estimate for γ_2, for example, captures the effect of a temporary increase in the expected inflation rate at time t on total expenditure at time $t+2$, all else remaining equal.

Figure 5 provides a graphic summary of the estimates for $\gamma_0, \gamma_1, \ldots, \gamma_{12}$ with 90% confidence intervals. The dependent variables are the level or the logarithm of quarterly total expenditure (adjusted as described above). Regardless of whether we use the level or the logarithmic specification, or control for consumer perceptions, a temporary rise in the expected inflation rate has a statistically significant contemporaneous stimulative effect on total expenditure, which is consistent with the findings in Table 6. However, the effect becomes negative after a few quarters. For instance, in the logarithmic specification in which consumer perceptions are controlled for, the estimates for γ_0, γ_1, and γ_2 are 0.018, 0.000 and -0.018, and the estimates for γ_0 and γ_2 are statistically significant at the 10% level. In this case, the stimulus effect brought about by a rise in inflation expectations disappears after two quarters. After that, the temporary increase in inflation expectations has no significant impact on subsequent total expenditure.

Taken together, our estimation results indicate that a temporary rise in inflation expectations can be expected to have a stimulative impact on household expenditure (especially durable and storable non-durable expenditure) in the short run through intertemporal substitution. However, the positive effect is largely offset by an immediate expenditure reversal after a few quarters, and there is no

[8] As a robustness check, we also estimate Equation (2) using four and eight lags of the expected inflation rate. The main estimation results are similar to those depicted in Figure 5.

evidence of a lasting stimulative effect. Thus, assuming that a temporary rise in inflation expectations does not affect households' expected lifetime resources, the dynamic responses of total expenditure observed in Figure 5 are in line with the theoretical prediction of the standard LC/PIH.

5. Conclusion

Focusing on Japan, this study examined to what extent a rise in inflation expectations stimulates household expenditure. For this purpose, we matched three micro datasets and constructed a quarterly pseudo-panel dataset containing both the cell average of household expenditure and the cell average of quantitative inflation expectations. In addition, we adjusted the durable expenditure in the FIES using the more reliable durable expenditure information from the SHE since it is well known that durable expenditure in the FIES is highly likely underreported.

Our baseline fixed effects estimation (Table 6) revealed the following. First, adjusted quarterly total expenditure increased by 11,930–14,779 yen or 1.0–1.4% in response to a one percentage point rise in the expected inflation rate. Second, a large part of the total expenditure response is due to the response of durable expenditure (9,826–10,141 yen or 8.8–9.1%), followed by the response of storable non-durable expenditure (2,586–2,755 yen or 0.9–1.0%), reflecting the fact that households can purchase durable and storable non-durable goods at a lower price today and consume them later. Third, the response of expenditure on non-storable non-durable goods is not significantly different from zero, which is consistent with Cashin and Unayama' (2016a) finding for Japan that the EIS of non-storable non-durable expenditure is close to zero.

Due to averaging within cells, the variation in inflation expectations in the baseline estimation was somewhat limited. To address this problem, we also used data based on inflation expectation categories (reflecting, e.g., whether respondents expected prices to "Go up by 10% or more") and found that essentially the response of total expenditure increased in line with the inflation expectations category. However, we did not find any statistically significant evidence indicating that deflationary expectations lead households to postpone expenditure – a mechanism that lies at the heart of the "deflationary spiral" hypothesis.

Meanwhile, the estimation with lagged expected inflation rates indicated that a temporary one percentage point increase in the expected inflation rate instantaneously boosted quarterly total expenditure by 23,895–24,651 yen or 1.8–1.9%. However, expenditure declined over the following few quarters, leading to a long-run impact of close to zero. This implies that the intertemporal substitution effect plays an important role in determining the impact of changes in inflation expectations on household expenditure.

Finally, it should be noted that the analysis in this study focused on the response of *household expenditure* to a rise in inflation expectations. However, in order to evaluate the impact of inflation expectations on *aggregate demand* (and hence GDP), it is necessary to also examine to what extent

other demand factors such as (firm and housing) investment and net exports are influenced by a rise in inflation expectations. This is left for future research.

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Table 1: Descriptive statistics

	FIES		CCS		SHE	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Demographics						
Male dummy	0.91	0.29	0.91	0.29	0.93	0.26
Age (household head)	56.72	15.26	57.24	14.82	57.43	14.30
Number of household members	3.05	1.11	3.22	1.23	3.12	1.19
Number of working household members	1.34	0.96	1.46	0.98	1.47	1.01
Homeowner dummy	0.80	0.40	0.82	0.38	0.84	0.37
Mortgage dummy	0.29	0.45	0.30	0.46	0.30	0.46
Quarterly total expenditure (a+b+c, 10,000 yen)	87.5	80.0				
(a) Durables	5.2	38.4				
(a') Durables (twelve goods)	3.1	34.9			6.9	60.0
(b) Storable non-durables	23.0	18.0				
(c) Non-storable non-durables	59.3	58.0				
Pretax annual income (10,000 yen)	624	395				
Net worth (d−e+f, 10,000 yen)	2,207	3,307				
(d) Financial wealth	1,652	2,281				
(e) Debt	510	1,100				
(f) Value of land owned	1,065	1,641				
Expected inflation rate (%)			2.50	3.06		
Consumer perceptions regarding the coming six months						
Overall livelihood			3.37	0.72		
Income growth			3.36	0.74		
Employment			3.27	0.79		
Asset values			3.33	0.72		
Number of observations	679,003		386,873		1,906,371	

