

Are Consumers' Spending Decisions in Line With an Euler Equation?

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Abstract

Evaluating a new survey of German consumers, we test whether individual consumption spending decisions are formed according to an Euler equation model. We thus evaluate whether individual current consumption spending is positively related to expected spending, negatively to expected nominal interest rates and positively to expected inflation. We are thus able to distinguish between two different channels via which the perceived real interest rate may affect current spending decisions. Our results are overall supportive of the Euler equation model: We find a significantly positive correlation between current consumption and both expected spending as well as expected inflation, and a significantly negative correlation with expected nominal interest rates in the subsample of financially literate households. These results remain robust with both qualitative and quantitative expectations and once we control for the role of perceived inflation. In addition, we evaluate whether the impact of interest rate and inflation expectations becomes stronger if the consumer observed monetary or financial market news. Overall, inflation expectations affect current spending decisions more strongly if the consumer heard any news on monetary policy or inflation, while the effect of nominal interest expectations becomes stronger if she heard news on financial markets. These news effects are particularly pronounced for consumers who save and who are thus able to use the perceived real interest rate for their consumption-smoothing. Overall, these results imply that consumers incorporate new information into their economic decision-making in a meaningful way.

Keywords: Euler equation; consumption spending plans; macroeconomic expectations; consumers; survey micro data.

JEL classification: E52; D12; D84; C83.

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1 Introduction

In recent years, consumers' macroeconomic expectations have become increasingly important for central banks aiming at guiding and anchoring expectations of the general public. These expectations are usually measured in household survey data. While the literature so far has mainly focused on investigating the expectation formation process of consumers' macroeconomic expectations (e.g. [Branch, 2004](#), [Coibion and Gorodnichenko, 2015a](#) and [Dräger et al., 2016](#)), an important question remains: Do consumers act on these expectations in their economic decision making? This question is crucial, since central banks implicitly assume that consumers' inflation and interest rate expectations will affect their wage negotiations as well as their consumption and saving decisions and thereby impact on actual inflation.

In light of the recent zero lower bound (ZLB) experience in the US and in European economies, several studies have used micro survey data to test for a link between inflation expectations and consumers' current spending, or their reported readiness to consume ([Bachmann et al., 2015](#); [Burke and Ozdagli, 2013](#); [Ichiue and Nishiguchi, 2015](#); [D'Acunto et al., 2016](#); [Crump et al., 2015](#); [Duca et al., 2018](#)). The main theoretical hypothesis underlying these studies is that in times of negative shadow interest rates, an increase in expected inflation might help to lower real interest rates, as long as the nominal interest rate stays at zero, and thereby boost consumption and investment.¹

In this paper, we estimate Euler equation models using household survey micro data obtained from our own telephone survey conducted on the German population at the University of Hamburg. We add to the previous literature along several dimensions: First, we jointly test whether consumers' current spending decision is affected by both individually expected nominal interest rates and by expected inflation. Thereby, we are able to distinguish between two different channels via which consumers' perception of real interest rates may affect their current spending decision: The nominal interest rate channel and the inflation channel. Second, we incorporate data on both inflation expectations and inflation perceptions in our Euler equation models. This is important, since consumers likely base their expectations on the *perceived* level of current inflation, which is not necessarily equal to the actual inflation data. We can thus use this information to account for a potential overestimation bias in both perceived and expected inflation. Third, our survey records both qualitative and quantitative measures of inflation expectations, inflation perceptions and interest rate expectations. Our analysis shows how these qualitative and quantitative measures are related, which gives important insights for surveys recording only qualitative data. Finally, we evaluate whether having heard any news on monetary policy, inflation, and financial markets increases the effect of interest rate and inflation expectations on

¹Note that theoretically also a negative link between inflation expectations and consumption might be possible if the adverse income effect from higher expected inflation dominates over the intertemporal substitution effect or if higher expected inflation is seen as a negative economic indicator, resulting in higher precautionary saving ([Shiller, 1997](#); [Bachmann et al., 2015](#)).

spending decisions. This links the analysis also to models of expectation formation under rational inattention as in [Sims \(2003\)](#) or the epidemiology model of [Carroll \(2003\)](#). We hypothesize that news make consumers more informed and, hence, better able to incorporate their interest rate and inflation expectations into their spending decision. We test this hypothesis for the whole sample and for sub-groups that are more likely to be better able to use this information, such as financially literate consumers, those with relatively accurate inflation forecasts or those that save and can hence use the perceived real interest rate for their consumption-smoothing.

The analysis is conducted using two cross-sectional waves from a new household survey of the German population conducted by the authors at the University of Hamburg. The survey is tailored to obtain detailed information on consumers' current and planned consumption and saving behavior, as well as a large set of individual macroeconomic expectations and socio-demographic details including consumers' financial risk attitude. In addition, we use the first two cross-sectional waves from the large German Panel on Household Finances (PHF), conducted by the Bundesbank, to corroborate our results for a larger cross-section and show the results in the appendix.

Our results give evidence in favor of the consumption Euler equation. We find that reported consumption in the previous 12 months is related positively to consumers' planned consumption in the next 12 months. Moreover, consumers' current spending is significantly positively related to expected inflation, in line with the results in [Crump et al. \(2015\)](#), [D'Acunto et al. \(2016\)](#) and [Duca et al. \(2018\)](#). Expected changes in nominal interest rates are negatively correlated with current spending for households with high financial literacy, resulting in an overall negative effect of consumers' perceived real interest rate. This result is interesting due to the ZLB environment in Germany at the time of the survey and the previous contrasting evidence in other studies. Also interestingly, our results are reversed when instead of actual reported consumption, we evaluate consumers' "readiness to spend", in line with the results in [Bachmann et al. \(2015\)](#).

Moreover, our data analysis reveals that qualitatively measured inflation perceptions, and not expectations, are more closely related to the level of quantitative inflation expectations. This result could be due to the wording in the qualitative answer categories, which for inflation expectations are phrased in terms of changes in expectations relative to perceptions. The wording is identical to that in the EU Joint Harmonised Programme of Consumer Surveys for which quantitative inflation expectations and perceptions have only recently become available. Our analysis thus yields important insights for studies using the longer time-series of qualitative answers such as [D'Acunto et al. \(2016\)](#). At the same time, we find that quantitative inflation expectations corrected for quantitative perceptions are less dispersed and centered around zero. We thus estimate also models with qualitative inflation perceptions instead of expectations and with quantitative inflation

expectations corrected for perceptions.² Our results show that the positive relation of the expected inflation measure with current consumption spending remains significant. We can thus corroborate earlier results in a more thorough analysis.

Evaluating the effect of having heard monetary policy news or news on financial market developments, we find that consumers who recall monetary news react more strongly to their own inflation expectations in their current consumption spending decision. At the same time, consumers who heard news on financial markets have a stronger negative correlation of their interest rate expectations with their spending decision. While the latter effect nevertheless remains insignificant in the whole sample, it becomes strongly significant for savers and for households with high financial literacy. Consumers who save also show a particularly strong positive correlation of their inflation expectations with current spending if they observed news on monetary policy and inflation. Overall, our results suggest that news help consumers to incorporate their macroeconomic expectations into their economic decision making in an informed way. This mechanism is particularly pronounced for those households that benefit from an informed decision (i.e. households able to use the real interest rate for their consumption-smoothing vs. hand-to-mouth households) and those households that have a basic financial and macroeconomic knowledge.

The present study is related to the literature testing for a link between household consumption and consumers' macroeconomic expectations. Most of the earlier literature focuses on the impact of consumers' inflation expectations on their consumption behavior, where, as pointed out by [Ichiue and Nishiguchi \(2015\)](#), the question arises whether the positive link predicted by consumption life-cycle models arises empirically or whether other factors such as wealth effects or precautionary saving motives dominate.

In an early contribution, [Juster and Wachtel \(1972\)](#) test for a link between aggregate data on consumer sentiment and inflation expectations from the University of Michigan Survey of Consumers and aggregate durables and car purchases in the US. The authors report that higher inflation reduces durables expenditures, but leads to an increase in non-durables and services expenditures, with a slightly negative effect on balance. [Bachmann et al. \(2015\)](#) analyze the microdata of the University of Michigan Survey of Consumers and report mostly an insignificant or even negative link between consumers' inflation expectations and their reported "readiness to spend". Nevertheless, they find a positive link for those whose inflation forecasts are relatively accurate. This could suggest that consumers' financial and economic literacy plays a role in this relationship. Similarly, [Burke and Ozdagli \(2013\)](#) evaluate the link of inflation expectations to actual consumer spending on a variety of durable and non-durable goods in a household panel setting covering the ZLB period in the US, and find little robust effects apart from a positive link between short-run inflation expectations and the likelihood of a car purchase. In contrast

²The latter specification with $(\pi_{quant,it}^e - \pi_{quant,it}^p)$ is also used in [Duca et al. \(2018\)](#).

to the previous US results, [Crump et al. \(2015\)](#) report a positive relation between consumption growth and inflation expectations of US consumers in panel cross-sections from the new Survey of Consumer Expectations (SCE) conducted at the New York Fed. [Ichiue and Nishiguchi \(2015\)](#) take advantage of a longer ZLB period in Japan and report robust findings that consumers increase actual consumption, and reduce planned consumption, when they report higher inflation expectations. Finally, [Duca et al. \(2018\)](#) estimate a similar relation to the one evaluated in [Bachmann et al. \(2015\)](#) for a large European panel. In contrast to the U.S. results reported by [Bachmann et al. \(2015\)](#), the authors find a positive link between inflation expectations (adjusted for inflation perceptions) and consumers' reported readiness to spend on durables, which becomes even stronger during the ZLB period. Our paper extends these previous studies as we simultaneously test for the role of expected spending, expected nominal interest rates and expected inflation for current spending decisions, while controlling for the effect of inflation perceptions.

Evaluating an earlier European survey dataset outside the ZLB, [D'Acunto et al. \(2016\)](#) report a positive relationship between German consumers' "readiness to spend" on durables and their inflation expectations, while a negative relation emerges regarding their likelihood to save. [D'Acunto et al. \(2016\)](#) further evaluate the impact of an unexpected VAT increase in Germany. Comparing the results with matched households in other European countries, the authors attribute a large increase in "readiness to spend" after the shock to increases in the inflation expectations after the VAT shock. Regarding the impact of further economic expectations on household consumption, [Hurd and Rohwedder \(2013\)](#) estimate the effect of the individual assessment of the likelihood of unemployment on household consumption during the recent Great Recession in the US and report that spending on non-durable goods such as clothing is reduced significantly if households perceive a higher likelihood of unemployment.

Moreover, our analysis relates to the vast literature on consumption life-cycle models and the question whether households smooth their consumption (see [Browning and Crossley \(2001\)](#) for an overview of the empirical literature). In his seminal contribution, the model developed by [Friedman \(1957\)](#) states that rationally forward-looking consumers should consider their "permanent" income over their life-cycle when determining consumption and money demand and choose consumption levels that keep the marginal utility of money constant. While in this paper, we do not focus on households' consumption smoothing *per se*, our analysis relates to empirical studies estimating consumption Euler equations. Previous approaches, such as for instance [Carroll \(2001\)](#) and [Attanasio and Low \(2004\)](#), discuss issues related to the estimation of the structural parameters in the Euler equation with GMM instruments for expectational terms. More recently, the papers by [Smith and Yetman \(2013\)](#) and [Crump et al. \(2015\)](#) use quantitative survey data for expected consumption growth and expected inflation to estimate an Euler equation relationship. In this paper, due to the qualitative nature of our survey data, we focus on the sign and significance of the correlations in the Euler equation relationship, but can-

not estimate any structural parameters. Instead, we extend the analysis in [Crump et al. \(2015\)](#) by controlling also for individual nominal interest rate expectations, so that we can evaluate two channels via which the perceived real interest may influence individual spending decisions. Moreover, we analyze the role of news on monetary policy, inflation and financial market developments that are recalled by consumers. We test if these news are incorporated into the Euler equation relation in a meaningful way and whether household types such as savers vs. hand-to-mouth consumers differ in their reaction to these news.

The rest of the paper is structured as follows. The theoretical framework for the analysis is described in [section 2](#). [Section 3](#) describes the new survey data set and [section 4](#) presents stylized facts regarding nominal interest rate expectations, the link between perceived and expected inflation, and the relation between qualitative and quantitative inflation expectations and perceptions. [Section 5](#) presents the estimates of our Euler equation model and [section 6](#) evaluates the role of news. Finally, [section 7](#) summarizes and concludes.

2 Relating Consumers' Consumption Plans to an Euler Equation

Ever since the seminal contribution in [Friedman \(1957\)](#), the standard consumption Euler equation describes the optimal intertemporal consumption path with consumption smoothing and thus relates current consumption c_t to expected future consumption $E_t c_{t+1}$, nominal interest rates i_t and expected inflation $E_t \pi_{t+1}$:

$$c_t = E_t c_{t+1} - \sigma^{-1} (i_t - E_t \pi_{t+1}), \quad (1)$$

In this framework, the marginal rate of substitution between current and future consumption thus equals the opportunity cost of choosing consumption over saving as measured by the real interest rate (adjusted for the household's time preference rate).

