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Households' Macroeconomic Beliefs: The Role of Education*

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Abstract

We investigate how education shapes households' macroeconomic beliefs by surveying Dutch households on their perceptions and forecasts of inflation, unemployment, mortgage rates, and stock prices. Our findings unveil significant differences between highly-educated and less-educated households. Highly educated respondents form beliefs consistent with a monetary policy trade-off between inflation and unemployment, whereas less-educated households adopt a "supply-side" perspective. When exposed to vignette-based scenarios simulating monetary policy shocks, highly educated individuals adjust their beliefs and consumption-saving decisions in line with intertemporal substitution and textbook economic models. In contrast, less-educated respondents often retain pre-existing beliefs or

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revise them using non-standard mental models. Moreover, highly educated households primarily rely on formal education and newspapers for economic information, while less-educated households are more influenced by social media. These findings point to the need to model education-related heterogeneity and communicate policy targets and decisions in a simplified manner to reach different socio-economic groups.

Keywords: Households' expectations, subjective models, survey data, monetary policy.

JEL codes: E31, E52, E58.

1 Introduction

Motivation. How do agents form beliefs about inflation and unemployment? A recent but fast-growing strand of the literature has relied on survey data to address this question and documented a substantially cross-sectional heterogeneity among households, firms, and professionals (see, for example, Coibion et al., 2018b, 2020, Weber et al., 2022, Ropele et al., 2024). Particular attention has been posed to households' expectation formation over future inflation and its connection with monetary policy (Coibion et al., 2022, D'Acunto and Weber, 2024, D'Acunto et al., 2024). Understanding how households form their beliefs and the drivers of their heterogeneity is essential for developing macroeconomic frameworks to design optimal monetary policy (Woodford, 2003, Sims, 2003, Galí, 2008, Eusepi and Preston, 2018).

This paper contributes to the literature by examining the role of education as a key driver of heterogeneity in household beliefs. Recent studies highlight education as a factor that reduces households' upward bias in inflation expectations (D'Acunto et al., 2022, Fofana et al., 2024), yet its broader role in shaping belief formation remains insufficiently explored. Given that individuals' understanding of economic mechanisms is likely influenced by personal knowledge of the functioning of the economy, it is reasonable to expect education to be a significant determinant of belief heterogeneity. Previous research has shown substantial differences in beliefs among individuals with varying IQ levels or income (D'Acunto et al., 2023), traits that are often correlated with education. However, education offers the distinct advantage of being both easily observable and directly addressable through policy interventions. Therefore, identifying whether education serves as a critical dimension of heterogeneity in how individuals conceptualize the economy is an important area of investigation. This paper attempts to contribute in this area.

What we do. We investigate the role of education in the formation of households' *unconditional* beliefs on inflation, unemployment, and mortgage rates as well as *conditional* beliefs on the response of inflation, unemployment, and the stock market to hypothetical monetary policy shocks. As in Andre et al. (2022), we employ vignettes to put all households in front of the very same hypothetical scenario regarding such shocks and ensure they are provided with identical information about the characteristics of the shock and the extant macroeconomic conditions (for a discussion on the use of vignettes in surveys, see Stantcheva (2023) and Haaland et al. (2023)). The presence of symmetric information

enables us to attribute heterogeneous responses to differences in the interpretative models of the economy instead of the different information sets they possess (Mankiw and Reis, 2002, Reis, 2006, Coibion and Gorodnichenko, 2012).

The data come from a novel survey of 1,500 Dutch respondents, designed to represent the entire population. It was conducted in May 2024 via the LISS panel, an online research platform in the Netherlands. This approach allows our survey data to be linked to the core LISS survey, which has collected diverse background data from 5,000 respondents since 2007.

Findings: Unconditional moments. A wealth of facts emerges when analyzing households' unconditional beliefs. First, we document unconditional prior beliefs on one-year predicted realizations of inflation, unemployment, and mortgage rates to be extremely heterogeneous across households. This heterogeneity is object-specific. The cross-sectional distribution of inflation is right-skewed, very dispersed, and points to an upward bias with respect to the prediction by professional forecasters. We share these three stylized facts with most existing surveys (see, for instance, D'Acunto et al., 2024). The literature has attributed this heterogeneity to different sources, including the role of experiences (Malmendier and Nagel (2016)), narratives (Andre et al. (2024)), cognitive abilities (D'Acunto et al. (2019), D'Acunto et al. (2023)), monetary policy communication (Coibion et al. (2022), Roth et al. (2022)) and people's subjective models of the economy (Andre et al. (2022)). We interpret this evidence as external validation in favor of the credibility of our collected data. Households' beliefs on future unemployment and mortgage rates are also dispersed, although much less with respect to those over inflation. This is possibly due to the perceived complexity of the inflation process, which is likely associated with a variety of factors, e.g., changes in production costs associated with the pandemic, oil price fluctuations, supply chain disruptions, political views (Binetti et al., 2024).

Second, when combining prior beliefs over inflation and unemployment, we replicate another well-known empirical fact in household surveys, i.e., cross-sectionally, inflation and unemployment expectations are *positively* correlated (Bhandari et al., 2024, Candia et al., 2020, Kamdar and Ray, 2024, Zhang, 2024, Ferreira and Pica, 2024). To be precise, we run regressions of *changes* in expected inflation over *changes* in expected unemployment, where the changes are computed as differences between priors over future realizations of these objects and perceptions ("nowcasts") of the very same variables. Using changes as

opposed to levels enables us to associate the so-obtained "Phillips correlation" (Reis and Watson, 2010, Stock and Watson, 2020) to the slope of the supply curve while controlling for households' specific factors. The positive correlation we find in our data reflects a supply-side view by households, who see inflation as "bad" and associate it with a weak economy (as opposed to a demand-side view, which would see inflation driven by a strong demand). This positive correlation between changes in inflation and unemployment is also consistent with households' beliefs on a lack of monetary policy trade-off, i.e., increasing inflation may - in households' minds - go hand-in-hand with a worsening in real economic activity (Stantcheva (2024)). Crucially, we find that the Phillips correlation turns *negative* when we focus on highly educated (i.e., college and above) respondents, while it remains positive when conditioning on the low-educated fragment of the population. Hence, the outcome of our regressions is consistent with the hypothesis of dramatically different views on one of the fundamental economic relationships - the Phillips curve - by households with different formal education. These results are robust to controlling for elements that are likely drivers of inflation beliefs: age and income (Fofana et al., 2024), gender and marital status (D'Acunto et al., 2021), number of children, employment status, homeownership, sentiment, and the placebo score (that we will explain later).

A third finding regards the correlations between mortgage rates and inflation on the one hand, and unemployment on the other. We find the first correlation (as before, computed by considering expected changes in the objects of interest) to be positive. This is potentially in line with a Taylor rule interpretation of this correlation: An increase in inflation leads to an increase in the policy rate that translates into an increase in mortgage rates. This evidence is consistent with the one in Carvalho and Nechio (2014). On the other hand, it is also consistent with mortgage rates being a crucial component of households' cost of living and that can, therefore, drive inflation expectations as recently documented by Bolhuis et al. (2024).[1] Turning to the correlation between expected changes in the mortgage rate and the unemployment rate, we find a positive correlation that is inconsistent with a Taylor rule view. Once again, this finding is in line with that put forth by Carvalho and Nechio (2014), who document this correlation in phases of the US business cycle characterized by a strong

[1] The Dutch mortgage rate (loans for house purchases, new business) increased from 1.65% (December 2021, lowest realization since January 2003) to 3.83% in May 2024 (month in which we ran our survey) after hitting 4.08% (December 2023). The mortgage rate series is available at: https://data.ecb.europa.eu/data/datasets/MIR/MIR.M.NL.B.A2C.AM.R.A.2250.EUR.N.

labor market, a situation in place when conducting our own survey.[2] Another possible interpretation of this correlation regards once again the cost of living of mortgagors, which in the presence of increases in the mortgage rate (as in the case of the Dutch economy) may induce a negative economic sentiment and, therefore, a pessimistic view regarding the economy (Bolhuis et al., 2024). Hence, while the Taylor rule model does not entirely square with the cross-sectional correlations in our sample, the cost-of-living hypothesis does and it does so independently on the level of education.

Findings: Conditional moments. Turning to conditional moments generated by the hypothetical monetary policy shock, our first finding is that households' heterogeneity is substantial even when it comes to impulse responses to a monetary policy shock. Second, the cross-sectional mean response of *both* variables is positive, with an average value for inflation equal to 0.27% and that of unemployment 0.35%. Hence, our evidence suggests that households' supply view may very well extend to conditional moments such as impulse responses. Once again, this evidence masks a heterogeneous view by households possessing different formal education. We unveil this heterogeneity by identifying different mental models based on the combined signs of impulse responses. In particular, we consider the following different mental models: *standard* models, which predict a deflationary and recessionary response to a policy tightening, e.g., the popular Smets and Wouters (2007) model; *cost channel* models, where a recessionary jump in the policy rate also affects firms' marginal costs and, therefore, inflation (Barth and Ramey, 2001, Christiano et al., 2005, Ravenna and Walsh, 2006); *information channel* models, that interpret the monetary policy shocks as a positive signal to the markets by the Federal Reserve that leads to an economic boom and an inflationary period (e.g., Campbell et al., 2012, Melosi, 2017, Nakamura and Steinsson, 2018, Jarociński and Karadi, 2020, Miranda-Agrippino and Ricco, 2021). While households forming beliefs in line with those described above have *textbook* mental models, our data also point to respondents predicting at least one of the two variables to remain unchanged despite the large shock simulated with our vignette.[3] We classify these

[2] During the pandemic, the unemployment rate hit 5.5% in July 2020, then gradually reverted back to 3.6%, which is the figure recorded in May 2024 when we conducted our survey.

[3] We simulate an unexpected change of policy rate as large as 50 basis points.This is roughly a 5-to-7 standard deviation shock according to Euro area data. Consider for instance the VAR by Badinger and Shiman (2023), who identify monetary policy shocks in the Euro area with a state-of-the-art narrative approach. When re-estimating their empirical model with year-one-year CPI inflation and the unemployment rate (our variables of interest that replace, respectively, CPI in log-levels and unemployment in their original VAR), we found a median value for the standard deviation of monetary policy shock equal to 7

households as *stubborn*, while those predicting both variables to be unaffected by monetary policy shocks are identified as *super stubborn*. Finally, agents jointly predicting a business cycle expansion and a deflation point to the existence of a *residual*, non-textbook model.

For each class of models (respondents), we run a probit regression to establish a statistical link between the various different understandings of the macroeconomic environment and the level of education. Our findings read as follows. Mental models associated with traditional macroeconomic frameworks (standard AD/AS, cost channel, information shock) are more likely to be chosen by highly educated respondents. This result holds true when further refining our types by adding the theoretically correct response of stock prices, therefore requiring that the responses of inflation, unemployment, and stock prices jointly obey the theoretical predictions. Differently, low-educated respondents are more likely to choose the *residual* mental models, whose predictions are not in line with conventional wisdom or standard economic mechanisms (for instance, a reduction in unemployment after an unexpected monetary policy tightening). Highly educated people are more likely to state they would implement economic actions in response to a monetary policy tightening in line with optimal intertemporal substitution in textbook models, i.e., they would decrease spending and increase savings. Differently, low-educated people are more likely to decrease savings and increase spending following the same monetary policy shock. The first choice can be rationalized by hand-to-mouth consumers willing to smooth consumption in the presence of a sudden reduction in income. The second choice, however, is more difficult to reconcile with an optimal consumption response to a negative shock, unless the interpretation given by households to "spending" is actually "expenditures", which may increase according to the cost-of-living framework.

Highly educated: Features. The last part of the paper characterizes highly educated households. We do so by correlating education with a set of observables in our sample and by assessing people's understanding of a placebo treatment that deals with a macroeconomic shock - the discovery of a copper mine in Australia - that should be relatively uninfluential for the Dutch economy. Our description of highly-educated respondents is the following: (i) they are asset owners: they are more likely to own a house, have insurance, possess financial assets, and less likely to be mortgagors; (ii) they achieve a

basis points. A similar estimate is provided by Jarociński and Karadi (2020). The idea of a large shock is that of a very large (but still empirically credible) unexpected policy move that should induce a response of households because of its size while not being discarded as unrealistic.

higher score when facing the placebo vignette; (iii) they base their belief formation process mainly on information obtained via traditional sources (their own background, newspapers). Differently, less educated households rely mostly on social media.