Note: All expenditure variables, which are collected monthly, are multiplied by three to make them quarterly variables. All monetary variables, except total expenditure, are converted into real terms using the CPI (2015=100). The homeowner dummy takes a value of one if the household owns its home and zero otherwise. The mortgage dummy takes a value of one if the household has a mortgage and zero otherwise. Real total expenditure is obtained by summing up real durable expenditure, real storable non-durable expenditure, and real non-storable non-durable expenditure. “Durables (twelve goods)” is the sum of expenditures on the twelve durable goods covered by both the FIES and the SHE. Annual income is the previous year’s pretax annual income. Net worth is calculated by subtracting households’ outstanding debt from the sum of their financial wealth and value of the land they own. The sample statistics for consumer perceptions regarding the coming six months are based on the number respondents chose, which range from 1 to 5, where a larger number represents a more pessimistic outlook for the future. See Appendix C for more details. In all three surveys, the inverse of the sampling rates calculated from the Population Census is used as weight.

Table 2: Descriptive statistics for durable expenditure

Variables	FIES	SHE	FIES/SHE
	Quarterly mean (yen)		
Durable goods (sum of twelve goods below)	31,023	69,183	45%
1. Motorized vehicles other than automobiles	301	965	31%
2. Automobiles	19,533	50,310	39%
3. Cupboards (*Shokki todana*)	155	379	41%
4. Beds	358	758	47%
5. Chests of drawers (*Tansu*)	184	364	51%
6. Cameras	559	1,023	55%
7. TV sets	2,323	3,794	61%
8. Lounge suites (*Osetsu set*)	479	770	62%
9. Refrigerators	1,477	2,315	64%
10. Personal computers	2,199	3,350	66%
11. Washing machines	1,126	1,673	67%
12. Air conditioners	2,332	3,483	67%
Durable goods (in FIES, all goods)	52,277	n.a.	
Number of observations	679,003	1,906,371	

Table 3: Descriptive statistics for cell size (number of households contained in each cell)

Survey	Number of cells	Mean	Std. dev.	Min	Max
FIES	612	1,109	269	379	2,465
CCS	612	632	213	197	1,334
SHE	612	3,115	1,377	763	7,306

Notes: For each survey, we construct 612 cells (=17 cohorts×36 quarters).

Table 4: Regression results

(a) Levels

Dependent variable:	(1) Total	(2) Durables	(3) Storable non-durables	(4) Non-storable non-durables
Panel A				
Expected inflation rate (%)	10,373**	5,735***	2,755**	1,883
	(4,154)	(1,532)	(1,277)	(2,794)
Consumer perceptions regarding coming six months				
N	612	612	612	612
(Within) Adj. R-sq	0.69	0.16	0.74	0.73
Panel B				
Expected inflation rate (%)	6,572	4,468***	2,586**	-483
	(4,173)	(1,458)	(1,057)	(3,337)
Consumer perceptions regarding coming six months	✓	✓	✓	✓
N	612	612	612	612
(Within) Adj. R-sq	0.69	0.18	0.74	0.73

Notes: The dependent variable is the cell average of quarterly expenditures in levels (yen). A complete list of goods and services contained in each expenditure category is provided in Appendix A. Explanatory variables consist of the cell average of the male dummy, which takes one if the household head is male and zero if female, the cell average of the age of the household head and of age squared, the cell average of the number of household members, the cell average of the number of working household members, the cell average of the pretax annual household income, the cell average of household net worth, year dummies, and quarter dummies. To control for consumer perceptions regarding the coming six months, we first create a dummy for each option for all four consumer perceptions variables at the individual household level, calculate the cell mean, and then add them as explanatory variables. The within adjusted R-squared reports how much of the variation in the dependent variable within a cohort is captured by the variation in the explanatory variables. Standard errors clustered at the cohort level are in parentheses. ***, **, * denote statistical significance at the 1, 5, and 10% levels, respectively.

(b) Logarithm

Dependent variable:	(1) Total	(2) Durables	(3) Storable non-durables	(4) Non-storable non-durables
Panel A				
Expected inflation rate (%)	0.010**	0.084**	0.010*	0.002
	(0.004)	(0.030)	(0.005)	(0.004)
Consumer perceptions regarding coming six months				
N	612	612	612	612
(Within) Adj. R-sq	0.70	0.13	0.73	0.75
Panel B				
Expected inflation rate (%)	0.005	0.063*	0.009*	-0.002
	(0.005)	(0.031)	(0.005)	(0.005)
Consumer perceptions regarding coming six months	✓	✓	✓	✓
N	612	612	612	612
(Within) Adj. R-sq	0.70	0.14	0.73	0.75

Notes: The dependent variable is quarterly household expenditures in logarithm. For further notes, see Table 4(a).

Table 5: Regression results (Durable expenditure, FIES vs. SHE)

	(1)	(2)	(3)	(4)
	(Levels)			
Dependent variable:	Durables (twelve goods)	Durables	Durable (twelve goods)	Durables
Survey:	FIES	SHE	FIES	SHE
Expected inflation rate (%)	4,641***	9,047***	4,490***	9,847***
	(1,317)	(1,447)	(1,260)	(2,460)
Consumer perceptions regarding coming six months			✓	✓
N	612	612	612	612
(Within) Adj. R-sq	0.13	0.33	0.15	0.35

Notes: Durables (twelve goods) in the FIES refers to the twelve durable goods that are also covered by the SHE. For further notes, see Table 4(a).