Since our survey data records expectations on future consumption, interest rates and inflation not one month ahead, but over the *period of the next 12 months*, we iterate forward and get ([Coibion et al., 2018](#)):³

$$c_t = \frac{1}{12} \sum_{k=1}^{12} \left[E_t c_{t+k} - \sigma^{-1} \sum_{j=0}^{k-1} E_t (i_{t+j} - \pi_{t+j+1}) \right] \quad (2)$$

Moreover, current consumption in our survey is also measured over the period of the previous 12 months. Hence, the Euler equation relevant to our survey setting is the following:

³The exact wording of the main survey questions is discussed in the next [section 3](#) and the wording for the remaining questions is given in the appendix.

$$\frac{1}{12} \sum_{l=0}^{11} c_{t-l} = \frac{1}{12} \sum_{l=0}^{11} \left\{ \frac{1}{12} E_{t-l} \left[\sum_{k=1}^{12} c_{t-l+k} - \sigma^{-1} \sum_{j=0}^{k-1} (i_{t-l+j} - \pi_{t-l+j+1}) \right] \right\} \quad (3)$$

From the Euler equations in (2) and (3), we can show that both expected nominal interest rates and expected inflation should matter for current consumption. We thus hypothesize that current consumption is positively related to planned consumption and expected inflation, and negatively to expected nominal interest rates.

Since the available survey data contains mostly qualitative variables, it should be noted that we cannot estimate any structural parameters of the Euler equation and, hence, are not able to test for the consumption smoothing parameter being equal to unity or the size of the intertemporal elasticity of substitution. Instead, we focus on whether the signs of the correlations between the qualitative variables is significant and correct according to the theory, i.e. whether consumers are more likely to increase current consumption if they expect their future consumption to rise or if they expect real interest rates to fall.

To evaluate whether consumers form their qualitative consumption plans in line with the simple Euler equation in (3), we estimate the individual likelihood to report higher current spending over the past 12 months relative to an average year from ordered probit estimates of the following regression set-up:

$$c_{it}^{current} = \beta_0 + \beta_1 c_{it}^e + \beta_2 i_{it}^e + \beta_3 \pi_{it}^e + \mathbf{X}_{it}^{controls'} \mathbf{\Gamma} + u_{it}, \quad (4)$$

where $c_{it}^{current}$ measures consumers' reported consumption over the previous 12 months, c_{it}^e is their reported expected spending in the next 12 months, i_{it}^e and π_{it}^e are individual expectations reported in t on nominal interest rates and the inflation rate over the next 12 months and the vector $\mathbf{X}_{it}^{controls}$ includes individual controls, and a wave time fixed effect.

Note that two caveats apply: First, the University of Hamburg survey measures c_{it} and c_{it}^e as consumers' reported *total expenditure* over the last/next 12 months. Hence, this may include purchases of durable goods and, thus, strictly speaking we estimate a spending, rather than a consumption, Euler equation. Nevertheless, this question wording is frequently used in other consumer surveys to capture households' consumption. Moreover, we also estimate a specification with durable consumption where we take consumers' reported readiness to spend on durable goods as a proxy for current durable consumption as in [Bachmann et al. \(2015\)](#). Second, the questions ask about nominal, rather than real, current and planned spending. This means that the estimated parameters are linear transformations of the underlying structural ones, as discussed in [Crump et al. \(2015\)](#). However, it should not affect their sign or significance, especially since actual inflation was very low at the time of the survey. Moreover, evaluating the impact of interest rate and inflation expectations separately has the advantage that we can distinguish between two potential channels of real interest rates affecting consumers' consumption.

3 Data

Within the new Consumer Survey on Expectations, Consumption and Saving conducted at the University of Hamburg, telephone interviews with a representative sample of German households were conducted in two waves. The first wave was interviewed from October 20, 2015 to December 23, 2015 and consists of 313 interviews.⁴ The second wave consists only of respondents who were already interviewed in the first wave and agreed to a second interview six months later, resulting in a small panel dimension. This wave consists of 183 interviews, which were conducted between May 12, 2016 and June 29, 2016. We use sample weighted observations in order to ensure the representativeness of our results with respect to the overall population.

The survey is especially suited for the analysis of an Euler equation relationship, since unlike other existing surveys it includes information on both households' individual spending patterns and their individual macroeconomic expectations.⁵ Specifically, the survey includes information on consumers' expectations regarding a range of macroeconomic variables, of which we mainly use information on expected interest rates and inflation in the present analysis. Moreover, consumers are asked in detail about their current and planned consumption and savings. These questions were phrased similarly to comparable questions in the Bundesbank Panel of Household Finances (PHF), the European Commission Joint Harmonized Survey of Consumers and the University of Michigan Survey of Consumers.

Our main survey questions of interest are phrased as follows:⁶

- Current consumption $c_{it}^{current}$: *“How would you say do your total expenditures in the past 12 months compare to an average year in the past? They were”*
 - Considerably higher
 - About the same
 - Considerably lower

- Expected consumption c_{it}^e : *“How would you say will your total expenditures in the next 12 months compare to an average year in the past? They will be”*
 - Considerably higher
 - About the same

⁴The whole survey sample is obtained from both landline and mobile telephone numbers registered in Germany, using the Häder-Gabler approach (Häder et al., 2009).

⁵Well established surveys on consumers' macroeconomic expectations such as the University of Michigan Survey of Consumers in the US do not include information on their individual spending path, while surveys such as the Bundesbank Panel of Household Finances (PHF) include very detailed information on households' spending and saving, but only sparsely ask about households' macroeconomic expectations.

⁶Additional survey questions used in the analysis are included in the appendix. The complete survey questionnaire (in German) is available from the authors upon request.

- Considerably lower

Regarding the survey questions on consumers' interest rate and inflation expectations, we compare the results with qualitative and quantitative expectations:

- Qualitative nominal interest rate expectations $i_{it}^{e,qual}$: *“How do you think interest rates on saving accounts on average will develop over the next 12 months? They will”*
 - Increase strongly
 - Increase somewhat
 - Stay about the same
 - Decrease somewhat
 - Decrease strongly
- Quantitative nominal interest rate expectations $i_{it}^{e,quant}$: *“What do you think, how high will interest rates on saving accounts in percentage terms be on average over the next 12 months?”*⁷
 - ... Percent
- Qualitative inflation expectations $\pi_{it}^{e,qual}$: *“How do you think prices in general will develop over the next 12 months compared to the previous 12 months? They will”*
 - Increase more than before
 - Increase at about the same rate
 - Increase less strongly than before
 - Stay about the same
 - Fall
- Quantitative inflation expectations $\pi_{it}^{e,quant}$: *“How many percent do you think prices in general will increase/decrease on average over the next 12 months?”*
 - ... Percent
- Qualitative inflation perceptions $\pi_{it}^{p,qual}$: *“How do you think prices in general have developed over the past 12 months? They have”*
 - Increased strongly

⁷Unfortunately, response rates to the question on quantitative interest rate expectations in the first wave was very low. In the second wave, the wording of the question was changed very slightly, adding the phrase “in percentage terms”, leading to a much higher response rate. In order to ensure that this does not affect the results, we use only quantitative expectations from the second wave in our analysis.

- Increased moderately
 - Increased slightly
 - Stayed about the same
 - Fallen
- Quantitative inflation perceptions $\pi_{it}^{p,quant}$: “How many percent do you think prices in general have increased/decreased on average over the past 12 months?”
 - ... Percent

Throughout the paper, we truncate quantitative inflation perceptions and inflation expectations in the range $-15 \leq \pi_{it}^{e,p} \leq 15$ and quantitative interest rate expectations in the range $i_{it}^e \leq 5$ in order to avoid extreme outliers affecting our results.⁸ Note that the University of Hamburg survey took place with interest rates close to the zero lower bound in Germany, as the ECB moved the main refinancing rate to 0.15% in June 2014, to 0.05% in September 2014, and finally to 0.00% in March 2016.

Socio-demographic control variables include consumers’ sex and their age (including a squared term). Additionally, we control for whether their personal income falls in the lowest category (*inc_l* for income < 1000€ per month), the medium low category (*inc_ml* for 1000€ ≤ income < 2000€ per month) or the medium high category (*inc_mh* for 2000€ ≤ income < 4000€ per month) with personal income above 4000€ per month in the reference category. Note that controlling for income also partly controls for regional effects since incomes tend to be higher in West vs. East Germany and in metropolitan areas vs. rural areas. Moreover, we control for education, where we include dummies for those with university education (*edu_h*) and for those with vocational training (*edu_m*), with those with no finished job training or those still in school as reference group. The employment status is measured in five employment groups: Those that do not work are taken as reference category and compared to consumers who are retired (*retired*), to those in a medium low category (*employ_ml* for those infrequently working or working in so-called mini jobs), a medium high category (*employ_mh* for those working part-time) and a high category (*employ_h* for those working full time). Finally, we account for consumers’ financial risk attitude (*risk*) with answers to a qualitative question asking whether they take very high/above average/average/no financial risk in order to earn very high/above average/average/no specified returns.

We also control for consumers’ qualitative expectations regarding the change in the general economic situation ($y_{qual,it}^e$) and in the unemployment rate ($u_{qual,it}^e$). Additional time fixed-effects are controlled for with a dummy *wave* which accounts for the two waves of the survey.

⁸Truncating the data cuts about 7-8% of the observations on inflation expectations and perceptions, and about 5% of the observations on interest rate expectations. Our results are robust to alternative truncations such as $-10 \leq \pi_{it}^{e,p} \leq 10$.

The University of Hamburg survey also records information on consumers' perception of economic news. After asking whether consumers recall any economic news they recently heard, an open question follows asking them what news they recall.⁹ The answers are coded into categories. In the regression analysis, we distinguish between monetary news including information on interest rates, currency news and news on inflation (*news_monetary*), and between news on financial markets, covering news on banks, stock markets and housing markets (*news_financial_markets*).

Summary statistics of truncated quantitative inflation expectations, inflation perceptions and nominal interest rate expectations from the University of Hamburg survey are presented in Table A1 in the appendix. Both inflation expectations and inflation perceptions show a strong upwards bias across the two waves, with mean expected rates of 3.67% and mean perceived current inflation of 3.59%. Interest rate expectations measured in the second wave are much more accurate with mean expectations at 1%.¹⁰ The finding that consumers tend to overestimate inflation in recent years is also frequently found in other surveys (see Dräger and Fritsche (2013) for Germany and Coibion and Gorodnichenko (2015b) for the US).

Moreover, we find that both inflation expectations and perceptions are generally found to be lower, i.e. forecast accuracy is found to be better, for men than for women, and rising with income. The pattern for age groups is less clearly defined, but points to somewhat better forecast accuracy of the middle-age groups compared to the young and the old. These patterns regarding households' inflation expectations across socio-demographic groups are very well documented also in other surveys and for different time-spans, see for instance Jonung (1981) for Sweden and Bryan and Venkatu (2001) for the US. In the large Bundesbank Panel of Household Finance, the heterogeneity across socio-demographic groups and the cross-sectional variation measured by the standard deviation is similar to that in the University of Hamburg survey for a much larger German household panel, as shown in Table A2 in the appendix. We thus argue that the smaller University of Hamburg survey seems to capture the characteristics of the German population reasonably well and discuss results for our baseline Euler equation model from the PHF data as a robustness check.

4 Stylized Facts

Our University of Hamburg survey is one of few household surveys which includes information on both perceptions of current inflation and expectations of future inflation, measured both quantitatively and qualitatively. We can thus analyze the differences be-

⁹A similar question is also included in the University of Michigan Survey of Consumers.

¹⁰Annual inflation in Germany in December 2015 was very low at 0.3%, with interest rates near the zero lower bound (1.17% Euro area 10-year government benchmark bond yields and 0.64% on bank deposits redeemable within 3 months in the Euro area).

tween quantitative and qualitative perceptions and expectations which is important for surveys which have to rely only on qualitative measures. Moreover, we can evaluate the relationship between perceptions and expectations of inflation. Finally, the survey includes also quantitative interest rate expectations, which are seldom measured in other surveys. In this section, we thus discuss stylized facts of these measures and incorporate the results in our estimations of the consumption Euler equation.

4.1 Inflation Expectations and Perceptions

Figure 1 shows histograms of truncated quantitative inflation expectations and perceptions in panels 1a and 1b. Both measures show a right-skewed distribution with a surprisingly large range considering the low-inflation environment in Germany at the time of the survey. While the majority of respondents expects and perceives price increases between 0-5%, there is still a large degree of heterogeneity with answers clustering at so-called “focal points” such as multiples of 5 (Binder, 2017).

