ARE CONSUMERS' SPENDING DECISIONS IN LINE WITH A 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 a Euler equation model. We find that consumers are more likely to increase current spending if they plan to increase spending in the future and if they expect higher inflation. In the subsample of financially literate households, we find an additional negative effect of nominal interest rate expectations. The effects of macroeconomic expectations become stronger if consumers observed news on monetary policy or financial markets. These news effects are particularly pronounced for consumers who save and those with low inflation forecast accuracy.

I. Introduction

IN the recent zero lower bound (ZLB) environment, central banks in many countries have focused their communication efforts on households with the aim of guiding and anchoring households' inflation expectations and thereby influencing real interest rates. The main theoretical hypothesis underlying this channel is derived from the well-known Euler equation: assuming that current consumption depends negatively on the real interest rate, in times of negative shadow interest rates, an increase in expected inflation will lower real interest rates and thereby boost consumption.[1] Therefore, an important question is: Do consumers act on their expectations in their economic decision making? In particular, are households' perceptions of real interest rates as measured in survey data significantly related to their consumption spending decisions in the way predicted by the theory?

Recently, several studies have used microsurvey data to test for a link between consumers' inflation expectations and measures of their current spending or their reported readiness to consume (Bachmann, Berg, & Sims, 2015; Burke & Ozdagli, 2013; Ichiue & Nishiguchi, 2015; D'Acunto, Hoang, & Weber, 2016; Crump et al., 2015; Duca, Kenny, & Reuter, 2018; Coibion et al., 2019). However, the results so far have been mixed: some studies report a positive link between inflation expectations and current spending, while others find insignificant or negative effects.

In this paper, we estimate Euler equation models using household survey microdata obtained from our own telephone survey conducted with the German population. We add to the previous literature along several dimensions: First, while previous papers have mainly focused on the effect of inflation expectations on current spending, we jointly test whether consumers' current spending decision is affected by individually expected future spending, expected nominal interest rates, and expected inflation.[2] Thereby, we are able to distinguish between two different channels by which consumers' perception of real interest rates may affect their current spending decision: the nominal interest rate channel and the inflation channel. Moreover, we test if future expected spending significantly affects current spending decisions.

Second, we evaluate whether having heard any news on monetary policy, inflation, and financial markets strengthens the marginal effect of consumers' interest rate and inflation expectations on their spending decisions. This is highly relevant, since any effect from observed news on the link between macroeconomic expectations and spending choices could provide evidence for a potential channel via which central bank communication influences economic choices by the general public. If having heard news makes consumers more informed about current inflation, interest rates, or monetary policy, this likely also reduces the information costs related to incorporating macroeconomic expectations into economic choices (Sims, 2003). In addition, we evaluate whether news effects differ among groups with differences in financial literacy, socioeconomic status, or financial market participation.

Finally, 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 into surveys recording only qualitative data.

The analysis is conducted using two cross-sectional waves from a new household survey of the German population we conducted at the University of Hamburg. The survey is tailored to obtain detailed information on consumers' current

[1]Note 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).

[2]Notable exceptions are the papers by Burke and Ozdagli (2013) and Bachmann et al. (2015) who evaluate the impact of both inflation expectations and nominal interest rate expectations on current spending on durable and nondurable goods (Burke & Ozdagli, 2013) or on consumers' reported readiness to spend on durables (Bachmann et al., 2015).

and planned consumption and saving behavior, as well as a large set of individual macroeconomic expectations, a question on economic news observed by the consumer, and sociodemographic details including consumers' financial literacy and risk preferences. 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 online appendix.

Our results give some evidence in favor of the consumption Euler equation. We find that reported current consumption is related positively to consumers' planned consumption over the next twelve months in the full sample. Moreover, consumers are more likely to report higher current spending if they expect higher inflation, in line with the results in Crump et al. (2015) and Ichiue and Nishiguchi (2015). Higher expected nominal interest rates have no significant impact on total current spending in the full sample, but decrease the likelihood of higher current spending for households with high financial literacy. Interestingly, the marginal effect of inflation expectations is reversed and becomes negative when, instead of actual current overall consumption, we evaluate consumers' reported "readiness to spend on durables," in line with the results for the United States (during the ZLB) in Bachmann et al. (2015), but in contrast to the results for the European countries in D'Acunto, Hoang, and Weber (2016) and Duca et al. (2018). At the same time, we find that expected nominal interest rates have no significant effect on the readiness to spend on durables, which is in contrast to the mostly positive marginal effects reported in Bachmann et al. (2015).

Evaluating the effect of having heard monetary 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 decisions. At the same time, consumers who heard news on financial markets show a stronger negative marginal effect of their interest rate expectations on their spending decisions. While the latter effect nevertheless remains insignificant in the full sample, it becomes strongly significant for households with high education. Overall, our results suggest that news helps consumers to incorporate their macroeconomic expectations into their economic decision making in an informed way. This mechanism is particularly pronounced for households that benefit from a more informed decision, that is, those able to use the real interest rate for their consumption-smoothing or households with a low initial level of information.

This study is related to the literature testing for a link between household consumption and consumers' macroeconomic expectations, where most studies focus on the effect of consumers' inflation expectations. 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 on durables." Expected nomi-

nal interest rates are found to have a positive effect on the readiness to spend on durables. Similarly, Burke and Ozdagli (2013) evaluate the effect of inflation expectations on actual consumer spending on both durable and nondurable goods in a household panel and find some positive effects of inflation expectations on durable spending but none on nondurable consumption. By contrast, 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. D'Acunto et al. (2016) report a positive relationship between German consumers' "readiness to spend" on durables and their inflation expectations outside the ZLB. They further evaluate the impact of an unexpected VAT increase in Germany and attribute a large increase in readiness to spend after the shock to increases in inflation expectations. Similarly, Duca et al. (2018) estimate a larger panel of European countries and 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. Vellekoop and Wiederholt (2019) link Dutch household survey data on inflation expectations with administrative data measuring household income and wealth. The authors find a negative relation between individual household saving and inflation expectations in a panel setting. D'Acunto et al. (2019a, 2019b) show for a unique data set on Finnish men that a positive link between respondents' inflation expectations and their reported readiness to spend on durables exists only for high-IQ men, while the relation is insignificant for the low-IQ sample. Finally, Coibion et al. (2019) apply a randomized control trial approach in a Dutch household survey to identify causal effects of exogenous changes in inflation expectations on household spending. The authors report a small, positive effect of an exogenous rise in inflation expectations on current nondurable spending, but a sharp fall in expenditures on durables, leading to an overall negative effect. A similar effect on durable spending by Italian households is reported in Rondinelli and Zizza (2020). 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 overall spending decisions. In addition, we evaluate the impact of news observed by consumers on the effect of individual macroeconomic expectations on current spending.

Moreover, our analysis relates to the vast empirical literature on consumption life-cycle models and the question of whether households smooth their consumption (see Browning & Crossley, 2001, for an overview of the empirical literature). Previous approaches, such as 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, studies such as Crump et al. (2015) use quantitative survey data for expected consumption growth and expected inflation to estimate a Euler equation relationship. In this

paper, due to the qualitative nature of our survey data, we focus on the sign and significance of the estimated marginal effects in the Euler equation relationship but cannot 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 through 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 consumers recall.

Finally, since we evaluate the effect of news regarding monetary policy, inflation, or financial markets from consumers' own recollection (the receiver perspective) on the way that macroeconomic expectations are incorporated into spending decisions, we also indirectly relate to the literature on central bank communication. As Coibion et al. (2018) argued, inflation expectations of both households and firms across countries are currently far from being anchored, with a large degree of overestimation in inflation and general lack of knowledge about the concept of inflation or the targets of monetary policy. In a survey experiment, Coibion et al. (2019) show that treating individual consumers with information on inflation or recent Fed announcements significantly increases the forecast accuracy of respondents, albeit with a relatively short-lived effect. While the authors show that media news in their setup have fewer strong effects, Lamla and Vinogradov (2019) report in a different survey experiment that Fed announcement effects on consumers' inflation and interest rate perceptions and expectations become effective only with media coverage. We add to these studies by evaluating the effect of news not for level expectations but for their effect on spending decisions. In addition, by focusing on the receiver perspective of news recalled by consumers, we can abstract from differences between news received via direct central bank communication channels or news received via the media.

The rest of the paper is structured as follows. The theoretical framework for the analysis is described in section II. Section III describes the new survey data set, and section IV 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 V presents the estimates of our Euler equation model, and section VI evaluates the role of news. Finally, section VII summarizes and concludes.