Table 6: Regression results (using adjusted data for durables)

(a) Levels

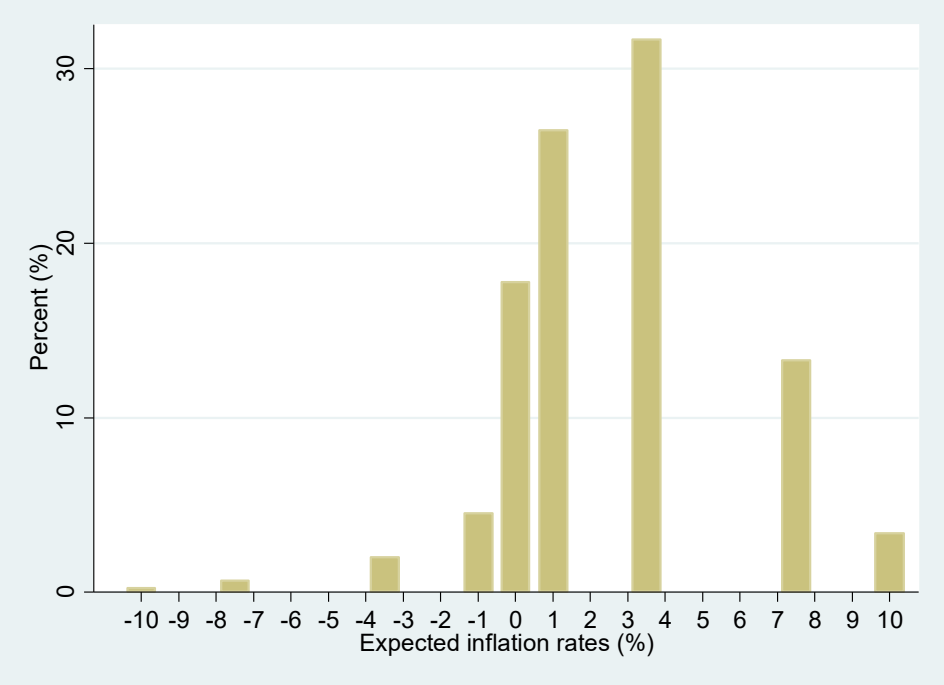
Dependent variable:	(1) Total (Adjusted)	(2) Durables (Adjusted)	(3) Storable non-durables	(4) Non-storable non-durables
Panel A				
Expected inflation rate (%)	14,779***	1,0141***	2,755**	1,883
	(4,158)	(1,594)	(1,277)	(2,794)
Consumer perceptions regarding coming six months				
N	612	612	612	612
(Within) Adj. R-sq	0.69	0.32	0.74	0.73
Panel B				
Expected inflation rate (%)	11,930**	9,826***	2,586**	-483
	(4,990)	(2,508)	(1,057)	(3,337)
Consumer perceptions regarding coming six mo	✓	✓	✓	✓
N	612	612	612	612
(Within) Adj. R-sq	0.69	0.35	0.74	0.73

Notes: Adjusted durable expenditure is the sum of the expenditure on the twelve durable goods listed in Table 2 in the FIES multiplied by 2.23 and the other durable expenditure reported in the FIES. Adjusted total expenditure is the sum of adjusted durable expenditure, storable non-durable expenditure, and non-storable non-durable expenditure. Also see Figure 3.

(b) Logarithm

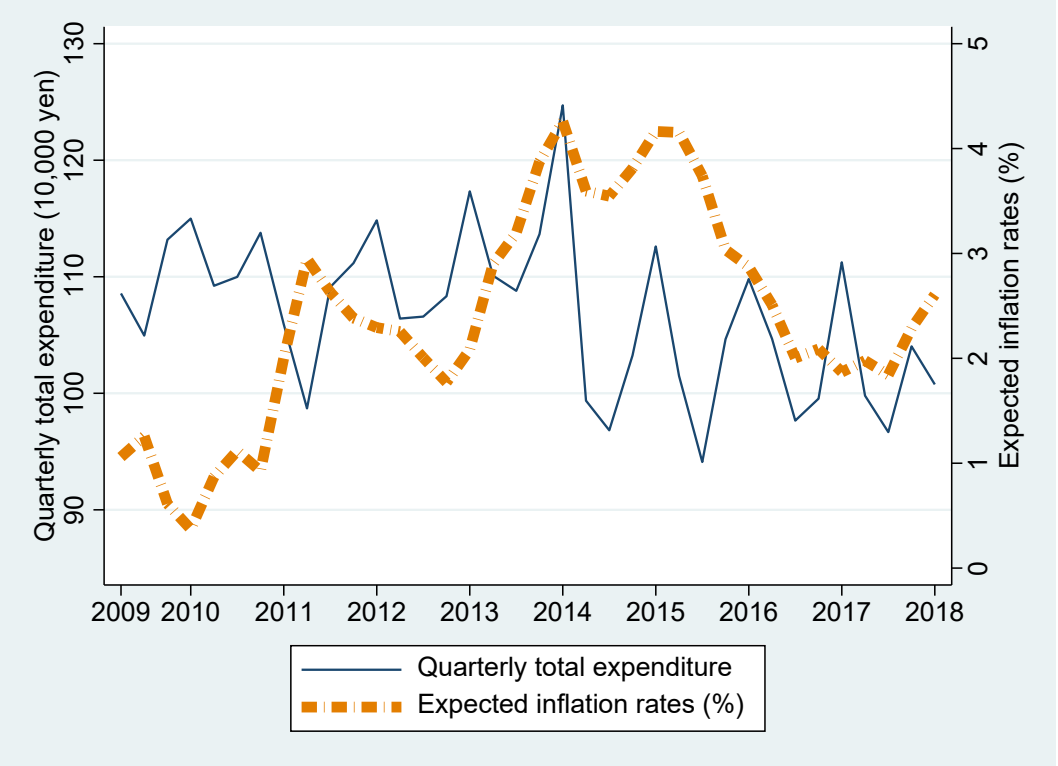
Dependent variable:	(1) Total (Adjusted)	(2) Durables (Adjusted)	(3) Storable non-durables	(4) Non-storable non-durables
Panel A				
Expected inflation rate (%)	0.014***	0.091***	0.010*	0.002
	(0.004)	(0.014)	(0.005)	(0.004)
Consumer perceptions regarding coming six months				
N	612	612	612	612
(Within) Adj. R-sq	0.72	0.35	0.73	0.75
Panel B				
Expected inflation rate (%)	0.010**	0.088***	0.009*	-0.002
	(0.005)	(0.022)	(0.005)	(0.005)
Consumer perceptions regarding coming six mo	✓	✓	✓	✓
N	612	612	612	612
(Within) Adj. R-sq	0.72	0.36	0.73	0.75