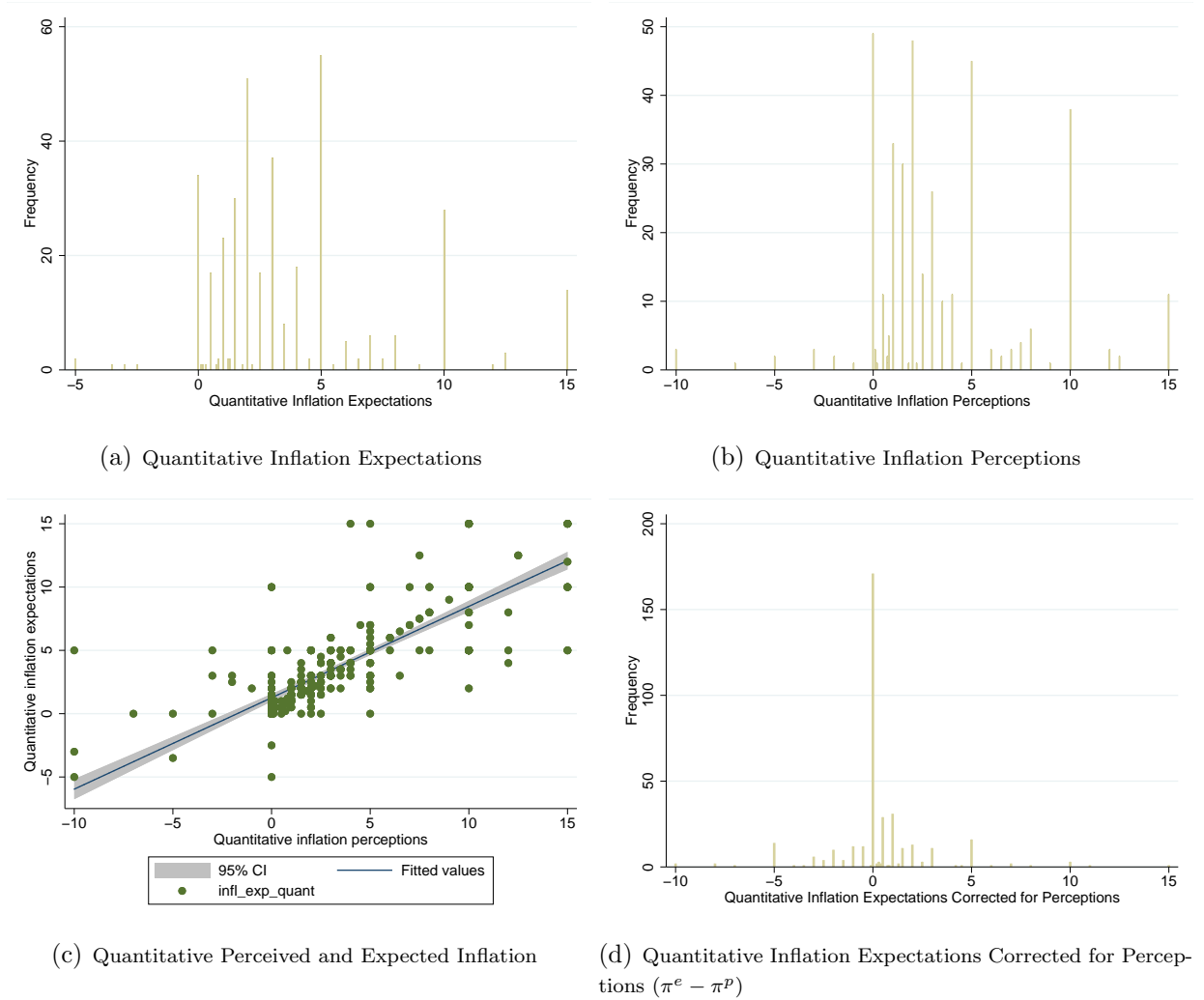
Moreover, as shown in panel 1c, inflation expectations and inflation perceptions are strongly positively correlated. The estimated slope coefficient is 0.72 and is highly significant. Hence, it is likely that a consumer who perceives inflation to be high or low will continue to expect high or low inflation, pointing to some degree of adaptive expectation formation. Indeed, when forming the difference between inflation expectations and perceptions, we observe in panel 1d that a large majority of consumers expects the same level of inflation as the one they perceive today. Moreover, the difference ($\pi^e - \pi^p$) is more evenly distributed between negative and positive values and less dispersed than level expectations or level perceptions.¹¹ To account for this fact, we estimate a version of the consumption Euler equation with the difference ($\pi^e - \pi^p$), where we add π^p as additional regressor so that the original model equation remains unchanged (Duca et al., 2018).

4.2 Quantitative vs. Qualitative Inflation Expectations and Perceptions

The relationship between qualitative and quantitative inflation perceptions and expectations is shown in the scatter plots in Figure 2. Both qualitative questions are phrased according to the European Commission Joint Harmonized Survey of Consumers, where they are frequently interpreted as measuring level expectations, see for instance D’Acunto et al. (2016). However, the first three answer categories of qualitative inflation expectations are about changes in expected inflation relative to current perceived inflation, while the first three answer categories of qualitative perceptions are about current changes in inflation.

¹¹Since 2016, the University of Michigan Survey of Consumers includes quarterly questions on inflation perceptions. While the data are still not publicly available, the relationship between inflation expectations and perceptions in the U.S. data is similar to the one in our dataset as discussed in Axelrod et al. (2018).

Figure 1: Inflation Perceptions and Expectations

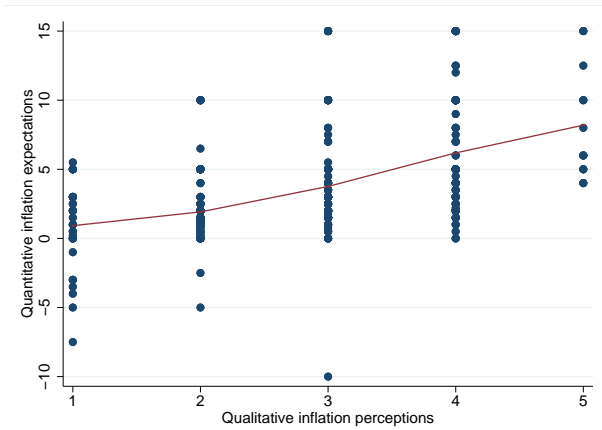
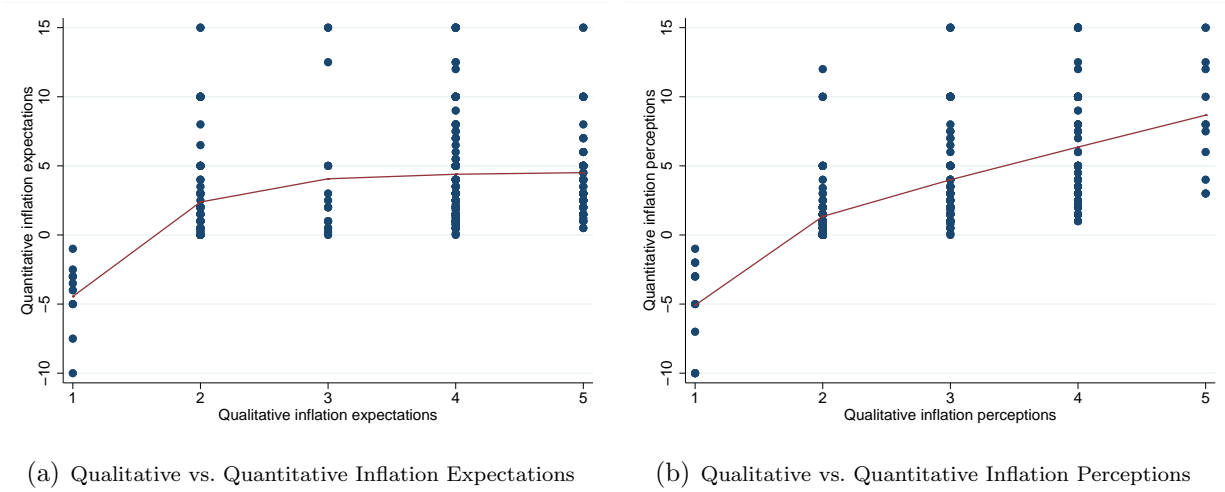


As shown in Figure 2a, in the mean there is a positive relationship between quantitative and qualitative inflation expectations in the lower two answer categories (even though the data have a large dispersion), but the relationship becomes flat for the upper three answer categories. It thus seems that qualitative expectations are only partly informative about the corresponding quantitative level of inflation expectations. This does not seem to be the case for inflation perceptions, where we observe a positive relationship between the quantitative and qualitative measures throughout all five answer categories in Figure 2b. Finally, in Figure 2c we show that qualitative inflation perceptions are also more informative about the quantitative level of inflation expectations in the upper three answer categories. Therefore, we test specifications of the consumption Euler equation with both qualitative inflation expectations and qualitative inflation perceptions.

4.3 Interest Rate Expectations

Finally, our survey also measures both qualitative and quantitative interest rate expectations, where the quantitative data are available only for the second wave. Figure 3a

Figure 2: Quantitative vs. Qualitative Inflation Expectations



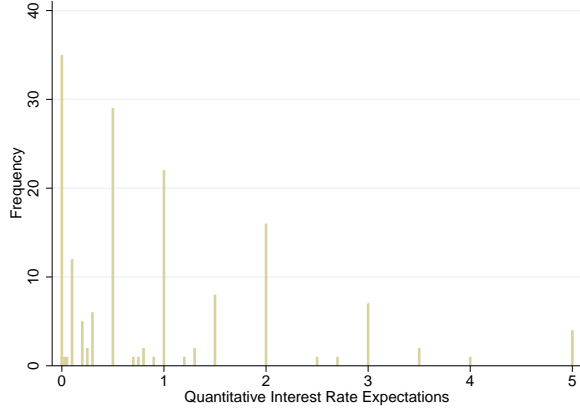
(c) Qualitative Inflation Perceptions Across Quantitative Expectations

shows the distribution of interest rate expectations, which like inflation expectations and perceptions have a right-skewed distribution with clustering at focal points, in this case multiples of 0.5. Notably, households in the survey seem to be better informed about current interest rates than about current inflation, as the majority report interest rate expectations in the range between 0-1%. Plotting answers in the five qualitative categories against the corresponding quantitative interest rate expectations in Figure 3b suggests that the upper three answer categories relating to expected unchanged or rising interest rates in the mean relate positively to the quantitative level forecast. By contrast, the two lower categories about expected falling interest rates have a flat relationship with quantitative interest forecasts. This could be due to the zero lower bound environment prevailing during the survey, which led to a large number of 0% interest forecasts, but no negative ones.

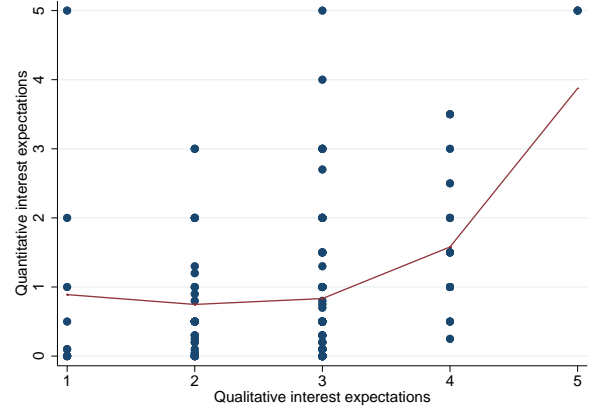
Panels 3c and 3d finally show the correlation between quantitative interest rate expectations and quantitative inflation expectations or perceptions in the second wave. In both cases, the estimated slope coefficients are positive, close to 1 and strongly signifi-

cant. Thus, even though the data dispersion remains wide, it seems that consumers tend to view nominal interest rates and inflation as moving together.

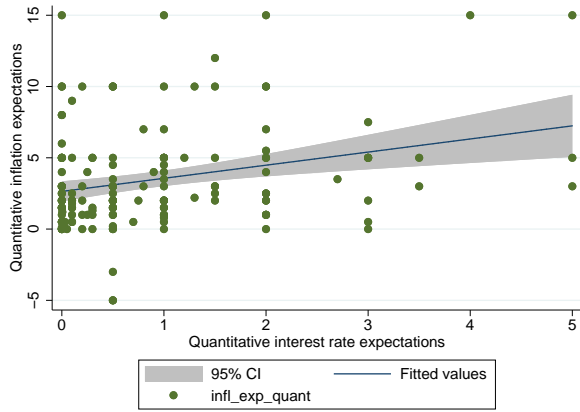
Figure 3: Interest Rate Expectations



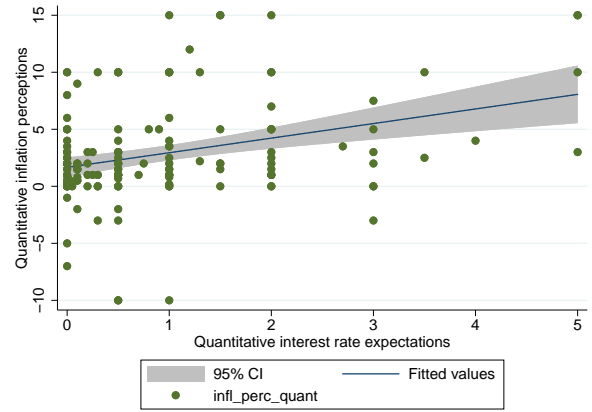
(a) Quantitative Interest Rate Expectations, Wave 2



(b) Qualitative vs. Quantitative Interest Rate Expectations, Wave 2



(c) Inflation Expectations and Interest Rate Expectations, Wave 2



(d) Inflation Perceptions and Interest Rate Expectations, Wave 2

5 Estimation of a Consumption Euler Equation

In this section, we test whether consumers' reported current consumption spending is affected by the expected level of spending and by consumers' nominal interest rate as well as inflation expectations in line with a consumption Euler equation as in (1). Under this hypothesis, we expect a positive relationship between current and expected future spending, a negative relation with expected nominal interest rates and a positive link to expected inflation.

Moreover, we expect that consumers need at least a basic level of financial knowledge in order to be able to form consumption decisions according to the Euler equation model. To test this hypothesis, we define consumers with high financial literacy as those who correctly answered the two questions about nominal interest rate compounding and about the real

interest rate defined as in Lusardi and Mitchell (2011, 2014).¹² We then test whether the sub-sample of financially literate consumers reacts differently to nominal interest rate and inflation expectations in their consumption decision.