II. Relating Consumers' Consumption Plans to a Euler Equation

Ever since the seminal contribution by Friedman (1957), the standard consumption Euler equation describes the optimal intertemporal consumption path with consumption smoothing and thus relates current real consumption c_t to expected future consumption $E_t c_{t+1}$, nominal interest rates i_t, and expected inflation $E_t \pi_{t+1}$. Under the assumption of utility with constant relative risk aversion (CRRA), the following log-linear, first-order approximation arises:

$$c_t = E_t c_{t+1} - \sigma^{-1} (i_t - E_t \pi_{t+1} - \ln \beta). \tag{1}$$

In this framework, the intertemporal substitution elasticity between current and future consumption, σ^{-1}, thus measures the effect of the opportunity cost of choosing consumption over saving as given by the real interest rate, adjusted for the household's time preference rate β.[3]

The questions about current and expected consumption spending in our survey are phrased in qualitative categories relative to an average year but are not explicitly asked in real terms.[4] Therefore, as Crump et al. (2015) discussed, the estimated parameter for the effect of expected inflation on current nominal spending is a linear transformation of the underlying structural one. In our setup, the Euler equation in equation (1) can be reformulated in nominal terms as follows:

$$c_t^{nominal} - p_t = E_t c_{t+1}^{nominal} - E_t p_{t+1} - \sigma^{-1} (i_t - E_t \pi_{t+1}),$$
$$c_t^{nominal} = E_t c_{t+1}^{nominal} - \sigma^{-1} i_t + \sigma^{-1} E_t \pi_{t+1}$$
$$- (E_t p_{t+1} - p_t),$$
$$c_t^{nominal} = E_t c_{t+1}^{nominal} - \sigma^{-1} i_t + (\sigma^{-1} - 1) E_t \pi_{t+1}. \tag{2}$$

When the Euler equation is formulated in nominal terms, the coefficients on nominal interest rates and expected inflation are thus not of the same size. Since, unlike in Crump et al. (2015), our survey questions of current and expected spending are measured qualitatively; we cannot estimate any structural parameters and hence do not attempt to estimate the size of the intertemporal elasticity of substitution σ^{-1}. Instead, we analyze whether the estimated marginal effects on the likelihood of responding that current spending are higher than in an average year are significant and with the correct sign according to the theory. From equation (2), we thus expect a negative marginal effect of the nominal interest rate on current nominal spending. The theoretical marginal effect of expected inflation on current nominal spending is less clear. For values of $\sigma^{-1} > 1$, we would expect a positive marginal effect. For values of $0 < \sigma^{-1} < 1$, the marginal effect could become negative, and for values around 1, it could be 0.[5] Moreover, equations (1) and (2) also imply that if the estimated marginal effect of inflation expectations on current

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[3]In our econometric setup, we assume homogeneity in the time preference rate conditional on observables and thus include it in the constant. For simplicity, we leave out β in all further derivations. The time period t refers to one month.

[4]The exact wording of the main survey questions is discussed in section III, and the wording for the remaining questions is given in the online appendix.

[5]Note that we need to assume a specific utility function in order to be able to write the Euler equation in nominal terms. Otherwise, we would need to make assumptions on how the marginal utilities of current and future real consumption could be transformed into marginal utilities of nominal consumption.

nominal consumption is positive, inflation expectations will also affect current real consumption positively.

Our survey data record expectations of both inflation and nominal interest rates over the period of the next twelve months. To show that both expected interest rates and expected inflation influence current spending in the Euler equation, we follow Coibion et al. (2018) and iterate forward over the next twelve months:

$$c_t^{nominal} = E_t c_{t+12}^{nominal} - \sigma^{-1} \sum_{j=0}^{11} E_t \left(i_{t+j} \right)$$

$$+ \left(\sigma^{-1} - 1 \right) \sum_{j=0}^{11} E_t \left(\pi_{t+j+1} \right). \tag{3}$$

The Euler equation in equation (3) shows that the expected signs of the marginal effects of interest rate expectations and inflation expectations are the same as in equation (2).

Finally, both current and expected consumption in our survey are measured as qualitative assessments relative to an average year. Subtracting average past consumption on both sides of the equation helps to deal with consumption heterogeneity in levels, as well as volatility in monthly consumption expenditures due to inaccurate recall or the occurrence of large but infrequent durable goods purchases. The signs of the marginal effects of both expected nominal interest rates and expected inflation are not affected. Equation (3) thus becomes

$$c_t^{nominal} - \overline{c} = E_t c_{t+12}^{nominal} - \overline{c} - \sigma^{-1} \sum_{j=0}^{11} E_t \left(i_{t+j} \right)$$

$$+ \left(\sigma^{-1} - 1 \right) \sum_{j=0}^{11} E_t \left(\pi_{t+j+1} \right). \tag{4}$$

The University of Hamburg survey measures c_{it} and c_{it}^e as consumers' reported total expenditure over the last/next twelve months. Hence, this may include purchases of durable goods and, thus, strictly speaking, we estimate a spending, rather than a consumption, Euler equation. In the case of durable consumption, the credit channel could potentially render the marginal effect of nominal interest rate expectations positive. If consumption spending is credit-financed with fixed-rate loans, as may be the case, for instance, for spending on durable goods like cars, then the nominal interest rate not only measures the trade-off between current spending and saving but also becomes a cost factor for durable spending. In this case, an expected higher nominal interest rate will lead to higher costs in the future and could thus be expected to increase, rather than reduce current spending on durables. Indeed, this is a channel that is identified for consumers' reported readiness to spend on durables in Bachmann et al. (2015) and Burke and Ozdagli (2013). In

order to test for a potential difference between durable and nondurable consumption, we also estimate a specification of the Euler equation where we take consumers' reported readiness to spend on durable goods as a proxy for current durable consumption as in Bachmann et al. (2015).

III. 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.[6] The second wave consists only of respondents who were 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 a Euler equation relationship, since unlike other existing surveys, it includes information on households' individual spending patterns and their individual macroeconomic expectations.[7] 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 as follows:[8]

- Current consumption $c_{it}^{current}$: "How would you say 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 your total expenditures will be in the next 12 months compared to an average year in the past? They will be [considerably higher; about the same; considerably lower]."

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[6]The whole survey sample is obtained from both landline and mobile telephone numbers registered in Germany, using the Häder-Gabler approach (Häder, Gabler, & Heckel, 2009).

[7]Well-established surveys on consumers' macroeconomic expectations such as the University of Michigan Survey of Consumers in the United States 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.

[8]Additional survey questions used in the analysis are included in the online appendix. The complete survey questionnaire (in German) is available from the authors on request.

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 $i_{it}^{e,quant}$: "How high do you think interest rates will be on average on saving accounts in percentage terms over the next 12 months?" [. . . percent][9]
- 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 $\pi_{it}^{e,quant}$: "By what percentage do you think prices in general will increase or 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; increased moderately; increased slightly; stayed about the same; fallen]."
- Quantitative inflation perceptions $\pi_{it}^{p,quant}$: "By what percentage do you think prices in general have increased or 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.[10] Note that the University of Hamburg survey took place with interest rates close to the ZLB in Germany, as the European Central Bank (ECB) moved the main refinancing rate to 0.15% in June 2014, 0.05% in September 2014, and finally 0.00% in March 2016.

Sociodemographic 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 < 1,000 euros per month), the medium-low category (*inc_ml* for 1,000 euros ≤ income < 2,000 euros per month) or the medium-high category (*inc_mh*

for 2,000 euros ≤ income < 4,000 euros per month) with personal income above 4,000 euros per month as the reference category. Note that controlling for income also partly controls for regional effects since incomes tend to be higher in west versus east Germany and in metropolitan areas versus rural areas. Moreover, we control for education, where we include dummies for those with university education (*edu_h*) and those with vocational training (*edu_m*); those with no finished job training or those still in school are the reference group. Employment status is measured in five employment groups: those who do not work are taken as the 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.

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.[11] The answers are coded into categories. In the regression analysis, we distinguish between monetary news including information on the monetary policy stance, its implications as well as news on inflation (*news_monetary*), and between news on financial markets, covering news about stock market developments, asset prices, housing markets, and banks (*news_financial_markets*).