Figure 1: Distribution of expected inflation rates



Notes: The sample is taken from the CCS over the period 2009Q2−2018Q1. Household-level data are used to draw this histogram. (The number of observations is 386,873.)

Figure 2: Illustration of the total expenditure and expected inflation rate profile of those belonging to the cohort born between 1963 and 1965.



Note: Quarterly total expenditure is in nominal terms and both variables are not seasonally adjusted.

Figure 3: Adjustment of durable expenditure in the FIES

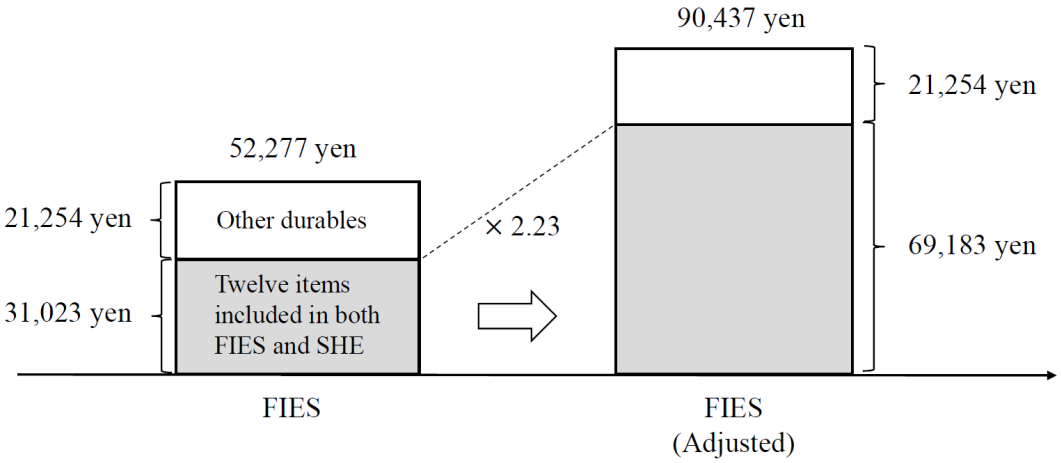
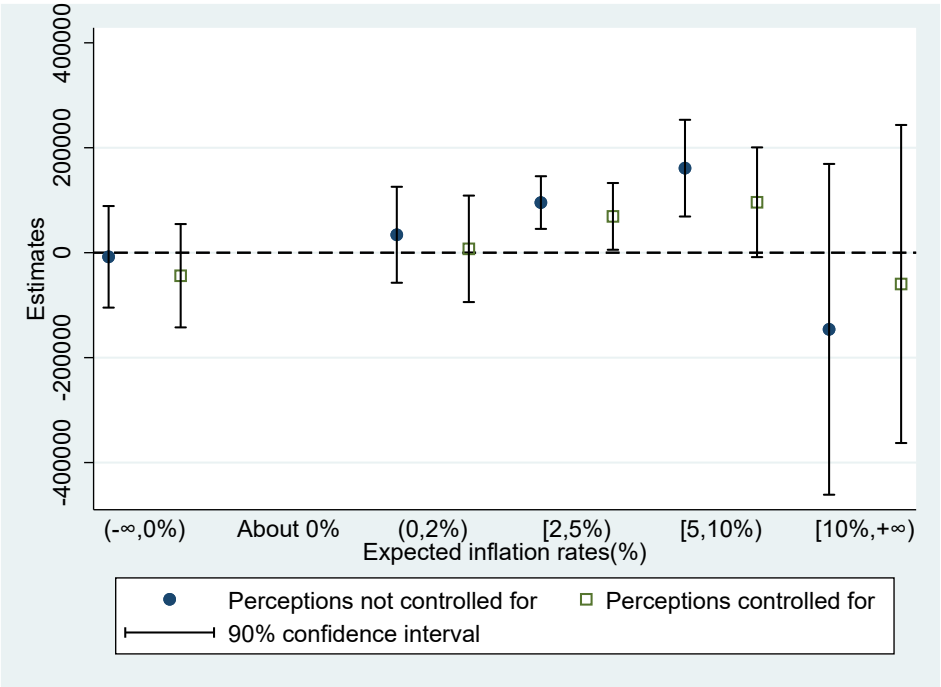