All models include a large range of demographic control variables, a time dummy for the second wave accounting for unobserved time fixed effects and further macroeconomic expectations, namely expectations on the general economic situation and on unemployment. We report marginal effects from ordered probit models for the likelihood of consumers answering “total expenditures in the past 12 months were considerably higher than in an average year” evaluated at the sample mean. All models are estimated with sample weights and standard errors clustered at the household level.

Tables 1 and 2 show the baseline estimations of a consumption Euler equation using qualitative and quantitative expectations, respectively. Overall, the results support the hypothesis that consumers’ expenditure patterns may indeed be related to life-cycle models of consumption captured in the Euler equation. First, we find that consumers are more likely to report above-average spending in the past 12 months if they expect to increase their consumption also in the coming 12 months, although this link becomes insignificant for financially literate consumers. Second, there is a negative relationship between both qualitative and quantitative nominal interest rate expectations and current consumption, and the relationship is stronger and significantly different from zero for households with financial literacy.¹³ Third, qualitative and quantitative inflation expectations have a significantly positive relation to current consumption spending in all models. Again, the effect becomes stronger in the sub-sample of financially literate individuals. Overall, we thus find supportive evidence for the Euler equation model in our dataset. Note that this evidence is corroborated in the larger PHF survey, where again we find a significantly negative effect of interest rate expectations on current spending, and a significantly positive impact of inflation expectations, see Table A3 in the appendix.¹⁴

Following the results regarding the relationship between inflation expectations and perceptions in the previous section, we also estimate the model with qualitative expectations with inflation perceptions instead of expectations. Column 2 in Table 1 reveals a positive and significant effect also of qualitative inflation perceptions. In the model with quantitative expectations, we also test a specification with the de-trended measure $(\pi^e - \pi^p)$, adding π^p as regressor to leave the equation unchanged. Column 2 of Table 2 shows a significantly positive effect only quantitative inflation perceptions, but in the

¹²The exact wording of the two financial literacy questions is given in the appendix. In our survey, financially literate consumers account for about 70% of the sample.

¹³Models with quantitative interest rate expectations are only estimated for the second wave.

¹⁴Further robustness checks are included in section 9.3 (Tables A4 and A5) in the appendix, where we estimate the basic Euler equation model separately for the two waves of the University of Hamburg survey and including long-run and house price inflation expectations. We find that our results are not driven by one of the waves in the University of Hamburg survey. In addition, the robustness checks show that there is only a weak positive relation of long-run inflation expectations to current spending, and none for house price expectations.

model for financially literate consumers in column 5 both $(\pi^e - \pi^p)$ and π^p are significantly positively related with current consumption decisions.

The set-up of the survey also allows to test for habit formation, another feature of households' consumption preferences often included in the theoretical literature. If households form habits on consumption levels, we would expect additional persistence in their consumption path, with current consumption related to consumption levels of the previous period. We test for this hypothesis by using only the data from the second wave, and by incorporating consumers' qualitative answer about current spending changes from the first wave as an additional regressor. The results are shown in Table 3 for the model with qualitative expectations. We find evidence of habit formation in the sense that current consumption decisions are significantly positively related to consumption decisions reported six months earlier. However, nominal interest rate and inflation expectations only remain significant in a few specifications. The results for habit formation with quantitative expectations are shown in Table A6 in the appendix.

Finally, we re-estimate our baseline models using consumers' reported readiness to spend on durables as the dependent variable, using a similar identification to the one in Bachmann et al. (2015). To do so, we use the same question as included in the Michigan Survey of Consumers: *"When looking at the current economic situation, do you think now is a good or a bad time for people to make large purchases such as furniture or electronic devices and so on?"* [Now is a good time; Neither a good, nor a bad time; Now is a bad time]. Table 4 shows the results for the whole sample. We find that there is no significant link between nominal interest rate expectations and the reported readiness to spend on durables. Surprisingly, both inflation perceptions and inflation expectations are negatively correlated with the readiness to spend on durables. This is in line with the findings of Bachmann et al. (2015) for the US during the zero lower bound. These results also remain unchanged when we estimate the model for financially literate individuals (see Table A7 in the appendix). Overall, our results suggest that interest rate and inflation expectations affect non-durable consumption in line with the Euler equation, while the relationship with durable consumption is different either due to a difference between durable and non-durable consumption or due to the fact that current durable consumption is only measured with a proxy.

Table 1: Consumption Euler Equation, Qualitative Expectations

	(1)	(2)	(3)	(4)
	All HHs	All HHs	Fin. literacy	Fin. literacy
c_{it}^e	0.151** (0.062)	0.163** (0.066)	0.005 (0.049)	0.015 (0.052)
$i_{qual,it}^e$	-0.016 (0.042)	-0.020 (0.042)	-0.146*** (0.040)	-0.150*** (0.042)
$\pi_{qual,it}^e$	0.063** (0.025)		0.064*** (0.023)	
$\pi_{qual,it}^p$		0.039* (0.021)		0.016 (0.023)
Macro Expectations	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes
Wave Dummy	Yes	Yes	Yes	Yes
Pseudo R ²	0.130	0.117	0.142	0.121
N individuals	278	277	187	186
N observations	425	424	292	291

Note: University of Hamburg survey. Marginal effects for the probability of answering in the highest category are reported from weighted estimations and evaluated at the sample mean. The last two columns are estimated for the sub-sample correctly answering the two literacy questions on interest rates. Macro expectations are on the general economic situation and the unemployment rate. Demographic factors include age, age², income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Consumption Euler Equation, Quantitative Expectations

	(1) All HHs	(2) All HHs	(3) All HHs Wave 2	(4) Fin. literacy	(5) Fin. literacy	(6) Fin. literacy Wave 2
c_{it}^e	0.153** (0.076)	0.078 (0.069)	0.103 (0.096)	-0.032 (0.059)	-0.051 (0.059)	-0.089 (0.098)
$i_{qual,it}^e$	-0.021 (0.047)	-0.010 (0.045)		-0.172*** (0.048)	-0.148*** (0.046)	
$i_{quant,it}^e$			-0.027 (0.062)			-0.121** (0.049)
$\pi_{quant,it}^e$	0.011** (0.006)		0.021 (0.014)	0.020*** (0.007)		0.025** (0.012)
$\pi_{quant,it}^p$		0.024*** (0.008)			0.032*** (0.008)	
$\pi_{quant,it}^e - \pi_{quant,it}^p$		-0.001 (0.010)			0.029** (0.015)	
Macro Expectations	Yes	Yes	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Wave Dummy	Yes	Yes	No	Yes	Yes	No
Pseudo R ²	0.119	0.139	0.181	0.142	0.163	0.148
N individuals	246	231	150	169	161	109
N observations	368	333	150	260	237	109

Note: University of Hamburg survey. Marginal effects for the probability of answering in the highest category are reported from weighted estimations and evaluated at the sample mean. The last three columns are estimated for the sub-sample correctly answering the two literacy questions on interest rates. Macro expectations are on the general economic situation and the unemployment rate. Demographic factors include age, age², income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Testing for Habit Formation

	(1)	(2)	(3)	(4)
	All HHs	All HHs	Fin. literacy	Fin. literacy
$c_{it-1}^{current}$	0.170** (0.078)	0.175** (0.074)	0.244*** (0.075)	0.259*** (0.077)
c_{it}^e	0.150* (0.083)	0.154* (0.083)	-0.046 (0.069)	-0.049 (0.071)
$i_{qual,it}^e$	0.019 (0.065)	0.017 (0.065)	-0.116** (0.049)	-0.119** (0.050)
$\pi_{qual,it}^e$	0.020 (0.044)		0.056 (0.037)	
$\pi_{qual,it}^p$		-0.007 (0.045)		-0.002 (0.038)
Macro Expectations	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes
Pseudo R ²	0.185	0.184	0.221	0.206
N individuals	167	167	118	118
N observations	167	167	118	118

Note: University of Hamburg survey. Marginal effects for the probability of answering in the highest category are reported from weighted estimations and evaluated at the sample mean. The last two columns are estimated for the sub-sample correctly answering the two literacy questions on interest rates. Macro expectations are on the general economic situation and the unemployment rate. Demographic factors include age, age², income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Euler Equation with the Readiness to Spend on Durables

	(1)	(2)	(3)	(4)	(5)
	All HHs	All HHs	All HHs	All HHs	All HHs_Wave2
$c_{it}^{e,dur}$	0.029 (0.038)	0.015 (0.042)	0.034 (0.036)	0.063** (0.032)	0.065 (0.073)
$i_{qual,it}^e$	-0.006 (0.036)	-0.009 (0.039)	-0.009 (0.039)	-0.008 (0.038)	
$i_{quant,it}^e$					0.010 (0.037)
$\pi_{qual,it}^e$	-0.022 (0.027)				
$\pi_{quant,it}^e$			-0.041*** (0.012)		-0.037*** (0.013)
$\pi_{qual,it}^p$		-0.112*** (0.038)			
$\pi_{quant,it}^p$				-0.031*** (0.010)	
$\pi_{quant,it}^e - \pi_{quant,it}^p$				-0.036** (0.015)	
Macro Expectations	Yes	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes	Yes
Wave Dummy	Yes	Yes	Yes	Yes	No
Pseudo R ²	0.129	0.154	0.201	0.223	0.300
N individuals	271	270	243	228	149
N observations	415	415	363	328	149

Note: University of Hamburg survey. Marginal effects for the probability of answering in the highest category are reported from weighted estimations and evaluated at the sample mean. Macro expectations are on the general economic situation and the unemployment rate. Demographic factors include age, age², income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6 The Role of News, Financial Market Participation and Financial Literacy

In this section, we evaluate whether news affect the way that consumers incorporate their expectations on future inflation and interest rate into their current consumption decision. In particular, we analyze the importance of monetary news and of financial market news observed by the consumers in our survey. Monetary news summarize all news about monetary policy, inflation, interest rates or the exchange rate that consumers recall, while financial market news summarize news about banks, stock markets and housing markets.¹⁵

These news can influence consumers' macroeconomic expectation formation and, thus, constitute potential "news shocks" affecting the consumption Euler relationship. In terms of theory, news may affect consumers' expectation formation since they rationally choose to be attentive to these issues (Sims, 2003) or since new information is diffused gradually throughout the population (Carroll, 2003). Indeed, we find that those consumers who heard monetary or financial news in our survey predict inflation somewhat more precisely with a mean of 3.04% and 2.43%, while those who did not hear such news expect mean inflation of 3.77% and 3.81%, respectively.

A priori, we thus expect the effect of inflation expectations on current consumption to become stronger for consumers that report having heard monetary news, with a lesser effect on interest rate expectations. By contrast, we expect that news on financial markets strengthen the effect of interest rate expectations on current consumption as consumers are more informed about financial market developments that affect interest rates.

Hence, the baseline Euler equation model with qualitative expectations from equation (4) is re-estimated with level and interaction effects of each news category with both interest rate and inflation expectations.¹⁶ Since the marginal effects for dummy interaction terms cannot be directly interpreted in the non-linear model setting estimated here, we show marginal effects of interest rate and inflation expectations estimated for those that

¹⁵News on monetary policy in this sample were mainly news observed by consumers about the interest rate setting by the ECB, potential negative effects of the low interest rate environment on saving and potential negative effects on future inflation and the future economic situation in general related to the very expansive stance of current monetary policy. News on inflation were mainly news observed about rising prices, such as consumer prices or specific prices of food or rents. News on financial market developments include mainly news observed about strong stock markets and rising house prices and some news on potential stability problems in the banking sector. Over both waves, 64 respondents recalled monetary news and 48 observed news on financial markets. More prevalent economic news topics were news on labor market developments, news about potential economic effects of the refugee crisis at the time of the survey and specific sector news like the Diesel scandal in the car industry.

¹⁶Since the number of observations for monetary and financial news is relatively low, we estimate the models only with qualitative expectations in order to keep the number of observations as high as possible.

observed news in the respective category versus those that did not observe these news in Figures 4-7.¹⁷

Figure 4 shows the interaction effects of monetary and financial market news on interest rate and inflation expectations for all consumers in the survey. As expected, having heard monetary news coincides with a significantly stronger positive effect of consumers' inflation expectations on their current consumption decision. The point estimate of the effect of interest rate expectations does not change significantly with monetary news and remains insignificant. When consumers heard financial market news, we do observe a noticeably more negative point estimate for the effect of interest rate expectations on consumption, which, however, is imprecisely estimated possibly due to the low number of observations.

In the following, we evaluate whether the effects of monetary and financial market news observed for the full population in Figure 4 differ for specific sub-groups. The effect of news on economic choices is not necessarily just a function of observing the news (which, of course, is a pre-requisite), but also depends on the ability to process the news and adjust the behavior accordingly. We thus test whether consumers who are able to save or who have a high degree of economic and financial knowledge react to their inflation and interest rate expectations more strongly when they receive news. Our hypothesis is that savers are able to adjust their level of consumption to changes in their perceived real interest rates in contrast to the group of hand-to-mouth consumers who are not able to save and, thus, have more reason to be attentive to monetary and financial market news. Regarding the latter group, we hypothesize that their better economic understanding might enable them to better incorporate news into their consumption decisions.

