Subjective Models of the Macroeconomy and the Transmission of Monetary Policy^{*}

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Abstract

Extant theories propose a single model of the macroeconomy to which the representative agent or heterogeneous agents adhere. In contrast, households hold heterogeneous narratives about how macroeconomic variables affect each other (subjective models). The same shock or policy measure might thus produce heterogeneous reactions by otherwise identical households that hold different subjective models of the macroeconomy. We investigate this conjecture using a novel customized module of the Consumer Expectations Survey of the European Central Bank that covers about 19,000 households across 11 countries and measures directly subjective models, beliefs, and planned choices. Respondents who think monetary tightening mostly affects the economy through changes in borrowing or savings rates plan to reduce their consumption more when perceived rates increase, whereas those who think about general equilibrium channels or inflation do so to a lesser extent. Demographics such as debt holdings, savings, unemployment, and systematic country-level characteristics like national economic narratives or the organization of the mortgage market do not explain these differences. Although noisier, we detect similar patterns for respondents' actual consumption response to actual policy rate changes. Despite their relevance, the heterogeneous mediating effects of subjective models for the transmission of monetary policy are missing from the frameworks used for policy design around the globe.

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I Introduction

Whether based on a representative agent or allowing for heterogeneous agents, extant macroeconomic theories typically aim to explain macroeconomic dynamics based on a single model of the macroeconomy, which is the same for all agents that populate the economy. Either explicitly or implicitly, such theories postulate that all economic agents are aware of the model and how it operates and react to the model-implied incentives by maximizing their objectives based on it. In sharp contrast, recent research employs methods from cognitive and social psychology to document empirically that different types of economic agents believe in alternative and highly subjective models of the macroeconomy—they believe that certain economic channels and causal relationships between macroeconomic variables are more plausible than others. For instance, Andre et al. (2022) show that households and economists have systematically different channels in mind about how the same macroeconomic shocks will affect unemployment and inflation. Moreover, such heterogeneity in subjective models can help explain the large disagreement in expectations that can arise even if agents base their views on the same information sets.

In this paper, we ask if agents who hold different subjective models of the macroeconomy make heterogeneous economic choices and respond differently to changes in interest rates and monetary policy. If this were the case, heterogeneous subjective models could explain why economic policy measures designed based on extant theories are often less effective in terms of both economic prediction and policy design. And, at the micro level, heterogeneous subjective models could help explain why observationally similar agents act differently when facing the same personal and aggregate economic conditions, which potentially leads to overlooked redistributive effects of economic shocks and policies. Specifically, we ask whether households that are observationally similar but hold different subjective models of the macroeconomy react differently in terms of their consumption and saving choices to the same monetary policy measures. By comparing households that are observationally similar, for instance, in terms of characteristics such as mortgage holdings and financial constraints, we are able to avoid the concern that

subjective models are a mere restating of heterogeneous exposures to monetary policy. Tackling our question faces a set of empirical and conceptual challenges. First, the econometrician needs to design a homogeneous framework to define and elicit measures of households' subjective models of the macroeconomy. Second, the setting needs to allow providing quasi-exogenous variation in interest rate changes to estimate the causal effect of such measures on households' consumption-saving choice and whether this effect is mediated or moderated by their subjective models of the macroeconomy.

To tackle the first challenge, we propose two complementary survey-based methods to elicit individual-level subjective models of the macroeconomy using the Consumer Expectations Survey (CES) implemented across 11 euro area (EA) countries by the European Central Bank (ECB), which we describe in more detail below (see also Georgarakos and Kenny (2022) and Bańkowska et al. (2021)). Both methods ask agents to report what they think will be the effects of the specific macroeconomic shock we aim to study, i.e., an increase in policy rates, on economic and financial conditions in their country's economy and their household. The first method (open-ended questions) asks households to report their answers in free-text format. This method allows us to identify the economic channels through which a monetary policy tightening is believed to affect the macroeconomy and personal economic conditions without any prompting or priming. At the same time, this method does not allow for constructing a household-level ranking of alternative potential economic channels or assessing which reported channels are deemed more relevant than other reported channels. For this reason, we also propose a second method (closed-ended questions) in which households are asked to indicate on an ordered scale the extent to which they believe that each of a set of economic channels provided to them in randomized order is likely to be a consequence of a monetary policy tightening.

To tackle the second challenge, we perform a randomized-controlled trial (RCT) by randomly allocating scenarios about the size of the monetary policy tightening over a 12-month horizon. Because respondents hold different priors about future policy rates, this procedure produces heterogeneous individual-level updates in beliefs about future interest rates. We then elicit the change in respondents' planned consumption behaviour induced by the update by asking quantitatively if and how they would

change their consumption under the interest rate scenario they were assigned to. Our focus is not on the average planned consumption changes but on whether the planned changes differ systematically across respondents who hold different subjective models of the macroeconomy after keeping constant their observable demographic and financial characteristics. To reduce concerns about experimenter demand effects due to the priming of economic channels in the procedure to elicit subjective models, we perform the elicitation of subjective models and the RCT in two separate survey waves (in March and June 2023, respectively). Moreover, the CES also collects some information about the same households' *actual* consumption, which allows us to link survey-elicited subjective models with changes in actual consumption after actual changes in policy rates implemented by the ECB. Even though these changes are not randomly assigned to households, studying the relationship between subjective models and actual consumption behaviour can help to cross-check the relevance and external validity of our experimental results .

In the first part of the paper, we show that households', subjective models of the macroeconomy are highly heterogeneous: respondents differ dramatically in the extent to which they think that a monetary policy tightening mostly affects the economy through its effects on debt holders, savers, prices and inflation, or other macroeconomic variables and general equilibrium effects such as unemployment, exchange rates, or the stock market. This heterogeneity arises at both the extensive margin (whether households think that any of these channels is likely to transmit the effects of monetary policy) and the intensive margin (the extent to which each channel is deemed relevant and plausible). At both margins, we find that the vast majority of households believes in the effects of a monetary policy tightening through debt holders, whereas a lower proportion believes in the effects through savers as well as the effects through reduced inflation. The latter result is surprising given that the standard motivation for a monetary policy tightening that central banks around the globe communicate to the public is the need to tame inflation and revert it back to a pre-set target rate or range.

We find that observable demographic and other characteristics help in part to explain the heterogeneity in subjective models. For instance, households that reside in "frugal" EA countries such as Germany and the Netherlands are substantially more likely to believe that a monetary policy tightening affects the economy through its effects on households' savings, whereas those residing in Southern EA countries such as Spain and Italy believe in the effects on households' borrowing, which leads the two sets of households to ultimately have different views about the aggregate effects of a monetary policy tightening on the economy and how it affects their consumption-saving behavior. Similar systematic differences arise based on households' demographics and their economic and financial characteristics, such as whether they hold mortgages or face liquidity constraints. Although these variations pose interesting follow-up questions, such as how media narratives, historical collective experiences, and/or using information from one's local economic context rather than aggregate information shape subjective models of the macroeconomy, it is important to stress that our empirical analyses keep all these systematic drivers of subjective models constant. We compare households who are similar on a rich set of dimensions—they live in the same country and hence are likely exposed to common media narratives and collective memories, are both borrowers or savers, face liquidity constraints or not, and so on. In this way, subjective models capture variation that explains different economic choices above and beyond individual economic incentives and exposures to the economic and financial shocks or common narratives at the country level.

We use this setting to investigate how households react to an interest rate tightening based on their subjective models of the macroeconomy. We regress the planned change in current consumption on the update in beliefs about interest rates over a 12-month horizon that are induced by our RCT, the interaction of this update with the extent to which households believe in various potential channels of transmission, and our rich set of demographic characteristics and other controls. The randomisation embedded in our RCT design ensures that we can estimate the causal effect on planned consumption and how these causal effects are mediated by subjective models. We find that the average household plans to cut their current consumption by 0.37 percentage points after a one-percentagepoint higher update in beliefs about rates, which is consistent with standard models of the intertemporal consumption choice. At the same time, we detect economically and statistically significant heterogeneity in the size of the reaction. On the one hand, households who believe more in the effects of monetary policy tightening through debt or through saving both plan to cut their current consumption by more—about 38% and 11% more, respectively. By contrast, households who believe more in the effects through reduced inflation or other macroeconomic variables and general equilibrium effects plan to cut their spending by less—about 31% and 26% less, respectively. These results suggest that heterogeneous subjective models can lead to heterogeneity in the transmission of monetary policy to consumption above and beyond what is explained by observable household characteristics.

We then move on to dig deeper into the role of demographics and other consumer characteristics. We know from our baseline analysis that such factors do not explain the average mediating effects of subjective models but the effects could be higher or lower across different groups of agents. We find that households who have high financial literacy are on average less likely to plan to decrease their consumption following an increase in policy rates, but, once accounting for their subjective models, they behave similarly to less financially literate households who hold the same subjective models. For a broad set of other characteristics, such as education levels, the extent of liquidity constraints households face, households' trust in the central bank, or whether they live in countries with a higher or lower share of borrowers, we fail to detect any systematically different reactions for households who hold the same subjective models.

Because the relative majority of respondents in our sample believe in the effects of monetary policy tightening through debt holders, we further investigate this channel. In particular, we ask if the mediating role of believing in the debt channel is higher or lower based on respondents' own debt exposures. The baseline analysis shows that these characteristics do not explain the baseline mediating role of the debt narrative, that is, irrespective of whether households hold a mortgage or are liquidity constrained, if they believe that a monetary policy tightening will operate via the debt channel they plan to cut their consumption proportionately more after a monetary tightening. Interestingly, we do not detect any systematic differences even on the size of the effects of subjective models: irrespective of their debt-holding status or whether they face liquidity constraints, households who believe in the same subjective models plan to change their consumption to a similar extent (after controlling for the baseline effect of debt holding and liquidity constraints on consumption plans by rate changes). For the subset of households that hold mortgages, we also know whether they have a fixed-rate or adjustable-rate mortgage and what is their loan-to-value (LTV) ratio. Both dimensions capture differential exposure to a monetary policy tightening. We do not detect differences in the size of the consumption reaction by subjective models even for mortgage holders that are differently exposed to a tightening because of their rate structure or LTV (after controlling for the baseline effect of mortgage type and LTV on consumption plans by rate changes).

Overall, demographic and other economic and financial characteristics do not appear to explain the variation in the transmission of interest rates to consumption based on subjective models. We therefore turn to ask if differences that may relate more to households' economic preferences play a role. To do this, we consider the savings channel, for which economic theory has predictions based on consumers' preferences and the utility function. On the one hand, higher policy rates should increase perceived real interest rates based on the Fisher equation if inflation expectations do not move to offset them, which in turn should increase consumers' willingness to save based on the consumption Euler equation (substitution effect). On the other hand, higher interest rates produce a positive income effect for savers which should increase overall consumption, including current consumption. Whether the income or substitution effect prevails depends on the extent of consumers' intertemporal elasticity of substitution (IES). Even though we do not have a direct measure of our respondents' IES, the CES asks about planning horizons for consumption and saving choices. We can thus compare the reactions of respondents who have a short planning horizon, by whom the substitution effect should be perceived as a less relevant channel, or a long planning horizon, who should perceive the substitution effect to be a potentially more relevant channel. Consistent with this conjecture, we find that the mediating role of believing in the savings channel on the transmission of monetary policy to consumption differs based on the length of respondents' planning horizons. In particular, the mediating role is stronger for those who have a long planning horizon, who plan to cut their current consumption (and hence increase their savings) substantially

more than consumers who have only a short planning horizon. Conversely, we find that, indeed, consumers who have likely a low IES and think that the savings channel is an important macroeconomic channel are less willing to cut their spending after a positive shock to perceived interest rates.