Finally, we define financial literacy and financial market participation in the University of Hamburg survey as follows. Consumers with high financial literacy are defined as those who correctly answer two questions about nominal interest rate compounding and about the real interest rate defined as in Lusardi and Mitchell (2011).[12] Financial market participation is defined as being able to save, where we further distinguish the assets in which the household saves. *Saver* is a dummy that takes the value of 1 if the consumer answers that the household saves regularly. A follow-up question then asks about the assets in which the household saves, where we distinguish between consumers who save in assets such as bonds, stocks, life insurance, private pension schemes, and home ownership savings plans and between consumers who save by paying off a credit or a mortgage.

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[9]Unfortunately, the response rate 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.

[10]Truncating the data cuts about 7% to 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 $-10\% \leq \pi_{it}^{e,p} \leq 10\%$.

[11]A similar question is also included in the University of Michigan Survey of Consumers.

[12]The 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.

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 online appendix. Both inflation expectations and inflation perceptions show a strong upward bias across the two waves, with mean expected rates of 3.67% and mean perceived current inflation of 3.59%.[13] Interest rate expectations measured in the second wave are much more accurate, with mean expectations at 1%.[14] The finding that consumers tend to overestimate inflation in recent years is also frequently found in other surveys (see, e.g., Dräger & Fritsche, 2013, for Germany and Coibion & Gorodnichenko, 2015, for the United States).

Moreover, both inflation expectations and perceptions are generally found to be lower: forecast accuracy is found to be higher for men than for women[15] and falling with both income and education. The pattern for age groups is less clearly defined but points to a better forecast accuracy of the middle-age groups, in particular those aged 26 to 45 compared to the young and the old. These patterns regarding households' inflation expectations and perceptions across sociodemographic groups are very well documented in other surveys too and for different time—for instance, Jonung (1981) for Sweden, Bryan and Venkatu (2001) for the United States, and recently Arioli et al. (2017) for a large data set of European countries. In the large Bundesbank Panel of Household Finance, the heterogeneity across sociodemographic 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 A3 in the online 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.

As shown in the cross-correlations for the University of Hamburg survey in table A2 in the online appendix, being a saver is positively correlated with the lower age groups and the higher income groups, while having high financial literacy is positively correlated with high income and

high education. However, the cross-correlations for savers and financial literacy are generally small. Regarding the sociodemographic characteristics, we find that most consumers in the low-income category are young and of low education. For the remaining age groups, the correlations with income and education are less clear, but we find a strong, positive correlation between income and education across all groups.

IV. Stylized Facts

Our University of Hamburg survey is one of few household surveys that includes information on both perceptions of current inflation and expectations of future inflation, measured quantitatively and qualitatively. We can thus analyze the differences between 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 quantitative interest rate expectations. In this section, we discuss stylized facts of these measures.

A. 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 expect and perceive price increases between 0 and 5%, there is still a large degree of heterogeneity with answers clustering at so-called focal points, such as multiples of 5 (Binder, 2017). This effect is likely connected to low financial and economic literacy or low cognitive abilities: As reported in D'Acunto et al. (2019b), individuals with lower cognitive abilities are more likely to round their inflation expectations to multiples of five than those with relatively high IQs.
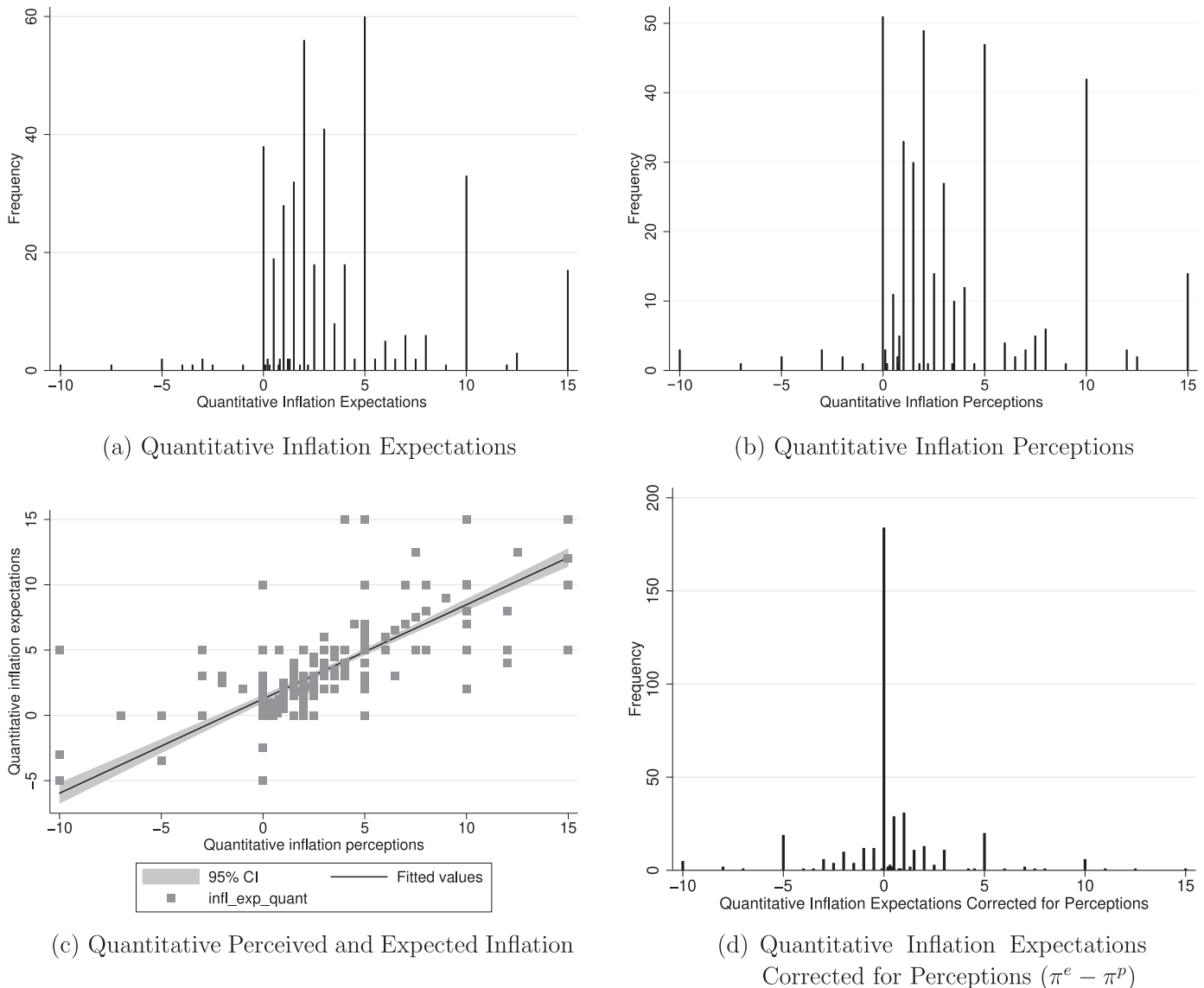
Moreover, as shown in panel 1c, inflation expectations and perceptions are strongly positively correlated, consistent with evidence from the large Nielsen panel of U.S. households (D'Acunto et al., 2019). The estimated slope coefficient is 0.72 and is highly significant. Hence, it is likely that a consumer 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, we observe in panel 1d that a large majority of consumers expect the same level of inflation as the one they perceive today. The difference $(\pi^e - \pi^p)$ is more evenly distributed between negative and positive values and less dispersed than level expectations or perceptions. As a robustness check, we account for a potential role of inflation perceptions by instrumenting inflation expectations with the corresponding inflation perceptions. The results are shown in section VB.

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[13]D'Acunto et al. (2019) show for a large panel of U.S. households that price changes from frequent grocery shopping experiences can explain variation in perceived and expected inflation over time both in the cross-section and within individuals. A similar point has been made in an earlier experimental study by Jungermann et al. (2007).

[14]Annual inflation in Germany in December 2015 was very low at 0.3%, with interest rates near the ZLB (0.05% ECB interest rate for main refinancing operations, 1.17% euro area ten-year government benchmark bond yields, and 0.64% on bank deposits redeemable within three months in the euro area). The statistics provided by the Bundesbank also show relatively constant spreads over time between effective interest rates of German banks on loans to households for consumption and other purposes and on interest rates for saving deposits with a maturity of up to one year, implying that the expected interest rate on saving accounts could also be used as a proxy for the expected interest rate for borrowing.

[15]D'Acunto, Malmendier, and Weber (forthcoming) show in a recent study that gender differences in inflation expectations are driven by differences in daily shopping experiences.