Policy and modeling implications. Our findings have both modeling and policy implications. From a modeling standpoint, our paper stresses the need to embed economic knowledge-related heterogeneity in monetary policy frameworks, a call similar to the one done by (Lusardi and Mitchell, 2023) regarding households with different degrees of financial literacy. Financial literacy and education are positively correlated, possibly the outcome of an optimal choice by households who have to deal with more complex portfolios to manage and savings decisions for retirement (Lusardi et al. (2017)). Consistently, Calvet et al. (2009) find that better-educated Swedish households hold more stocks than the less-educated, and that achieves lower non-systematic risk on their portfolios conditional on holding stocks. Kaplan et al. (2014) find that households who are not hand-to-mouth have on average two more years of education with respect to poor hand-to-mouth households. Embedding human capital formation via households' decisions to invest in financial literacy in heterogenous agents models appears to be a promising way to offer a microfoundation to poor hand-to-mouth ("rule-of-thumb") consumers in two-agent models à la Galí et al. (2007), Bilbiie (2008, 2020, 2024), Debortoli and Gali' (2024)) and Debortoli and Gali' (2024), as well as to poor and wealthy hand-to-mouth households in HANK models (e.g. Kaplan et al., 2018, Auclert, 2019, Acharya et al., 2023, Auclert et al., 2023). Another fruitful avenue seems to be that of combining standard rational expectations models, which could be representative of highly educated agents' thinking, with models of pessimism à la Kamdar and Ray (2024) and Bhandari et al. (2024), whose beliefs formation appear to be more in line with that of low-educated households. This approach enables researchers to strike a balance between incorporating macroeconomic expectations documented by survey evidence (Moll (2024)) and maintaining a rigorous aggregation of heterogeneous behaviors across households.

From a policy standpoint, our paper confirms that economic knowledge may significantly affect the formation of households' beliefs and actions after a monetary policy shock. Heterogenous responses of households to monetary policy shocks may reduce the efficacy of monetary policy and generate wealth inequality (Lusardi and Mitchell, 2023).[4] Interven-

[4] Lusardi et al. (2017) find imperfect financial knowledge to imply meaningful welfare losses. According to their estimates, consumers would be willing to give up about 3 percent of period consumption over their

tions to increase the level of financial literacy in the population and reduce heterogeneity in economic and financial knowledge are desirable and have been increasingly implemented in various countries. Courses in personal finance have been taught at different levels across the world (Lusardi and Mitchell, 2023). On top of what Governments and supranational institutions such as e.g. the European Commission and the OECD have done, many central banks and institutions have launched outreach programs aimed at reducing financial illiteracy.[5] Turning to policy institutions, an effort to simplify policy communication in an attempt to reach a wider fragment of the population has also been undertaken (see, e.g., Haldane and McMahon, 2018, Coibion et al., 2022, Blinder et al., 2024). Our findings support these efforts and point to a non-traditional source of information - social media - as a possible vehicle to inform citizens about easily accessible educational programs.

Our paper is structured as follows. Section 2 describes the survey. Section 3 documents our empirical findings based on unconditional moments. Section 4 moves to our vignette and documents the changes in beliefs that are triggered by our hypothetical monetary policy shock. Moreover, it offers a mapping between such beliefs and existing interpretative models and relates such views of the macroeconomy to education. Section 5 characterizes highly educated people. Section 6 draws connections between our contribution and the extant literature. Section 7 concludes.

2 Data and design

The LISS panel. The survey data are collected through the LISS Panel, a household survey administered by Tilburg University (Centerdata Research Institute) in the Netherlands. The panel is based on a true probability sample of 5,000 households, drawn from the population register of Statistics Netherlands. Since 2007, the LISS panel has collected detailed background information on households through the LISS Core Study, a collection of 11 annual or bi-annual survey modules investigating household economic and family status, as well as health information, personality traits, and beliefs. The LISS Panel allows

lifetimes to live in a world with perfect financial knowledge.

[5] Examples include, among many others, the "FedEd" launched by the Federal Reserve (https://www.federalreserve.gov/aboutthefed/educational-tools/fed-education.htm) and the "Money and Me" program of the Bank of England (https://www.bankofengland.co.uk/education/education-resources/money-and-me).

external researchers to conduct their own survey modules, providing considerable flexibility in structure and design, including the ability to conduct survey experiments and pose vignette-style questions. The data of such external modules is therefore linked to the rich household-level information from the LISS Core Study, enabling to conduct of heterogeneous analyses across various dimensions, such as respondents' economic status, personality traits, values, and political ideologies. Additionally, the data within the LISS Panel can be linked to administrative microdata from Statistics Netherlands (CBS) for further in-depth analysis.

Sample. In May 2024, we recruited a sample of 1,500 respondents. The sample was cleaned by eliminating respondents who took an abnormally long time - more than one hour - to complete the survey. After this cleaning, the median completion time equals 12 minutes and 45 seconds, and 90% of the respondents completed within 27 minutes and 5 seconds. The cleaned sample's completion rate is 83%. Also, we censored away respondents indicating a number larger than 15% concerning inflation perceptions or priors; 10% regarding the unemployment rate; and 6% regarding the mortgage rate. Finally, we cut away respondents whose posteriors were negative or larger than the 99th percentile. After cleaning, the sample size is 1,056 respondents aged 18-75. Our findings remain robust when alternative censoring are applied.

Structure of the survey. Figure 1 presents a graphical representation of the survey design. The survey begins with an introduction that includes two questions designed to gauge respondents' sentiment, their optimism about the future of their personal finances compared to their own situation in the past and relative to their peers. The first part of the questionnaire focuses on respondents' perceptions and expectations regarding the three primary macroeconomic variables: year-on-year CPI inflation, unemployment, and mortgage rate on new loans. Measuring expectations for three of the most relevant macroeconomic variables within the same survey enables the test for joint expectation formation rather than independent ones (see also Coibion and Gorodnichenko, 2012). In other words, combining expectations of different macroeconomic variables enables us to gain insights into the mental models households appeal to when they have to think about the structure of the economy (or part of it, e.g., the Phillips curve). Respondents are provided with non-technical definitions of each variable; subsequently, they are asked to estimate its current value and predict its value in 12 months' time. Asking both the perception (how is the

variable today compared to 12 months ago) and what the variable is predicted to be in 12-month time allows us to measure accuracy in the perception, which can be considered a proxy for how informed they are about the macroeconomic environment. Perceptions are also useful for capturing households's knowledge of variable-specific trends. To control for information exposure, we directly inquire about the main sources of information influencing respondents' knowledge of each macroeconomic variable. Additionally, we assess the relevance of these variables in respondents' lives by asking if they consider them influential to their economic situation.

The second part of the survey presents all participants with economic vignettes featuring a hypothetical yet realistic scenario describing the occurrence of a monetary policy shock that involves an unexpected change in the policy rate.[6] Respondents are randomly assigned to one of two groups, one exposed to negative shocks (i.e., an increase in the policy rate) and the other one to positive ones (a monetary policy easing). The randomization is performed by the LISS Panel. The two groups are statistically similar in terms of demographics such as gender, employment status, family size, education, homeownership, debt status, and income.

For each scenario, respondents are tasked to provide an estimate on one-year ahead inflation and unemployment rates, as we as are asked to predict the direction of change of the stock market. Comparing households' beliefs on future inflation, unemployment, and stock prices before and after exposure to the hypothetical shock scenario enables us to quantify the impact of the hypothetical monetary policy shocks controlling for heterogeneity in the information set. Respondents are also required to provide their views on the transmission channels at play. This includes whether they believe the shock primarily affects household consumption decisions or the costs/revenues of firms and whether they expect these variables to be positively or negatively affected by the shock. This allows us to determine whether households perceive the shocks to transmit in the economy via a supply-side channel (namely, mainly through the effect that the shock has on the production side of the economy) or via a demand channel (which is to say, by altering consumer demand). Moreover, to distinguish pure policy shocks from information shocks, we inquire about respondents' expectations regarding changes in stock prices, which positively cor-

[6] Our survey also proposes vignettes on an oil price shock and a tax shock. Given the relevance of households' beliefs for monetary policy, in this paper we focus on monetary policy shocks. Further information on the survey can be found at https://sites.google.com/site/efremcastelnuovo/home .

relate with tightening monetary and fiscal policies in the presence of information shocks (Jarociński and Karadi, 2020, Miranda-Agrippino and Ricco, 2021). Finally, we investigate how monetary policy shocks matter for households' intentions over economic decisions and actions; therefore we ask whether in the hypothetical scenarios described, they would consider making changes in some of their current economic choices (spending, saving, paying off mortgages, borrowing, buying durables, working hours, asking for a raise) and whether they think that a shock of this kind will have a relevant impact on their personal economic situation.

Discussion of the design. The questions we include after the vignette are designed to elicit the mechanism through which monetary policy shocks are thought to affect different aspects of the macroeconomy with a focus on key indicators such as inflation, unemployment, the stock market, firms' production costs, and households' expenditures. Through the comparison between changes in households' beliefs over these variables with theoretical frameworks' predictions, we can assess whether the respondent's reasoning can be interpreted via standard macroeconomic frameworks or, instead, if households form expectations in a more heterodox manner. Importantly, we do not suggest to respondents any narrative explanation of why the shock would affect each of the variable, thus avoiding the risk of post-hoc rationalization.

Our approach relies solely on multiple choice, closed-ended questions, and avoids open-ended ones. As pointed out by Andre et al. (2022), closed-ended questions can be preferred to open-text questions for many reasons. First, they enable easy comparison of responses across different participants, unlike open-text questions which can produce highly varied answers. Second, structured questions facilitate the measurement of well-defined propagation channels, a task that is challenging with the often imprecise open-text responses. Third, they demand less effort from respondents, potentially reducing measurement errors. Lastly, structured questions eliminate the need for categorization and interpretation, thus avoiding subjective decisions by researchers. Another challenge in identifying subjective models of the macroeconomy is that respondents may adjust their answers to align with what they believe the experimenter expects, thereby introducing experimenter demand effects. To address this issue, we include in the survey a placebo vignette, and we employ households' responses to control for possible biases due to experimenter demand effects.

3 Unconditional moments

Unconditional expectations. The first part of the survey collects perceptions and prior expectations on inflation, unemployment, and the mortgage rate on new loans. Given the relevance of households' beliefs formation for macroeconomic modelling, let us focus on households' priors. Figure 2 documents the distribution of such priors across our respondents. The inflation density displays: (i) a wide dispersion in households' forecasts; (ii) positive right-skewness; (iii) a mean value clearly above the one of professional forecasters, here proxied by the Dutch National Bank's. These three facts are stylized facts in this literature (D'Acunto et al., 2024, Fastbø et al., 2024). Notably, the magnitude of the bias is about 1.8% in our sample, as documented by Table 2. This figure belongs to the range documented by previous studies, which suggest that household inflation expectations can exceed professional forecasts by 1-3 percentage points (Carroll, 2003, Armantier et al., 2016, Coibion et al., 2018a), possibly because of a downward-biased memory of past prices that leads them to overestimate current and future inflation (Bordalo et al., 2017, D'Acunto and Weber, 2022). Our estimate of the inflation expectations bias is not particularly high due to the arguably higher attention posed by households on inflation given the relatively high numbers due to the pandemic (Weber et al., 2024, Link et al., 2024).

Turning to the density of the unemployment rate, we notice a milder bias (about 0.5%), the presence of a lower degree of positive skewness, a dispersion much milder than that of inflation. To some extent, this is not a surprise: labor market conditions are possibly easier to understand and more frequently monitored than inflation, which is a complex phenomenon (Binetti et al., 2024) whose perception can also depend by idiosyncratic elements, for instance, the fact of being a mortgagor or not (Bolhuis et al., 2024). Along these lines, it is perhaps not too surprising that the dispersion across households' estimates on mortgage rates is even lower, and we also notice a negative degree of skewness.

Wrapping up, our data: (i) replicate the well-established facts regarding households' inflation beliefs inflation; (ii) document a lower skewness and bias concerning unemployment beliefs; (iii) point to an even less dispersed distribution across households as far as mortgage rates are concerned. While these facts are of interest *per se*, the joint collection of these expectations (and the corresponding perceptions) enables us to attempt an understanding on how households think of basic macroeconomic relationships. This is what we turn to next.