We also ask whether the role of subjective models for the transmission of interest rate changes is similar irrespective of the direction of the change. We can ask this question in our setting because, even if our RCT assigns varying degrees of monetary policy tightening and does not refer to monetary policy loosening, our respondents' priors about 12-month-ahead interest rates can be above or below the value in the scenario they are assigned to. Consider two respondents who believe that interest rates will increase by 3 percentage points over the following 12 months. If one respondent is assigned to a scenario of a 2-percentage-point increase and the other of a 4-percentage-point increase, the first one will face a negative change in beliefs of future rates, whereas the second one a positive change. In contemporaneous work, D'Acunto et al. (2024) exploit this variation to document that the transmission of interest rate changes to consumption is sizable and aligns with theory following a perceived tightening whereas it is minimal and not different from zero statistically following perceived loosening of rates. We find that subjective models are also relevant for this asymmetric transmission of interest rates to consumption: the heterogeneous patterns of transmission arise similarly to our baseline analysis for respondents who face a perceived tightening of monetary policy, whereas for those who face a perceived loosening of monetary policy, not only the baseline transmission disappears but also no differential transmission is present as a result of respondents' different subjective models.

In the last part of the paper, we link survey-based subjective models to respondents' *actual* consumption choices to actual policy rate changes. This analysis faces two empirical shortcomings. First, the data on actual consumption levels is noisier than the survey-based elicited consumption plans by construction given that it is not produced on a homogeneous scale. Second, no randomized allocation of interest-rate scenarios exists in the setting. We need to consider changes in actual ECB policy rates, which are the same for all households thus losing one dimension of heterogeneity we have in the scenario-based RCT.

Both shortcomings are likely to lead to noisier estimates. Armed with these caveats, we regress the actual change in consumption at the consumer level across subsequent quarters on the change in policy rates that intervened in those quarters, the consumers' subjective models of the macroeconomy, and the same controls and fixed effects as in the scenario-based analysis. Not only do we replicate the baseline drop in consumption after policy-rate increases (even if the estimates are noisier and statistical significance at times sparse) but we also confirm that consumers who believe more in a debt channel of the transmission of monetary policy, irrespective of whether they hold debt or are financially constrained themselves, do cut their consumption by more than others after facing the same rate change. For the other channels, we find results that are qualitatively similar to the ones in the scenario-based analysis, although the estimates are substantially noisier and generally not statistically different from zero. These results are important to provide external validity to our analysis and especially to dismiss any potential remaining concerns about priming or experimenter demand effects that might arise from the scenario-based analysis.

Our analysis relates to a broader and rapidly expanding recent literature which uses surveys to document wide dispersion in economic agents' beliefs about the economy and how those beliefs may influence subsequent economic behaviour and policy effectiveness. An important focus of this recent research program has been on household and firm inflation beliefs, their determinants and implications for economic behavior and outcomes (for recent reviews, see, Weber et al. (2022), D'Acunto and Weber (2024) and D'Acunto et al. (2024)). In the area of fiscal policy, Georgarakos and Kenny (2022) provide an example of how the public's beliefs about the effectiveness and adequacy of fiscal policy interventions during the Covid-19 pandemic had a strong causal role in shaping their own individual spending response. Most closely related to the present paper is the recent paper by Andre et al. (2022) who study people's subjective models of the macroeconomy and shed light on their determinants, finding that there is a wide dispersion in beliefs about the propagation of shocks, in particular demand- vs. supply-side mechanisms. More generally, much of this literature has highlighted imperfections and limitations in the publics' knowledge about economic policies and the economic mechanisms on which they are assumed to rely. Indeed, as highlighted in Sapienza and Zingales (Sapienza and Zingales), the public's knowledge about economic phenomena diverges substantially compared with how economists tend to reason. As highlighted earlier by Blinder and Krueger (Blinder and Krueger), there may be an important role for "ideology" and therefore for communication channels in shaping peoples subjective narratives, i.e. what they see in different and increasingly fragmented media channels can shape in heterogeneous ways the public's perceptions about how the economy functions. Our contribution to this growing literature is to examine the relevance of subjective models or economic narratives for understanding the transmission of monetary policy and interest rate changes to household spending.

Looking forward the evidence we gather for the importance of subjective models in shaping consumer behaviour and interest rate transmission can open up a set of novel questions for further empirical and theoretical research (see, also, the recent discussion in (Haaland, Roth, Stantcheva, and Wohlfart, Haaland et al.)). On the empirical side, subjective models of the macroeconomy might be important also for the transmission of other policy measures and economic shocks, such as fiscal policy measures, forward guidance, structural policy interventions or supply-side and other business cycle shocks. The survey-based setting we build can be adapted and extended to answer all these and other questions in terms of both the elicitation of subjective models as well as the design of viable information-provision experiments. On the theoretical side, our work informs advances in macroeconomic models that allow for heterogeneity across agents: not only demographic heterogeneity but also heterogeneity in the ways agents conceptualize the functioning of the economy and how this can affect their reactions to changes in macroeconomic conditions. The challenge of incorporating this form of heterogeneity in macroeconomic models is still wide open.

II Setting: ECB's Consumer Expectations Survey

In our analysis, we use the ECB's Consumer Expectations Survey (CES), an online, monthly frequency panel survey of EA consumer expectations and behavior. Building on recent international experiences and advances in survey methodology and design, the CES was launched in the pilot phase in January 2020 and is currently fielded in the eleven largest EA counties (for further information see Georgarakos and Kenny (2022), ECB (2024), and the CES website).

In this paper, we combine data from various modules of the CES. Respondents are invited to answer online questionnaires every month and then typically leave the CES panel between 18 and 24 months after joining. The survey provides sample weights that are used to ensure the survey results are representative of the adult population in each country. Each respondent completes a questionnaire upon entry into the panel, providing background information that changes minimally from one month to another (e.g., education, family situation, measures of financial literacy).

More time-sensitive information is collected in a series of monthly, quarterly, and ad hoc topical questionnaires. A monthly module used to collect subjective macroeconomic and individual expectations and beliefs, e.g. related to inflation, interest rates, house prices, GDP growth, labor market developments, and own financial situation is the core component of the survey. In addition, the CES also collects detailed information about non-durable consumption in its quarterly module that we are also able to exploit for our analysis. Furthermore, we use data from a topical module on housing and mortgages which is fielded once per year (in February) and provides information about important borrowing decisions such as the choice to take out a mortgage or which type of mortgage interest rate contract they have chosen (e.g. fixed versus variable rate mortgages).

The flexibility offered by the CES online platform allows for fielding additional ad-hoc modules for research purposes. In this paper, as we describe in more detail below, we make use of data collected in three such ad-hoc research modules fielded in March and June 2023 and subsequently in June 2024. As we discuss below, having access to different survey waves is important to reduce concerns of experimenter demand effects in our setting.

The CES data during the period of our analysis covers eleven EA economies with a total sample size of approximately 19,000 consumers: 3,000 survey participants from each of the four largest EA countries (Germany, Italy, France, Spain), and 1,000 in each of the other remaining seven countries (Austria, Belgium, the Netherlands, Finland, Greece,

Ireland and Portugal). Our empirical analysis requires matching individual data across different modules using the panel structure of the survey and this reduces the effective working sample size to approximately 16,000 individual observations.

We report summary statistics for the most relevant individual-level demographic variables that enter our analysis, which are all defined as dummy variables, in 1. We can see that more than half of our respondents hold a college degree and have relatively high financial literacy scores. As described in more detail in Christelis, Georgarakos, Jappelli, and Kenny (Christelis et al.), and following Lusardi and Mitchell (2011), we take the count of correct responses to four financial literacy questions as a measure of financial literacy and consider as highly literate those answering correctly three or (all) four questions (which corresponds to roughly 55% of the sample). Moreover, about one fifth of the sample consists of single individuals whereas, among couples, the vast majority have no children or up to two children. Our data also allow us to observe whether respondents hold a mortgage (or if they are liquidity constrained (just under one third of the sample). Finally, we also observe information about whether respondents declare that they only think about their immediate near future when planning their consumption and savings (Short Planning Horizon), which is the case for about one quarter of the sample, and whether they exhibit relatively high trust score in the ECB. All questions used to derive these measures of financial literacy, liquidity constraints, trust and planning horizons are detailed in the Appendix.

III Eliciting Subjective Models of the Macroeconomy

Measuring subjective models of the macroeconomy empirically faces a set of challenges the most compelling of which is the fact that, contrary to other commonly measured individual economic preferences and beliefs, the definition of subjective models is less precise and could lead to confusion or misunderstanding on the part of respondents. For instance, while all agents typically understand what the concept of "household income" entails and can provide an assessment of their current and future income prospects, asking them directly about how they think the macroeconomy works requires them to conceptualize several relevant macroeconomic variables, many of which they might have never thought of before. In addition, we need to elicit information on how these variables are related to each other—a set of relationships and cause-effect links that the respondent might have very limited familiarity with.

The first way in which we tackle these challenges is by asking respondents about the effects of a specific macroeconomic shock—an increase in policy rates by the European Central Bank (ECB) rather than a generic assessment of the steady-state relationship across economic variables. Moreover, we use two measurement approaches – a first open text approach and a second which asks respondents to select from a pre-defined but randomised set of potential transmission channels. This dual approach allows us cross check the results and helps to balances the competing needs to elicit what non-economic experts think when making decisions without any prompting on the part of survey designers and economists with the equally important need to provide some structure to the elicitation endeavor and obtain systematic measures that can be compared across respondents. We describe both approaches, which we implemented in the March 2023 survey wave, in detail below. We note that both approaches as well as the empirical analysis of the data they produce can be easily implemented in surveys of households and firms around the world and can be amended to assess the subjective effects of other macroeconomic shocks.

A. Open-ended Elicitation (Extensive Margin)

Our first approach builds on Andre et al. (2022) and asks respondents unpromptedly and in their own words how they think that a future increase in policy rates might affect the economy of their country and their own financial situation. Specifically, we use the following formulations:

"The European Central Bank (ECB) has raised interest rates since July 2022 and has indicated that it is likely that interest rates will need to be raised further in the future. In your own words, how do these rising interest rates affect the economic situation of the country you live in over the next 12 months?"

"In your own words, how do these rising interest rates affect the financial situation of your household over the next 12 months?"

Respondents provide open answers to these questions without any pre-specified format, guidance, or cue. Respondents read and answer the questions in their national language. To analyze the answers homogeneously, they are translated into English using a translation service.

We provide summary raw-data evidence of the text data that these questions produce in Figure 1, which plots the word cloud depicting the frequency of word stems reported by respondents in the answers to their open text answer to the first question. The font size of each word stem is proportional to the frequency with which the word is mentioned in answers and only the words that are mentioned above a minimal threshold enter the cloud. e can see that respondents tend to indicate not only words related to prices and inflation but also to other macroeconomic variables related to debt, spending, savings and investments, unemployment among others. The answers thus clearly indicate some awareness of different channels of monetary transmission including effects on lending and borrowing, savings and spending, transmission to inflation and inflation expectations as well as other general equilibrium effect via the labor market or the corporate sector.

The aggregate distribution of words at the euro area level in Figure 1 also masks substantial heterogeneity across various dimensions, such as countries and demographics. For instance, Figure 2 plots the most frequent words mentioned in the answers to the first question by Spanish households (left cloud) and German households (right cloud). We can see that a relatively higher share of Spanish households stresses the effects that increasing interest rates have on liability-related variables, such as mortgages and loans, whereas a relatively higher share of German households stresses the effects on asset-related variables, such as investments or the effects on the corporate sector ("company"). In the Online Appendix, we report more examples of words clouds split by demographic characteristics, including whether respondents hold mortgages, by employment status, and age, among others.