FIGURE 1.—INFLATION PERCEPTIONS AND EXPECTATIONS

(a) Quantitative Inflation Expectations

(b) Quantitative Inflation Perceptions

(c) Quantitative Perceived and Expected Inflation

(d) Quantitative Inflation Expectations Corrected for Perceptions $(\pi^e - \pi^p)$
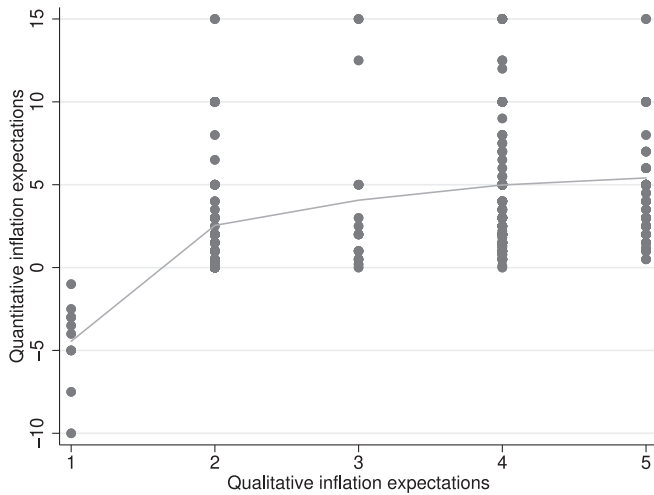
B. Quantitative versus Qualitative Inflation Expectations and Perceptions

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 (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.

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. As a further robustness check in our regression analysis, we thus instrument quantitative inflation expectations with qualitative expectations and vice versa using the multiple measurement IV approach. Moreover, we instrument quantitative inflation expectations with qualitative perceptions. Again, the results are discussed in section VB.
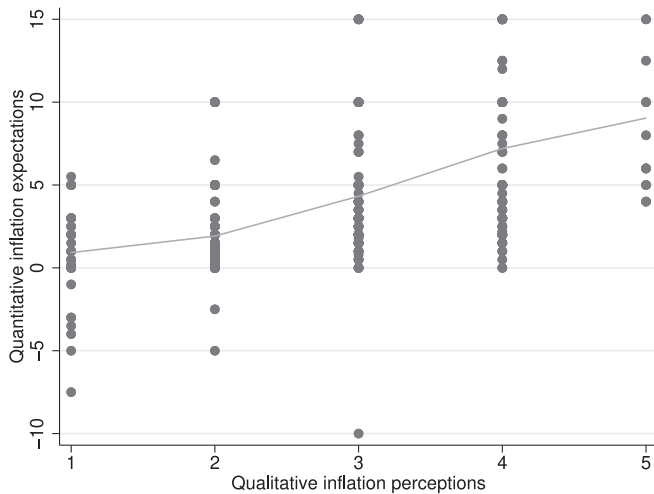
FIGURE 2.—QUANTITATIVE VERSUS QUALITATIVE INFLATION EXPECTATIONS

(a) Qualitative vs. Quantitative Inflation Expectations
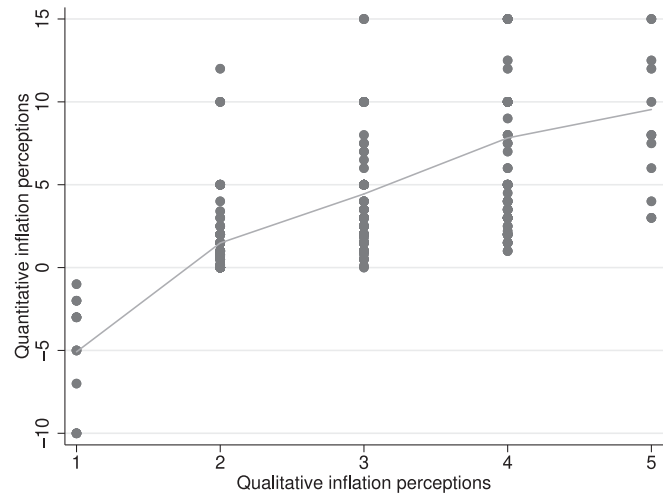
(b) Qualitative vs. Quantitative Inflation Perceptions

(c) Qualitative Inflation Perceptions Across Quantitative Expectations
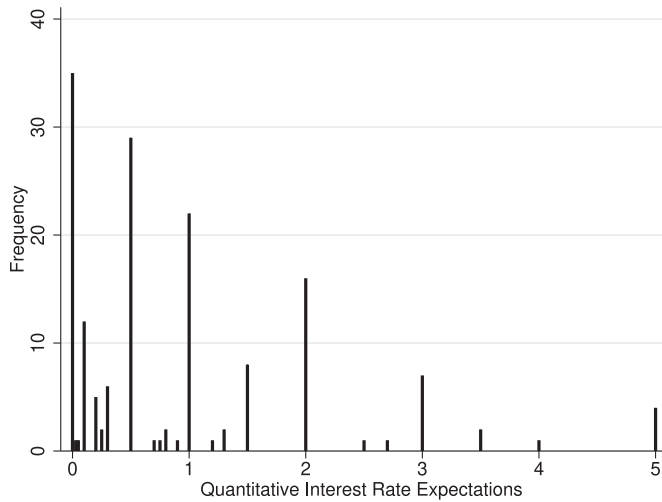
C. Interest Rate Expectations

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 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 and 1%. Plotting answers in the five qualitative categories against the corresponding quantitative interest rate expectations in figure 3b suggests that the upper three an-

swer categories relating to 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 ZLB 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 significant. 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
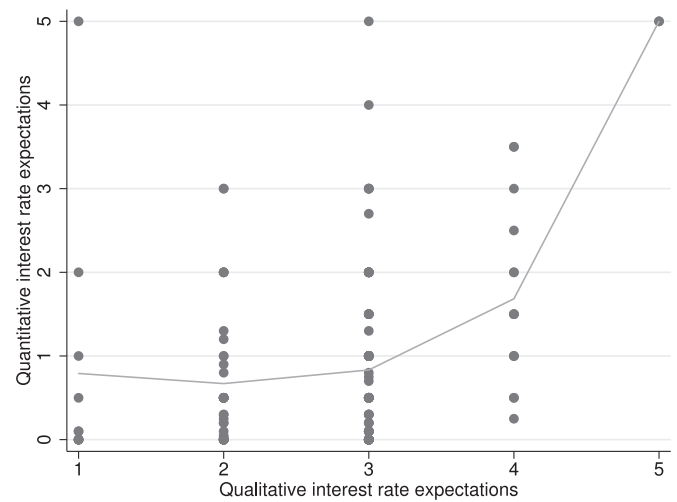
(b) Qualitative vs. Quantitative Interest Rate Expectations, Wave 2
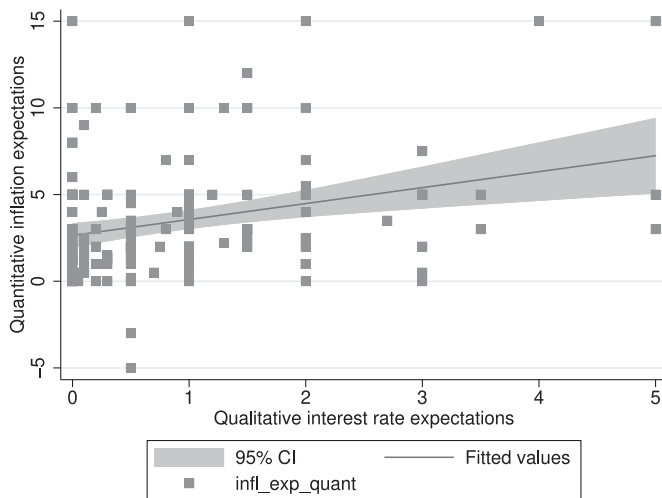
(c) Inflation Expectations and Interest Rate Expectations, Wave 2
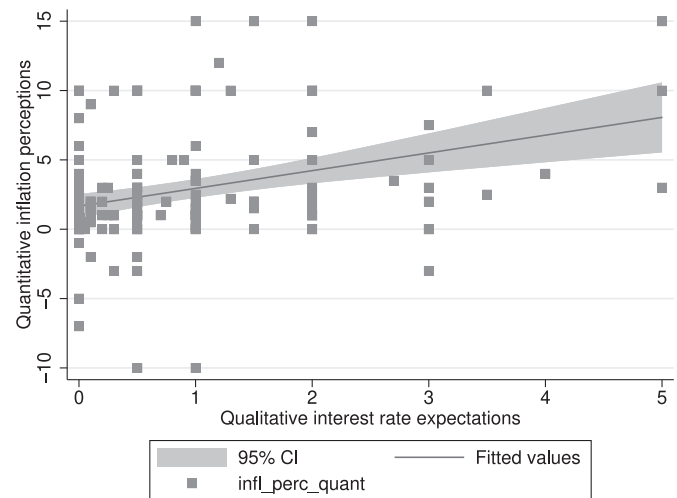
(d) Inflation Perceptions and Interest Rate Expectations, Wave 2

V.   Estimation of a Consumption Euler Equation

In this section, we test whether the likelihood to report higher current consumption spending is affected by consumers' expected level of spending and their nominal interest rate and inflation expectations. The Euler equation model in equation (4) matches the regression setup with our qualitative and quantitative survey data most closely, albeit not perfectly, to the theoretical model. Under equation (4), we thus expect a positive relationship between current and expected future spending and a negative relation with expected nominal interest rates. The marginal effect of inflation on current nominal spending can be ambiguous depending on the size of the underlying σ^{-1}.