Expected changes in macroeconomic indicators. With the data at hand, we can compute the respondent-specific expected changes of the three variables of our interest, i.e., inflation, unemployment, and mortgage rates, as follows:

$$\mathbb{E}^i \Delta_{z,t+1} = \underbrace{\mathbb{E}^i[z_{t+1}|\mathcal{I}_t]}_{\text{Prior}} - \underbrace{\mathbb{E}^i[z_t|\mathcal{I}_t]}_{\text{Perception}}$$

where $z \in \{\pi, u, r\}$, and the objects in the triplet are, respectively, inflation, unemployment, and the mortgage rate. Figure 3 illustrates the correlation between priors and perceptions for inflation, unemployment, and mortgage rates. While the correlations across all three items are high, consistent with findings in Weber et al. (2022), the figures reveal significant dispersion, particularly for inflation. This pattern aligns with Ropele et al. (2024), who document a decoupling between perceptions and expectations during periods of elevated inflation, such as the one preceding the interviews for this survey. Importantly, subtracting perceptions of the variable of interest allows us to purge idiosyncratic differences stemming from individuals' varying interpretations of the economic concept, for example. We combine these changes to understand households' view(s) of the macroeconomic environment.

Phillips correlation. One key reference in macroeconomics is the Phillips correlation between unemployment and inflation, which is often documented by regressing inflation over unemployment (Reis and Watson, 2010, Stock and Watson, 2020). A stylized fact in the survey literature is that households have a supply view of the economy and tend to associate high inflation with high unemployment (D'Acunto et al., 2024, Binetti et al., 2024). Figure 4 (left-panel) scatter-plots cross-sectional inflation changes vs. unemployment changes. Importantly, we plot expected changes (differences between priors and perceptions) to draw information from the data about the slope of the supply curve, something that would not be possible to obtain when focusing on priors only.

The scatter plot points to a positive Phillips correlation. Regressions documented in Table 3 confirm that this positive coefficient is robust to accounting for a vector of controls. Furthermore, the regression analysis confirms that the correlation remains robust even when using respondents' qualitative answers about changes in unemployment and inflation. In these questions, respondents indicated whether the variables were increasing, decreasing, or remaining unchanged relative to current levels. Unlike quantitative responses, qualitative answers are less prone to distortions caused by potential outliers.

The evidence documented above confirms previous findings on households' supply-side

view. However, one could argue that households who are more acquainted with economic principles or more used to acquiring and processing information (either via the use of theoretical models or empirical evidence) about economics or other disciplines may have a different view of this correlation with respect to those that are not that used to think in a fully structured way. We proxy this way of thinking with the fact of having a certain level of education, which we determine to be "some college or above". In our sample, this translates into having more than 16 years of education (no matter in what discipline).

Figure 4 (right-panel) unveils that the previous scatter plot masks heterogeneous views on the correlation between the changes in inflation and unemployment. Conditioning on education, what we observe is that low educated respondents are again associated with a positive Phillips coefficient, while households holding a college degree (or above) change their beliefs consistently with a negative relationship between inflation and unemployment. These correlations remain robust even after controlling for a variety of covariates and when using qualitative responses instead of quantitative ones for priors and perceptions, as documented in Table 3. This empirical finding is consistent with an understanding of the monetary policy trade-off by highly educated households, who may be better at processing the information regarding the shocks hitting the economic system and the consequences for the decisions the European Central Bank has to take to maintain price stability. Our results are in line with Malmendier and Nagel (2016), who document the role played by experiences and sophistication in shaping expectations.[7]

It is important to note that our evidence, which is based on heterogeneous correlations between *expected* inflation and unemployment across households conditional on different groups identified by their education levels, can be seen as perfectly consistent with the recent empirical evidence on the "flat" Phillips curve based on aggregate *realized* inflation and real activity (see, e.g. Del Negro et al., 2018). First, *beliefs* about the inflation-unemployment relationship may be formed on the basis of theoretical knowledge of the most fundamental macroeconomic relationships, a downward-sloping Phillips curve included. Second, most of the evidence on the "dead" Phillips curve refers to pre-pandemic data, while our respondents were interviewed in May 2024, i.e., in the aftermath of the pandemic. Interestingly, Cerrato and Gitti (2024) and Gitti (2024) point to a steepening of the Phillips

[7]Differently, Ferreira and Pica (2024) do not find any role for education as a driver of expectations of households in six European countries. However, their exercise is not about changes in households' idiosyncratic expectations, but instead variations in cross-sectionally aggregated expectations.

curve during the pandemic due to the tight labor market that led firms to translate higher marginal costs into prices. Third, a recent strand of the literature points to demand shocks as the main drivers of the 2021-2023 inflation (see e.g., Giannone and Primiceri, 2024, Mori, 2024, Ascari et al., 2024). All else being equal, large demand disturbances such as the monetary policy and fiscal interventions implemented after the advent of the Covid shock facilitate the identification of a supply curve in the data both from a structural standpoint (Barnichon and Mesters, 2020) and from a reduced-form standpoint (Lepetit et al., 2023). All in all, it seems plausible to associate beliefs to a Phillips curve that is "alive and well" to beliefs formulated by highly educated households.

Unconditional correlations: Mortgage rate and macroeconomic aggregates. Figure 5 displays the correlations between the expected changes in the mortgage rate and inflation (left panel) and unemployment (right panel). The positive correlation between changes in the mortgage rate and changes in inflation is in line with a Taylor rule. However, the positive correlation between changes in the mortgage rate and changes in unemployment is not. Interestingly, these positive correlations are in line with the empirical evidence put forth by Carvalho and Nechio (2014), who work with data on U.S. households from the Michigan Survey. According to their empirical analysis, households are more aware about the systematic response of the Federal Reserve to changes in unemployment in times of weak labor markets. Our survey was conducted in May 2024. The unemployment rate recorded in that month was 3.6%, much lower than the average unemployment rate in the previous two decades (5.8% since January 2003). Hence, we see our empirical evidence in line with Carvalho and Nechio's. Interestingly, households data seem to point to a different understanding of the systematic policy response to real activity than professional forecasters' data, who tend to associate policy tightenings (easings) as a response to economic booms (busts) (Bauer et al., 2024).

A different interpretation to the correlations depicted in Figure 5 regards the impact on mortgage rates on households' cost of living and economic sentiment. Bolhuis et al. (2024) provide international evidence in favor of the link between mortgage rates and households' cost of living, a connection which naturally help us interpret the positive correlation in our survey between expected change in inflation and the mortgage rate. Interestingly, they show that the component of consumer sentiment not explained by the official inflation rate and unemployment is strongly and negatively correlated with changes in mortgage

rates. To the extent that this consumer sentiment may affect households' predictions about changes in unemployment, Bolhuis et al. (2024)'s story is also consistent with the positive correlation between changes in mortgage rates and unemployment present in our data. This is likely to be relevant in countries with a large share of mortgagors with adjustable-rate mortgages. In our sample, 80% of households have a mortgage, which has been shown to raise households' attention to interest rate developments, particularly when inflation is high (Baldassarri et al., 2024). Interestingly, the correlations shown in Figure 5 as well the regressions reported in Table 4 are robust to different education levels, i.e., we do not find the pairwise correlations between changes documented above to be significantly different between economically literate and non-literate households *per se*. Once again, the correlations are consistent regardless of whether quantitative or qualitative responses to the questions about changes are considered.

4 Households' beliefs and monetary policy shocks

Vignette. How do households change their beliefs about the evolution of the macroeconomic environment in response to a monetary policy shock? We address this question by working with a hypothetical scenario via a "vignette" that simulates an unexpected policy move by the European Central Bank to our respondents and recording their beliefs over the one-year-ahead realizations of inflation, unemployment, and stock prices. The vignette reads as follows:

"Imagine that the European Central Bank unexpectedly raises (lowers) interest rates from 4.5% to 5% (4.0%). No other major economic events occur at the same time."

The vignette is followed by three questions regarding three different macroeconomic indicators:

"What do you think inflation/unemployment will be in 12 months if this event happened today?"

"How to you think the prices of stocks in the stock market would react? Increase/Decrease/No change"

The exogeneity of the policy intervention is established by telling respondents that the change in the policy rate happens even if the European Central Bank does not change its

assessment of economic conditions. Half of the respondents are exposed to the vignette concerned with an unexpected increase in the policy rate of 50 basis points, while the other half face a hypothetical decrease of the same magnitude. The change regards a pre-shock interest rate set to be 4.5%, which was the value of the main refinancing operation rate in May 2024 (when the survey was conducted). Conditional on this vignette, all respondents have comparable information sets, which enables us to appreciate heterogeneity in households' beliefs driven by their subjective models as opposed to, say, information frictions (see, e.g., Coibion and Gorodnichenko, 2012).

We label households' responses to the vignette as "posteriors" because they represent beliefs formed *after* being exposed to the hypothetical monetary policy shock. We contrast them with households' priors, which are beliefs formed *before* the vignette. Given that the only difference in households' information set when formulating their priors vs. posteriors is the information about the policy change provided by the vignette, the difference between the posterior and the prior is providing us with information on how households assess the impact of a monetary policy shock on future inflation and unemployment, i.e., the impulse response functions of households' beliefs regarding these two variables.

Formally, we compute households' beliefs on the impulse responses of inflation and unemployment as follows:

$$IRF^i_{z,t+1,\delta} = \underbrace{\mathbb{E}^i[z_{t+1}|\tilde{\mathcal{I}}_t]}_{\text{Posterior}} - \underbrace{\mathbb{E}^i[z_{t+1}|\mathcal{I}_t]}_{\text{Prior}}, \ \tilde{\mathcal{I}}_t = \{\mathcal{I}_t\} \cup \{\varepsilon_t = \delta\}$$

where $z \in \{\pi, u\}$. Figure 6 depicts the impulse responses of one-year ahead inflation (left panel) and unemployment (right one).[8] In Table 6, we test for the symmetric effects of positive and negative shocks and find no evidence supporting asymmetry. Consequently, we reverse the sign of responses in the case of monetary easing, and from now onward, we refer to monetary policy shocks as monetary tightening. A few observations are in order. First, a massive cross-sectional heterogeneity can be detected, with realizations on the tails pointing to values above 10% (5%) in absolute value for inflation (unemployment). Second,

[8]For inflation and unemployment, we ask quantitative questions on households' beliefs about these variables in 12 months. For inflation, unemployment, and stock prices, we also ask qualitative questions on how prices of goods and services, companies hiring and layoffs and stock prices would change after such a shock. For inflation and unemployment, we combine quantitative answers pre and post-vignette. In Table 7, we verify the significant and positive correlation between quantitative and qualitative impulse responses of inflation and unemployment. We will instead employ qualitative answers to the impact of monetary policy shocks on stock prices as a selection device for mental models later.

the cross-sectional mean response of inflation reads 0.27. This positive realization, which is reminiscent of the VAR "price puzzle" (Eichenbaum, 1992), can actually be associated with a supply-side view of the economy characterized by a cost-channel (Barth and Ramey, 2001, Christiano et al., 2005, Ravenna and Walsh, 2006). Differently, the mean realization of the one-year ahead unemployment rate (0.35) points to a textbook recessionary effect of a monetary policy tightening. Third, a sizeable mass of respondents point to a zero value for the response of inflation and/or unemployment to an unexpected monetary policy change. Regarding inflation, this outcome is in line with recent findings by Binetti et al. (2024), who document how households' perceptions over inflation are hard to move experimentally. Our empirical evidence lines up with Binetti et al.'s as far as inflation is concerned, and points to a similar "stubbornness" by households regarding unemployment.[9] Fourth, the wide cross-sectional dispersion largely covers both positive and negative realizations of both variables. Hence, the cross-sectional heterogeneity in beliefs is not only a quantitative one, but it also reflects different views on the directions taken by these two key-macroeconomic variables after a policy shock.