The systematic qualitative heterogeneity of the economic channels that come to respondents' minds unpromptedly deliver interesting insights into the potential narratives that define their views about the macroeconomy at both the aggregate and individual level. At the same time, in all our empirical analyses in the paper, we will absorb any systematic sources of variation in narratives that are associated with country fixed effects and various controls for observed demographic and economic or financial characteristics. Our aim will be to assess if and how subjective economic models per se relate to the beliefs and consumption choices of observationally similar households rather than describing the cross-sectional variation in subjective economic models across households and countries that may be associated with such characteristics.

The main advantage of these open-ended questions is that they allow the econometrician to virtually eliminate any concerns about framing effects, priming, or demand effects in the elicitation of subjective models. At the same time, operationalizing the answers empirically faces a set of challenges. First, the answers can capture the "extensive margin" of subjective models, that is, what channels, variables, and relationships come to the respondent's mind when assessing the effects of an increase in policy rates, but the answers do not inform us on how intensively each respondent believes each mentioned word and/or channel operates. For instance, two respondents might both indicate that higher policy rates will lead households to be "worse off" going forward but the size of this expected worsening of personal economic conditions might differ and the open-ended answers provide no information about such difference. Moreover, the same respondent might discuss multiple economic channels in his/her answers but might believe that one channel is more likely or more relevant than the others. We cannot rank the perceived importance of different channels for a given respondent unless they themselves provide a ranking in their open text replies (which is mostly not the case). For these reasons, as we discuss in section III. B., we also propose a second elicitation strategy that aims to measure the "intensive margin" of subjective models and allows the construction of a ranking among alternative channels.

Open-ended elicitation faces an additional challenge: the information contained in

answers is not in a numerical or ordered multinomial format and, hence, it cannot be readily analyzed empirically. Each respondent produces text data that needs to be organized and homogenized before any empirical analysis. To tackle this challenge, we resort to text-analysis techniques that are used increasingly in economic research (Gentzkow et al., 2019). Our approach consists of two stages. The first stage is a form of supervised learning. First, based on dictionary information unrelated to the data in our sample, we compile lists of word stems that belong to the same semantic areas across four domains: Debt, Savings, Prices, and Macro/General Equilibrium (GE). We selected these four areas because they cover the vast majority of economic channels that relate interest rate changes to other macroeconomic variables based on macroeconomic theory and they are relatively encompassing in terms of the coverage of important transmission channels (e.g. as also observed in the word clouds of Figure 2). After standard cleaning of the answers data for stop words and logical connectors, we apply these external lists to the full sample of answers to create a set of four topics that include the word stems from the list that appear in our sample as well as the word stems that are frequently used by respondents in the same sentences. The topics this procedure creates are therefore not equivalent to the external lists but dismiss the words from the lists that do not appear in our answers while potentially introducing words that are mentioned often close to the ones in the lists but are not part of the lists. In the last step, we delete all the words that appear in more than one topic.

Reducing topics to the subset of words that are defining and unique is important for our analysis in order to separately identify which economic channels the respondent had in mind. For instance, word stems like "bank", "cost", "all" or directional or qualifying words such as "high", "difficult", "veri" do not univocally relate to a specific economic channel and we do not want somebody who mentions these words to be assigned to an economic channel they might have not implied at all in their answers. Moreover, because of the translation from national languages into English, this procedure provides a homogeneous elicitation by only including one word for all potential synonyms respondents might have used to refer to the same economic concept—synonyms whose number varies systematically across national languages. Based on this first-stage procedure, we obtain the following finalized lists of unique word stems for each of the initial four areas: <u>Debt:</u> loan, mortgag, debt, financi, hous, borrow

Savings: invest, save

<u>Macro/GE:</u> countri, compani, purchas, expens, spend, unemploy

<u>Prices:</u> price, inflat, money, pay

In the second stage, we consider each answer individually and, for each topic, we assess whether any word stems from the topic are mentioned in the answer. For each topic, we define a dummy variable that equals 1 if any of the topic's word stems are mentioned in the answer, and zero otherwise. In this way, each answer might be detected to mention no topics, a single topic, or multiple topics. Our empirical analyses using this extensivemargin elicitation procedure will use the topic dummies as a measure of the subjective models respondents have in mind and will exploit the cross-sectional variation in the types and numbers of topics that come to mind to different respondents who are otherwise observationally similar in terms of demographics or other measured characteristics.

B. Closed-Ended Elicitation (Intensive Margin)

To allow ranking the subjective importance of each economic channel within individuals as well as the intensity of the subjective effects of an increase in policy rates on each channel, we propose a second elicitation method based on a closed-ended questions that ask respondents to indicate on a Likert scale from 1 to 6 (1, Very unlikely, 2. Unlikely, 3. Rather unlikely, 4. Rather likely, 5. Likely, 6. Very likely) the extent to which they believe a set of pre-specified channels are more or less likely to capture the consequences of a tightening in monetary policy on the economy of their country and a binary elicitation for how it affects themselves. Importantly, this closed ended question appears only after the open text question in the CES online platform and therefore should have no impact on the results of the latter. Specifically, we use the following question formulations:

"When the European Central Bank (ECB) increases interest rates, how likely do you think it is for each of the following to happen?" The predefined list of 14 channels is as follows:

- 1. Households earn higher returns on their savings accounts
- 2. Households face higher mortgage and loan payments
- 3. It is costlier to take out a new mortgage/loan
- 4. More workers lose their jobs
- 5. Prices of everyday goods and services stabilise or decrease
- 6. The prices of oil and gas stabilises or decreases
- 7. It is cheaper to purchase foreign-produced goods
- 8. The stock market performs poorly
- 9. House prices in my area decrease
- 10. Rents increase
- 11. There will be an economic downturn
- 12. People are able to spend less on goods and services
- 13. Businesses invest less and are not able to expand the supply of goods
- 14. Governments are able to borrow and spend less

These channels appear to respondents on the online questionnaires in a randomized order in order to avoid that the order would impact the importance of different channels (see also the appendix). For each respondent and each channel, we thus obtain a measure of the subjective intensity of the effect of a monetary policy tightening for each channel. As can be seen from the above list, the channels include sentences such as "Households earn higher returns on their saving accounts", "Households face higher mortgage and loan payments", and more general equilibrium effects such as "More workers lose their jobs" or "There will be an economic downturn". To keep our analysis homogeneous when comparing open-ended and closed-ended elicitation methods and for ease of exposition, in the main text, we create four variables for each respondent that average the numeric values assigned to the channels that belong to each of the four domains we also isolated in the open-ended measurement: *Debt, Savings, Prices, and Macro/General Equilibrium (GE).* We assign channels 2 and 3 to Debt, channels 1 to Savings, channels 5, 6, 7, 9, 10, 11 to Prices and channels 4, 8, 12, 13 and 14 to Macro/GE but for completeness, in the Online Appendix, we also report the results of our analyses when considering each of the 14 channels in the closed-ended questions separately.

The four intensive-margin variables we use for the main text analysis thus obtain values between 1 and 6 and the higher the variable's value the more the respondent believes that the channel is likely to be active after increases in interest rates. We report the summary statistics for each intensive-margin measure in the bottom panel of Table 1. On average across all respondents, it is interesting to note that the *Debt* channel is the one with the highest Likert score with average and median values of 4.81 and 5.00, respectively, followed by the *Macro/GE* channel, whereas the *Savings* and *Prices* channels appear to gather systematically less support, on average. This fact is especially surprising for the *Prices* channel, which includes the decline in aggregate inflation: despite the fact that the main motivation economists and policymakers portrayed to justify monetary-policy tightening measures during the time period we study—taming inflation rates—households appear to assign the least likelihood to this channel while assigning a higher likelihood to the possibility that increasing rates would affect debt, savings, and other macroeconomic variables unrelated to inflation and prices.

To compare the information that can be elicited from the intensive-margin measures to the information from the extensive-margin measures, which we presented in the form of cross-country examples in Figure 2, we report additional raw-data evidence about the properties of our intensive-margin measures of subjective models of the macroeconomy in Figure 3. The figure plots the average values of each of the four intensive-margin measures for each Euro Area (EA) country in our sample. On the one hand, the information across measures is consistent. For instance, we can see that the average values of the *Savings* channel are higher for frugal EA countries, such as Germany, whose households were more likely to report words related to the *Savings* channel also in the open-ended question (see Figure 2) and lower for Southern EA countries, such as Spain, which is again consistent with the information from the open-ended question. Also consistent across measures is the fact that the average values of support for the *Debt* channel mirror those for *Savings*: they are higher for Southern countries and lower for frugal countries such as Germany. On the other hand, the intensive-margin measures allow ranking the subjective intensity of each channel across respondents. For instance, we can see that, across the sample, the level of support for the *Debt* channel is higher than the level of support for other channels across all countries. This latter pattern shows the advantage on eliciting narratives in different ways, because it would completely be missed by considering only the unprompted responses to the open-ended questions discussed previously.

The main challenge with our intensive-margin elicitation procedure is that respondents are forced to be aware and think about the potential channels we propose to them in the survey but the same channels might not all come to mind when they form beliefs and make decisions in the actual daily life. To the extent that higher agreement with one channel also proxies for a higher likelihood that respondents would think about the channel unprompted, the intensive-margin measure can also provide us with some information about the extensive margin. Note also that, in line with the intensive-margin variation, our main analysis only exploits intensive-margin variation in subjective models in our sample after controlling for systematic predictability from observable demographics and other characteristics. In this way, we only capture the variation in subjective models of the macroeconomy across observationally similar households.

IV Subjective Models and the Transmission of Monetary Policy to Consumption

Armed with individual-level measures of the extent to which consumers think that monetary policy acts through each of the four grouped channels we defined in Section III, we move on to test if these subjective models mediate the transmission of monetary policy to consumption.

We first focus on several hypothetical monetary policy measures we provide randomly to different groups of consumers and on how these measures affect consumers' planned change in consumption, if at all. This step allows us to exploit pure exogenous variation in the size of the monetary policy measure based on individual perceptions and beliefs about interest rates. We derive this exogenous measure as the difference between a proposed hypothetical level of interest rates after monetary policy interventions and consumers' own individual priors beliefs about the same interest rates. It also lets us dig deeper into the channels that might drive any of the effects of subjective models by exploiting the design of our survey questions.

It is important to stress that, given the aims of our analysis, focusing on planned and hypothetical changes in consumption based on some information provided within the experiment should not be interpreted as a negative feature or a second-best solution relative to observing actual consumption responses to actual interest rate changes. In fact, in this part of the study we want to understand the heterogeneous effects of subjective models of the macroeconomy on what consumers think should be the appropriate consumption reaction to interest rate changes. Observing stated hypothetical reactions and correlating them with elicited subjective models of the macroeconomy is exactly what we aim for in this part of the analysis. In other words, the experimental part of our analysis can be interpreted as a way to ask consumers what they think should be, theoretically, their optimal reaction to provided changes in macroeconomic conditions and to assess the role of subjective models in shaping this response.

However, as a supplementary way to validate our scenario based results, we also assess in a second step whether consumer-level subjective models of the macroeconomy are consistent with the same consumers' actual choices about consumption as are also measured in the CES. These actual consumption choices were made at different points in time relative to the survey experiment, as well as changes in actual interest rates based on the ECB's monetary policy interventions that occurred over our sample period.

A. Exogenous Variation in Perceived and Expected Interest Rates

To obtain exogenous variation in consumers' perceived and expected interest rates based on monetary policy measures, we designed a randomized control trial (RCT) that embeds an information treatment intervention in the June 2023 wave of the CES. Note that the time of the information treatment differs from the time of the elicitation of subjective models of the macroeconomy, which was conducted in March 2023 as we discussed above. This timing difference is helpful to limit concerns about experimenter demand effects, which could arise if we alerted respondents about potential macroeconomic channels affected by monetary policy tightening of which they might not be aware and then provide them with information about monetary policy tightening to gauge their beliefs and consumption plans.