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 estimate the Euler equation model separately for those with a high level of financial literacy. This group accounts for about 70% of the sample.

TABLE 1.—CONSUMPTION EULER EQUATION

	(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	0.151**	0.153**	0.103	0.005	−0.032	−0.089
	(0.062)	(0.076)	(0.096)	(0.049)	(0.059)	(0.098)
$i_{qual,it}^e$	−0.016	−0.021		−0.146***	−0.172***	
	(0.042)	(0.047)		(0.040)	(0.048)	
$i_{quant,it}^e$			−0.027			−0.121**
			(0.062)			(0.049)
$\pi_{qual,it}^e$	0.063**			0.064***		
	(0.025)			(0.023)		
$\pi_{quant,it}^e$		0.011**	0.021		0.020***	0.025**
		(0.006)	(0.014)		(0.007)	(0.012)
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	0.130	0.119	0.181	0.142	0.142	0.148
Number of individuals	278	246	150	187	169	109
Number of observations	425	368	150	292	260	109

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 subsample correctly answering the two literacy questions on interest rates. Macroexpectations are on the general economic situation and the unemployment rate. Demographic factors include age, age^2, income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

We estimate ordered probit models in the following regression setup,

$$\Pr\left(c_{it}^{current} = 3\right) = \Pr\left(\kappa_2 < \beta_1 c_{it}^e + \beta_2 i_{it}^e + \beta_3 \pi_{it}^e + \mathbf{X}_{it}^{controls'} \mathbf{\Gamma} + u_{it} \leq \kappa_3\right), \quad (5)$$

where $\kappa_{2,3}$ denote the estimated cutpoints between the three answer categories for qualitatively measured current consumption spending.[16] c_{it}^e measures consumers' reported qualitative measure of expected spending in the next twelve months and i_{it}^e and π_{it}^e are individual expectations reported in t on nominal interest rates and the inflation rate over the next twelve months. The vector $\mathbf{X}_{it}^{controls}$ includes demographic control variables (age, age^2, income, employment status, education, and risk aversion), a time dummy for the second-wave accounting for unobserved time fixed effects, and further individual macroeconomic expectations, namely, expectations on the general economic situation and on unemployment. We report marginal effects evaluated at the sample mean. All models are estimated with sample weights and standard errors clustered at the household level.

A. Baseline results

Table 1 shows the baseline estimations of a consumption Euler equation using both qualitative and quantitative expectations. Overall, the results give some evidence in favor of the hypothesis that consumers' expenditure patterns may 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 twelve months

if they expect to increase their consumption in the coming twelve months, although this link becomes insignificant for financially literate consumers. Second, qualitative and quantitative inflation expectations have a significantly positive marginal effect on the likelihood of higher current consumption spending in all models. This effect becomes stronger in the subsample of financially literate individuals. The positive estimated marginal effects of inflation expectations on current nominal consumption also imply that inflation expectations affect current real consumption positively, as we discussed in section II. Third, the marginal effect of qualitative and quantitative nominal interest rate expectations on current spending is insignificant in the overall sample, but becomes significantly negative for households with high financial literacy.[17] Note that this evidence is corroborated in the larger PHF survey, where we again find a significantly negative marginal effect of interest rate expectations on current spending and a significantly positive effect of inflation expectations (see table A4 in the online appendix).

Next, we reestimate our baseline models with consumers' reported readiness to spend on durables as the dependent variable, as 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]." Note that while the question is not explicitly phrased in nominal terms, it is also not explicitly stated in real terms. Since consumers often tend to think in nominal terms, there is a positive likelihood that this question is understood and answered in nominal terms. Table 2 shows the results. We find no significant link between nominal

---

[16]The categorical levels of current consumption $c_{it}^{current}$ are coded as 1, 2, and 3 and correspond to answers that current spending over the past twelve months, is considerably lower, about the same as, or considerably higher relative to an average year, respectively.

[17]Models with quantitative interest rate expectations are estimated only for the second wave.

TABLE 2.—EULER EQUATION WITH THE READINESS TO SPEND ON DURABLES

	(1) All HHs	(2) All HHs	(3) All HHs Wave 2	(4) Fin. literacy	(5) Fin. literacy	(6) Fin. literacy Wave 2
$c_{it}^{e,durable}$	0.029	0.034	0.065	0.065*	0.066	0.174**
	(0.038)	(0.036)	(0.073)	(0.037)	(0.041)	(0.083)
$i_{qual,it}^e$	−0.006	−0.009		−0.005	−0.025	
	(0.036)	(0.039)		(0.046)	(0.046)	
$i_{quant,it}^e$			0.010			−0.005
			(0.037)			(0.043)
$\pi_{qual,it}^e$	−0.022			−0.026		
	(0.027)			(0.023)		
$\pi_{quant,it}^e$		−0.041***	−0.037***		−0.053***	−0.037***
		(0.012)	(0.013)		(0.013)	(0.013)
Macro Expectations	Yes	Yes	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Wave Dummy	Yes	Yes	Yes	Yes	No	No
Pseudo-R^2	0.129	0.201	0.300	0.179	0.277	0.365
Number of individuals	271	243	149	183	166	108
Number of observations	415	363	149	287	256	108

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 subsample correctly answering the two literacy questions on interest rates. Macroexpectations are on the general economic situation and the unemployment rate. Demographic factors include age, age^2, income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

interest rate expectations and the reported readiness to spend on durables. This is in contrast to the result in Bachmann et al. (2015). Interestingly, the marginal effect of inflation expectations is significantly negative. This is partly in line with the findings of Bachmann et al. (2015) for the United States who report mostly an insignificant effect of inflation expectations that turns negative during the ZLB period.[18] If consumers understand the question on readiness to spend in nominal terms, the negative marginal effect could be indicative of a change in the size of the underlying intertemporal substitution elasticity σ^{-1}. Alternatively, our results could support the view that households take a stagflationary view of inflation when it comes to durable purchases, as Coibion et al. (2019) suggested.

B. Robustness Checks

In this section, we provide several robustness checks using an instrumental variable approach. First, we use inflation perceptions as instruments for inflation expectations. The two-step estimation procedure thus accounts for the strong correlation between inflation perceptions and expectations discussed in section IV. Moreover, the standard consumption Euler equation also suggests that the only way in which inflation perceptions may affect current consumption is through their effect on inflation expectations. Table 3 shows that our baseline results remain robust.[19] Except for the model with qualitative inflation expectations in the subsample of finan-

TABLE 3.—CONSUMPTION EULER CONSUMPTION: USING INFLATION PERCEPTIONS AS INSTRUMENTS FOR INFLATION EXPECTATIONS

	(1) All HHs	(2) All HHs	(3) Fin. literacy	(4) Fin. literacy
c_{it}^e	0.139**	0.081	0.014	−0.053
	(0.064)	(0.069)	(0.050)	(0.059)
$i_{qual,it}^e$	−0.013	−0.007	−0.147***	−0.147***
	(0.043)	(0.045)	(0.041)	(0.046)
$\pi_{qual,it}^e$	0.132*		0.051	
	(0.070)		(0.074)	
$\pi_{quant,it}^e$		0.042***		0.033***
		(0.014)		(0.009)
First-Stage F-Statistic	13.59	66.18	15.13	141.46
Macro expectations	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes
Wave Dummy	Yes	Yes	Yes	Yes
Pseudo-R^2	0.133	0.139	0.146	0.163
Number of individuals	277	231	186	161
Number of observations	423	333	290	237

University of Hamburg survey. We instrument $\pi_{qual,it}^e$ with $\pi_{qual,it}^p$ for models 1 and 3, while we instrument $\pi_{quant,it}^e$ with $\pi_{quant,it}^p$ for models 2 and 4. 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 subsample correctly answering the two literacy questions on interest rates. Macroexpectations are on the general economic situation and the unemployment rate. Demographic factors include age, age^2, income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

cially literate individuals, the marginal effects of inflation expectations on current spending remain significantly positive and the estimated effects are larger than in the baseline models. Although perceptions are significantly correlated with expectations in all models, the differences in the F-statistics of the first-stage estimations suggest that this link is particularly strong for quantitative perceptions and expectations (see section IVA).