IRFs and mental models. What mental models do households refer to when evaluating the impact of a policy shock like the one proposed in our vignettes? How do they think about the macroeconomy in presence of an unexpected change in the policy rate? We address these questions by considering household-level combinations of sign of the impulse responses depicted in Figure 6 and mapping them (when possible) with known macroeconomic frameworks. Table 9 collects these mappings, which are also depicted in Figure 7. A few interesting facts emerge. First, standard DSGE frameworks concerned with the aggregate responses of inflation and real activity to a monetary policy shock would predict a temporary deflation and a real activity bust in response to a monetary policy shock (see, for the Euro area, (Smets and Wouters, 2003); for the US, Smets and Wouters (2007)). In our sample, 14.4% of the interviewed households indicate signs of the IRFs of inflation and real activity indicators in line with such standard models. As much as 22.8% of households

[9]One possibility is that our respondents had already factored in expected changes in the *actual* policy rate when responding to our vignette. In May 2024, expectations were set for a cut of the policy rate in June 2024 (see e.g., https://www.reuters.com/markets/rates-bonds/ecb-rate-cut-case-getting-stronger-says-chief-economist-lane-2024-05-06/). A 25 basis points cut materialized in June 2024. One possibility is that our vignette has got an immaterial impact on households' expectations when dealing with an interest rate *cut* (although of a larger size, i.e., 50 basis points). However, this would imply a more powerful impact of the vignette proposing an unexpected policy rate *increase* of 50 basis points. Regressions reported in Table 7 that test for the possibly larger effect of interest rate increases proposed by our vignette failed to support this theoretical argument.

(i.e., the largest group, according to our classification) formulate answers consistent with a temporary increase in inflation and an increase in unemployment. These responses are in line with the cost-channel model of the business cycle, which features a supply channel of monetary policy transmission due to the presence of working capital and a cash-in-advance constraint faced by firms (i.e., Barth and Ramey, 2001, Ravenna, 2007, Christiano et al., 2005).[10]

An alternative interpretation for this positive conditional correlation between inflation and unemployment is the "cost of living" hypothesis formulated by Bolhuis et al. (2024), which points to an increase in the mortgage rates as a main driver of the recent bout of inflation and of consumers' pessimism, which could be behind their dismal predictions about the labor market. Our survey does not enable us to compute the impulse response of the mortgage rate (because of the lack of post-vignette beliefs on this variable). However, the correlation between the 3-month short-term interest rate in the Euro area and the Dutch mortgage rate in the January 2003-May 2024 sample is 0.77. Moreover, monetary policy shocks are the dominant drivers of the fluctuation of the 3-month Euro area rate (Altavilla et al., 2019). As much as 8.5% of our respondents point to an inflationary effect of monetary policy shocks associated with model featuring an information channel (Campbell et al., 2012, Melosi, 2017, Nakamura and Steinsson, 2018, Jarociński and Karadi, 2020, Miranda-Agrippino and Ricco, 2021), where due to information frictions agents may interpret a policy tightening as driven by Federal Reserves' private information on a rosy future which leads them to anticipate inflation and induce optimism in household and firms. Overall, about 46% of our respondents form beliefs over the effects of monetary policy shocks that are easily interpretable (in terms of sign) in light of well-known models of the business cycle.

How about the remaining respondents? Close to 38% of the households in this survey believe that either inflation or unemployment would not change in response to a monetary policy shock, while about 9.5% believe that neither inflation nor unemployment would be affected. This result is in line with recent findings by Binetti et al. (2024), who also document households' resistance to change their beliefs when faced with a policy rate

[10] As pointed out by Cochrane (2017), an increase in the short-term interest rate may also be inflationary and expansionary. However, this "new-Fisherian" effect materializes after a widely anticipated, slow, and steady, persistent interest rate rise, accompanied by steady fiscal policy. Differently, the shock in our vignette is specified to be an unexpected one. For an empirical comparison between the information channel and the new-Fisherian effect, see Schmitt-Grohé and Uribe (2024).

change. 7% of the respondents believe that both inflation and unemployment will decrease in response to an unexpected increase in the policy rate. This negative correlation is not common in macroeconomic models of monetary policy: We then term "residual" the mental models these households have in mind.[11]

Monetary policy shocks and stock prices. How do households think of the response of the stock market to a monetary policy shock? Can we exploit their views to further test the interpretative models reported in Table 9? Figure 8 documents the sign of the change in stock prices associated by households to an unexpected hike in the policy rate. On aggregate, 33% of Dutch households believe that such a shock would generate a stock market bust, a prediction in line with standard monetary policy frameworks. As much as 18% think that monetary policy shocks are irrelevant to the stock market, and 49% of the respondents point to a stock market boom, which would be consistent with e.g., the information channel view. Once again, we document a pretty heterogenous view of the functioning of the economy (in this case, of financial markets) across households.

This evidence can be employed at a household level to refine the association between beliefs of impulse responses and interpretative models. Table 10 reports the shares of the three textbook models (standard, cost channel, information channel) that "survive" the further refinement due to the joint imposition of signs on the impulse responses of inflation, unemployment, and stock prices, and contrasts it with the one previously obtained by imposing the signs on the first two macro indicators only. By construction, all three shares decline, with a marked drop for the info channel mental model (3.05%, from 8.5%) and a sizeable one both for the standard view of the business cycle effects of monetary policy shocks (8.10%, from 14.40%) and the cost channel one (13.25%, from 22.8%). We will then work with so-selected households, among which the stubborn and super-stubborn ones identified before, to assess the role played by education. The results remain robust even when using a less restrictive model classification that does not require the stock market

[11] Search-theoretic frameworks in which money is essential for transactions in decentralized markets where agents face frictions (e.g., matching frictions, limited commitment) may generate a positive comovement between inflation and unemployment (see, e.g., Lagos et al. (2017). Inflation affects households' real balances, their purchasing power, and the frequency and efficiency of trades in these decentralized markets. Lower inflation, which may come after a monetary policy easing via the Fisher relationship, increases the real balances held by agents, making it less costly to trade. Firms' labor demand increases and this reduces unemployment. Notice, however, that the short-run correlation between the policy rate and inflation (or unemployment) in these models is positive. Differently, the correlation in our "residual" models is negative, i.e., according to these households, inflation and unemployment respond negatively to a monetary policy tightening.

response to a monetary policy shock to have consistent signs.

Mental models: Role of education. Is there any connection between education and the way households interpret the economy? Figure 9 reports the coefficients of a probit regression where the dependent variable is a dummy variable equal to one if a household is associated with a specific mental model (e.g., for the standard model, the indicator equals one when a household is classified under the standard model and zero otherwise). The explanatory variable is a dummy variable for education. Belonging to the highly educated group increases by 30% the likelihood of interpreting the macroeconomic environment via a standard model, and by 24% that of referring to a cost channel framework. Interestingly, low-educated respondents are instead associated with a higher likelihood of referring to our catchall residual model category (23%) or being super-stubborn (22%). No significant effect is detected as far as the group of stubborn respondents is concerned, although the sign of the coefficient would point to a link with the "low-educated" status. Overall, being highly educated goes hand-in-hand with thinking of the economy in a textbook way (either via a standard AD/AS model of some sort, or via a cost channel framework). Differently, non-standard beliefs on the macroeconomic effects of monetary policy shocks are more likely to be those of low-educated households.

Actions and education. What would households do after a monetary policy shock? Our survey asks this question and proposes alternatives regarding spending and savings. Respondents can indicate if they would increase, decrease, of leave spending and savings unchanged. The top panel of figure 10 reports the coefficients of a probit regression linking actions to education. Highly educated households are more likely to increase savings and decrease spending after a monetary policy tightening. While such households feature savvy financial behavior, low-educated people have a significantly large probability of behaving against the predictions of standard consumption/savings frameworks, i.e., they are estimated to have a probability of decreasing savings 26% larger and increasing spending 22% larger than highly educated people. This is problematic because it increases the likelihood of financial hardship for households that are already low-income. In this sense, our results are in line with the findings in Lusardi and Mitchell (2014, 2023), who point to the sub-optimality of economics choices by low-literate households.

5 Characterizing highly educated households

Are highly educated households different? What are their characteristics? This section addresses these questions by considering: (i) the assets they own; (ii) their ability to deal with a placebo scenario; (iii) the sources of information they appeal to.

Assets. The bottom panel of figure 10 displays the outcome of a probit regression that targets different assets. Highly educated households are more likely to possess a house, insurance, and financial assets. This squares with their stated action, i.e., in response to a monetary policy shock, they dissave also because they are in the position of doing so, given the presence of financial assets in their portfolios. Somewhat consistently with the fact of being homeowners, they are also less likely to have a mortgage.

Placebo. As anticipated, our survey features a placebo vignette that is meant to collect information on the way respondents form their beliefs. Our vignette contains information on the discovery of a new copper mine in Australia, which is realistic information given that Australia is a resource-rich country. The information provided to our respondents reads as follows:

"The Netherlands does not import copper from Australia. Imagine a new copper mine being discovered in Australia".

After providing respondents with this information, we asked them what would happen in the Netherlands to the cost of companies, the expenditure of households, the prices of goods, and unemployment. For each of these four economic dimensions, respondents are provided with three options, i.e., up, down, and no change. We then assign each respondent a score determined by valuing each correct answer as "one" and zero otherwise, i.e., the placebo score ranges from zero (all answers wrong) to four (all answers right). A "partial equilibrium" view of this question could very well be that, after all, this supply shock originating in Australia should have zero or negligible effects on the Dutch economy given the absence of a direct trade of copper and the relatively limited indirect exchanges.[12] On the other hand, a "general equilibrium" take involving the reaction of the copper market at the world level might suggest a reduction of the cost of companies and the price of goods

[12] The Netherlands does trade in copper ore, with an import (export) equal to 0.25% (0.15%) of real GDP in 2022, which makes the country the 27th largest importer (80th largest exporter) in the world (source: https://oec.world/en/profile/bilateral-product/copper-ore/reporter/nld). For comparison, the Netherlands' imports (exports) of refined petroleum in 2022 were 5.10% (6.80%).

for households. Hence, we compute our placebo score by assigning a value equal to one both to the "no change" answers and to the "down" answers as far as the cost of companies and the price of goods are concerned.

Figure 11 plots the distribution of the placebo score. As we can see, while about 60% percent of the respondents "get it right", all the possible realizations of the placebo score are covered. While this may be a signal of inattention by certain households, it is of interest to note that the placebo score is positively correlated with education, as documented in Table 11; it is not correlated with the time of execution of the survey, which we take as a signal against the hypothesis of disinterested respondents going too short or long with the survey.

Sources of information. Where do households draw the information they rely upon to form their macroeconomic beliefs? Figure 12 reports the estimated coefficients of a probit regression that considers different possible sources proposed to our respondents in the survey and associates each one of them to the status of high education. Highly educated respondents are significantly more likely to refer to newspapers (8.3%) and economic knowledge (cumulated via formal or informal education, 6.6%), while low-educated households are significantly more likely to refer to social media (2.3%).

Wrapping up, highly educated households: (i) are more likely to own assets; (ii) have an understanding of economics that enables them to perform well to the "placebo" test; (iii) draw information from traditional sources such as newspapers or their own background. Differently, our low-educated households are likely to be mortgagors and appeal to social media.

6 Connection with the literature

The paper closest to ours is Andre et al. (2022). They use vignettes to elicit households' and experts' beliefs about macroeconomic variables such as inflation and unemployment to four macroeconomic shocks (monetary policy, Government spending, tax rate, oil), They also find dispersion across households' responses and provide evidence of associative memory's role as a possible driver of households' heterogeneous beliefs. With respect to them, we: (i) focus on education and unveil its role behind households' beliefs formation; (ii) explore also households' beliefs regarding the reaction of stock prices to macroeconomic shocks,

which is relevant information that we exploit to support (or reject) beliefs formation in line with supply-side channels such as the cost channel and the information channel; (iii) collect unconditional beliefs about mortgage rates, which we exploit to check the consistency of households' beliefs formation with the cost-of-living hypothesis; (iv) rely only on structured questions, which have a variety of advantages with respect to open-text questions, such as ease of comparability across respondents; easier connection with fully identified transmission channels; lower effort by the respondents, which may limit measurement error; absence of the need by the researcher to interpret the respondents' answers, which would induce subjectivity in the collected data; (v) propose a placebo vignette, which we use in our regressions as a control for idiosyncratic biases; (vi) exploit the rich set of household background information connected to our survey data to explore how households' socioeconomic situation, personality and values influence their interpretation of macroeconomic shocks and their transmission mechanisms.