The trial consisted of three steps. First, the survey elicited respondents' priors about perceived current rates, focusing on rates that are salient to households, that is, mortgage interest rates.¹ Second, respondents were randomly split into 5 experimental arms, each of which was allocated hypothetical values for mortgage rates 12 months after the survey. The hypothetical values started from 2% and increased by increments of 2 percentage points until 10%.

For the sake of our tests, we compute the difference between the randomly assigned hypothetical value of 12-months-ahead mortgage rates and respondents' priors about current mortgage rates:

$$\Delta Rates_i = Random \ Hypothetical \ Rate_k - Rate \ Prior_i, \tag{1}$$

where k indexes one of the 5 hypothetical values between 2% and 10% assigned to respondents randomly, whereas priors vary at the level of respondent *i*.

 $\Delta Rates_i$ thus measures the shock to the perceived current interest rate induced at the subject level by the randomized information treatment, which is our main covariate

¹Specifically, the question asked: "What do you think is the current interest rate on a mortgage for someone like you and what do you think it will be at the following points in the future?" and elicited perceived current rates and future rates at 12-month and 3-year horizons.

of interest to measure the transmission of changes in interest rates, such as those induced by monetary policy, on respondents' consumption.

Figure 4 plots the distribution of $\Delta Rates_i$ in our sample after winsoziring these changes at the 1-99% levels. The distribution stresses three relevant properties of $\Delta Rates_i$ for our empirical analysis. First, the range of induced changes in perceived and expected rates is large (21 percentage points), which provides us with substantial cross-sectional variation in the main covariate of interest. Second, not only the magnitudes but also the signs of the changes vary, which allows us to assess whether the mediating effect of subjective models of the macroeconomy on the transmission interest rates on consumption differs based on whether consumers face hypothetical increases as opposed to decreases in interest rates. Third, we note a long and fat left tail in the distribution of $\Delta Rates_i$, which suggests that a nonnegligible fraction of consumers in our sample have quite elevated priors for current interest rates which results in a negative shock given the range of hypothetical values that we assign.²

In the third step of the trial, the survey elicited respondents' planned change in total household spending, if any, conditional on the information they were provided in the second step. As we describe further in the appendix, ew elicited planned changes in spending using a slider that ranged from -30% (decrease) to +30% (increase) and included 0 (no change).

In our empirical analysis, we use this variable directly as elicited and call it $\Delta Planned \ Consumption_i$. The last line of Table 1 reports $\Delta Planned \ Consumption_i$'s mean, standard deviation, and median values. We can see that, on average, consumers plan to decrease their consumption based on the information they were provided at the information treatment stage. This fact is consistent with the higher mass of consumers lying in the positive domain of the distribution of $\Delta Rates_i$, as is visually evident in Figure 4 and consistent with the positive mean (1.21%) and median (1.50%) of $\Delta Rates_i$ reported in Table 1.

Overall, the majority of consumers in our sample are therefore presented with potential future mortgage rates that are higher than those they perceived at the beginning

 $^{^{2}}$ Note that the right tail of this distribution is bounded given that consumers do not report negative priors for interest rate and the values our information treatments provide are all positive.

of the survey and plan to cut their total household spending based on this information.

B. Consumption Plans' Response to Changes in Interest Rates by Subjective Models

To assess the potential role of subjective models of the macroeconomy in shaping consumers' views about how consumption should react to changes in interest rates, we estimate several versions of the following linear specification by ordinary least squares (OLS):

$$\Delta Planned \ Consumption_i = \Delta Rates_i + \sum_j Subjective \ Channel_{i,j} + \sum_j Subjective \ Channel_{i,j} \times \Delta Rates_i + X'_i \delta + \eta_c + \epsilon_i, \ (2)$$

where $\Delta Planned \ Consumption_i$ and $\Delta Rates_i$ are the change in consumption plans and the shock to perceived interest rates elicited at the level of subject i as described in the previous subsection; Subjective $Channel_i$ are the four channels to measure consumerlevel subjective models of the macroeconomy (Savings, Debt, Macro/GE, and Prices) based on closed-ended quantitative questions, as described in Section III; X is a vector of dummy variables capturing the consumer-level demographic and other characteristics we observe for the full sample, which include: whether the consumer has higher financial literacy, whether they have a mortgage outstanding, whether they report facing liquidity constraints, whether they report that they have a short-planning horizon, i.e. are not planning beyond the immediate future when making financial decisions, whether they have relatively high trust in the ECB, whether they have a high school diploma but no college degree, whether they have a college degree, whether they are single, whether they live with a partner in a couple but have no kids, whether they live with a partner in a couple and have up to two kids, and any alternative solutions (excluded category of reference); η_c is a full set of country fixed effects for the 11 euro area countries whose households were interviewed in the July 2023 wave of the CES.

We report the results for estimating Equation (2) in Table 2. Column (1) only

includes $\Delta Rates_i$ as a covariate and shows that after a one-percentage-point shock to perceived interest rates, on average, consumers plan to reduce their consumption by 0.37 percentage points. Such a consumption response to an increase in interest rates is both quantitatively and statistically significant.

Column (2) adds the consumer-level subjective support for each of the four channels, whose values constitute the consumers' subjective model of the macroeconomy, as well the interactions of these subjective models with $\Delta Rates_i$. Now, $\Delta Rates_i$ captures the planned change in consumption after being exposed to a one-percentage-point shock to perceived interest rates for consumers who attribute the lowest score (1 out of 6) to all four channels, i.e. in other words they do not think that *any* of the subjective models channel are a good representation of the effects of a monetary policy tightening on macroeconomic outcomes. The estimated effect is economically and statistically similar to the average for the whole sample reported in Column (1).

The interactions of $\Delta Rates_i$ with the values attributed to the four channels constitute one of the main result of our paper: it shows that the baseline negative transmission of hikes in interest rates to household consumption is mediated and moderated based on consumers' subjective models of the macroeconomy. We observe significant negative interaction coefficients for the *Savings* and *Debt* interactions, whereas the estimated coefficients are positive for the *Macro/GE* and *Prices* narratives. These results imply that consumers who think that the savings and debt channels are more important react more to the same change in interest rates than consumers who instead think that general equilibrium and price effects are more relevant. The transmission of a monetary policy tightening is therefore heterogeneous across consumers based on the subjective models consumers have in their mind when forming their consumption plans.

In terms of magnitudes, a consumer who attributes one additional point to the *Savings* channel (out of 6) plans to react about 11% more (-0.039/-0.353) to the same one-percentage-point increase in interest rates relative to a consumer who does not think the Savings channel is relevant, i.e. attributes a score of 1 out of 6 to that channel. The the mediating effect is substantially higher for consumers who attribute one additional point to the *Debt* channel. The estimated coefficients imply that they would react by

about 38% more than consumers in the baseline category. These results suggest that the transmission of monetary policy to consumption is substantially higher for consumers who think about the Savings and/or Debt channels when assessing the effects of higher interest rates on the economy and the response is particularly strong for consumers who believe in a subjective model that focusses on the narratives related to debt and borrowing.

Moving on to the Macro/GE and Prices channels, our estimates imply a moderating effect on policy transmission relative to the baseline category of consumers of about 31% and 26%, respectively. Ultimately, the transmission of monetary policy to consumption is substantially lower for consumers who think about the Macro/GE and/or Prices channels even though those consumers also plan to cut their spending after an increase in interest rates.

In column (3), we add the set of individual-level controls for demographic and other characteristics and we observe to find that the estimated extent of monetary policy transmission to consumption and the estimated mediating and moderating effects of different channels are almost unchanged. This result does not mean that the characteristics we observe, such as whether consumers are financially literate, whether they have college degrees, as well as whether they have mortgages outstanding (and hence are debtors and might be more aware of the debt channel, for instance), among others, are not important for consumption plans or potential correlates with consumers' subjective models of the macroeconomy. Indeed, Table A.1 in the Online Appendix shows that our four channels correlate significantly with many of those observables. Rather, the results in column (3) imply that consumers who hold the same subjective models of the macroeconomy—irrespective of their demographic and other characteristics—plan to react similarly to the same change in interest rates.

Finally, column (4) of Table 2 adds a full set of country-fixed effects to the RHS of the specification, which also appears to not change any of the estimated coefficients materially. Absorbing country fixed effects is important because consumers in the same country at the time of our survey might be exposed to the same systematic drivers of subjective models of the macroeconomy as well as of consumption reactions to changes in

interest rates.³ For instance, the political debate and media coverage of economic news is likely to differ systematically across countries based on which by monetary transmission channels are more relevant for the majority of consumers in those countries. Moreover, consumers might be exposed to different national narratives about the macroeconomy based on a country's economic performance in the past and over the years leading up to our analysis, such as the COVID-19 pandemic period. Similar to demographics, we find that, indeed, support for alternative channels differs systematically across countries (see Table A.1 in the Online Appendix) and generally in ways that appear consistent with national economic narratives. However, the estimated role of economic narratives is almost unchanged compared with the regressions in columns (2) and (3). This result underlines the importance of narratives because it implies consumers who hold the same subjective models in different countries plan to react in the same way to a given change in interest rates.

C. Do Subjective Models Merely Capture Demographic Characteristics? Evidence from the Debt Channel

While our baseline analysis suggests that subjective models play an independent role above and beyond observable characteristics they do not fully answer an important question: Do the subjective models of the macroeconomy consumers hold capture the ways in which they think the economy works, irrespective of their own specific demographic characteristics, or are they simply a way to rephrase in qualitative terms observable demographics?

On the one hand, the subjective models we measure might simply capture households' observable characteristics. For instance, a consumer who holds a mortgage might stress the debt channel when asked about how they think macroeconomic variables relate because that channel is salient to the consumer at the time she is asked. The same might be true for a saver in terms of the savings channel, and so on. Subjective models could thus merely be an alternative and qualitative measure that captures quantitative observable

 $^{^{3}}$ Note that our survey-based analysis includes observations at a single point in time, so no scope exists to add time-varying country effects or time fixed effect to our specifications.

characteristics that can be measured precisely through administrative and transactionlevel data. In that case, focusing on the measurement and effects of subjective models might be interesting in terms of understanding why consumers that are directly affected by monetary policy react in the direction in which they are affected directly, but subjective models would capture no additional heterogeneity in consumption choices and reactions to policy than what is explained by observable demographics. The fact that several demographic characteristics are systematically correlated with our measures of subjective models (see Table A.1) makes this possibility relevant.

On the other hand, the subjective models consumers hold might capture their views about the macroeconomy and drive their reactions to shocks and policy above and beyond what would be predicted by their demographic characteristics. This alternative could arise if consumers' subjective models formed over time as a combination of many determinants, such as, for instance, one's education and accumulation of knowledge, the political debate to which consumers are exposed, experienced macroeconomic outcomes over time, and cognitive abilities. In this case, consumers' observed demographic characteristics at any specific point in time would not be able to capture the heterogeneity in choices and reactions produced by subjective models. Subjective models would capture more of the variation in observed choices and reactions than what the variation in observed demographics across consumers is able to capture, which would justify the importance of measuring and understanding subjective models and their effects.

Our results in columns (3) and (4) of Table 2 keep constant important demographics that correlated with consumption plans and subjective models, but do not assess if the mediating and moderating effects of subjective models are relevant above and beyond the potential mediating and moderating roles of such demographics in the transmission of changes in interest rates to consumption choices. We tackle this point in Table 3, where, in each column, we assess whether the baseline mediating and moderating roles of subjective models differ systematically across demographic characteristics.