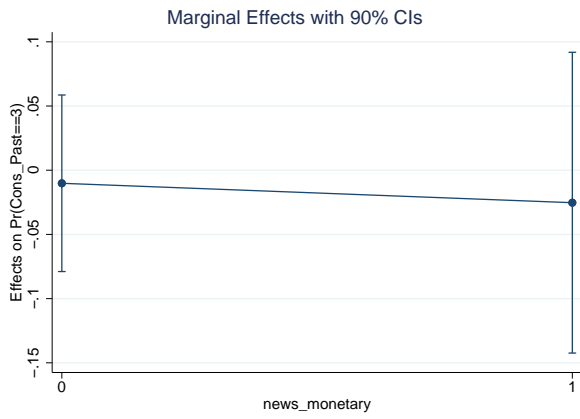
Figure 5 presents the interaction effects with monetary and financial market news for consumers who save. As expected, savers show a much more pronounced reaction to both monetary and financial market news: The positive effect of inflation expectations on current consumption in panel 4b is significantly stronger when the consumer observed monetary news, where both the point estimate and the difference to those who did not observe any news is larger than for the full sample in Figure 4. Similarly, the negative effect of interest rates on consumption is more pronounced and significant for savers who observed news on financial markets, while the positive effect of inflation expectations also becomes slightly stronger (panels 4c and 4d). Figures A1 and A2 in the appendix show news interaction effect for the subgroup of consumers who save in assets traded on

¹⁷We also estimate news interaction effects of monetary news for age and income groups in Figures A3-A4 in the appendix. We find that the old react more strongly to their inflation expectations when they observe monetary news, while there are no significant news effects on the young. It thus seems that older consumers are particularly sensitive to monetary news (which are mainly observed news on price increases), possibly due to their experience of higher inflation rates during the 1960s and 1970s. Interestingly, we also find that low income consumers show a significantly positive correlation of current spending with their inflation expectations only once they observed monetary news. By contrast, high income households react significantly to their inflation expectations already in the full sample, and the effect does not change significantly once they observe monetary news. This could indicate that higher income consumers are already better educated about the role of inflation for their spending so that any additional information does not lead to an adjustment in their economic choice.

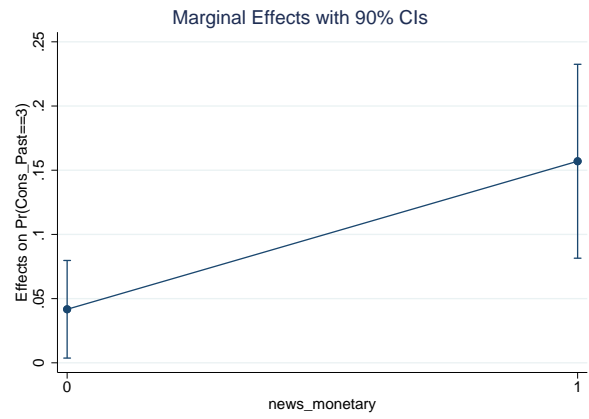
financial markets such as bonds, stocks, life insurance funds as well as private pension schemes and the subgroup of consumers who save by paying off a credit or a mortgage. We observe that the news effects on savers in general are largely driven by those saving in assets traded on financial markets. In particular the effect of financial market news cannot be observed for consumers paying off debt. This is not surprising since credit and mortgages frequently have fixed interest rate payments for long periods of time and are thus not as affected by changes in financial market prices and in expected short-run interest rates.

Finally, we check whether consumers with a high degree of economic and financial knowledge are better at incorporating news into their macroeconomic expectations and their economic decisions. In Figure 6 we thus show news effects for the sub-group of consumers with relatively high inflation forecast accuracy in the range of $-2 \leq \pi_{quant}^e \leq 2$ (actual inflation was 0.3% at the time of the survey), while Figure 7 presents news effects for those consumers with high financial literacy according to the definition by [Lusardi and Mitchell \(2011, 2014\)](#). As expected, panel 6b shows that consumers with high inflation forecast accuracy react more to their inflation expectations when they observe monetary news, while there is no significant effect of financial market news on either interest rate or inflation expectations. While we observe a similar effect of monetary news for inflation expectations of those with high financial literacy in panel 7b, we also see a stronger negative response to interest rate expectations for those recalling financial market news in panel 7c. However, due to the low number of observations with both high financial literacy and observed news in these categories, the interaction effects are imprecisely estimated. Interestingly, however, consumers with high financial literacy are the only sub-group for which we find a significantly negative impact of interest rate expectations on current consumption regardless of any news. It thus seems that some basic understanding for the way interest rates work is vital for being able to use nominal interest rate expectations for current consumption decisions.

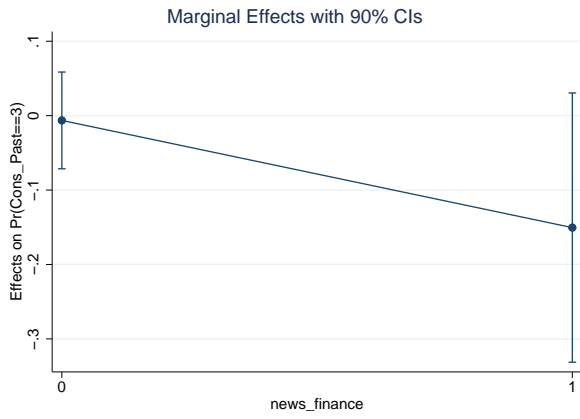
Figure 4: News Effects



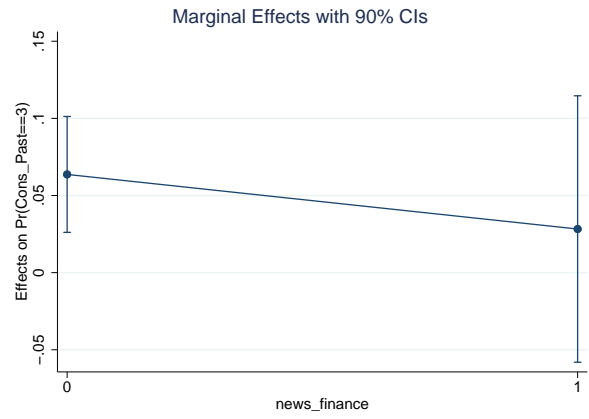
(a) Interest Expectations – Monetary News



(b) Inflation Expectations – Monetary News

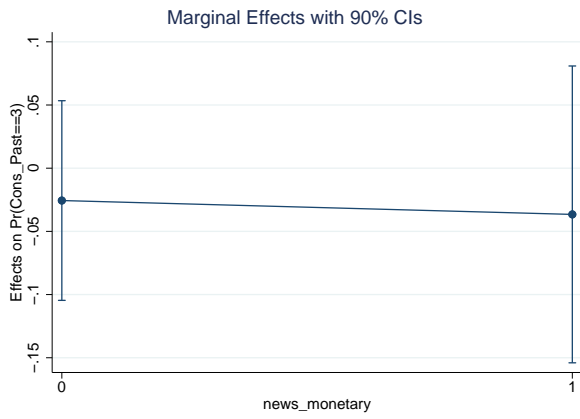


(c) Interest Expectations – Financial News

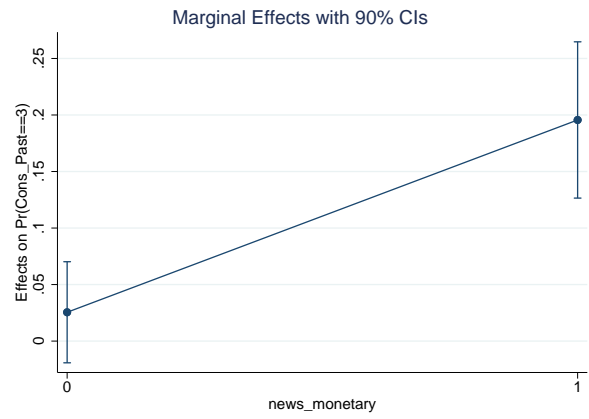


(d) Inflation Expectations – Financial News

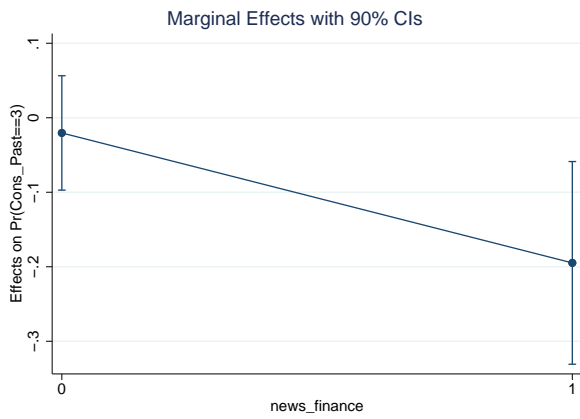
Figure 5: News Effects for Savers



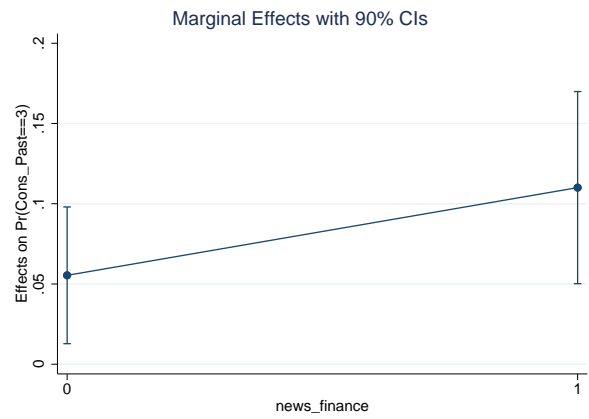
(a) Interest Expectations – Monetary News



(b) Inflation Expectations – Monetary News



(c) Interest Expectations – Financial News



(d) Inflation Expectations – Financial News

Figure 6: News Effects for those with $-2 \leq \pi_{quant}^e \leq 2$

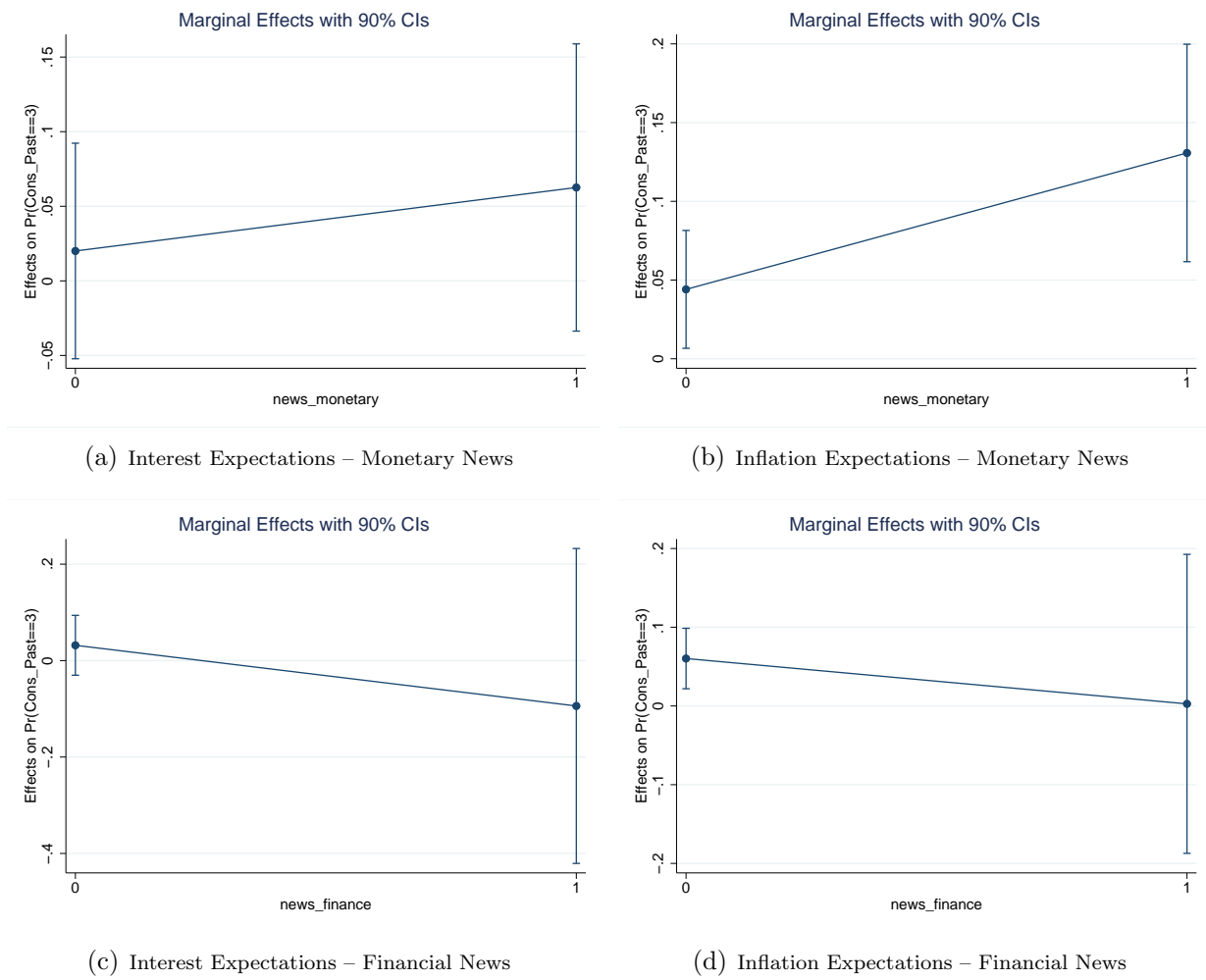
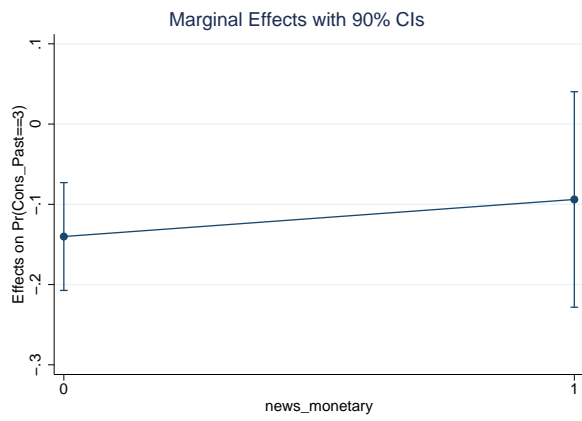
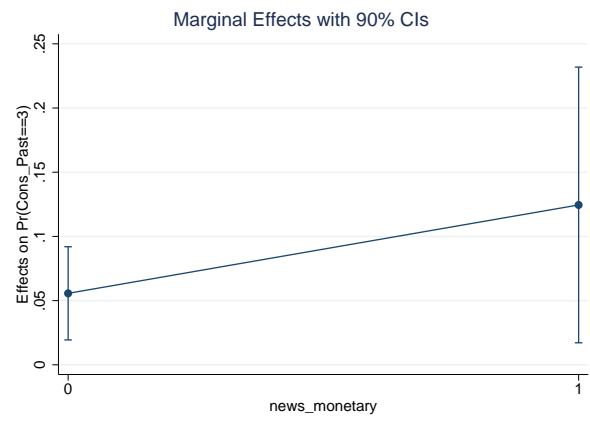