A related paper is Binetti et al. (2024), who study how variations in policy instruments (e.g., changes in the interest rate and government spending) and changes in oil prices can affect inflation and unemployment. They also investigate drivers of heterogeneity across households and find political leaning to be a distinct one, with Democrats (Republicans) more likely to associate inflation with inequality (Government policies and negative economic outcomes). Knotek et al. (2024) run multi-wave randomized control trials to test the effects of real-world monetary policy actions on consumers' expectations during and in the aftermath of the pandemic inflation occurrence. Isolating respondents who were unaware of policy actions and are sufficiently attentive to the treatments, they find monetary policy communications around positive changes in interest rates to reduce long-run inflation expectations. With respect to these two papers, we use vignettes to *exogenous* changes in the policy rate from its systematic response to macroeconomic conditions and single out the role of education as a driver of households' heterogeneous beliefs.

Our respondents' beliefs regarding the changes in inflation, unemployment, and stock prices after a monetary policy shock are extremely heterogeneous from a quantitative standpoint and cover both positive and negative realizations. This evidence confirms the substantial disagreement in macroeconomic expectations often found in the literature (Mankiw et al., 2003, Coibion and Gorodnichenko, 2015, Link et al., 2023, Giglio et al., 2021). This is problematic because disagreement implies a difficult management of the transmission of macroeconomic policy impulses (Ball et al., 2005, Paciello and Wiederholt, 2014, An-

geletos and Lian, 2017). To some extent, our evidence is complementary to the one put forth by Lewis et al. (2020), who work with survey data and show that monetary policy announcements can shift households' macroeconomic expectations. On the other hand, a larger share of our respondents do not change their beliefs after being exposed to our vignette. Our findings, which regard inflation, unemployment, and stock prices, complement and expand those by Binetti et al. (2024), who document the reluctance of respondents to vary their inflation beliefs after experimental interventions.

As anticipated in the Introduction, our paper links education to textbook concepts such as the Phillips correlation and the models for the transmission of monetary policy shocks. As pointed out by Lusardi and Mitchell (2014, 2023), financial literacy and education are strictly correlated. Hence, our results square with those in the literature surveyed by those two papers, e.g., inflation is better understood by people possessing a college degree (or above). Lusardi and Mitchell (2023) document a number of survey-based facts connecting households' understanding of the economy and financial and economic choices to their education level. Among the other facts, they document a positive correlation between the score assigned to respondents who correctly address their "big three" questions on financial literacy (i.e., questions about nominal returns on savings, the role of inflation for real returns on financial investment, and portfolio risk-diversification) and education. In particular, they document a striking difference between highly educated (college and above) respondents' understanding of the basic principles of financial economics and low-educated ones, with consequences on a variety of dimensions (e.g. different returns of a financial portfolio). In this respect, we document a positive correlation between education and the score associated with our placebo questions. Our results are also consistent with those in Malmendier and Nagel (2016), who find that sophistication and experience are positively correlated with a good understanding of inflation.

As discussed, recent contributions have documented the positive correlation in terms of households' expectations between inflation and unemployment (see e.g. Bhandari et al., 2024, Kamdar and Ray, 2024). We also find this unconditional correlation in beliefs and document that it extends to stock prices, i.e., some households expect inflation, unemployment, and the stock market to correlate positively. Our vignette approach allows us to identify the monetary policy shock as one of the drivers of this comovement.

7 Conclusions

This paper surveys Dutch households and documents their expectation formation over inflation, unemployment, stock prices, and mortgage rates both unconditional and after hypothetical monetary policy shocks simulated via vignettes. We combine households' beliefs to understand if the mental models they appeal to when thinking about the macroeconomy are associated with textbook models or more exotic ones. Our main finding is that education draws a clear line separating highly-educated households and low-educated respondents. Low-educated households think of inflation as being "bad", i.e., they have a supply-side view of the economy. This evidence, which represents a regularity in the literature, is overturned when considering highly educated households, who form beliefs consistent with a downward-sloping Phillips curve that implies a monetary policy trade-off. Highly educated households also form beliefs over the macroeconomic effects of monetary policy shocks in line with textbook models (traditional AD/AS models, cost-channel models, information channel models). Differently, less-educated respondents either retain pre-existing beliefs or adjust them using non-standard mental models. These beliefs formation is associated with different actions after the hypothetical monetary policy shock: Highly educated households obey the intertemporal substitution motive, also thanks to their financial positions, while low-educated ones state they would reduce savings and increase spending. Finally, highly educated households refer to their background or newspapers as their main sources of information, while low-educated ones use social media to get informed.

From a modeling standpoint, our analysis suggests embedding education choices/endogenous human capital formation in business cycle models of monetary policy featuring heterogenous frameworks, therefore merging endogenous choices of investment in financial literacy as in Lusardi et al. (2017) in TANK or HANK models. Policywise, in line with Haldane and McMahon (2018), Coibion et al. (2022), Blinder et al. (2024), our findings call for simpler policy communications, which may be more effective to hit low-educated households. Possibly, the use of social media could have a large multiplier to convey information about policy targets and decisions.

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Tables and Figures

Variable	Our survey	DNB 2023
Gender (female)	50%	51%
Age (median)	56	53
Personal net income (in Euros, median)	2,218	2,394
Education (years, median)	16	16

Table 1: **Summary statistics: Covariates in the general population samples.** Comparison between the distributions of individual characteristics in our survey with those in the sample of the Dutch National Bank Household Survey.

	Inflation Priors	Unemployment Priors	Mortgage rate Priors
Mean	4.617	4.469	3.875
Median	3.6	4	4
Mode	3	5	4
Variance	9.332	3.636	1.127
Skewness	1.381	0.588	-0.701
Kurtosis	4.7	3.86	4.566
Normality test, p-value	0	0	0
DNB's estimate	2.8	4	not available
Difference test, p-value	0	0	0

Table 2: **Prior expectations: Summary statistics.** Moment comparison across different macroeconomic indicators regarding households' expectations at a one-year ahead horizon. DNB: Dutch National Bank's estimates. Normality test: Shapiro-Wilk test for normality. Difference test: t-test comparing the mean values of households' densities with DNB's estimate (the null hypothesis assumes equality).

	$\Delta\mathbb{E}(\pi)$	$\Delta\mathbb{E}(\pi)$	$\Delta\mathbb{E}(\pi)$	$\Delta\mathbb{E}(\pi)$
$\Delta\mathbb{E}(u)$	0.17^{**} (0.09)	0.26^{***} (0.10)	0.16^{***} (0.05)	0.17^{***} (0.05)
Education	-0.31^{***} (0.10)	-0.13 (0.12)	-0.18^{***} (0.05)	-0.07 (0.05)
$\Delta\mathbb{E}(u) \times$ Education	-0.37^{**} (0.18)	-0.39^{**} (0.20)	-0.25^{***} (0.08)	-0.25^{***} (0.08)
Controls	N	Y	N	Y
R-squared	0.02	0.07	0.03	0.10
Observations	1,056	993	1,056	993
Variables	Numerical	Numerical	Categorical	Categorical

Table 3: **Regression of expected change in inflation on expected change in unemployment**. Numerical variables: *Prior - Perception*. Categorical variables: indicator equal to one if inflation/unemployment expected to increase, equal to zero if inflation/unemployment expected not to change, and equal to minus one if inflation/unemployment expected to decrease. Controls: age, gender, marital status, number of children, net income, employment status, homeownership, sentiment, placebo. Huber-White standard errors in parentheses. */**/*** refer to p-values lower than 0.10/0.05/0.01, respectively.

	$\Delta\mathbb{E}(i)$	$\Delta\mathbb{E}(i)$	$\Delta\mathbb{E}(i)$	$\Delta\mathbb{E}(i)$	$\Delta\mathbb{E}(i)$	$\Delta\mathbb{E}(i)$	$\Delta\mathbb{E}(i)$	$\Delta\mathbb{E}(i)$
$\Delta\mathbb{E}(\pi)$	0.10^{***} (0.02)	0.08^{***} (0.02)			0.26^{***} (0.04)	0.23^{***} (0.04)		
$\Delta\mathbb{E}(u)$			0.02 (0.05)	0.003 (0.07)			0.01 (0.04)	-0.00^{***} (0.05)
Education	-0.07^{*} (0.04)	-0.01 (0.004)	-0.11^{***} (0.04)	-0.01 (0.05)	-0.09^{**} (0.04)	-0.05 (0.05)	-0.15^{***} (0.05)	-0.06 (0.05)
$\Delta\mathbb{E}(\pi) \times$ Education	-0.00 (0.03)	0.01 (0.03)			0.08 (0.06)	0.09 (0.06)		
$\Delta\mathbb{E}(u) \times$ Education			0.03 (0.07)	0.05 (0.08)			-0.02 (0.07)	-0.02 (0.07)
Controls	N	Y	N	Y	N	Y	N	Y
R-squared	0.06	0.11	0.008	0.07	0.12	0.15	0.01	0.07
Observations	1,056	993	1,056	993	1,056	993	1,056	993
Variables	Numerical	Numerical	Numerical	Numerical	Categorical	Categorical	Categorical	Categorical

Table 4: **Regression of expected change in mortgage interest rates on expected change in inflation and on expected change in unemployment.** Numerical variables: *Prior - Perception*. Categorical variables: indicator equal to one if mortgage rates/inflation/unemployment expected to increase, equal to zero if mortgage rates/inflation/unemployment expected not to change, and equal to minus one if mortgage rates/inflation/unemployment expected to decrease. Controls: age, gender, marital status, number of children, net income, employment status, homeownership, sentiment, placebo. Huber-White standard errors in parentheses. */**/*** refer to p-values lower than 0.10/0.05/0.01, respectively.

	IRF inflation	IRF unemployment
Tightening vignette	0.04 (0.05)	0.05 (0.03)
Controls	Y	Y
R-squared	0.01	0.02
Observations	594	661

Table 6: **Symmetry between the monetary tightening scenario and the monetary easing scenario.** Dependent variable: IRF of inflation (column 1) and IRF of unemployment (column 2) obtained by reversing the sign of responses in the case of monetary easing. We eliminate the tails of the distributions of the two variables (below 16th percentile and above 84th percentile) to avoid the influence of outliers. Regressor of interest: dummy equal to 1 if the respondent is part of the randomized group who was assigned to the tightening vignette. Controls: age, gender, marital status, number of children, net income, employment status, homeownership, sentiment, placebo. Huber-White standard errors in parentheses.

	IRFπ_{sign}	IRFu$_{sign}$
IRF$\pi_{categorical}$	0.10^{***} (0.04)	
IRFu$_{categorical}$		0.45^{***} (0.04)
Controls	Y	Y
R-squared	0.01	0.14
Observations	980	987

Table 8: **Correlation between sign of numerical IRFs and categorical IRFs.** Results of regressions analyzing the relationship between the sign of numerical IRFs and categorical IRFs. The dependent variable in each regression is the sign of the numerical IRF, defined as 1 if the IRF is positive, 0 if it is zero, and -1 if it is negative. The key regressor of interest is the corresponding categorical IRF, derived from survey responses: for inflation, 1 indicates "increase," 0 indicates "no change," and -1 indicates "decrease"; for unemployment, 1 indicates "in response of this situation, companies will fire more people," 0 indicates "no change," and -1 indicates "in response of this situation, companies will hire more people". Huber-White standard errors in parentheses. */**/*** refer to p-values lower than 0.10/0.05/0.01, respectively.