Figure 4: Response of quarterly total expenditure to inflation expectations (using expected inflation categories)

(a) Levels



(b) Logarithm

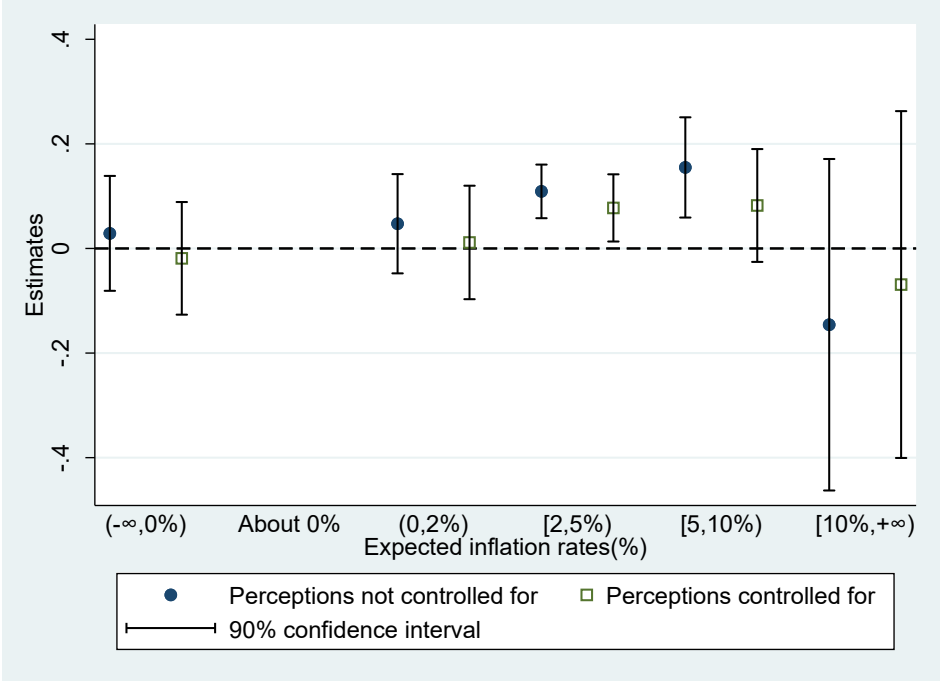
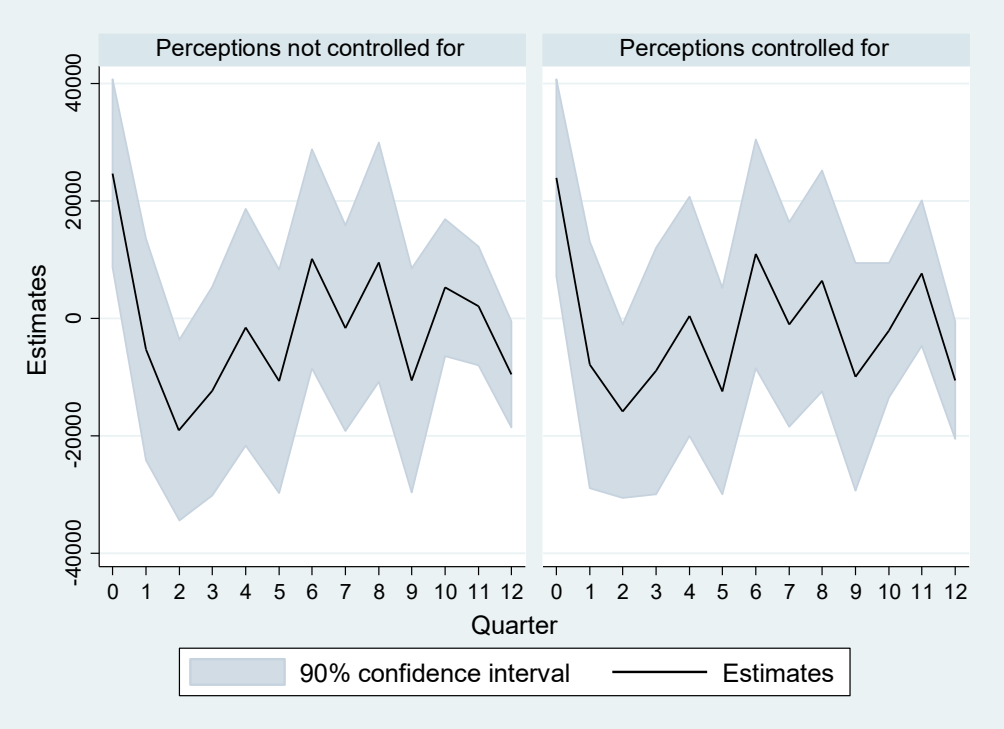
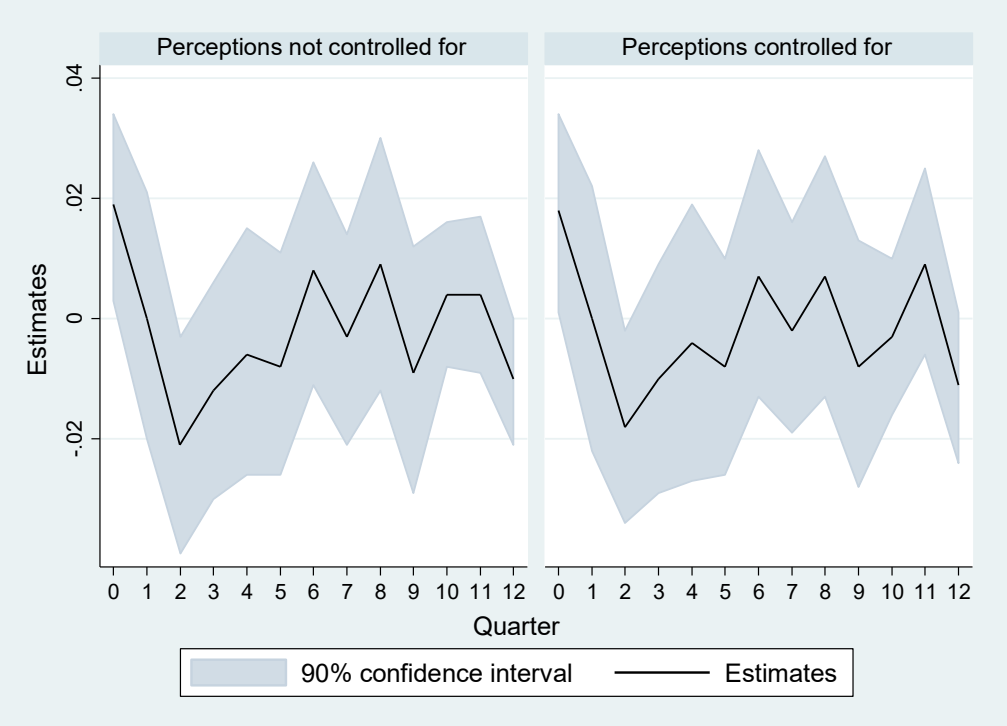