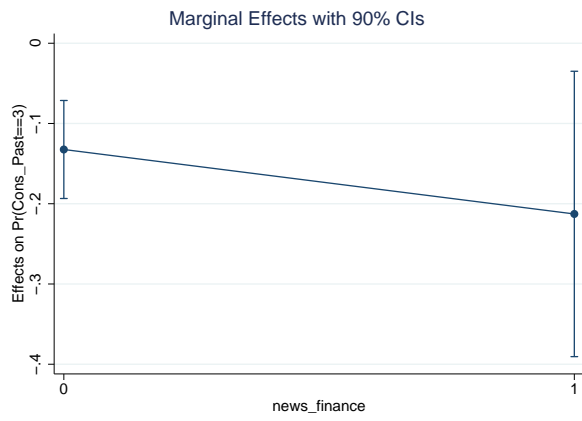
Figure 7: News Effects for Consumers with High Financial Literacy



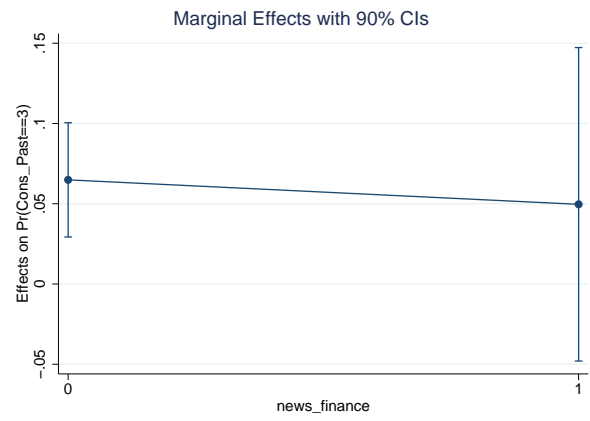
(a) Interest Expectations – Monetary News



(b) Inflation Expectations – Monetary News



(c) Interest Expectations – Financial News



(d) Inflation Expectations – Financial News

7 Conclusion

In this paper, we evaluate a new survey on German consumers' macroeconomic expectations, consumption and saving conducted at the University of Hamburg. Framing the analysis in the Euler equation, we test whether consumers' current spending is positively related to expected future spending, negatively to nominal interest rate expectations, and positively to expected inflation.

The results suggest that German consumers surveyed in 2015/2016 indeed report qualitative consumption paths with correlations in line with an Euler equation model: First, current spending depends positively on planned consumption spending in the next year. Second, current consumption is positively correlated with expected inflation, and negatively with nominal interest rate expectations, implying an overall negative link between current spending and the perceived real interest rate. These correlations are obtained while controlling for a large range of socio-demographic variables, additional individual macroeconomic expectations and a time fixed effect for the two waves. Moreover, the results are robust for both qualitative and quantitative macroeconomic expectations, when we include inflation perceptions in the models, and when we estimate the model in the larger cross-section of the Bundesbank Panel of Household Finances.

Finally, we evaluate the impact of news on monetary policy, inflation and financial market developments that are observed and reported by individual consumers in our survey. For the full cross-section, we find that the positive impact of inflation expectations on current spending becomes significantly stronger if the consumer observed any monetary news, including news on price changes. For the sub-group of savers, who are able to use the real interest rate for their consumption smoothing, this effect is even more pronounced. In addition, we find that savers also adjust their spending downwards significantly in response to higher nominal interest rate expectations if they observe news on financial market developments. Finally, consumers with high financial literacy also react significantly to both types of news. Overall, the results suggest that expectation formation under imperfect information may also influence the Euler equation relationship and that consumers incorporate news into their economic choices in a meaningful way.

To sum up, the analysis yields some interesting insights into consumers' decision making regarding their consumption allocation. Macroeconomic expectations matter for economic decisions, and the effects are in line both with economic theory and with the current German situation of a booming economy with very low inflation and interest rates near the ZLB at the time of the survey. Interestingly, consumers in the survey on average over-estimate current inflation strongly and the impact of their inflation expectations on current spending patterns is even more pronounced for the small sub-set of consumers who report having heard about rising prices, in line with theories of rational inattention (Sims, 2003). This gives some tentative indication that consumers' over-estimation of inflation in Germany may help to stabilize demand in deflationary periods, as also suggested by

Coibion and Gorodnichenko (2015b) for the US, but further research is needed to explore whether the expectations channel influencing spending decisions remains valid outside the zero lower bound.

8 Acknowledgements

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9 Appendix

9.1 Summary statistics

Table A1: Summary Statistics of Quantitative Inflation and Interest Rate Expectations

Variable	Mean	Median	SD	Min	Max	N
Inflation Exp. π_{it}^e	3.67	2.50	3.87	-10	15	421
Male	3.36	2.50	3.90	-10	15	221
Female	4.01	3.00	3.81	-3	15	200
-25	4.36	3.50	3.12	0	15	37
26-45	3.16	2.00	4.11	-10	15	134
46-65	3.69	2.50	3.78	-1	15	161
66+	3.95	3.00	3.76	-3	15	85
0-25% Income	3.76	3.00	3.48	0	15	44
25-50% Income	4.30	3.00	3.95	-3	15	51
50-75% Income	2.59	2.00	3.25	-7.5	10	57
75-100% Income	2.68	2.00	3.20	-3.5	15	38
Inflation Perc. π_{it}^p	3.59	2	4.13	-10	15	395
Male	3.21	2.00	3.95	-10	15	204
Female	3.98	2.50	4.30	-10	15	191
-25	4.89	4.25	4.00	-1	15	34
26-45	3.25	2.00	4.23	-10	15	129
46-65	3.44	2.00	4.24	-7	15	150
66+	3.68	2.50	3.60	-3	15	78
0-25% Income	4.23	3.50	3.51	0	15	43
25-50% Income	3.56	2.00	4.28	-10	15	50
50-75% Income	2.19	1.50	3.40	-10	10	51
75-100% Income	2.26	1.50	3.72	-5	15	35
Interest Rate Exp. i_{it}^e	1.03	0.50	1.15	0	5	250
Male	0.94	0.50	1.07	0	5	127
Female	1.13	0.75	1.23	0	5	123
-25	1.30	1.00	1.12	0	4	19
26-45	1.06	0.50	1.11	0	4	73
46-65	0.88	0.50	1.07	0	5	97
66+	1.14	0.90	1.25	0	5	58
0-25% Income	1.13	1.00	1.34	0	5	30
25-50% Income	0.90	0.90	0.88	0	4	38
50-75% Income	0.85	0.40	1.13	0	4	32
75-100% Income	0.97	0.50	1.08	0	3.5	25

Note: University of Hamburg data. Quantitative inflation expectations and inflation perceptions are truncated in the range $-15 \leq \pi_{it}^{e,p} \leq 15$ for both waves, and quantitative interest rate expectations are truncated in the range $i_{it}^e \leq 5$ with data only for the second wave.

9.2 Robustness Check: Analysis with PHF Data

In addition, we compare our findings from the University of Hamburg survey with the results obtained from the larger cross-section of the Bundesbank Panel on Household Finances (PHF) survey. While the PHF misses a number of desirable variables for the estimation of a consumption Euler equation, such as households' expected change in expenditures, expectations on durable consumption, measures of inflation perceptions as well as additional macroeconomic expectations, we can nevertheless use it to estimate a basic qualitative consumption Euler equation. Moreover, the survey has the advantage of including a much larger cross-section.

The PHF is a representative sample of the German households and an integral part of the Euro Area Household Finances and Consumption Survey (HFCS). The survey is conducted by face-to-face, computer-assisted personal interviews. The first two waves took place during the periods of September 2010 - July 2011 and April-November 2014, respectively.¹⁸ In total, 3,565 (wave 1) and 4,461 (wave 2) household interviews were collected. All households who participated in wave 1 were re-contacted, resulting in a participation rate of about 60% in the second wave. Since the survey question on nominal interest rate expectations, one of our key variables of interest, was only included in the second wave, our analysis mainly uses the second wave of the PHF survey. Moreover, the second wave is closer in timing to the University of Hamburg survey.

As shown in Table A3, our main results from the Euler equation estimation are robust also in the larger PHF survey datasets: In both waves, we find a significant positive correlation between current household spending and individual inflation expectations. This is true for both qualitative and quantitative inflation expectations, where the latter are only available in the second wave. Moreover, there is a significantly negative correlation between qualitative interest rate expectations and current spending, again in line with the Euler equation model. Since the PHF survey does not ask about expected consumption spending, we include expected saving instead in our estimations and hypothesize a negative relationship to current spending. While all estimates have a negative sign, they are not significantly different from zero.

¹⁸The third wave of the PHF started in March 2017 and the data was still not available at the time when we conducted this study.

Table A2: Summary Statistics of Quantitative Inflation and Interest Rate Expectations
PHF Wave 2

Variable	Mean	Median	SD	Min	Max	N
All	2.74	2.00	2.92	-15.00	15.00	4,121
Male	2.45	2.00	2.69	-10.00	15.00	2,464
Female	3.10	2.00	3.14	-15.00	15.00	1,657
-25	3.71	3.00	3.95	-0.70	15.00	138
26-45	2.76	2.00	3.07	-15.00	15.00	941
46-65	2.68	2.00	2.72	-10.00	15.00	1,757
66+	2.60	2.00	2.68	-10.00	15.00	1,285
0-25% Income	3.04	2.00	3.17	-10.00	15.00	976
25-50% Income	2.76	2.00	2.69	-5.00	15.00	1,031
50-75% Income	2.76	2.00	3.00	-15.00	15.00	1,036
75-100% Income	2.11	2.00	2.40	-10.00	15.00	1,062
All	0.84	0.50	0.77	0.00	5.00	3,889
Male	0.85	0.70	0.76	0.00	5.00	2,324
Female	0.82	0.50	0.77	0.00	5.00	1,565
-25	0.92	0.75	0.78	0.00	5.00	124
26-45	0.91	0.70	0.87	0.00	5.00	858
46-65	0.79	0.50	0.74	0.00	5.00	1,666
66+	0.80	0.50	0.66	0.00	5.00	1,241
0-25% Income	0.97	0.70	0.93	0.00	5.00	871
25-50% Income	0.77	0.50	0.67	0.00	5.00	976
50-75% Income	0.82	0.50	0.69	0.00	5.00	990
75-100% Income	0.71	0.50	0.61	0.00	5.00	1,041

Note: PHF data, second wave. Quantitative inflation expectations is truncated in the range $-15 \leq \pi_{it}^{e,p} \leq 15$, and quantitative interest rate expectations are truncated in the range $i_{it}^e \leq 5$.

Table A3: Consumption Euler Equation, the PHF Survey

	(1) Wave 1 & 2	(2) Wave 2	(3) Wave 2	(4) Wave 2
$saving_{qual,it}^e$	-0.019 (0.012)	-0.020 (0.017)	-0.025 (0.017)	-0.023 (0.018)
$i_{qual,it}^e$		-0.030** (0.012)	-0.027** (0.013)	
$i_{quant,it}^e$				0.003 (0.013)
$\pi_{qual,it}^{e,1yr}$	0.023** (0.010)	0.024* (0.014)		
$\pi_{quant,it}^{e,1yr}$			0.008** (0.003)	0.007** (0.003)
Real Income Expectations	Yes	Yes	Yes	Yes
Tax Expectations	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes
Wave Dummy	Yes	No	No	No
Pseudo R ²	0.009	0.015	0.016	0.012
N observations	7526	4014	3773	3510

Note: The PHF survey. Marginal effects for the probability of answering in the highest category are reported from weighted estimations and evaluated at the sample mean. Demographic factors include age, age², income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level for the pooled waves 1 & 2 (column 1), and at the municipal level for the second wave (column 2-4). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

9.3 Further Robustness Checks

This section contains further robustness checks for the Euler equation model with the University of Hamburg survey data. Specifically, we estimate the consumption Euler equation in its baseline specification separately for the first and the second wave of the University of Hamburg survey in Table A4. In addition, we check if current spending is also significantly related to long-run inflation expectations or to expectations of house prices in Table A5.