Next, table 4 shows the results using a multiple measurement IV approach to address the issue of measurement error as proposed by Gillen, Snowberg, and Yariv (2019). Specifically, since our survey has both qualitative and quantitative

[18]Our estimates for durable consumption also remain unchanged when we instrument inflation expectations with perceptions or when we use the multiple measurement approach (see tables A11 and A12 in the online appendix).

[19]Table 3 shows the results when we instrument $\pi_{qual,it}^e$ with $\pi_{qual,it}^p$ and $\pi_{quant,it}^e$ with $\pi_{quant,it}^p$. Our results also remain unchanged if we instrument $\pi_{quant,it}^e$ with $\pi_{qual,it}^p$.

TABLE 4.—CONSUMPTION EULER CONSUMPTION: MULTIPLE MEASUREMENT IV APPROACH

	(1) All HHs	(2) All HHs	(3) Fin. literacy	(4) Fin. literacy
c_{it}^e	0.120	0.090	−0.024	−0.101[*]
	(0.077)	(0.065)	(0.056)	(0.061)
$i_{qual,it}^e$	−0.007	−0.019	−0.155***	−0.170***
	(0.048)	(0.047)	(0.046)	(0.046)
$\pi_{qual,it}^e$	0.138**		0.191***	
	(0.064)		(0.062)	
$\pi_{quant,it}^e$		0.082***		0.067***
		(0.029)		(0.019)
First-Stage F-Statistic	13.79	14.66	24.99	32.61
Macro expectations	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes
Wave Dummy	Yes	Yes	Yes	Yes
Pseudo-R^2	0.139	0.139	0.166	0.166
Number of individuals	246	246	169	169
Number of observations	367	367	259	259

University of Hamburg survey. We instrument $\pi_{qual,it}^e$ with $\pi_{quant,it}^e$ for models 1 and 3, while we instrument $\pi_{quant,it}^e$ with $\pi_{qual,it}^e$ for models 2 and 4. 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 subsample answering the two literacy questions on interest rates correctly. Macroexpectations are on the general economic situation and the unemployment rate. Demographic factors include age, age[2], income, employment status, education, and risk aversion. Standard errors in parentheses are clustered at the household level. * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

inflation expectations, we use one measure as an instrument for the other. We find that the signs of the estimated effects of interest rate and inflation expectations remain unchanged. The estimated coefficients also become larger and more significant compared to our baseline estimations, which is in line with the attenuation effect due to the existence of measurement error.

We conduct a large range of additional robustness checks, which are reported in section 3 (tables A5–A10) of the online appendix. Overall, our results from the baseline models remain robust throughout. First, we estimate the model with OLS or OLS with individual fixed effects, treating qualitative current spending as a continuous variable.

When including fixed effects, the effect of inflation expectations stays significantly positive only at the 80% level, but is significant at conventional levels in the other OLS model. The effect of nominal interest rate expectations is significantly negative throughout all the models with OLS. Second, we estimate the relation separately for the two waves of the University of Hamburg survey and report that the results are not driven by one of the waves in the University of Hamburg survey. Third, we evaluate the role of income expectations and include long-run and house price inflation expectations. The results suggest that the effect of macroeconomic expectations in the baseline model remains robust when we additionally control for income expectations, while there is only a weak, positive relation of long-run inflation expectations to current spending and none for house price expectations. Fourth, we reestimate our baseline model using qualitative expectations as categorical variables. The results are in line with our baseline estimations when we treat qualitative expectations as continuous variables. Finally, we estimate the

baseline model with quantitative inflation expectations, excluding all respondents who report expected inflation as a multiple of five. This is another robustness check for a potential effect of financial illiteracy. We find that our results regarding the effects of nominal interest rate and inflation expectations remain robust. In line with the results in D'Acunto et al. (2019a, 2019b), the marginal effect of inflation expectations on current spending is larger than in the overall sample, while the marginal effect of nominal interest rate expectations is estimated to be somewhat smaller.
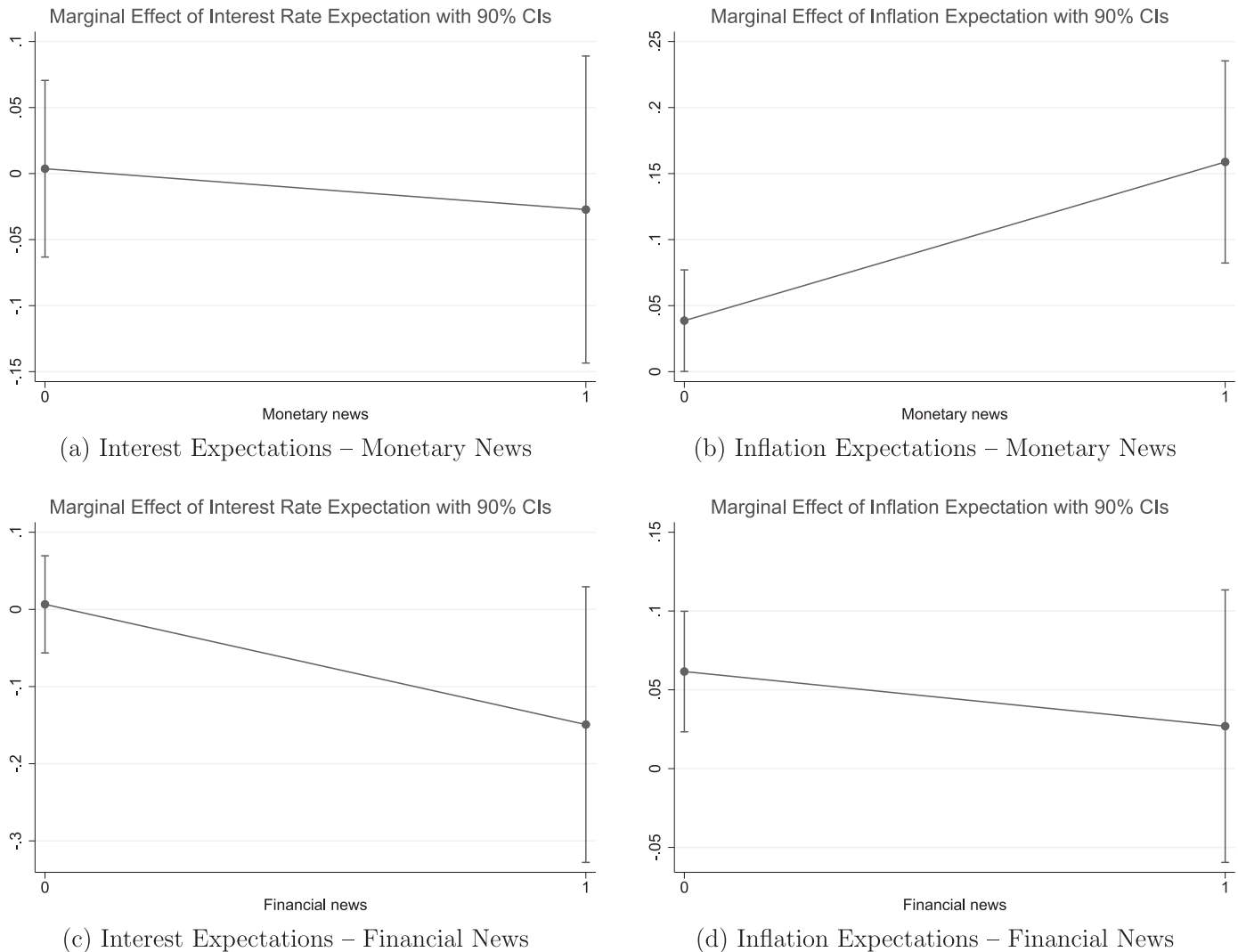
VI. The Role of News

In this section, we evaluate the role of news to explain heterogeneity across consumers within the Euler equation relationship. While previous studies have focused on heterogeneity across sociodemographic characteristics (e.g., Bachmann et al., 2015, and D'Acunto et al., 2016), here we focus on the role of news observed by the individual consumer. In particular, we analyze the importance of monetary news and financial market news. Monetary news summarizes all news about monetary policy and inflation that consumers recall, while financial market news summarizes news about stock market developments, asset prices, housing markets, and banks.[20] We thus analyze if the observation of news by an individual consumer leads to a stronger incorporation of her interest rate and inflation expectations into her spending decision.