Column (1) of Table 3 asks whether the different reactions of consumption plans after changes in perceived rates by subjective models differ between consumers that have high financial literacy and others. First, we find that high-financial-literacy consumers in our sample are in fact less likely than others to react to changes in perceived rates when forming their consumption plans: adding the estimated coefficients on $\Delta Rates$ and *High Financial Literacy* × $\Delta Rates$ actually delivers an economically and statistically insignificant effect of the change of perceived rates on consumption plans for high-financialliteracy consumers. Moving to the subjective models, we do not detect any differential reactions of high-financial-literacy consumers to changes in perceived rates when they believe in the *Savings*, *Debt*, or *Macro/GE* channels. Among those who believe in the prices channel, high-financial-literacy consumers appear to react less than other consumers in terms of consumption plans. Note that the baseline estimated mediating effect of the *Savings* channel and moderating effect of the *Macro/GE* channel are in line with the results in Table 2 in terms of economic magnitude, but statistical significance is reduced by the addition of triple interactions in the specification.

In Column (2) of Table 3, we compare consumers with a college degree to other consumers, because completing a college education might be correlated with potential drivers of subjective models of the macroeconomy above and beyond personal finance literacy, e.g. due to a deeper understanding of technical and written texts, higher cognitive abilities, and better understanding of cause-effect relationships. Once again, we do not find that the role of subjective models in the reaction to changes in interest rates differs between consumers with a college education and others.

We then consider an observable that captures consumers' own financial situation and the extent to which their consumption, saving, and borrowing decisions can react to changes in interest rates—whether the consumer declares that she is liquidity-constrained at the time of the survey. In column (3), we do not observe any systematic differences in the sensitivity to subjective models by these consumers and others with the exception of those who believe in the prices channel. Indeed, it is the liquidity-constrained consumers who believe that prices will decrease due to higher interest rates that plan on cutting their consumption by less than other consumers who believe in the same channel.

In order to capture the role of narratives based on the national political discourse, in column (4) we compare the reactions of consumers who live in countries which have had fiscal constraints including relatively high public debt over GDP ratios (Spain, France, Italy, Greece, Ireland, Portugal) and others. Even in this case, we find that consumers who believe in each of the channels that constitute subjective models plan to react similarly to the same changes in interest rates, irrespective of whether they are exposed to different national narratives about the macroeconomy and the relationship between national public accounts and the public accounts of other euro area countries.

Finally, we consider consumers with High levels of trust in the ECB. We find in column (5) that the baseline response of consumption plans to perceived changes in interest rates is somewhat larger for consumers who have low trust in. the ECB, which is captured by the estimated coefficient on $\Delta Rates$, relative to the baseline reaction we estimated in Table 2 (-0.353 to -0.425). At the same time, we do not detect systematic differences in the mediating and moderating effects of different channels on this reaction based on whether subjects have high or low trust in the central bank.

Our results so far suggest that the debt channel of subjective models of the macroeconomy is especially important to mediate the effect of an increase in perceived interest rates on consumers' consumption plans. To further check whether subjective models are not just mere proxies for observable household characteristics, we therefore focus on comparing debt holders to other consumers as well as comparing the role of subjective models within debt holders who are exposed to different forms of debt.

In Table 4, we propose triple-interaction specifications that build on equation (2) and are similar to those in Table 3 but consider also the interactions of specific financial characteristics with the debt channel. Specifically, we compare consumers who have mortgages outstanding to non-mortgage holders (column (1)) and consumers who declare being liquidity-constrained to non-liquidity-constrained consumers (column (2)). We then restrict our analysis to the subset of consumers who have a mortgage outstanding and, within them, we compare those who have a fixed-rate mortgage (FRM) to others and those whose mortgage is associated with a very high loan-to-value (LTV) ratio that is close to 100% to others. The results show that we fail to detect any significant economic or statistical differences in the extent to which those who believe in the debt channel plan to change their consumption based on the same change in perceived rates except for liquidity-constrained consumers, for whom the mediating effect of the Debt channel on

their reaction is muted. That is, among those who believe in the debt channel, liquidity constrained consumers are less willing to cut their consumption when their perceived interest rates increase.

Notably, for consumers who believe in the debt channel, whether they have a mortgage or not (extensive margin of debt) and whether, conditional on having a mortgage, they have higher or lower LTVs, does not change their planned consumption reaction to an increase in interest rates, which is stronger than the reaction planned by consumers who do not think that the debt channel is relevant.

D. One-sided vs. Two-sided Predictions: Evidence from the Savings Channel

So far, we have described how the four channels whose intensity determines agents' subjective models of the macroeconomy affect the transmission of randomized changes in perceived interest rates to consumption plans in our data without imposing any structure on the expected signs of the effects based on theoretically-informed predictions.

For the channel that appears to be the largest mediator of the transmission mechanism, i.e. the debt channel, the most plausible direct theoretical mechanisms lead us to expect a negative sign, which is what we detect in the data. Indeed, higher interest rates lower consumption through their effect on debt either by increasing the money households need to service variable interest-rate debt, or by making it more convenient for households to repay their debt early to avoid facing higher interest rates in the future, or by making it less attractive to refinance existing debt, which would free up resources for higher spending, or by making new debt costlier. Under any of these mechanisms, consumers who believe in the debt channel should plan on cutting their consumption by more than those who do not think the debt channel is a good description of what would happen after an increase in interest rates.

By contrast, for some of the other channels theory has two-sided predictions. The savings channel is a prime example of this case. First, higher interest rates produce an income effect, whereby savers earn more from their savings and hence can consume more. At the same time, higher interest rates produce a substitution effect, whereby, due to higher returns from saving, the opportunity cost of consumption increases, and hence savers might become less willing to consume but rather willing to save more and obtain higher future consumption. At the individual level, whether the income or substitution effect should prevail depends on agents' intertemporal elasticity of substitution (IES). Indeed, if agents have a low IES, they will value current consumption more than future consumption relative to other agents and hence the income effect should dominate the substitution effect. By contrast, the higher the agent's IES, the more future consumption will be valuable relative to current consumption and the more the substitution effect should be relevant.

The CES does not elicit a direct and numerical proxy of respondents' IES.⁴ However it does elicit information about respondents' planning horizons when making household economic and financial decisions—an observable that is among the demographic characteristics we included in our specifications based on equation (2) and that we can use as a qualitative proxy at the individual level for consumers; IES. Specifically, we define the dummy variable *Short Planning Horizon*, which equals 1 for respondents who state that when making economic and financial decisions they "just plan for the moment", and zero for those who state they planning horizons beyond one month (see appendix for the precise question wording). Table 1 shows that 25% of the consumers in our sample state that they only plan for the moment. We use *Short Planning Horizon* to proxy for the consumers whose IES is lowest within our sample.

Armed with this proxy variable for the consumers whose IES is lowest in our sample, in Table 5 we estimate variations of equation (2) that consider the effects of the savings channel in transmitting rate changes on consumption plans separately for consumers with a high and low IES.⁵ Across all our specifications, we find that, indeed, consumers who have a low IES and think that the savings channel is an important macroeconomic channel

⁴The micro data can be used to estimate indirectly the IES as in Crump et al. (2022). Marenčák and Nghiem (Marenčák and Nghiem) apply this approach to the euro area CES finding that the IES is positive and highly significant whilst also displaying considerable heterogeneity.

⁵Note that the level of *Short Planning Horizon* is one of the "Controls from Table 2" indicated at the bottom of the Table 5, but, contrary to the other controls, we report the associated estimated coefficients in Table 5.

are less willing to cut their spending after a positive shock to perceived interest rates. For them, and relative to consumers who similarly think that the saving channel is important but have a higher IES, the income effect is thus more important compared with the substitution effect. For high-IES consumers, similar to the baseline effect we detected in Table 2, thinking that the savings channel is important leads to a cut in planned consumption after a positive shock to perceived interest rates. This effect is highly prevalent in the full sample, as documented in Table 2, and, as discussed above, only about one quarter of our sample has a short planning horizon.

E. Subjective Models and Asymmetric Transmission of Monetary Policy

In contemporaneous work, D'Acunto et al. (2024) document a sizable asymmetry in the transmission of changes in perceived and expected interest rates to consumption based on the sign of the change: consumers who face a positive shock to interest rates plan to cut their spending by a larger amount than the amount by which consumers who face a same-sized negative shock plan to increase their consumption.

This asymmetry suggests that monetary policy tightening might be transmitted to households' consumption choices more than same-sized monetary policy loosening—an issue that central banks should consider when designing their monetary policy and especially when trying to assess the optimal timing and size of interest-rate cuts to avoid a rebounding of inflationary pressures from heightened aggregate demand.

Our setting allows us to ask if the mediating and moderating effects of subjective models of the macroeconomy change in magnitude based on the sign of the randomized shock to perceived and expected interest rates to which the consumers in our sample are exposed: Figure 4 shows that the information treatment in our survey produces a positive shock to perceived interest rates for some consumers and a negative shock for others. Answering this question is important to understand if the mediating and moderating roles of subjective models of the macroeconomy are state-dependent—and, in particular, stronger in times of monetary policy tightening—or stable across states of the economy. To answer this question, we define the absolute value of the shock to interest rates induced by our information treatment ($|\Delta|$ *Rates*) as well as an indicator for whether the shock is positive, i.e., consumers are provided with plausible interest rates 12 months later that are higher relative to their priors about current interest rates. We then estimate variations of equation (2) that allow us to estimate the difference in the effects on consumption plans for consumers who face same-sized shocks of opposite signs.

Table 6 reports the results. Columns (1) and (2) verify that the asymmetry documented by D'Acunto et al. (2024) survives once we control for the four channels that constitute consumers' subjective models of the macroeconomy: indeed, the size of the effect of a shock to interest rates on planned consumption is larger if the shock is positive rather than negative. This can be seen by comparing the absolute magnitude of the coefficient on the change in rates (which shows the effects for those experiencing a negative interest rate change) with the coefficient that include the interaction with the positive change dummy variable.

Columns (3) and (4) compare the estimated mediating and moderating effects of subjective models on the extent of transmission for the two types of shocks. Irrespective of whether we keep constant demographic characteristics, we can see that, indeed, the role of subjective models is more relevant for positive shocks than for negative shocks.

For the case of positive shocks, our results align with the baseline results in Table 2: consumers respond to positive shocks to perceived interest rates by planning to cut their spending, and this transmission is stronger for consumers who believe that the debt channel are a good representation of the economy, whereas they are weaker for consumers who believe in the macro/GE and prices channels. For the savings channel we also estimate a negative coefficient on the triple interaction term which would imply a strengthening the effect of the savings channel although we cannot reject the null of no effect statistically.

In contrast, in the case of a negative shock to interest rates, not only is the baseline transmission for consumers who do not support any of the subjective models weaker than for consumers who face a positive shock but none of the channels that constitute consumers' subjective models appears to mediate or moderate the transmission to consumption plans in a significant way. Note that the estimated coefficients attached to the interactions between $|\Delta|$ *Rates* and subjective models have the opposite sign for the case of negative shocks relative to the case of positive shocks, which suggests that subjective models might have the potential to mediate and moderate transmission in opposite directions in case of monetary policy tightening or loosening, but the size of these mediating and moderating effects is small enough to hinder us from rejecting the null that no mediating and moderating effects arise statistically.

V External validation and cross-checking: Actual Consumption

Our analysis so far has been based on hypothetical scenarios related to a change in future interest rates. This setting has a set of distinct advantages. The scenario-based approach allows us to design a RCT that provides different randomized information about interest rates to different consumers, which in turn allows for a causal test of the effects of changes in perceived interest rates on planned consumption. This in turn allows us to assess the mediating effects of subjective consumer models about how transmission works on consumers' planned responses (independently of other observed characteristics).