The estimates for the effect of expected spending and expected interest rates remain remarkably stable across the two waves, see Table A4. There is a significantly positive correlation of current and expected spending in the whole sample and a significantly negative correlation of spending with expected nominal interest rates in the subsample of consumers with high financial literacy. While the correlation between expected inflation and current spending is significantly positive for the whole sample in the first wave, in the second wave it becomes only significant for consumers with high financial literacy. Overall, it seems that the results are not driven by one of the two waves.

Including qualitative long-run inflation or houseprice expectations in Table A5 reveals a less strong relation to current consumption spending compared to the correlation with short-run inflation expectations. We find a significantly positive relation to current spending only in the model with long-run inflation expectations for households with high financial literacy. All the remaining effects remain robust. It thus seems that the evidence of an Euler equation relationship is much stronger for short-run inflation expectations than for other measures of expected price changes.

Table A4: Robustness Checks, Consumption Euler Equation

	(1)	(2)	(3)	(4)
	Wave 1	Wave 1 Fin. literacy	Wave 2	Wave 2 Fin. literacy
c_{it}^e	0.134*** (0.049)	0.024 (0.059)	0.134* (0.081)	-0.040 (0.076)
$i_{qual,it}^e$	-0.039 (0.042)	-0.136*** (0.049)	0.003 (0.065)	-0.131*** (0.050)
$\pi_{qual,it}^e$	0.073*** (0.021)	0.053** (0.025)	0.028 (0.043)	0.068* (0.037)
Macro Expectations	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes
Pseudo R ²	0.186	0.186	0.158	0.133
N observations	257	173	168	119

Note: University of Hamburg survey. Marginal effects for the probability of answering in the highest category are reported from weighted estimations and evaluated at the sample mean. Macro expectations are on the general economic situation and the unemployment rate. Demographic factors include age, age², income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A5: Euler Equation with Long-Run and House Price Inflation Expectations

	(1)	(2)	(3)	(4)
	All HHs	All HHs	Fin. literacy	Fin. literacy
c_{it}^e	0.170** (0.067)	0.172** (0.074)	-0.000 (0.052)	0.005 (0.051)
$i_{qual,it}^e$	-0.023 (0.042)	-0.052 (0.036)	-0.152*** (0.042)	-0.141*** (0.042)
$\pi_{qual,it}^{e,5yrs}$	0.010 (0.031)		0.053** (0.023)	
$\pi_{qual,it}^{e,house}$		0.004 (0.017)		-0.019 (0.020)
Macro Expectations	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes
Wave Dummy	Yes	Yes	Yes	Yes
Pseudo R ²	0.112	0.118	0.130	0.120
N individuals	274	276	184	188
N observations	419	420	288	294

Note: University of Hamburg survey. Marginal effects for the probability of answering in the highest category are reported from weighted estimations and evaluated at the sample mean. Macro expectations are on the general economic situation and the unemployment rate. Demographic factors include age, age², income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

9.4 Further Results

Table A6: Testing for Habit Formation, Quantitative Inflation Expectations

	(1)	(2)	(3)	(4)
	All HHs	All HHs	Fin. literacy	Fin. literacy
$c_{it-1}^{current}$	0.211** (0.083)	0.201** (0.078)	0.240*** (0.081)	0.242*** (0.080)
c_{it}^e	0.131 (0.098)	0.101 (0.096)	-0.055 (0.088)	-0.057 (0.086)
$i_{qual,it}^e$	0.036 (0.068)	0.018 (0.058)	-0.093* (0.051)	-0.089* (0.049)
$\pi_{quant,it}^e$	0.012 (0.013)		0.013 (0.013)	
$\pi_{quant,it}^p$		0.022* (0.013)		0.015 (0.011)
$\pi_{quant,it}^e - \pi_{quant,it}^p$		-0.023 (0.020)		0.008 (0.025)
Macro Expectations	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes
Wave Dummy	Yes	Yes	Yes	Yes
Pseudo R ²	0.208	0.255	0.204	0.204
N individuals	155	151	110	109
N observations	155	151	110	109

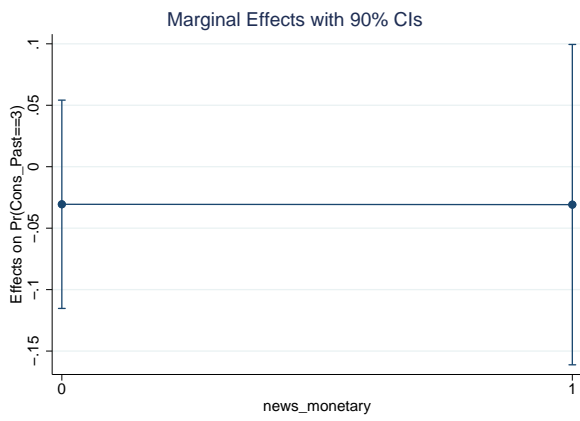
Note: University of Hamburg survey. Marginal effects for the probability of answering in the highest category are reported from weighted estimations and evaluated at the sample mean. Macro expectations are on general economic situation and unemployment rate. Demographic factors include age, age², income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A7: Euler Equation with the Readiness to Spend on Durables for Households with High Financial Literacy

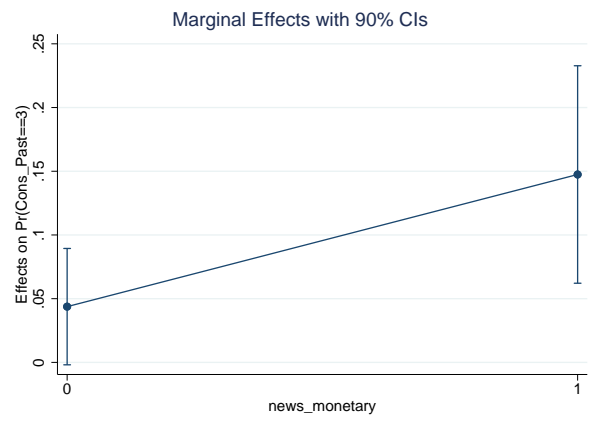
	(1)	(2)	(3)	(4)	(5)
	Financial literacy	Financial literacy	Financial literacy	Financial literacy	Fin. literacy Wave 2
$c_{it}^{e,dur}$	0.065* (0.037)	0.056 (0.039)	0.066 (0.041)	0.088** (0.042)	0.174** (0.083)
$i_{qual,it}^e$	-0.005 (0.046)	0.010 (0.045)	-0.025 (0.046)	-0.020 (0.050)	
$i_{quant,it}^e$					-0.005 (0.043)
$\pi_{qual,it}^e$	-0.026 (0.023)				
$\pi_{quant,it}^e$			-0.053*** (0.013)		-0.037*** (0.013)
$\pi_{qual,it}^p$		-0.132*** (0.039)			
$\pi_{quant,it}^p$				-0.038*** (0.011)	
$\pi_{quant,it}^e - \pi_{quant,it}^p$				-0.026 (0.017)	
Macro Expectations	Yes	Yes	Yes	Yes	Yes
Demographic	Yes	Yes	Yes	Yes	Yes
Wave Dummy	Yes	Yes	Yes	Yes	No
Pseudo R ²	0.179	0.209	0.277	0.293	0.365
N individuals	183	182	166	158	108
N observations	287	286	256	234	108

Note: University of Hamburg survey. Marginal effects for the probability of answering in the highest category are reported from weighted estimations and evaluated at the sample mean. Macro expectations are on general economic situation and unemployment rate. Demographic factors include age, age², income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

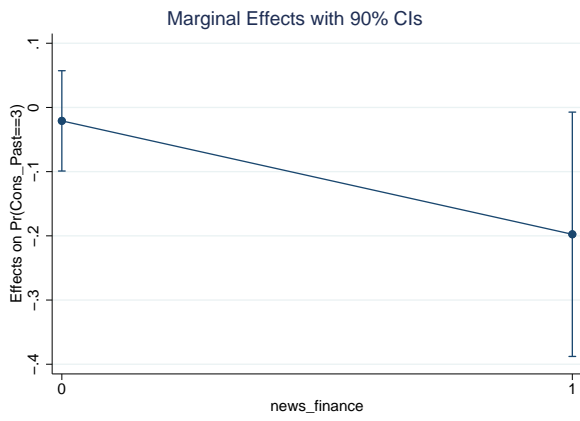
Figure A1: News Effects for Consumers Saving on Financial Markets



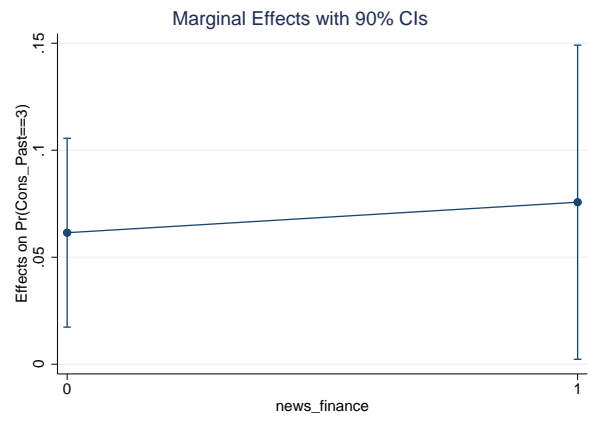
(a) Interest Expectations – Monetary News



(b) Inflation Expectations – Monetary News

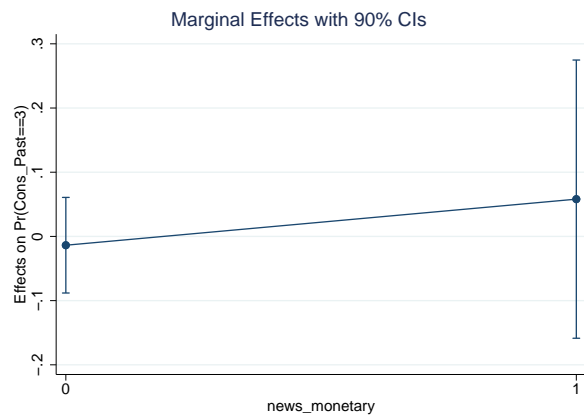


(c) Interest Expectations – Financial News

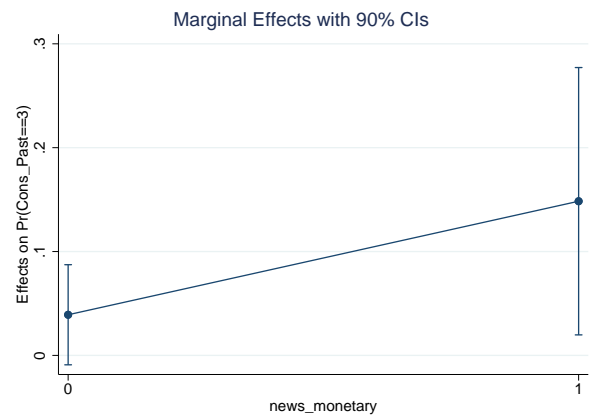


(d) Inflation Expectations – Financial News

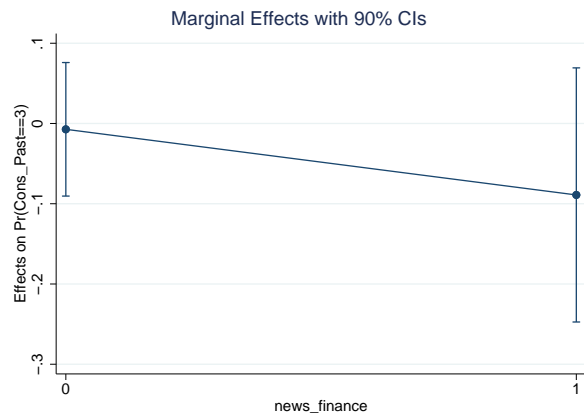
Figure A2: News Effects for Consumers Holding Credit



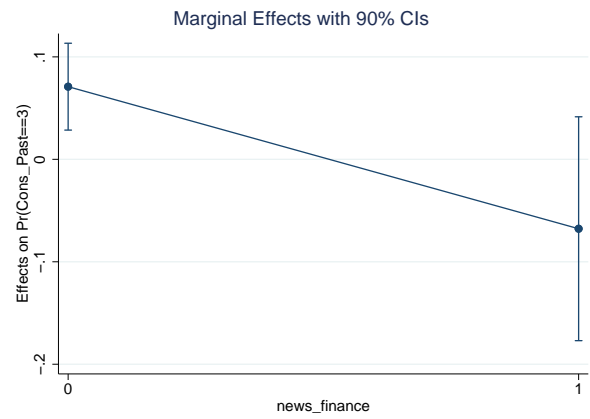
(a) Interest Expectations – Monetary News