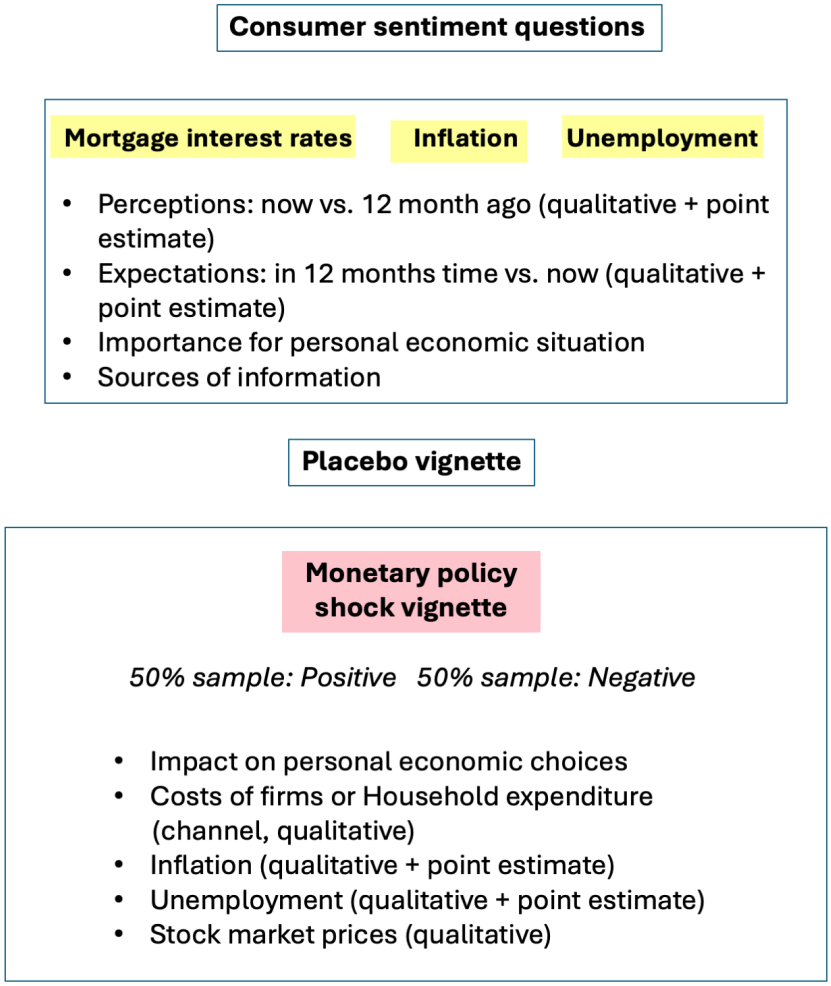

Figure 1: **Overview of the survey structure.** Sequence of blocks in the survey. "Placebo" refers to the discovery of a copper mine in Australia. The monetary policy shock vignette simulates an unexpected change in the policy rate by the European Central Bank of 50 basis points in absolute value.

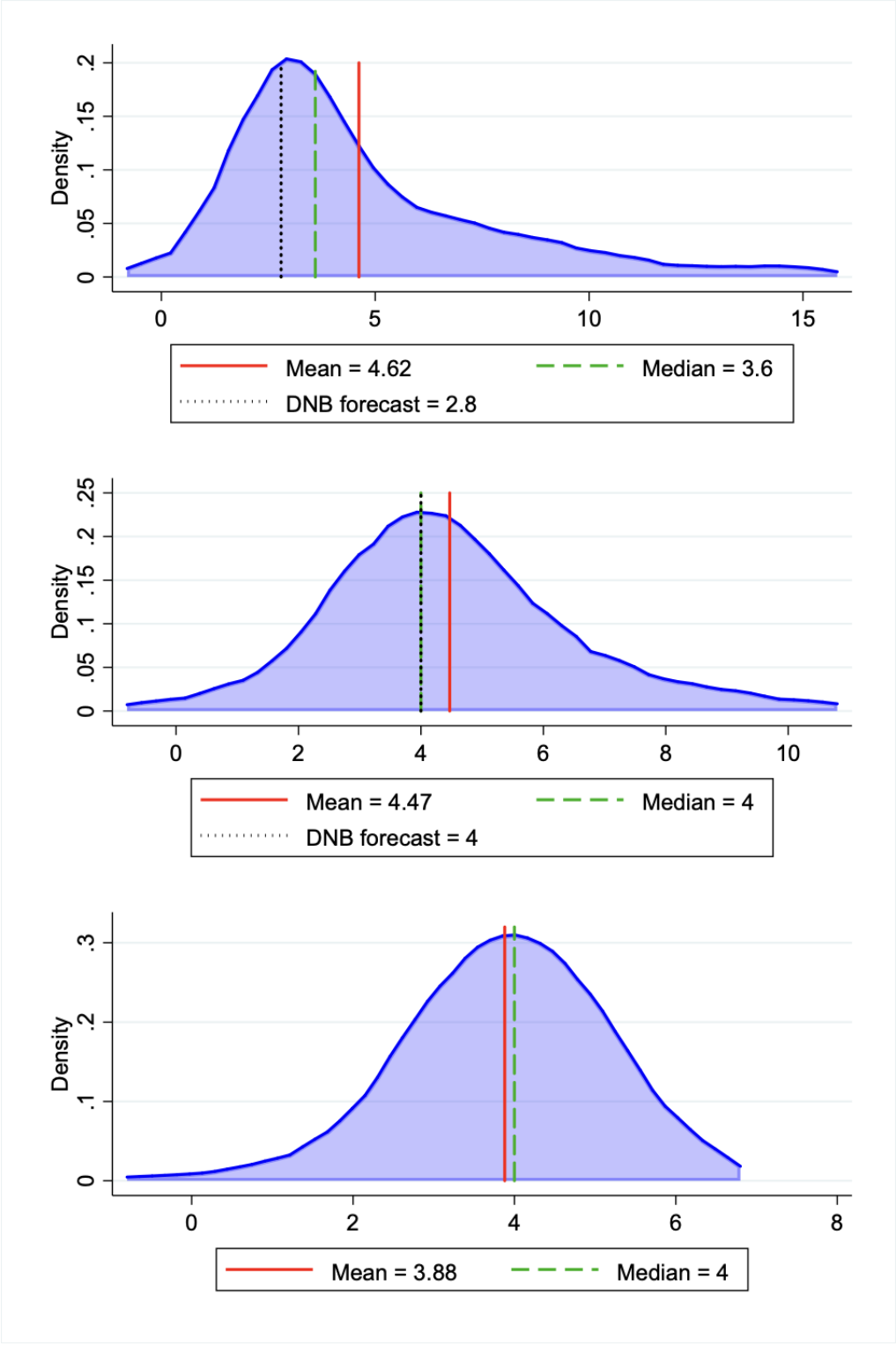

Figure 2: **Prior densities of inflation, unemployment, and mortgage rates one-year ahead.** Top panel: Prior density of year-on-year inflation. Central panel: Prior density of the unemployment rate. Bottom panel: Prior density of the mortgage rate (new loans). Mean and median figures refer to location measures conditional on households' forecasts. DNB forecasts: Predictions by the Dutch National Bank. Red dashed/green dash-dotted/black solid lines indicate the mean, median, and DNB's forecasts (where available). Densities plotted by employing an Epanechnikov Kernel, bandwidths: 0.8.

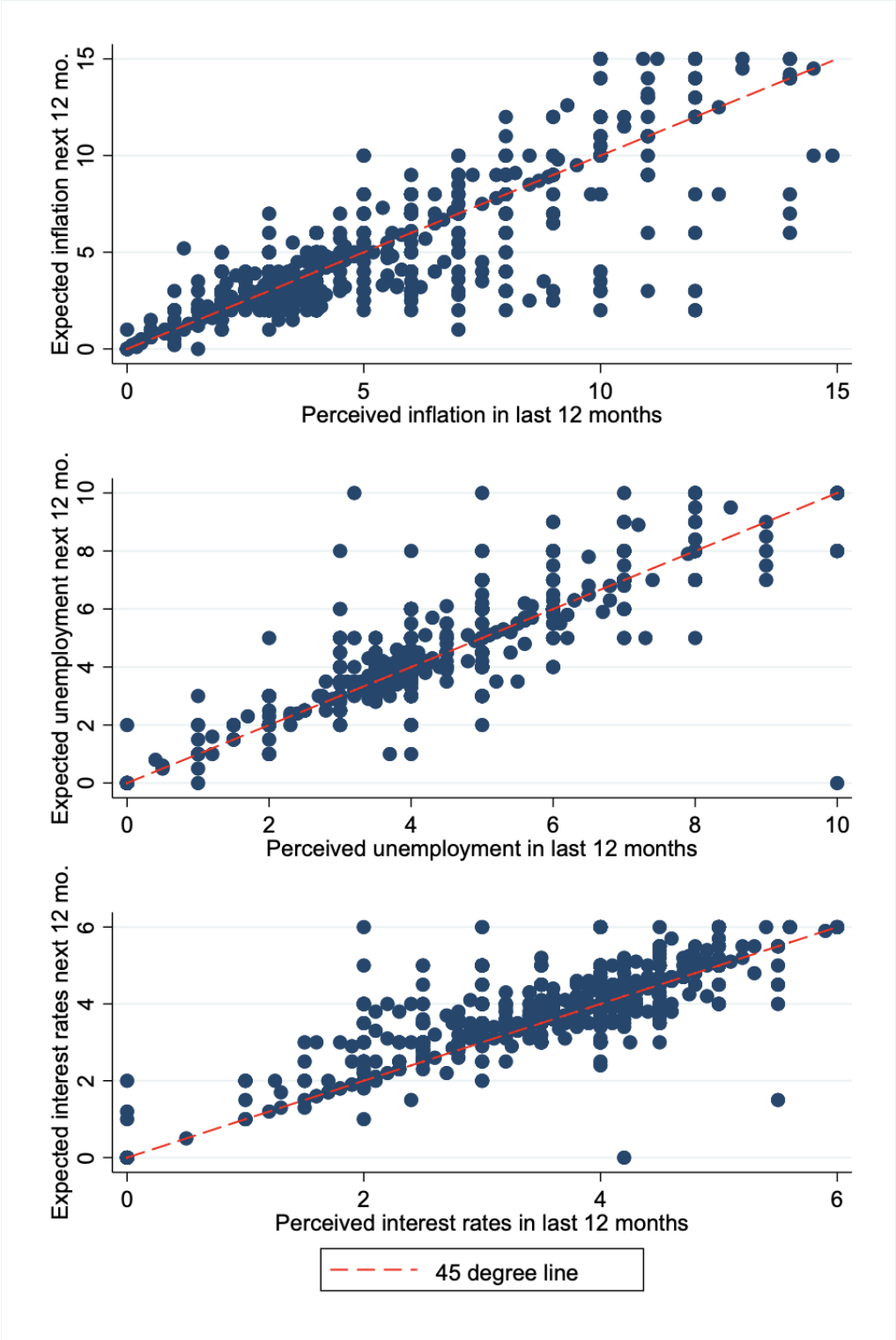

Figure 3: **Correlation of expectation one-year ahead with prior for inflation, unemployment, and mortgage rates.** Top panel: Correlation on inflation; regression coefficient: 0.871*** (robust SE: 0.03). Central panel: Correlation on unemployment; regression coefficient: 0.939*** (robust SE: 0.02). Bottom panel: Correlation on mortgage rate (new loans); regression coefficient: 0.830*** (robust SE: 0.02).