At the same time, our main outcome variable of interest—change in planned consumption—is also elicited within the survey. This feature raises a set of concerns common to all survey-based experimental settings, such as the possibility that demand effects, rather than a genuine behavioral change, drive our results as well as the fact that stated plans in a survey do not necessarily correspond to the actual behaviors consumers will have outside of the survey experiment. It is therefore interesting to examine whether the transmission of interest rates and the role of subjective models that we identify is also observed for the case of actual interest rate changes implemented by the ECB and actual changes in spending, information which is also collected in the CES.

To tackle this issue and to provide an external-validity test for the role of subjective models of the macroeconomy in the transmission of monetary policy to consumption, in this section, we merge our consumers' actual consumption data and actual (endogenous) changes in actual ECB policy rates with the information about them we measured and elicited about their subjective models of the macroeconomy.

In the CES, consumption data is reported in euro values and across several categories by consumers four times at the quarterly frequency (January, April, July and October of each year). These measures of actual spending are gathered in different waves of the CES to the waves in which we elicit consumers' subjective models of the macroeconomy. This feature ensures that when consumers made consumption choices they were not directly prompted by our questions to elicit their subjective models of the macroeconomy. Moreover, changes in euro-area interest rates are not hypothetical and randomly assigned to consumers by us—we consider the actual changes in interest rates across the periods in which consumption data is measured, which are identical for all consumers and set by the ECB.

At the same time, a caveat with the analysis using actual consumption data is that these data are likely to contain substantiall noise, both because of measurement error and because idiosyncratic shocks at the consumer level might affect actual consumption irrespective of the subjective models of the macroeconomy consumers have in the back of their minds. This contrasts with the consumption plans used in the previous analysis as these are unrelated to subsequent idiosyncratic shocks. For these reasons, we would expect that our coefficient estimates are noisier and that measures of goodness of fit (e.g., R2) for the same specification we considered earlier are much lower in this setting.

We use this setting to estimate variations of the following specification, which mirrors the specification in equation (2):

$$\Delta Log \ Actual \ Consumption_{i,t} = \Delta MRO \ Rate_t + \sum_j Subjective \ Channel_j + \sum_j Subjective \ Channel_{i,j} \times \Delta MRO \ Rate_t + X'_{i,t}\delta + \eta_c + \epsilon_{i,t}$$
(3)

where $\Delta Log Actual Consumption_{i,t}$ is the change of the logarithm of consumption

by consumer *i* in quarter *t* (that is, the change between the month in which consumption is elicited and three months earlier); $\Delta MRO \ Rate_t$ is the change in the ECB's Main Refinancing Operations interest rate in quarter *t*; and all other variables are defined as in equation (2), including, crucially, the subjective models measured at the individual consumer level. The sample period for this test is from XX to YY and the actual increase in policy rates during this period was Y.X%.

Table 7 reports the estimates of equation (3). We consider two definitions of consumption—discretionary consumption (columns (1)-(4)), which includes the categories of consumption that agents can change more easily from one quarter to the other, and total consumption (columns (5)-(8)), which also includes categories of consumption that cannot be easily changed at high frequency, such as utility bills, housing-related fees, or health expenses, which are either set based on yearly or longer-horizon contracts or refer to goods or services for which spending is quite inelastic.⁶

For discretionary consumption, i.e. the components of total consumption that consumers can easily adjust at the monthly and quarterly frequencies, we first replicate the baseline correlation between changes in interest rates and change in consumption from Table 2: a one-percentage-point increase in the MRO rate relates to about 10% lower discretionary consumption over the same quarter.

In terms of the role of subjective models, we replicate the earlier result for the channel that appeared to be the strongest mediator of the transmission of rate increases in consumption, namely, the debt channel. Consumers who are more likely to think that the debt channel is a plausible description of the effects of rate increases on the macroeconomy reduce their discretionary consumption by about one-third more than consumers who think that none of the channels is a good representation of reality, whose change in consumption is captured by the coefficient attached to Δ *MRO Rate*. For the other channels, the estimates are quite noisy—for instance, we estimate effects of similar size for the macro-GE channel but we cannot reject the null that those coefficients equal zero in standard two-tailed t-tests. The same is true for the savings and prices channels, for which the estimates are close to zero and the signs are sometimes inconsistent with

⁶We exclude debt repayments from both measures of consumption.

the earlier estimated effects of subjective models.

Columns (5)-(8) consider total consumption as the outcome variable. Even in this case, we detect the baseline negative transmission of monetary policy tightening to consumption for the average consumer. Moreover, we detect the mediating role of the debt channel in this transmission, even though we can only reject the null of no mediating effect at the 10% level of significance. The results for the other channel are similar to what we found for discretionary consumption.

Overall, merging our measures of subjective models of the macroeconomy elicited at the consumer level with actual consumption choices made at different points in time reveals evidence in support of the debt channel as an important mediator of the transmission of changes in interest rates on both discretionary and total consumption. The evidence on the other channels is more sparse. This result might be due to the noisier consumption variable we use in this analysis relative to the RCT discussed above or to the fact that subjective models of the macroeconomy might be state-dependent, that is, consumers might believe more or less in one channel or the other depending on the state of the economy. Testing this claim would require measuring subjective models multiple times within an individual over time and across different states of the economy, which unfortunately is not possible in our setting.

VI Conclusions

We ask whether the subjective models of the macroeconomy households have in their mind to explain the relationships between economic variables mediate the transmission of monetary policy to their consumption choices. To answer this question, we propose two complementary survey-based approaches to elicit subjective models and use an RCT to provide households with exogenous variation in the extent of monetary policy tightening. We find that, conditional on a rich set of demographic and financial characteristics, households who think that monetary policy is more likely to affect debtholders and/or savers reduce their planned consumption systematically more than households who think it is more likely to affect inflation or other macroeconomic variables. These effects arise even when comparing households who are observationally similar, including in terms of their debt holdings and direct exposure to monetary policy (e.g. due to the flexibility of the interest rate on their mortgage contract). We find generally consistent results when relating households' hypothetical consumption response to their subjective modelto households' actual consumption choices around the actual changes in policy rates to which they are exposed.

Our evidence has a set of policy implications. At the aggregate level, subjective models produce heterogeneity that modulates the transmission of monetary policy through households above and beyond what is captured by demographics and observable characteristics. In principle, central banks might thus design their communication to make salient channels that can enhance policy effectiveness. For instance, because households who believe that monetary policy tightening mostly affects the economy through taming inflation (which is a relative minority of our broad sample) react less than others, insisting on communicating that the main aim of tightening is to reduce inflation might reduce the effectiveness of the transmission of monetary policy compared with stressing other subjective models, such as the effects on debt holding and savings. At the micro level, households' heterogeneous reactions based on ingrained subjective models above and beyond economic incentives might also give rise to unintended redistributive effects of policies that are currently overlooked by research and policy makers (e.g. because they stimulate some households to under- or overreact to policy changes).

These results open several paths for future empirical and theoretical research. On the empirical side, subjective models of the macroeconomy might be important also for the transmission of other measures of policy and economic shocks, such as fiscal policy measures, forward guidance, or structural policies and the transmission of other business cycle shocks. The survey-based setting we build can be adapted to answer all these and other questions in terms of both the elicitation of subjective models as well as the design of viable information-provision experiments. On the theoretical side, our work informs advances in macroeconomic models that allow for heterogeneity across agents: not only demographic heterogeneity but also heterogeneity in the ways agents conceptualize the functioning of the economy and how this may affect their reactions to changes in macroeconomic conditions. The challenge of incorporating this form of heterogeneity in macroeconomic models is still wide open.

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Figure 1: Subjective Models of the Macroeconomy (Extensive Margin): Channels Affected by an Increase in Interest Rates



This figure reports the frequency of word stems in consumers' open-ended answers to a question about what they thought are the effects of an increase in interest rates on the aggregate economy. Figure 2: Subjective Models of the Macroeconomy (Extensive Margin): Debtor vs. Frugal Countries



This figure plots the topical word cloud for the word stems most mentioned by respondents in a debtor country (Spain, left) and a frugal country (Germany, right) based on our open-ended elicitation question.



Figure 3: Subjective Models of the Macroeconomy (Intensive Margin): Variation Across Countries

This figure plots the average score for each of the four subjective models described in Section 2 across the 11 European countries that are part of the sample.

Figure 4: Distribution of Random Consumer-level Shocks to Interest Rates Priors



This histogram plots the distribution of the difference between randomly assigned information about one hypothetical mortgage interest rate level that could have realized 12 months after the survey (possible values include: 2%, 4%, 6%, 8%, and 10%) and consumers' own priors about mortgage interest rates prevailing at the time of the survey (*"current mortgage interest rates for someone like you"*). The difference is winsorized at the 1-99% levels.

	Observations	Mean	St. Dev.	Median
Domographica				
<u>Demographics</u>	16 100	0.99	0.47	0.00
$\begin{array}{c} \text{Ingli School Degree (0-1)} \\ \text{Calle as Damas (0, 1)} \end{array}$	10,100	0.55	0.47	0.00
College Degree (0-1)	10,100	0.50	0.50	0.00
High Financial Literacy (0-1)	16,100	0.55	0.50	1.00
Single $(0-1)$	16,100	0.19	0.39	0.00
Couple (0-1)	16,100	0.33	0.47	0.00
Couple, up to 2 kids $(0-1)$	16,100	0.42	0.49	0.00
Couple, more than $2 \text{ kids } (0-1)$	16,100	0.06	0.24	0.00
Has Mortgage (0-1)	16,100	0.29	0.45	0.00
Liquidity Constrained (0-1)	16,100	0.29	0.46	0.00
Short Planning Horizon (0-1)	16,100	0.25	0.43	0.00
Trust in ECB (0-1)	16,100	0.50	0.50	1.00
Perceptions and Choices				
$\Delta Rates (pp)$	16,100	1.21	4.32	1.50
Δ Planned Consumption (pp)	16,100	-1.67	12.65	0.00
Subjective Models				
Savings Channel (1-6)	16,100	3.43	1.45	4.00
Debt Channel (1-6)	16,100	4.81	1.16	5.00
Macro/GE Channel (1-6)	16,100	3.97	0.82	4.00
Prices Channel (1-6)	16,100	3.34	0.72	3.40

Table 1: Summary Statistics

Table 2:Senstivity of Planned Spending to Change in Interest Rates bySubjective Models

ABatos				/
	0.370***	0.252**	0.305**	0.42
	(0.03)	(0.17)	(0.17)	-0.420
Savings Channel	(0.05)	0.169**	0.175**	0.13
Savings Channel		(0.08)	(0.08)	(0.0)
Debt Channel		-0.481***	-0.422***	-0.498
		(0.11)	(0.11)	(0.1
Macro/GE Channel		0.244	0.221	0.10
7		(0.16)	(0.16)	(0.1)
Prices Channel		0.167	0.063	0.20
		(0.17)	(0.17)	(0.1)
$\Delta \text{Rates} \times \text{Savings Channel}$		-0.039*	-0.036*	-0.03
<u> </u>		(0.02)	(0.02)	(0.02)
$\Delta \text{Rates} \times \text{Debt Channel}$		-0.135***	-0.133***	-0.133
		(0.03)	(0.03)	(0.03)
$\Delta Rates \times Macro/GE$ Channel		0.109^{***}	0.110^{***}	0.110
		(0.04)	(0.04)	(0.04)
$\Delta \text{Rates} \times \text{Prices Channel}$		0.093^{**}	0.094^{**}	0.098
		(0.04)	(0.04)	(0.04)
High Financial Literacy $(0,1)$			-0.815***	-0.640
			(0.22)	(0.22)
Has Mortgage (0-1)			0.170	-0.07
			(0.23)	(0.23)
Liquidity Constrained (0-1)			-0.652^{***}	-0.552
			(0.25)	(0.25)
Short Planning Horizon (0-1)			-0.692^{***}	-0.684
			(0.25)	(0.25)
Trust in ECB $(0-1)$			0.549^{***}	0.526^{*}
			(0.20)	(0.20)
High School Degree (0-1)			-1.468***	-0.53
			(0.35)	(0.35)
College $Degree(0-1)$			-1.146***	-0.61
			(0.33)	(0.34)
Single $(0-1)$			-1.871***	-1.544
\mathbf{C} \mathbf{L} (0.1)			(0.46)	(0.40
Couple (0-1)			-0.912**	-0.76
			(0.44)	(0.44
Couple, up to 2 kids $(0-1)$			-0.513	-0.53
Constant	1 916***	0.006	(0.43) 1.645*	(0.4)
Constant	$-1.210^{+1.6}$	-0.980	1.043	1.908
Country FF	(0.10)	(0.71)	(0.89)	<u>(0.98</u>
Observations	16 100	16 100	16 100	А 16-10
Observations	10,100	10,100	10,100	10,10