(b) Inflation Expectations – Monetary News

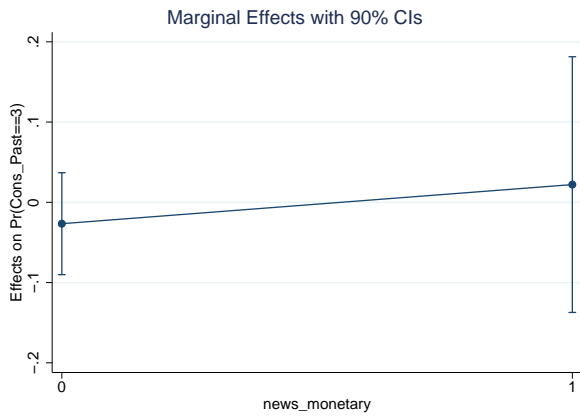


(c) Interest Expectations – Financial News

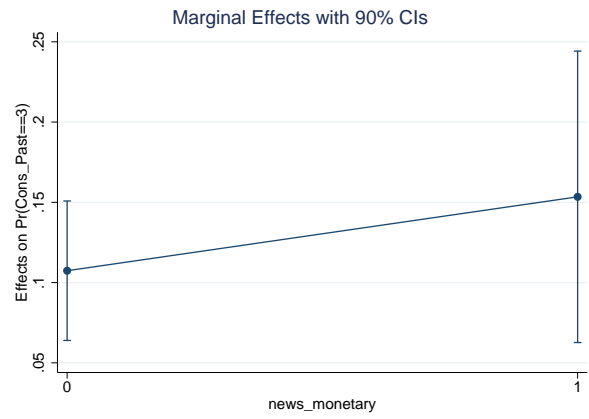


(d) Inflation Expectations – Financial News

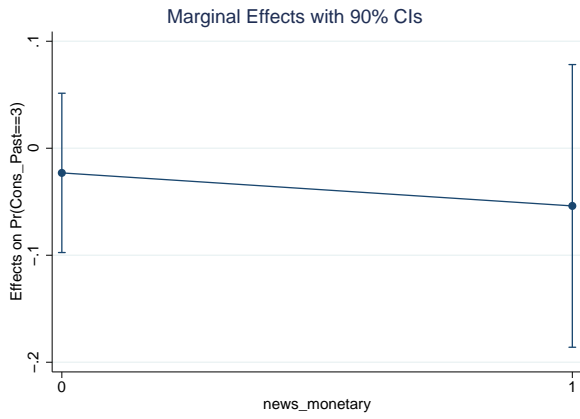
Figure A3: News Effects of Monetary News for Age groups



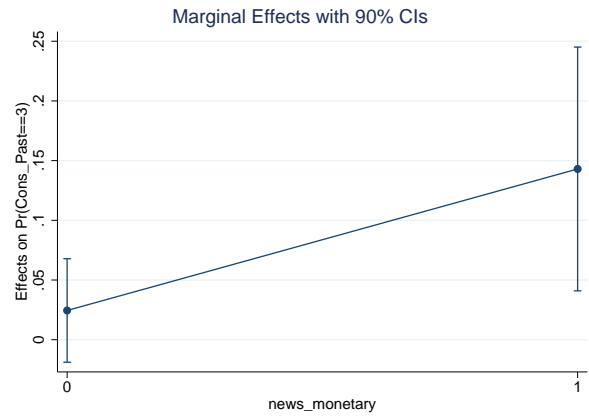
(a) Interest Expectations – Young ≤ 45



(b) Inflation Expectations – Young ≤ 45

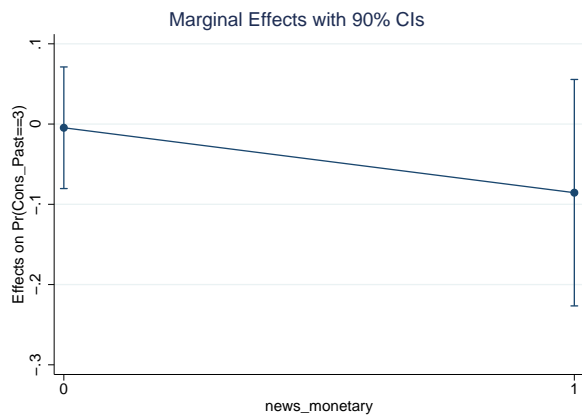


(c) Interest Expectations – Old > 45

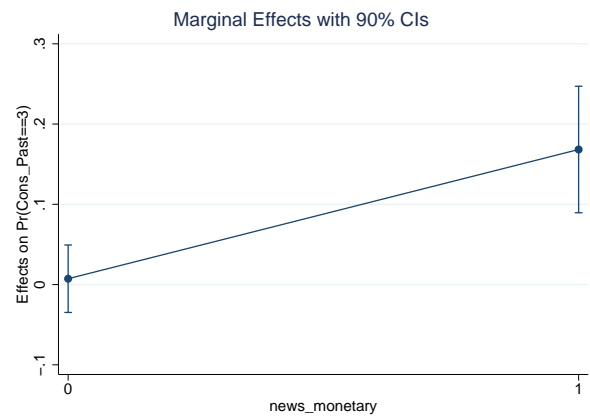


(d) Inflation Expectations – Old > 45

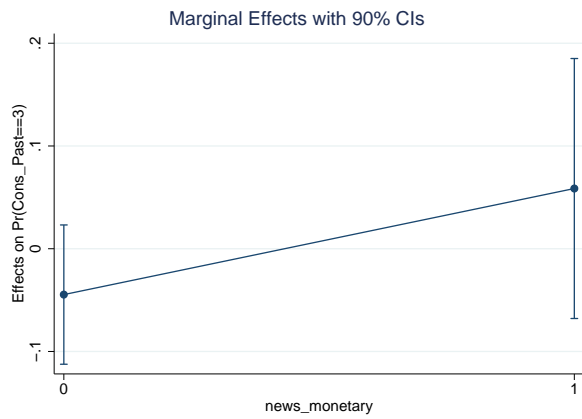
Figure A4: News Effects of Monetary News for Income groups



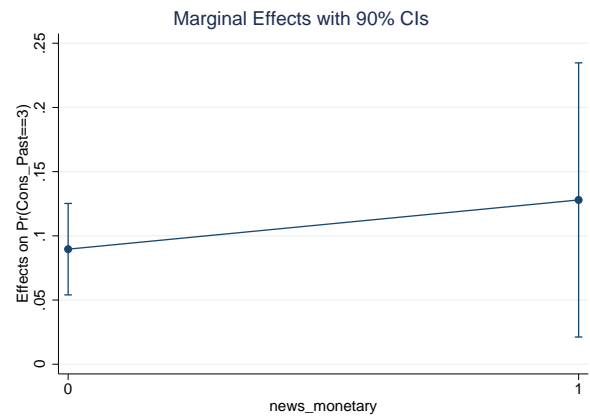
(a) Interest Expectations – Low Income ≤ 2.000 €



(b) Inflation Expectations – Low Income ≤ 2.000 €



(c) Interest Expectations – High Income > 2.000 €



(d) Inflation Expectations – High Income > 2.000 €

9.5 Survey Question Wording, University of Hamburg Survey

The wording of further survey questions regarding current and planned consumption is as follows:

- Expected consumption of durable goods $c_{it}^{e,dur}$: *“In the next 12 months, do you expect to spend more or less on large purchases such as furniture or electronic devices or such than in an average year in the past?”*
 - A lot more
 - Somewhat more
 - About the same
 - Somewhat less
 - A lot less
 - Don’t know
 - No answer

- Readiness to spend on durables $c_{it}^{readydur}$: *“When looking at the current economic situation, do you think now is a good or an bad time for people to make large purchases such as furniture or electronic devices and so on?”*
 - Now is a good time
 - Neither a good, nor a bad time
 - Now is a bad time
 - Don’t know
 - No answer

- Long-run inflation expectations $\pi_{qual,it}^{e,5yrs}$: *“How do you think prices in general will develop over the next 5 years compared to the previous year? They will”*
 - Increase more than before
 - Increase at about the same rate
 - Increase less strongly than before
 - Stay about the same
 - Fall
 - Don’t know
 - No answer

- Houseprice inflation expectations $\pi_{qual,it}^{e,house}$: *“How do you think house prices in your neighborhood will develop over the next 12 months compared to today? They will”*

- Increase considerably
- Increase somewhat
- Stay about the same
- Fall somewhat
- Fall considerably
- Don't know
- No answer

Wordings for additional control variables:

- Qualitative general economic expectations $econ_{it}^{e,qual}$: *“How do you think the economy in Germany in general is going to develop over the next 12 months? It will”*
 - Improve considerably
 - Improve somewhat
 - Stay about the same
 - Deteriorate somewhat
 - Deteriorate considerably
 - Don't know
 - No answer
- Qualitative unemployment expectations $u_{it}^{e,qual}$: *“How do you think unemployment in Germany in total is going to develop over the next 12 months? It will”*
 - Increase considerably
 - Increase somewhat
 - Stay about the same
 - Drop somewhat
 - Drop considerably
 - Don't know
 - No answer
- News heard $news_{it}$: *“In the recent months, have you heard or read about any positive or negative business or economic news in general?”*
 - Yes, positive
 - Yes, negative

- Yes, both
 - No, neither positive nor negative
 - Don't know
 - No answer
- News categories open question: *“If yes, what did you hear or read?”*
 - ...
 - Don't know
 - No answer
- Financial risk attitude $risk_{it}$: *“When taking decisions on savings or financial investment, which of the following statements best describes your personal attitude?”*
 - I take considerable risks and want to gain very high profits
 - I take above average risks and want to gain above average profits
 - I take average risks and want to gain average profits
 - I am not willing to take any financial risks
 - Don't know
 - No answer

Definitions for financial market participation:

- Respondents who save:
 - Question *“Which of the following statements best describes the current financial situation of your household?”*
 - Answer *“The household saves regularly”*
- Respondents active on financial markets:
 - Question *“In which assets do you normally save?”*
 - Possible answers *“Bonds, stocks, life insurance, private pension scheme (e.g. Riester), home ownership savings plan”*
- Respondents paying off debt:
 - Question *“In which assets do you normally save?”*

- Answer “*Paying off credit or a mortgage*”

Survey questions regarding financial literacy:

- Compound Interest Effect: “*Let us assume you have a balance of €100 in your savings account. This balance bears interest at an annual rate of 2%, and you leave it there for 5 years. What do you think: How high is your balance after 5 years?*”
 - Higher than €102
 - Exactly €102
 - Lower than €102
 - Don't know
 - No answer
- Real Interest Rate: “*Let us assume that the interest paid on your savings account is 1% per year and the inflation rate is 2% per year. What do you think: After a year, will you be able to buy just as much, more or less than today with the balance in your savings account?*”
 - More than today
 - Just as much
 - Less than today
 - Don't know
 - No answer

9.6 Survey Question Wording, Bundesbank PHF Survey

The wording of the survey questions regarding current consumption $c_{it}^{current}$ is as follows:

- “If you exclude financial investments: Would you say that the last 12 months’ expense correspond to a normal year in terms of the total expenditures of your household?”
 - Yes
 - No
 - Don’t know
 - No answer

- “Were the expenditures higher or lower than in a normal year?”
 - Higher
 - Lower
 - Don’t know
 - No answer

Survey questions regarding saving, interest rate, and inflation expectations:

- Saving expectation $saving_{qual,it}^e$: “If you now compare the next twelve months with the last two years: Will your household save or invest a larger, smaller or roughly equivalent percentage of the disposable household income in total?”
 - A larger percentage
 - A smaller percentage
 - An equivalent percentage
 - Don’t know
 - No answer

- Qualitative interest rate expectation $i_{qual,it}^e$: “What do you think, how will interest rates change for your savings accounts over the next twelve months on average?”
 - Increase significantly
 - Increase somewhat
 - Stay approximately the same
 - Fall somewhat
 - Fall significantly

- Don't know
 - No answer
 - Different
- Quantitative interest rate expectation $i_{qual,it}^e$: *“What do you think, how high will interest rates in your savings accounts be over the next twelve months on average?”*
 - ... Percent
 - Don't know
 - No answer
 - Different
- Qualitative inflation expectation $\pi_{qual,it}^{e,1yr}$: *“What do you think, how will the general price level change in the next twelve months?”*
 - Rise significantly
 - Rise somewhat
 - Stay approximately the same
 - Fall somewhat
 - Fall significantly
 - Don't know
 - No answer
- Quantitative inflation expectation $\pi_{quant,it}^{e,1yr}$: *“What do you think, by what percentage will the general price level in the next 12 months?”*
 - ... Percent
 - Don't know
 - No answer

Survey questions regarding further economic expectations:

- Qualitative real income expectation $real_income_{qual,it}^e$: *“What do you think, will the income of your household rise faster or slower in the next twelve months than the cost of living or approximately as same as the cost of living”*
 - Will rise more than the cost of living
 - Will rise about as much as the cost of living
 - Will rise less than the cost of living

- Don't know
- No answer
- Qualitative tax expectation $tax_{qual,it}^{e,1yr}$: *“What do you think, how will taxes and social security contributions change over the next twelve months?”*
 - Rise significantly
 - Rise somewhat
 - Stay approximately the same
 - Fall somewhat
 - Fall significantly
 - Don't know
 - No answer

Survey question regarding risk-taking attitude:

- *“How do you view yourself: Are you in general a risk-taking person or do you try to avoid risks?”* Please use the numbers from 0 to 10: 0 means that you are “not at all ready to take risks” and 10 means that you are “very willing to take risks”

Survey questions regarding financial literacy:

- Compound Interest Effect: *“Let us assume you have a balance of €100 in your savings account. This balance bears interest at an annual rate of 2%, and you leave it there for 5 years. What do you think: How high is your balance after 5 years?”*
 - Higher than €102
 - Exactly €102
 - Lower than €102
 - Don't know
 - No answer
- Real Interest Rate: *“Let us assume that the interest paid on your savings account is 1% per year and the inflation rate is 2% per year. What do you think: After a year, will you be able to buy just as much, more or less than today with the balance in your savings account?”*
 - More than today
 - Just as much
 - Less than today
 - Don't know
 - No answer