Figure 5: Effects of temporary increase in expected inflation rate on quarterly total expenditure (adjusted)

(a) Levels



(b) Logarithm



Appendix A

Table A.1 List of goods and services contained in each expenditure category

Durables	Storable non-durables	Non-storable non-durables
Tools & materials for repairs & maintenance	Rice	Non-dried “udon” & “soba” noodles
Durable goods assisting housework	Bread	Raw fish
(Refrigerators, washing machines, etc.)	Noodles	Shellfish
Heating & cooling appliances	(Pasta, cup noodles, instant noodles, etc.)	Salted & dried fish
(Air conditioners, stoves, fan heaters, etc.)	Other cereals	Raw meat
General furniture	(Wheat flour, rice-cakes, etc.)	Fresh milk
(Chests of drawers, tables, sofas, etc.)	Fish-paste products	Eggs
Interior furnishings & decorations	(“Chikuwa”, baked fish-paste bars, etc.)	Fresh vegetables
(Lighting appliances, floor coverings, curtains, etc.)	Other processed fish	Dried vegetables & seaweeds
Beds	(Pickled fish, canned fish, etc.)	Soybean products
Spectacles	Processed meat	Fresh fruits
Vehicles	(Ham, sausages, bacon, etc.)	Cakes & candies
Bicycles	Dairy products	(Cakes, bean-jam cakes, etc.)
Communication equipment	(Powdered milk, butter, cheese, etc.)	Cooked food with rice, bread or noodles
Recreational durable goods	Processed fruits	(Packed lunch, “Sushi” packed, etc.)
(TV sets, PCs, musical instruments, etc.)	Oils & fats	Other cooked food
Electric appliances for personal care	(Edible oil, margarine)	(Salad, croquettes, cutlets, etc.)
Wrist watches	Seasonings	Foodstuff for cooking
	(Salt, soy sauce, sugar, etc.)	Eating out
	Cakes & candies	Rents for dwelling & land
	(Biscuits, candies, chocolate, etc.)	Service charges for repairs & maintenance
	Beverages	Fuel, light & water charges
	(Tea, green tea, etc.)	Domestic services
	Coffee & cocoa	(Domestic help, sewage disposal charges, etc.)
	(Coffee, cocoa, etc.)	Services related to clothing
	Other beverages	(Washing charges, charges for clothing rent etc.)
	(Mineral water, sports drinks, etc.)	Medical services
	Alcoholic beverages	Public transportation
	(Beer, whisky, wine, etc.)	(Railway fares, bus fares, etc.)
	Materials for repairs & maintenance	Maintenance of vehicles
	Kerosene	(Automotive maintenance & repairs, rent for parking , et
	Other interior furnishings	Communication
	Bedding (excluding beds)	(Postage, mobile phone charges, etc.)
	(Blankets, sheets, etc.)	School fees
	Domestic utensils	Repair charges for recreational durable goods
	(Bowls & dishes, pans & kettles, etc.)	Newspapers, magazines
	Domestic non-durable goods	Package tours
	(Facial tissue, detergent, etc.)	Lesson fees
	Clothing	Other recreational services
	(Suits, shirts, underwear, etc.)	(Charges for TV license, etc.)
	Medicines	Admission fees & game charges
	Students' season tickets, railway	Membership dues
	Commuters' season tickets, railway	Personal care services
	Gasoline	Services related to personal effects
	Automotive parts	Other miscellaneous
	School textbooks & reference books for study	(Wedding and funeral expenses, etc.)
	Stationery	Pocket money (detailed uses of which unknown)
	Books	Social expenses
	Soap & cosmetics	(Money gifts, other social expenses)
	(Shampoo, toothpaste, skin lotion, etc.)	
	Personal effects (excluding wrist watches)	
	(Umbrellas, bags, accessories, etc.)	
	Tobacco	

Appendix B: Robustness checks

In this appendix, we check whether our main results reported in Table 6 are robust to a variety of different settings.