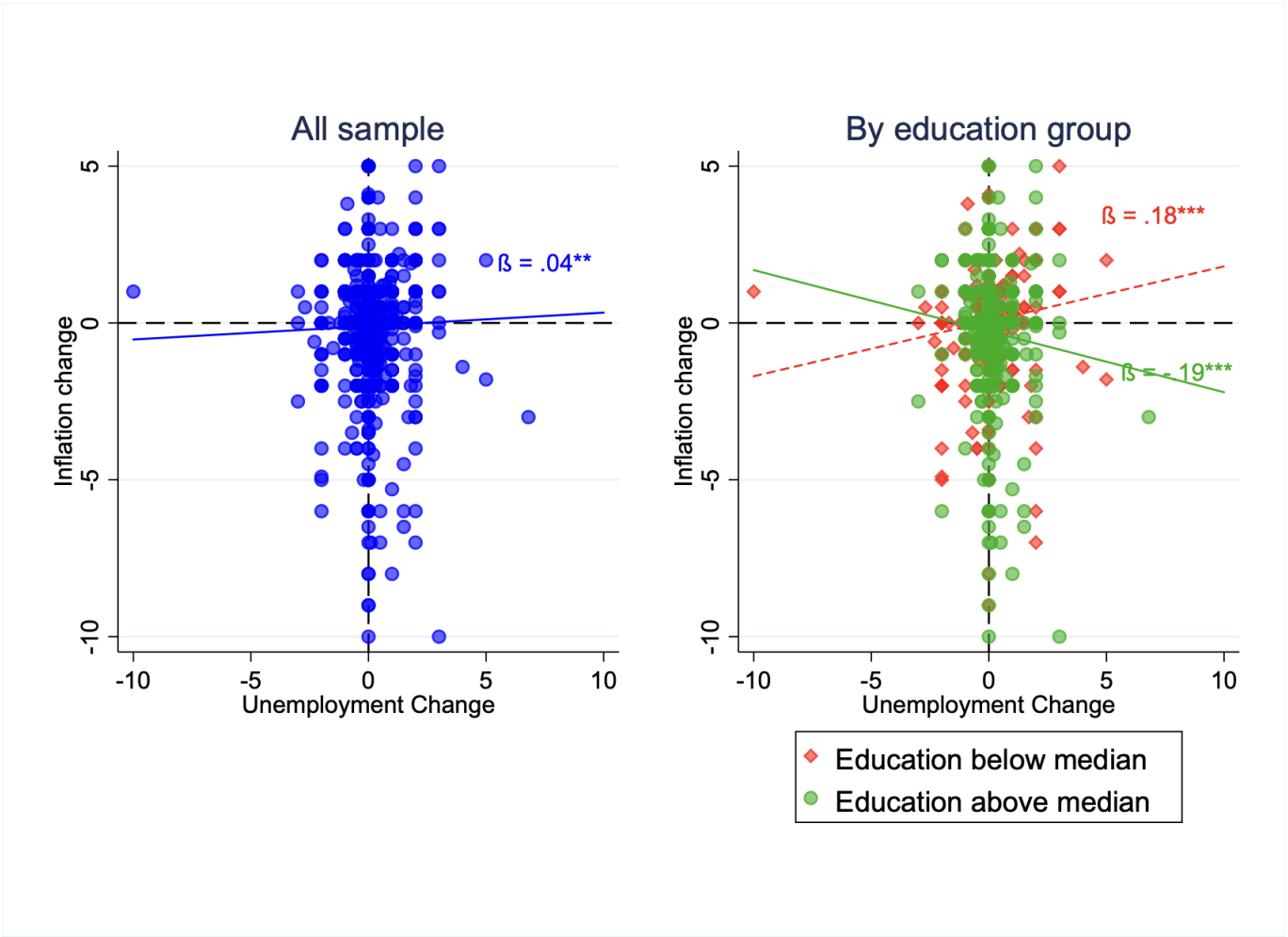

Figure 4: **Phillips correlation: Role of education, scatter plots.** Correlation between expected changes in unemployment and inflation. Regression coefficients of expected inflation changes over expected unemployment changes. Controls: age, gender, marital status, number of children, net income, employment status, homeownership, sentiment, placebo. Huber-White standard errors.

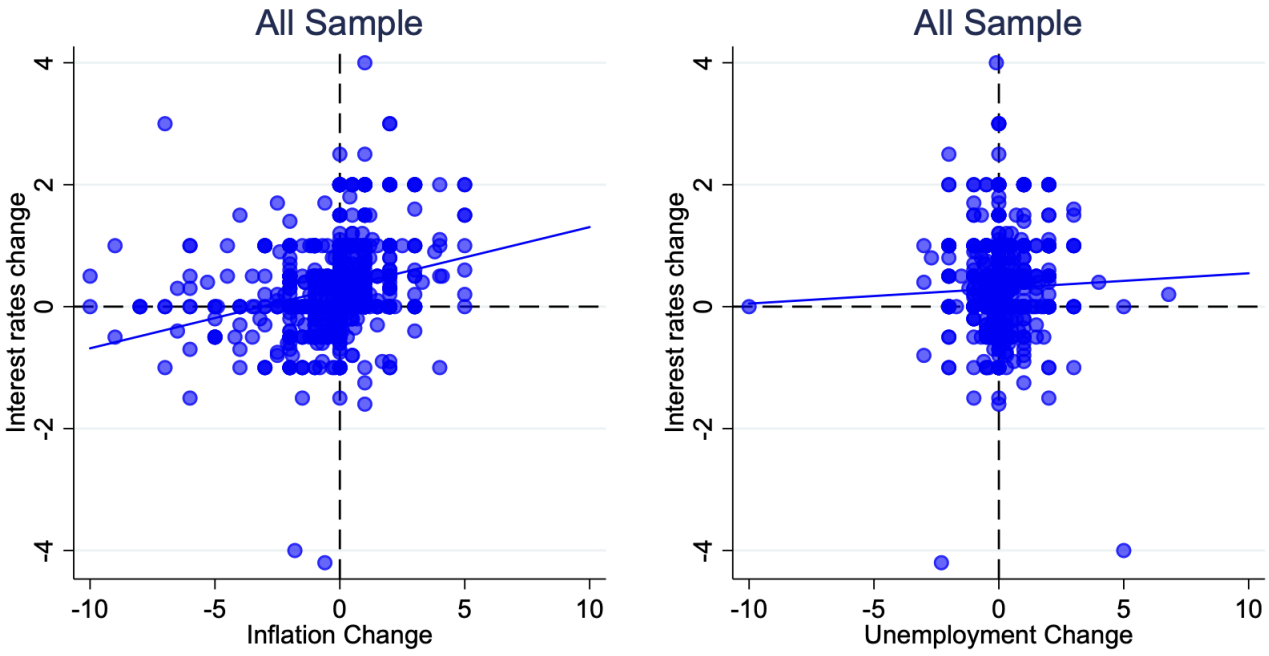

Figure 5: **Mortgage rates-macroeconomic indicators correlations.** Correlation between expected changes in the mortgage rate and inflation (left) and expected changes in the mortgage rate and unemployment (right). Controls: age, gender, marital status, number of children, net income, employment status, homeownership, sentiment, placebo. Huber-White standard errors.

		IRFπ_{sign}		
		< 0	$= 0$	> 0
IRFu_{sign}	< 0	residual models: 7.05%	stubborn: 4.15%	info channel: 8.5%
	$= 0$	stubborn: 8.99%	super stubb.: 9.47%	stubborn: 14.88%
	> 0	standard: 14.40%	stubborn: 9.76%	cost channel: 22.8%

Table 9: **Households' mental models: Classification conditional on the sign of the impulse responses of inflation and unemployment to an unexpected monetary policy tightening.** Responses to unexpected policy easings bunched with those of the policy tightening. The variables in rows and column are the signs of the numerical IRFs.

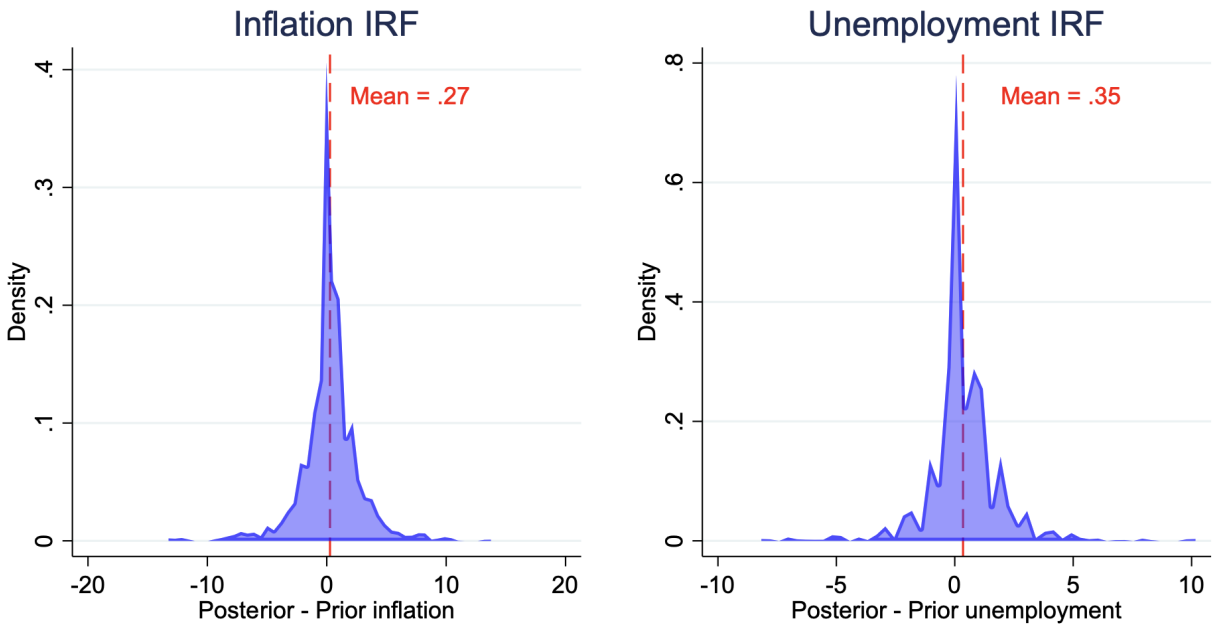

Figure 6: **Distribution of one-year ahead impulse response functions to an unexpected monetary policy tightening.** Size of the shock in our vignette: 50 basis points. Responses to unexpected policy easings bunched with those of the policy tightening, statistical evidence in favor of symmetry detected in the data. Densities plotted by employing an Epanechnikov Kernel, bandwidths: 0.2494 (inflation), 0.1660 (unemployment).

models	π	u	sp	% with sp	% without sp
standard	< 0	> 0	< 0	8.10%	14.40%
cost channel	> 0	> 0	< 0	13.25%	22.8%
info channel	> 0	< 0	> 0	3.05%	8.5%

Table 10: **Households' mental models: Refinement of textbook models conditional on the predicted response of stock prices.** Responses to unexpected policy easings bunched with those of the policy tightening. % with sp: share of models jointly meeting the sign constraints on the responses of inflation, unemployment, and stock prices. % without sp: share of models meeting the sign constraints on the responses of inflation and unemployment without considering the response of stock prices.

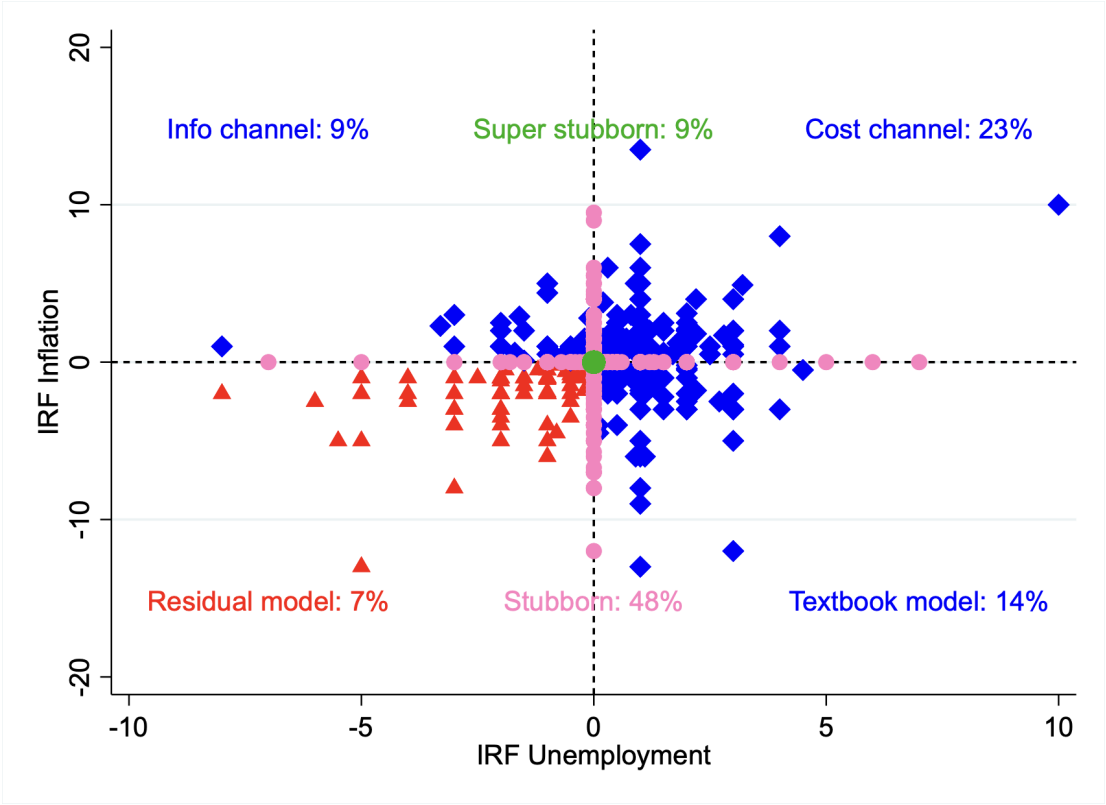

Figure 7: **Households' mental models: Classification conditional on the sign of the impulse responses of inflation and unemployment to an unexpected monetary policy tightening.** Responses to unexpected policy easings bunched with those of the policy tightening. The variables on the x- and y-axes are the numerical IRFs.