Outcome Variable: ΔPlanned Consumption	(1) Financial Literacy	(2) College Education	(3) Liquidity Constrained	(4) Debtor Countries	(5) Trust in the ECB
$\Delta Rates$	-0.722***	-0.390	-0.268	-0.076	-0.815**
$\Delta Rates \times Savings Channel$	(0.23) -0.041	(0.25) -0.025	(0.22) -0.032	$(0.29) \\ 0.005$	(0.35) - 0.033
$\Delta Rates \times Debt Channel$	(0.03) -0.087**	(0.03) -0.097**	(0.03) -0.146***	(0.03) -0.107**	(0.04) -0.090
$\Delta Rates \times Macro/GE$ Channel	(0.04) 0.097	(0.04) 0.055	(0.03) 0.147^{***}	(0.05) 0.072	(0.06) 0.137^*
$\Delta Rates \times Prices Channel$	(0.06) 0.170^{***}	(0.06) 0.101	(0.05) 0.015 (0.05)	(0.07) -0.038	(0.08) 0.142^{*}
High Financial Literacy \times $\Delta {\rm Rates}$	(0.06) 0.739^{**} (0.25)	(0.06)	(0.05)	(0.08)	(0.08)
High Financial Literacy \times $\Delta {\rm Rates}$ \times Savings Channel	(0.33) 0.038 (0.04)				
High Financial Literacy \times $\Delta {\rm Rates}$ \times Debt Channel	(0.04) -0.080 (0.06)				
High Financial Literacy \times $\Delta {\rm Rates}$ \times Macro/GE Channel	(0.00) (0.001 (0.08)				
High Financial Literacy \times $\Delta {\rm Rates}$ \times Prices Channel	-0.205^{**}				
College $\times \Delta Rates$	(0.00)	-0.069			
College \times ΔRates \times Savings Channel		(0.35) -0.014 (0.04)			
College \times ΔRates \times Debt Channel		(0.04) -0.073 (0.06)			
College \times $\Delta {\rm Rates}$ \times Macro/GE Channel		(0.00) 0.113 (0.08)			
College \times ΔRates \times Prices Channel		-0.016			
Liquidity Constrained \times $\Delta {\rm Rates}$		(0.00)	-0.445		
Liquidity Constrained \times $\Delta {\rm Rates}$ \times Savings Channel			(0.01) -0.004 (0.05)		
Liquidity Constrained \times $\Delta {\rm Rates}$ \times Debt Channel			(0.05) (0.053) (0.06)		
Liquidity Constrained \times $\Delta {\rm Rates}$ \times Macro/GE Channel			-0.082		
Liquidity Constrained \times $\Delta {\rm Rates}$ \times Prices Channel			(0.00) 0.179^{**} (0.09)		
Debtor Country \times $\Delta Rates$			(0.00)	-0.492	
Debtor Country \times $\Delta {\rm Rates}$ \times Savings Channel				-0.060 (0.04)	
Debtor Country \times $\Delta {\rm Rates}$ \times Debt Channel				-0.041 (0.06)	
Debtor Country \times $\Delta {\rm Rates}$ \times Macro/GE Channel				(0.06) (0.06) (0.09)	
Debtor Country \times $\Delta {\rm Rates}$ \times Prices Channel				0.191^{**}	
Trust ECB $\times \Delta Rates$				(0.00)	0.080
Trust ECB \times $\Delta {\rm Rates}$ \times Savings Channel					(0.00) (0.001)
Trust ECB \times $\Delta {\rm Rates}$ \times Debt Channel					-0.009
Trust ECB \times $\Delta {\rm Rates}$ \times Macro/GE Channel					-0.008
Trust ECB \times $\Delta {\rm Rates}$ \times Prices Channel					-0.008 (0.01)
Constant	1.318 (1.21)	2.544^{**} (1.22)	1.693 (1.08)	1.617 (1.32)	2.065^{**} (0.99)
Controls in Table 2 All Levels and Interactions Country FE	X X X X	X X X X	X X X X	X X X X	X X X X
Observations R-Square	$16,100 \\ 0.044$	$16,100 \\ 0.042$	$16,100 \\ 0.043$	$16,100 \\ 0.042$	$15,599 \\ 0.045$

Table 3: Sensitivity of Planned Spending to Change in Interest Rates bySubjective Models: (Lack of) Heterogeneity by Demographics

Outroma Variable:	(1)	(2)	(2)	(4)
A Planned Concumption		(2) Liquiditu	(J) Fived rate	(4) Lich
ΔPlanned Consumption	nas Montro mo	Constrained	Fixed-rate	
ADatas		0.491**		
Δ Rates	-0.442	-0.421	-0.304	-0.288
	(0.18)	(0.19)	(0.51)	(0.45)
Savings Channel	0.132	0.143^{+}	0.144	0.133
	(0.08)	(0.08)	(0.17)	(0.17)
Debt Channel	-0.480	-0.623	-0.734	-0.829****
	(0.13)	(0.13)	(0.25)	(0.24)
Macro/GE Channel	0.107	0.093	(0.35)	0.524
	(0.17)	(0.17)	(0.35)	(0.34)
Prices Channel	0.202	0.211	0.209	0.270
	(0.17)	(0.17)	(0.37)	(0.36)
$\Delta Rates \times Savings Channel$	-0.036*	-0.033	0.010	-0.010
	(0.02)	(0.02)	(0.05)	(0.04)
$\Delta Rates \times Debt Channel$	-0.129***	-0.138***	-0.115	-0.150**
	(0.03)	(0.03)	(0.09)	(0.07)
$\Delta Rates \times Macro/GE Channel$	0.110^{***}	0.107^{**}	0.132	0.123
	(0.04)	(0.04)	(0.10)	(0.09)
$\Delta Rates \times Prices Channel$	0.098**	0.099**	-0.008	0.036
	(0.04)	(0.04)	(0.10)	(0.10)
Has Mortgage $\times \Delta Rates$	0.068			
	(0.27)			
Has Mortgage \times Debt Channel	-0.061			
	(0.22)			
Has Mortgage $\times \Delta \text{Rates} \times \text{Debt Channel}$	-0.016			
	(0.06)			
Liquidity Constrained $\times \Delta Rates$		-0.073		
		(0.23)		
Liquidity Constrained \times Debt Channel		0.404**		
		(0.21)		
Liquidity Constrained $\times \Delta Rates \times Debt$ Channel		0.025		
		(0.05)		
Fixed-rate Mortgage $\times \Delta Rates$			0.156	
			(0.52)	
Fixed-rate Mortgage \times Debt Channel			-0.009	
			(0.09)	
Fixed-rate Mortgage $\times \Delta \text{Rates} \times \text{Debt Channel}$			-0.067	
			(0.11)	
High Loan-to-Value $\times \Delta Rates$				-0.503
				(0.55)
High Loan-to-Value \times Debt Channel				0.151
				(0.10)
High Loan-to-Value $\times \Delta \text{Rates} \times \text{Debt Channel}$				0.110
		0.100**	0.000*	(0.11)
Constant	1.825*	2.496**	3.826*	3.757*
	(1.01)	(1.02)	(2.02)	(1.94)
Controls in Table 2	X	X	X	X
Country FE	X	X	X	X
Observations	16,100	16,100	3,603	3,791
R-Square	0.042	0.042	0.027	0.029

Table 4: Can Observables Explain the Debt Channel of Subjective Models?

Outcome Variable:				
Δ Planned Consumption	(1)	(2)	(3)	(4)
$\Delta Rates$	-0.308*	-0.337*	-0.365**	-0.140
	(0.18)	(0.18)	(0.18)	(0.21)
Savings Channel	0.168^{*}	0.199^{**}	0.165^{*}	0.177^{*}
	(0.09)	(0.09)	(0.09)	(0.09)
Debt Channel	-0.510***	-0.431***	-0.508***	-0.683***
	(0.11)	(0.11)	(0.11)	(0.13)
Macro/GE Channel	0.259	0.233	0.119	0.092
	(0.16)	(0.16)	(0.17)	(0.19)
Prices Channel	0.159	0.061	0.203	0.247
	(0.17)	(0.17)	(0.17)	(0.20)
Short Planning Horizon	-0.962	-0.736	-0.657	-3.962**
	(0.66)	(0.66)	(0.66)	(1.58)
$\Delta Rates \times Savings$	-0.068***	-0.066***	-0.068***	-0.057**
-	(0.02)	(0.02)	(0.02)	(0.02)
$\Delta \text{Rates} \times \text{Debt Channel}$	-0.130***	-0.128***	-0.128***	-0.128***
	(0.03)	(0.03)	(0.03)	(0.03)
$\Delta Rates \times Macro/GE$ Channel	0.108^{**}	0.108^{**}	0.108^{**}	0.082^{*}
,	(0.04)	(0.04)	(0.04)	(0.05)
$\Delta \text{Rates} \times \text{Prices Channel}$	0.092**	0.094**	0.098^{**}	0.049
	(0.04)	(0.04)	(0.04)	(0.05)
Short Planning Horizon $\times \Delta Rates$	-0.232	-0.247*	-0.263*	-1.004***
0	(0.15)	(0.15)	(0.15)	(0.38)
Short Planning Horizon \times Savings Channel	-0.014	-0.032	-0.059	-0.091
0	(0.18)	(0.18)	(0.18)	(0.19)
Short Planning Horizon $\times \Delta Rates \times Savings$ Channel	0.103^{**}	0.109^{**}	0.118***	0.085^{*}
0	(0.04)	(0.04)	(0.04)	(0.05)
Controls in Table 2	× /	X	X	X
Country FE			Х	Х
All Interactions with Short Planning Horizon				Х
Observations	16,100	16,100	16,100	16,100
R-Square	0.022	0.027	0.043	0.044
•				