The effect of VAT rate hikes

In April 2014, the Japanese government raised the VAT rate from 5% to 8%. As shown by D'Acunto, Hoang, and Weber (2021), a VAT rate hike may potentially cause strong intertemporal substitution effects right before the implementation of the hike. One might therefore suspect that our results reported in Table 6 are mainly driven by the VAT rate hike in 2014. To examine whether this is the case or the response of expenditure to changes in inflation expectations are also observed in "normal" times, we simply drop the observations for 2013 and 2014 and conduct the same exercise as in Table 6. The estimation results are shown in Appendix Table B.1. As can be seen, the estimation results remain more or less unchanged. We therefore conclude that our results reported in Table 6 are not driven by the 2014 VAT tax hike and are also observed in "normal" times.

The upper and lower bounds for expected inflation rates

When we quantify the expected inflation rates, we use for simplicity a value of 10% when respondents answer that they expect prices to "Go up by 10% or more" and a value of −10% when they expect prices to "Go down by 10% or more." However, this is an arbitrary choice, and to check whether our main results are robust to different top- and bottom-coded values, we use values of +20% and −20% instead. The estimation results are presented in Table B.2. Although the estimates are generally smaller than those in Table 6, the basic findings (e.g., durable expenditure is the most responsive to a rise in inflation expectations) remain unchanged. We therefore conclude that our main results are also robust to using other top- and bottom-coded values for expected inflation rates.

Expenditure elasticity of intertemporal substitution

Our main results suggest that intertemporal substitution plays a critical role in the impact of inflation expectations on household expenditure. To further examine this, we attempt to estimate the expenditure elasticity of intertemporal substitution (EIS) using our pseudo-panel dataset. Note that the goal in this exercise is not to estimate the EIS as precisely as possible but to compare the estimated EIS across different categories of goods and services. In fact, our estimation specification contains at least several shortcomings such as a lack of a valid instrument for the expected inflation rate and a lack of information on expected (not actual) expenditure growth (see, for example, the discussion in Crump et al. 2019). We therefore do not compare the size of our estimated EIS with the estimates reported in previous studies (see Havranek, 2015, and Havranek et al., 2015, for a comprehensive survey on the EIS).

We estimate the following equation:

$$\Delta \log \bar{c}_{i,t+4} = \beta_0 + \beta_1 \bar{\pi}^e_{i,t} + \boldsymbol{\beta'}_2 \boldsymbol{\Delta \bar{x}_{i,t}} + \boldsymbol{\beta'}_3 \boldsymbol{year_t} + \boldsymbol{\beta'}_4 \boldsymbol{quarter_t} + \boldsymbol{\beta'_5 cohort_i} + \varepsilon_{it}, \quad (3)$$

where $\Delta \log \bar{c}_{i,t+4} \equiv \log \bar{c}_{i,t+4} - \log \bar{c}_{i,t}$. Recall that $\bar{\pi}^e_{i,t}$ is the expected inflation rate over the *next twelve months*. We therefore use the growth rate of real expenditure over the *next four quarters* as the dependent variable in Equation (3) to make the time span as similar as possible. Given that the Japanese economy was under the ZLB during our observation period (2009Q2–2018Q1), $-\widehat{\beta_1}$ can be interpreted as a (rough) estimate of the EIS.

Table B.3 shows the estimation results. Consistent with our main findings, the largest response to an increase in inflation expectations is observed in durable expenditure (the estimated EIS is 0.094–0.137). In contrast, no statistically significant response is found in non-storable non-durable expenditure. These findings therefore also imply that intertemporal substitution plays a critical role in the impact of inflation expectations on household expenditure.

Additional references for Appendix B

Crump, K. R., Eusepi, S., Tambalotti, A., and Topa, G. (2019) "Subjective intertemporal substitution," *Federal Reserve Bank of New York Staff Reports*, No. 734.

Havranek, T. (2015) "Measuring intertemporal substitution: The importance of method choices and selective reporting," *Journal of European Economic Association*, Vol. 13, No. 6, pp. 1180–1204.

Havranek, T., Horvath, R., Irsova, Z., and Rusnak, M. (2015) "Cross-country heterogeneity in intertemporal substitution," *Journal of International Economics*, Vol. 96, No. 1, pp. 100–118.