This news can influence consumers' macroeconomic expectation formation (Lamla & Vinogradov, 2019; Coibion et al., 2019) and thus constitutes potential "news shocks" affecting the consumption Euler relationship. In line with the findings reported in Coibion et al. (2019), we find that 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 rates of 3.77% and 3.81%, respectively. We are thus interested in whether this news has an additional effect on the way that consumers incorporate both interest rate and inflation expectations into their spending decisions.

Hence, the baseline Euler equation model with qualitative expectations from equation (5) is reestimated with a dummy-level effect for having observed the news and with

[20]News on monetary policy in this sample was 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 expansive stance of current monetary policy. News on inflation was mainly news observed about rising prices, such as consumer prices or specific prices of food or rent. 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 on labor market developments, about potential economic effects of the refugee crisis at the time of the survey, and on specific sector news like the diesel scandal in the car industry.

FIGURE 4.—NEWS EFFECTS

(a) Interest Expectations – Monetary News

(b) Inflation Expectations – Monetary News

(c) Interest Expectations – Financial News

(d) Inflation Expectations – Financial News

interaction effects of news with both interest rate and inflation expectations:

$$
\begin{aligned}
\Pr\left(c_{it}^{current} = 3\right) = \Pr(\kappa_2 &< \beta_0 + \beta_1 c_{it}^e + \beta_2 i_{it}^e + \beta_3 \pi_{it}^e \\
&+ \beta_4 news_{it} + \beta_5 i_{it}^e * news_{it} + \beta_6 \pi_{it}^e \\
&* news_{it} + \mathbf{X}_{it}^{controls'} \Gamma + u_{it} \leq \kappa_3). \quad (6)
\end{aligned}
$$

In the nonlinear ordered probit model estimated in equation (6), the estimates for interaction terms cannot be directly interpreted (see Ai & Norton, 2003, and Greene, 2010). Following the recommendations by Greene (2010), we thus graphically show the marginal effects of interest rate and inflation expectations calculated for those that observed news in the respective category versus those that did not observe these news in figure 4.

Figure 4 shows the marginal effects of interest rate and inflation expectations on the likelihood of higher current spending conditional on observing news for all consumers in the survey. We observe that consumers who recall monetary news show a significantly stronger marginal effect of their inflation expectations than those who did not hear such news (panel b). At the same time, when consumers hear financial market news, the results show a noticeably more negative marginal effect of their interest rate expectations on consumption (panel c), which narrowly misses significance at the 10% level. The remaining news interaction effects are small and insignificant. It thus seems that news about monetary policy, including news about price changes, is incorporated into consumers' spending decision mainly via their effect on inflation expectations, while news about financial market developments, including news about asset prices, is incorporated into the effect of nominal interest rate expectations. Overall, news thus influences not only the expectation formation process, but also strengthens the effect of expectations on spending decisions in a meaningful way.

A. News and Heterogeneity across Sociodemographic Groups, Financial Literacy, and Financial Market Participation

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 subgroups. The effect of news on expectations and economic choices is not necessarily just a function of observing the news. It also depends on the initial level of information, as well as the ability to process the news and adjust behavior accordingly. We thus analyze differences across age, income, education, and gender. Moreover, we evaluate differences across financial literacy defined as in Lusardi and Mitchell (2011) and across financial market participation. Here, we distinguish between savers and nonsavers, where savers are further distinguished into those who save in assets traded on financial markets and those who save by paying off credit cards or a mortgage.

In order to facilitate the interpretation of the news effects across sociodemographic groups, we first estimate simple interactions between sociodemographic characteristics and inflation or interest rate expectations within the Euler equation model. The results are shown in figures A1 to A8 in the online appendix. The marginal effects in figures A1 to A8 show that the significantly positive link between inflation expectations and current consumption is driven by those with relatively high inflation forecast accuracy, namely, the high-education, high-income, male, and younger groups.[21] In addition, consumers who save show a significantly larger marginal effect of inflation expectations on current spending, while there is no change in the marginal effect of their interest rate expectations. This implies that those who save, that is, those who can use the real interest rate to smooth consumption, are also more aware of real interest rate developments and their implications for current spending. While we observe no effect of income, gender, and age on the role of nominal interest rate expectations for current consumption, we do find a significantly negative marginal effect of interest rate expectations for the high-education group. A similar negative marginal effect is found for consumers with high financial literacy. Overall, the initial analysis suggests that inflation forecast accuracy and being a non-hand-to-mouth household are important for the incorporation of inflation expectations into current spending decisions, while in particular, financial education is relevant for a negative link between nominal interest rate expectations and current spending.

For the analysis of news effects across sociodemographic groups, we then reestimate the Euler equation relation with double interaction terms, including the news dummy $news_{it}$ and a dummy for the relevant sociodemographic category $socio_{it}$:

---

[21]For the group of consumers 45 years old or younger, the effect is likely driven by those in the age group 26 to 45 since our survey contains only a low number of observations for those 25 and younger.

$$\Pr\left(c_{it}^{current} = 3\right) = \Pr(\kappa_2 < \beta_0 + \beta_1 c_{it}^e + \beta_2 i_{it}^e + \beta_3 \pi_{it}^e$$
$$+ \beta_4 news_{it} + \beta_5 socio_{it} + \beta_6 i_{it}^e$$
$$\times news_{it} \times socio_{it} + \beta_7 \pi_{it}^e \times news_{it}$$
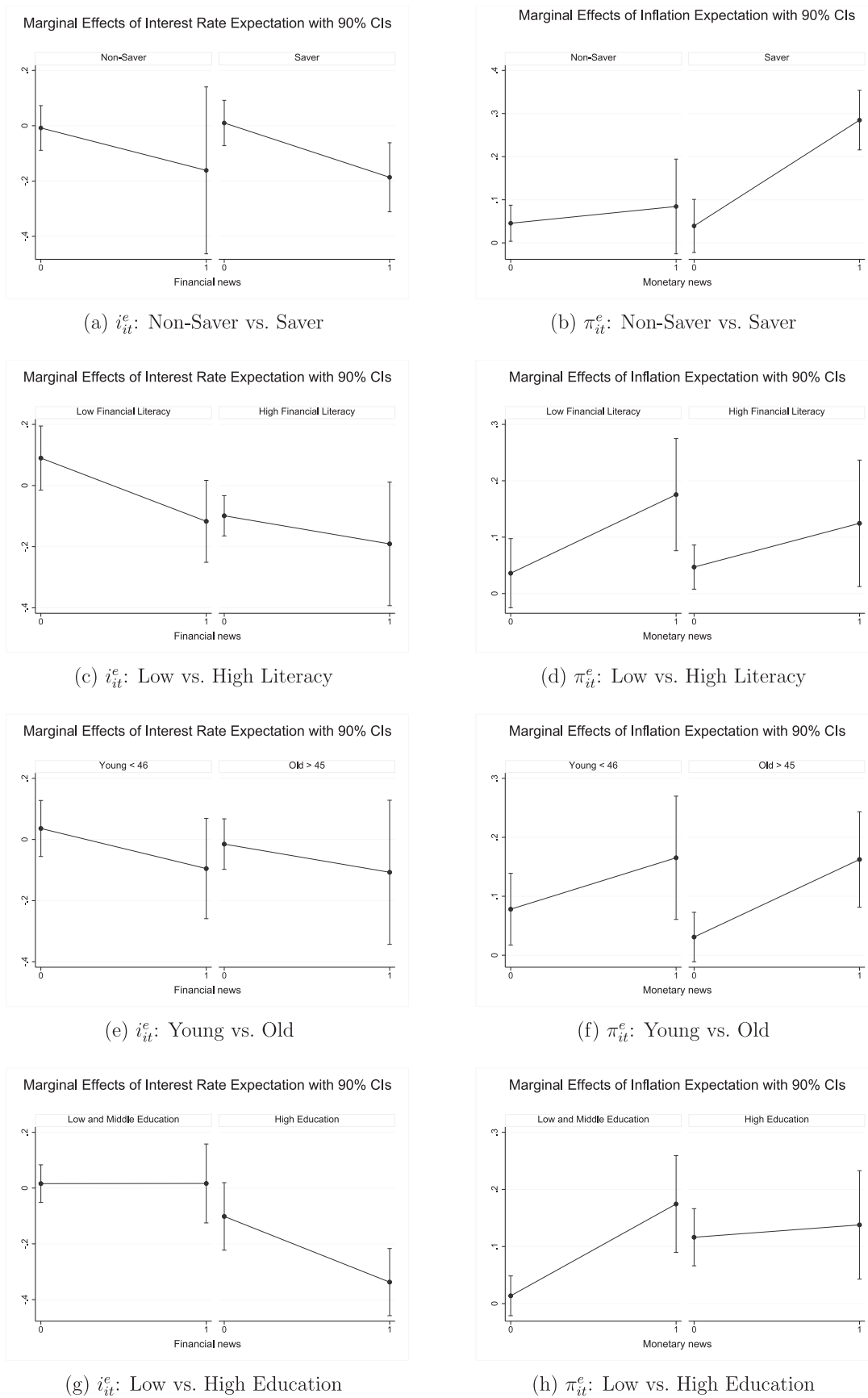$$\times socio_{it} + \mathbf{X}_{it}^{controls'} \mathbf{\Gamma} + u_{it} \leq \kappa_3), \quad (7)$$