 Table 5:
 Understanding the Savings Channel: Income vs. Substitution Effect

Outcome Variable:				
Δ Planned Consumption	(1)	(2)	(3)	(4)
 Δ Rates	0.233***	0.268***	0.453	0.494
	(0.05)	(0.05)	(0.35)	(0.35)
$ \Delta $ Rates × Positive Change	-0.751***	-0.811***	-0.764**	-0.900**
	(0.05)	(0.05)	(0.35)	(0.35)
Savings Channel	0.104	0.078	0.042	0.004
	(0.08)	(0.08)	(0.12)	(0.12)
Debt Channel	-0.673***	-0.677***	-0.134	-0.158
	(0.11)	(0.11)	(0.16)	(0.17)
Macro/GE Channel	0.378^{**}	0.244	0.154	0.001
	(0.16)	(0.16)	(0.24)	(0.24)
Prices Channel	0.286^{*}	0.325^{*}	0.098	0.144
	(0.17)	(0.17)	(0.26)	(0.26)
$ \Delta $ Rates × Savings Channel			0.053	0.053
			(0.04)	(0.04)
$ \Delta $ Rates × Positive Change × Savings Channel			-0.053	-0.047
			(0.04)	(0.04)
$ \Delta $ Rates × Debt Channel			0.031	0.033
			(0.05)	(0.05)
$ \Delta $ Rates × Positive Change × Debt Channel			-0.269***	-0.266***
			(0.06)	(0.06)
$ \Delta $ Rates × Macro/GE Channel			-0.067	-0.065
			(0.08)	(0.08)
$ \Delta $ Rates × Positive Change × Macro/GE Channel			0.198^{**}	0.200^{**}
Albeter v Driver Chemical			(0.08)	(0.08)
$ \Delta $ Rates × Prices Channel			-0.079	-0.087
A Datas V Desitive Change V Drives Changel			(0.08)	(0.08)
$ \Delta $ Rates × Positive Change × Prices Channel			(0.00)	(0.208)
Constant	0.300	9 110**	(0.09)	(0.09)
Constant	(0.60)	(0.07)	(1.00)	(1.26)
Controls in Table 2	(0.03)	$\frac{(0.31)}{\mathbf{X}}$	(1.03)	(1.20) X
Country FE		X		X
Observations	16 100	16 100	16 100	16 100
R-Square	0.019	0.040	0.022	0.043
	0.010	0.010	0.022	0.010

Table 6: Asymmetric Transmission of Policy Tightening vs.Loosening bySubjective Models

Outcome Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Log Actual Consumption	Dise	cretionary	^v Consump	tion	r	Total Con	sumption	
Δ MRO Rate	-0.096***	-0.110	-0.112	-0.113	-0.068***	-0.150**	-0.138**	-0.140**
	(0.01)	(0.09)	(0.09)	(0.09)	(0.01)	(0.07)	(0.07)	(0.07)
Savings Channel		-0.011	-0.009	-0.009		-0.002	0.000	0.000
		(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.01)
Debt Channel		0.023^{**}	0.026^{**}	0.028^{**}		0.009	0.014	0.015
		(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.01)
Macro/GE Channel		-0.017	-0.023	-0.024		-0.009	-0.013	-0.014
		(0.02)	(0.02)	(0.02)		(0.01)	(0.01)	(0.01)
Prices Channel		-0.003	-0.003	-0.003		-0.023*	-0.023*	-0.023*
		(0.02)	(0.02)	(0.02)		(0.01)	(0.01)	(0.01)
Δ MRO Rate \times Savings Channel		0.014	0.012	0.012		0.003	0.001	0.001
		(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.01)
Δ MRO Rate \times Debt Channel		-0.033**	-0.037***	-0.038***		-0.016	-0.021*	-0.021^{*}
		(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.01)
Δ MRO Rate \times Macro/GE Channel		0.020	0.029	0.030		0.009	0.015	0.015
		(0.02)	(0.02)	(0.02)		(0.02)	(0.02)	(0.02)
Δ MRO Rate \times Prices Channel		-0.000	-0.001	-0.002		0.027^{*}	0.026	0.026
		(0.02)	(0.02)	(0.02)		(0.02)	(0.02)	(0.02)
Constant	0.084^{***}	0.126^{*}	0.129^{*}	0.140^{*}	0.051^{***}	0.142^{**}	0.140^{**}	0.147^{**}
	(0.01)	(0.07)	(0.07)	(0.07)	(0.01)	(0.06)	(0.06)	(0.06)
Controls in Table 2			Х	Х			Х	X
Country FE				Х				Х
Observations	$50,\!355$	$45,\!944$	44,276	$44,\!276$	$50,\!574$	$46,\!135$	44,460	$44,\!460$
R-Square	0.002	0.003	0.003	0.003	0.001	0.002	0.002	0.003

 Table 7: Sensitivity of Planned Spending to Change in Interest Rates by Subjective Models: Actual Consumption

Online Appendix:

Subjective Models of the Macroeconomy and the Transmission of Monetary Policy

Francesco D'Acunto, Dimitris Georgarakos, Geoff Kenny, and Michael Weber

Not for Publication

I Surveys Questions

In this section, we report the wordings we use for our analysis. More details on the CES and the questions in the core modules can be found on the CES website.

Interest rate increase and overall economy – open text

In your own words, how do these rising interest rates affect the economic situation in the country you currently live in over the next 12 months?

Instruction: Please respond in full sentences. Your response length is not limited by the box size – it will adjust automatically. Usually, respondents take more time to answer this type of question.

Interest rate increase and perceived impact

When the European Central Bank (ECB) increases interest rates, how likely do you think it is for each of the following to happen?

- 1. Households earn higher returns on their savings accounts
- 2. Households face higher mortgage and loan payments
- 3. It is costlier to take out a new mortgage/loan
- 4. More workers lose their jobs
- 5. Prices of everyday goods and services stabilise or decrease
- 6. The prices of oil and gas stabilises or decreases

- 7. It is cheaper to purchase foreign-produced goods
- 8. The stock market performs poorly
- 9. House prices in my area decrease

10. Rents increase

- 11. There will be an economic downturn
- 12. People are able to spend less on goods and services
- 13. Businesses invest less and are not able to expand the supply of goods
- 14. Governments are able to borrow and spend less

Response options: 1 Very unlikely, 2 Unlikely, 3 Rather unlikely, 4 Rather likely, 5 Likely, 6 Very likely

Randomised order of responses 1 to 14.

Expectation for interest rate on mortgages multiple periods – open-ended

What do you think is the current interest rate on a mortgage for someone like you and what do you think it will be at the following points in the future?

- 1. in June 2023 (today):?
- 2. in June 2026:?
- 3. in June 2028:?

Please give your best guess. You can provide a number up to one decimal place.

Mortgage rate change – scenario (spending)

You said that the current interest rate on a mortgage for someone like you is [X]%Suppose that interest rates on mortgages for someone like you will be [Y]% in 12 months.

Randomised Treatment amount Y = 2, 4, 6, 8, 10

How would you change your total household spending on all goods and services in response to this development over the next 12 months?

Please use the slider below to provide your response in percentage terms. Please provide an answer to this question. There is no right or wrong answer.

(show a slider without anchoring (range: -30% to 30%), show a numerical entry box on top of the slider bar which moves with the slider

Financial literary

Respondents are asked the three standard literacy questions ("big 3") and a more advanced one (correct answers out of possible response options in bold):

1. Suppose you had EUR100 in a savings account and the interest rate was 2% per year. After five years, how much do you think you would have in the account if you left the money to grow?

(more than EUR102; exactly EUR102; less than EUR102; DK(don't know));

2. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?

(more than today; exactly the same; **less than today**; DK);

- 3. Do you think the following statement is true or false? Buying shares in a single company usually provides a safer return than buying shares in a mutual fund.
 - $(T; \mathbf{F}; DK);$
- 4. Suppose you owe EUR1,000 on a loan and the interest rate you are charged is 20% per year, compounded annually. If you didn't pay anything off, at this interest rate, how many years would it take for the amount you owe to double?

(years: $\langle 2; [\mathbf{2}, \mathbf{5}), [5, 10), \rangle = 10; DK$).

Trust

How much do you trust each of the following institutions and organisations?

Instruction: Please rate your level of trust on a scale from 0 to 10, where 0 means you have no trust at all in the institution and 10 means you trust it completely.

- 1. The European Central Bank
- 2. The European Commission
- 3. The European Parliament
- 4. The United Nations
- 5. The "National Central Bank"

Liquidity

Please think about your available financial resources, including access to credit, savings, loans from relatives or friends, etc. Suppose that you had to make an unexpected payment equal to one month of your household income. Would you have sufficient financial resources to pay for the entire amount?

Planning horizon

When making your savings and investment decisions, how far in the future do you, or does your household, typically plan?

- I/we just plan for the moment
- 1 to 3 months
- More than 3 months but less than a year
- 1 to 2 years
- 3 to 5 years
- $\bullet~6$ to 10 years
- more than 10 years



Figure A.1: Subjective Models of the Macroeconomy: Variation by Trust in the Central Bank

This figure plots the average score for each of the four subjective models described in Section 2 across the level of trust in the European Central Bank, which was elicited at the consumer level on a qualitative scale from 0 to 10.

	(1)	(2)	(3)	(4)
	Savings	\mathbf{Debt}	Macro/GE	Prices
	Channel	Channel	Channel	Channel
High Financial Literacy	0.379^{***}	0.445^{***}	0.109^{***}	0.009
	(0.02)	(0.02)	(0.01)	(0.01)
Has Mortgage (0-1)	-0.073***	0.214***	0.116***	0.028**
\mathbf{I} : \mathbf{I} : \mathbf{I} \mathbf{I} \mathbf{I} \mathbf{I} \mathbf{I} \mathbf{I} \mathbf{I}	(0.03)	(0.02)	(0.01)	(0.01)
Liquidity Constrained (0-1)	-0.434	-0.077^{+++}	(0.004^{+++})	-0.089^{+++}
Short Planning Horizon (0,1)	0.120***	(0.02)	(0.02)	(0.01) 0.037**
Short I failing Horizon (0-1)	(0.03)	(0.020)	(0.023)	(0.01)
Trust in ECB (0-10)	0.181***	-0.130***	-0.078***	0.097***
	(0.02)	(0.02)	(0.01)	(0.01)
High School Degree (0-1)	-0.011	0.133***	0.031	-0.049**
	(0.04)	(0.03)	(0.02)	(0.02)
College $Degree(0-1)$	0.097^{***}	0.155^{***}	0.022	-0.046^{**}
	(0.04)	(0.03)	(0.02)	(0.02)
Single $(0-1)$	0.034	0.122***	0.019	-0.038
C = 1 (0, 1)	(0.05)	(0.04)	(0.03)	(0.03)
Couple (0-1)	-0.025	0.202^{***}	0.042	-0.052^{**}
Couple, up to 2 kids $(0, 1)$	(0.03)	(0.04) 0.084**	(0.03) 0.025	(0.03)
Couple, up to 2 kids (0-1)	(0.025)	(0.034)	(0.023)	(0.03)
Germany	(0.06)	-0.122***	-0.128***	0.161***
e or monly	(0.05)	(0.04)	(0.03)	(0.03)
Spain	-0.502***	0.606^{***}	0.395^{***}	0.056^{**}
	(0.05)	(0.04)	(0.03)	(0.03)
France	-0.271^{***}	-0.173***	0.036	-0.018
	(0.05)	(0.04)	(0.03)	(0.03)
Italy	-0.613***	0.399***	0.222***	0.107***
	(0.05)	(0.04)	(0.03)	(0.03)
Netherlands	(0.06)	(0.098^{+})	-0.049	(0.02)
Austria	(0.00)	0.05)	(0.04) 0.043	0.03/***
Austria	(0.07)	(0.05)	(0.043)	(0.03)
Finland	-0.394***	0.361***	0.119***	0.098***
	(0.06)	(0.05)	(0.04)	(0.03)
Greece	-0.477***	0.338***	0.097^{**}	-0.010
	(0.07)	(0.06)	(0.04)	(0.04)
Ireland	-0.691^{***}	0.545^{***}	0.264^{***}	0.100^{***}
_	(0.07)	(0.05)	(0.04)	(0.03)
Portugal	-0.555^{***}	0.753^{***}	0.266***	-0.104***
Constant	(0.07) 2 564***	(0.05)	(0.04) 2 722***	(U.U3) 2 220***
Constant	5.004 (0.07)	4.000	ə.7əə''' (0.04)	3.328'''' (0.04)
Observations	16 100	16 100	16 100	16 100
R-Square	0.102	0.131	0.056	0.023
R-Square	0.102	0.131	0.056	0.023

 Table A.1: Correlation Between Subjective Models and Demographics