Appendix Table B.1: Regression results (Observations for 2013 and 2014 are dropped)

(a) Levels

Dependent variable:	(1) Total (Adjusted)	(2) Durables (Adjusted)	(3) Storable non-durables	(4) Non-storable non-durables
Panel A				
Expected inflation rate (%)	13,037**	6,791**	1,544	4,702
	(5,668)	(2,714)	(1,142)	(3,924)
Consumer perceptions regarding coming six months				
N	476	476	476	476
(Within) Adj. R-sq	0.74	0.30	0.78	0.76
Panel B				
Expected inflation rate (%)	12,040*	7,402**	1,838**	2,800
	(5,810)	(3,374)	(834)	(4,588)
Consumer perceptions regarding coming six mont	✓	✓	✓	✓
N	476	476	476	476
(Within) Adj. R-sq	0.74	0.31	0.78	0.77

(b) Logarithm

Dependent variable:	(1) Total (Adjusted)	(2) Durables (Adjusted)	(3) Storable non-durables	(4) Non-storable non-durables
Panel A				
Expected inflation rate (%)	0.012**	0.066**	0.006	0.007
	(0.006)	(0.025)	(0.005)	(0.006)
Consumer perceptions regarding coming six months				
N	476	476	476	476
(Within) Adj. R-sq	0.76	0.35	0.77	0.78
Panel B				
Expected inflation rate (%)	0.011*	0.072**	0.007	0.004
	(0.006)	(0.033)	(0.004)	(0.007)
Consumer perceptions regarding coming six month	✓	✓	✓	✓
N	476	476	476	476
(Within) Adj. R-sq	0.76	0.35	0.77	0.78

Table B.2: Regression results

(using +20% and −20% as the top- and bottom-coded values for expected inflation rates)

(a) Levels

Dependent variable:	(1) Total (Adjusted)	(2) Durables (Adjusted)	(3) Storable non-durables	(4) Non-storable non-durables
Panel A				
Expected inflation rate (%)	10,585**	7,243***	1,679	1,662
	(3,761)	(1,373)	(1,118)	(2,387)
Consumer perceptions regarding coming six months				
N	612	612	612	612
(Within) Adj. R-sq	0.69	0.31	0.74	0.73
Panel B				
Expected inflation rate (%)	8,321*	6,699***	1,393	229
	(4,395)	(2,254)	(825)	(2,717)
Consumer perceptions regarding coming six month	✓	✓	✓	✓
N	612	612	612	612
(Within) Adj. R-sq	0.69	0.34	0.74	0.73

(b) Logarithm

Dependent variable:	(1) Total (Adjusted)	(2) Durables (Adjusted)	(3) Storable non-durables	(4) Non-storable non-durables
Panel A				
Expected inflation rate (%)	0.010**	0.066***	0.006	0.002
	(0.004)	(0.013)	(0.004)	(0.004)
Consumer perceptions regarding coming six months				
N	612	612	612	612
(Within) Adj. R-sq	0.72	0.35	0.73	0.75
Panel B				
Expected inflation rate (%)	0.007	0.061***	0.005	-0.000
	(0.004)	(0.019)	(0.004)	(0.004)
Consumer perceptions regarding coming six month	✓	✓	✓	✓
N	612	612	612	612
(Within) Adj. R-sq	0.72	0.36	0.73	0.75

Table B.3: Regression results (Estimated EIS)

Dependent variable (Δlog):	(1) Total (Adjusted)	(2) Durables (Adjusted)	(3) Storable non-durables	(4) Non-storable non-durables
Panel A				
Expected inflation rate (%)	-0.018***	-0.137***	-0.020**	0.003
	(0.004)	(0.020)	(0.007)	(0.005)
Consumer perceptions regarding coming six months				
N	544	544	544	544
(Within) Adj. R-sq	0.23	0.20	0.26	0.15
Panel B				
Expected inflation rate (%)	-0.016***	-0.094***	-0.025***	0.002
	(0.004)	(0.020)	(0.006)	(0.005)
Consumer perceptions regarding coming six months	✓	✓	✓	✓
N	544	544	544	544
(Within) Adj. R-sq	0.23	0.22	0.27	0.14

Notes: The dependent variable is $\Delta \log \bar{c}_{i,t+4} \equiv \log \bar{c}_{i,t+4} - \log \bar{c}_{i,t}$.

Appendix C: Survey Questionnaire

This Appendix provides an English translation of selected survey questions in the CCS.

Inflation expectations

Q. How much do you expect the prices of goods and services that you frequently purchase to change over the coming twelve months? (Please select one)

* Based on information from your daily shopping, television, and newspapers, imagine how much more expensive (cheaper) goods and services you frequently purchase might be a year from now.

* "The prices of goods and services you frequently purchase" refers to the amount of money you actually pay and is inclusive of all taxes.

[1] Go down by 10% or more
[2] Go down by 5% or more but less than 10%
[3] Go down by 2% or more but less than 5%
[4] Go down by less than 2%
[5] Stay about the same (i.e., 0%)
[6] Go up by less than 2%
[7] Go up by 2% or more but less than 5%
[8] Go up by 5% or more but less than 10%
[9] Go up by 10% or more
[10] Don't know

Consumer perceptions regarding the coming six months

Household overall livelihood

Q. Do you think the overall livelihood of your household will improve or worsen over the next six months compared to now?

[1] It will improve
[2] It will improve slightly
[3] It will remain unchanged
[4] It will worsen slightly
[5] It will worsen

Household income growth

Q. Do you think your household income will increase or decrease over the next six months?

[1] It will increase
[2] It will increase slightly
[3] It will remain unchanged
[4] It will decrease slightly
[5] It will decrease

Employment

Q. Do you think the employment environment such as employment stability and the ease of find a job will improve over the next six months compared to now? (Please answer based on your own, your family's, and your neighbors' situation.)

[1] It will improve
[2] It will improve slightly
[3] It will remain unchanged
[4] It will worsen slightly
[5] It will worsen

Value of assets

Q. Do you think the value of assets your household holds, such as stocks and land, will rise or fall over the next six months compared to now?

[1] It will rise
[2] It will rise slightly
[3] It will remain unchanged
[4] It will fall slightly
[5] It will fall