where $\mathbf{X}_{it}^{controls}$ includes $i_{it}^e \times news_{it}$, $i_{it}^e \times socio_{it}$, $\pi_{it}^e \times news_{it}$, $\pi_{it}^e \times socio_{it}$, and $news_{it} \times socio_{it}$. It also includes the initial control variables (i.e., demographics, macroeconomic expectations, and time dummy fixed effect) apart from $socio_{it}$. Exceptions are the models with heterogeneous news effects between the young and the old, where we still control for the continuous variables age and age[2].

Figure 5 presents all interaction effects with monetary and financial market news for the sociodemographic groups. Distinguishing between savers and nonsavers in panels a and b, we observe that savers react strongly to both monetary news and financial market news: After observing monetary news, the marginal effect of inflation expectations on current consumption is strongly increased for savers, while there is no significant increase in the effect for the nonsavers control group. The increase in the point estimate is significantly higher than the news effect in the full sample or the effect of being a saver without news. Figures A11 and A12 in the online appendix suggest that this effect is mainly driven by consumers who save in assets traded on financial markets rather than by those who save by paying off credit. In addition, savers show a significantly negative marginal effect of nominal interest rate expectations on consumption after observing news on financial markets. This effect becomes significant for savers only after observing news. It thus seems that being able to smooth consumption not only increases the role of the perceived real rate for current consumption, but also gives higher relevance to news about inflation and financial developments, in line with theories of rational inattention as in Sims (2003).

Next, we evaluate the role of news across consumers with high and low financial literacy in panels c and d of figure 5. For both groups, the results suggest that the marginal effect of interest rate expectations becomes more negative after observing financial market news, while the marginal effect of inflation expectations becomes more positive after observing monetary news. However, there are some interesting differences across the groups: There is a significantly negative marginal effect of interest rate expectations for consumers with high literacy without any news effect (in line with our results in table 1), which is approximately the same size as the effect for consumers with low literacy after observing news. Moreover, consumers with high financial literacy are significantly more likely to increase their current spending with an increase in their inflation expectations regardless of whether they observe any news, while for consumers with low literacy, this effect becomes significant only after observing monetary news.

FIGURE 5.—NEWS AND HETEROGENEITY ACROSS SOCIODEMOGRAPHIC GROUPS

(a) i_{it}^e: Non-Saver vs. Saver

(b) π_{it}^e: Non-Saver vs. Saver

(c) i_{it}^e: Low vs. High Literacy

(d) π_{it}^e: Low vs. High Literacy

(e) i_{it}^e: Young vs. Old

(f) π_{it}^e: Young vs. Old

(g) i_{it}^e: Low vs. High Education

(h) π_{it}^e: Low vs. High Education

Regarding the role of news for the marginal effect of inflation expectations across sociodemographic groups, a similar pattern emerges for the age, education, gender, and income groups in panels e to h of figure 5 and in figures A9 and A10 in the online appendix. The groups with low inflation forecast accuracy—consumers with low education, aged 45 and above, women, or those with low income—do not significantly incorporate inflation expectations in their spending decision in the baseline but react strongly to news with a significantly positive marginal effect of inflation expectations conditional on observing monetary news. By contrast, the groups with high inflation forecast accuracy show a significantly positive marginal effect of inflation expectations in the baseline, and the increase in the marginal effect after observing news is often not significant. Moreover, the marginal effects of inflation expectations after observing news for those with high forecast accuracy are generally not statistically different from those in the control group with low inflation forecast accuracy. Overall, these results suggest that the information contained in the news can be more effective if the initial level of information is relatively low. In that sense, our results reinforce the importance of economic education for the general public—in particular, for informed economic decision making.

While the marginal effect of inflation expectations on current spending and the role of monetary news is clearly linked to financial market participation and inflation forecast accuracy, the marginal effect of nominal interest rate expectations and the role of financial market news seem to be mainly due to the level of education, in particular, financial education. As shown in panel g of figure 5, there is no significant effect of nominal interest rate expectations for the low and medium levels of education, but a strongly significant negative marginal effect emerges for consumers with high education after observing financial market news. The estimated marginal effect is more than twice the size of the effect estimated for nominal interest rate expectations after observing financial market news in the full sample or of the effect of high education without any news.

VII. 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 terms of the Euler equation, we test whether the likelihood to increase current spending is positively related to expected future spending and negatively to nominal interest rate expectations. Regarding the marginal effect of inflation expectations on current nominal spending, we show that the sign is theoretically ambiguous and depends on the size of the underlying intertemporal elasticity of substitution, σ^{-1}.

The results give some evidence in favor of the Euler equation model: First, in the full sample current spending depends positively on planned consumption spending in the next year. Second, the likelihood of higher current consump-

tion increases with higher expected inflation. Third, while there is no significant effect of nominal interest rate expectations in the full sample, we find a negative marginal effect for consumers with high financial literacy, implying an overall negative link between current spending and the perceived real interest rate. In addition, we show that the marginal effect of inflation expectations becomes negative once we analyze consumers' reported readiness to spend on durables instead of current overall spending. The differences in the marginal effect of expected inflation could be due to differences in σ^{-1}, or they could result from a stagflationary view on expected inflation when it comes to larger durable expenditures (Coibion et al., 2019). The results of the baseline model are robust for both qualitative and quantitative macroeconomic expectations, when we account for an effect of inflation perceptions on expectations in a two-stage IV regression, when we estimate the model in the larger cross-section of the Bundesbank Panel of Household Finances and for a large range of further robustness checks.

In addition, 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 marginal effect of inflation expectations on current spending becomes significantly stronger if the consumer observed any monetary news, including news on price changes. At the same time, the marginal effect of nominal interest rate expectations becomes more negative for consumers who recall financial market news. Evaluating these news effects across groups for socioeconomic characteristics, financial literacy, and financial market participation, we show that monetary news increases the effect of inflation expectations on current spending most strongly for savers who are active on financial markets and for groups with initially low levels of inflation forecast accuracy. In the case of nominal interest rate expectations, a significantly negative marginal effect on current spending emerges for consumers with high education who observed financial market 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' consumption allocation. Macroeconomic expectations matter for economic decisions, and the effects are in line with both economic theory and the 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 overestimate current inflation strongly. This gives some tentative indication that consumers' overestimation of inflation in Germany may help to stabilize demand in deflationary periods, as also suggested by Coibion and Gorodnichenko (2015) for the United States, but further research is needed to explore whether the expectations channel influencing spending decisions remains valid outside the ZLB. In addition, our results reinforce the

importance of economic education and communication for the general public. In particular for groups with relatively low levels of initial forecast accuracy, receiving additional information in the form of news is vital for consumers' incorporation of their inflation expectations into their spending decisions. Thus, central banks' increased efforts in communicating effectively with the general public is expected to have large effects not only for level inflation expectations but also for the inflation expectations–spending nexus within the Euler equation.

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