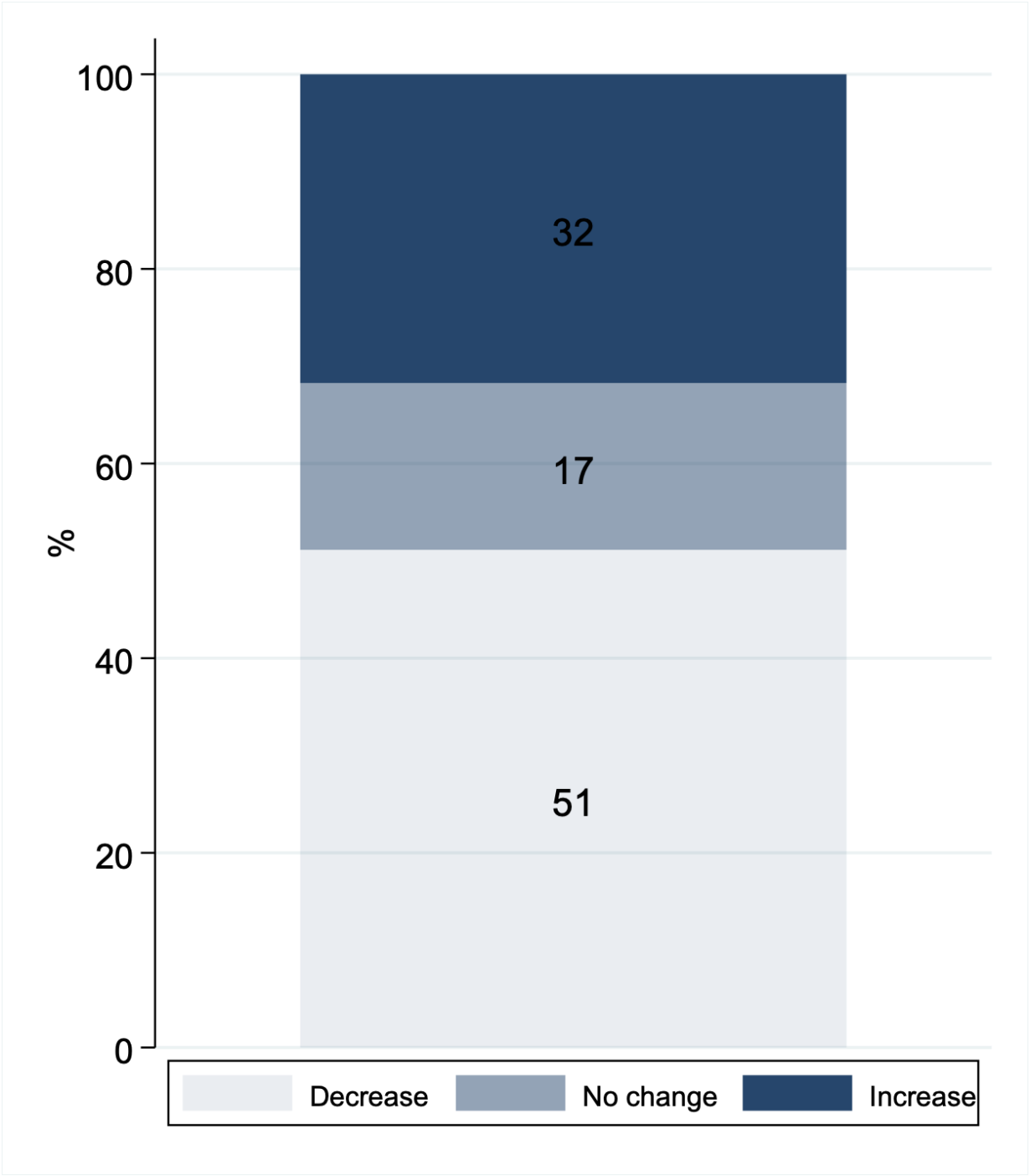

Figure 8: **Households' predictions on the response of stock prices to an unexpected monetary policy shock.** Responses to unexpected policy easings bunched with those of the policy tightening.

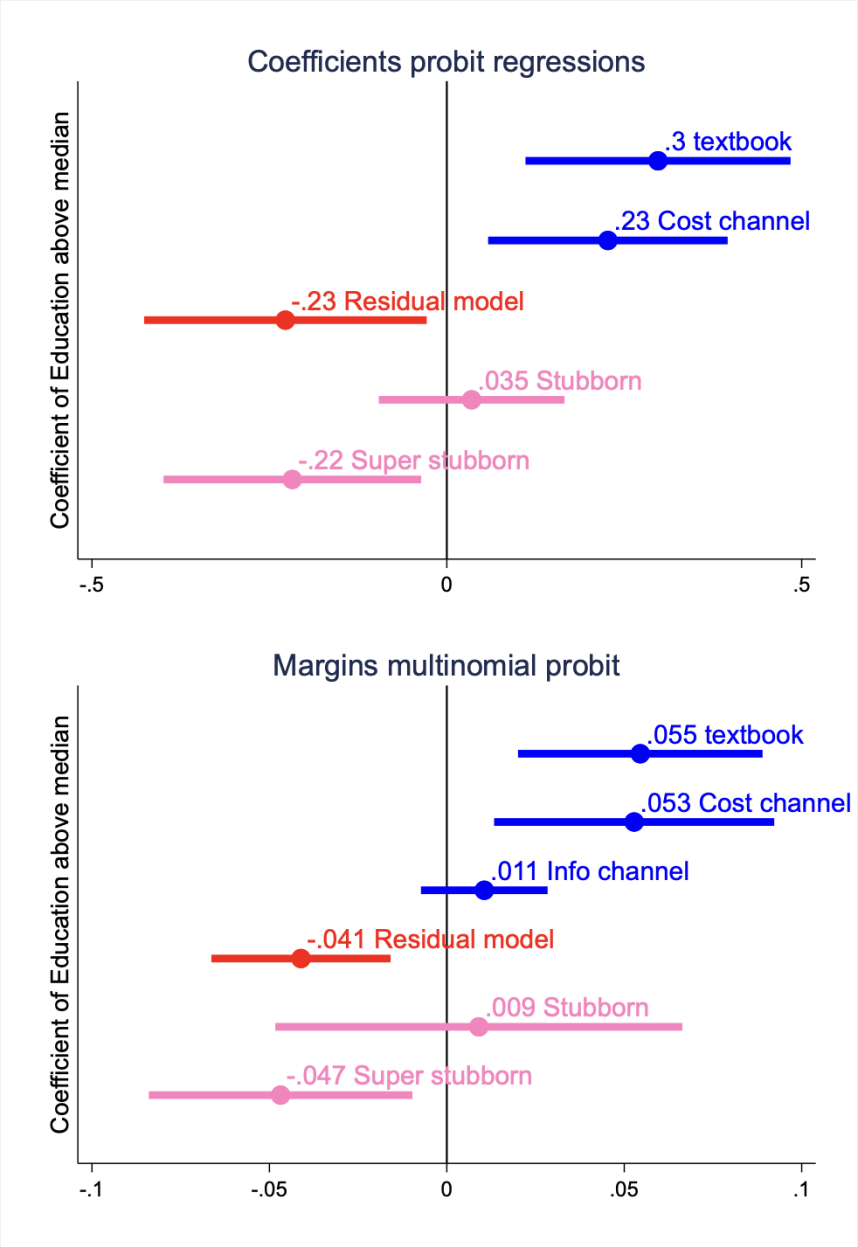

Figure 9: **Effect of high education on the probability of being associated with a given mental model.** Top panel: Probit regression conducted with the dependent variable defined as a dummy that equals 1 if an individual is associated with a specific mental model, as defined in Figure 7 and based on the sign restrictions on stock prices for group classification reported in Table 10, and 0 otherwise, considering each model at a time. Bottom panel: Multinomial probit regression conducted with the dependent variable defined as a categorical variable that takes values 1 when associated to Stubborn, 2 when associated to Super Stubborn, 3 when associated to Textbook, 4 when associated to Cost channel, 5 when associated to Info Channel, 6 when associated to Residual model. Mental models are defined in Figure 7, and based on the sign restrictions on stock prices for group classification reported in Table 10. In both panels, no controls are included.

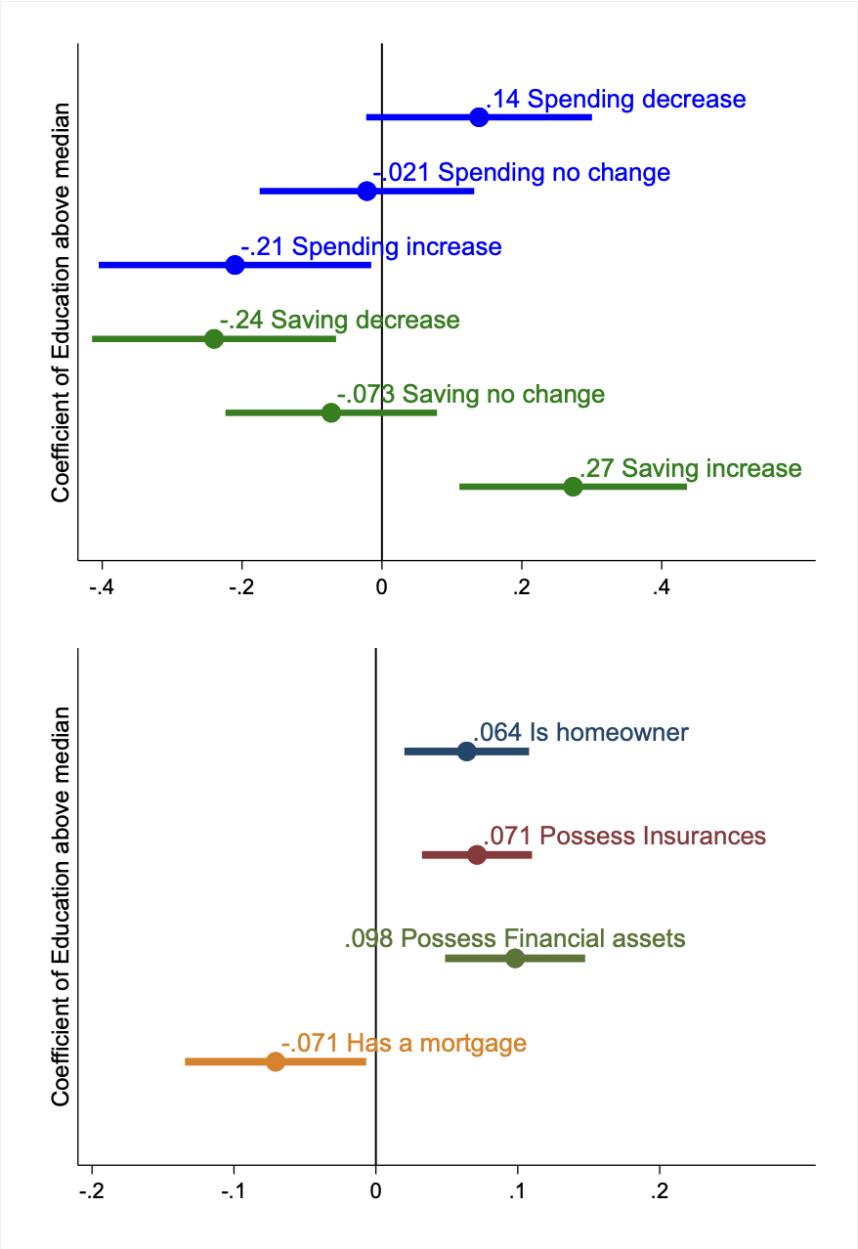

Figure 10: **Effect of high education on the probability of being associated with a given action and of owning assets.** Top panel: Probit regression conducted with the dependent variable defined as a dummy that equals 1 if an individual chooses a given action and 0 otherwise, considering each action at a time. Bottom panel: Probit regression conducted with the dependent variable defined as a dummy that equals 1 if an individual is in a given financial condition and 0 otherwise, considering each financial condition at a time. In all regressions, controls include gender, age, marital status, number of children, net monthly income, employment status, homeownership, sentiment, placebo score.

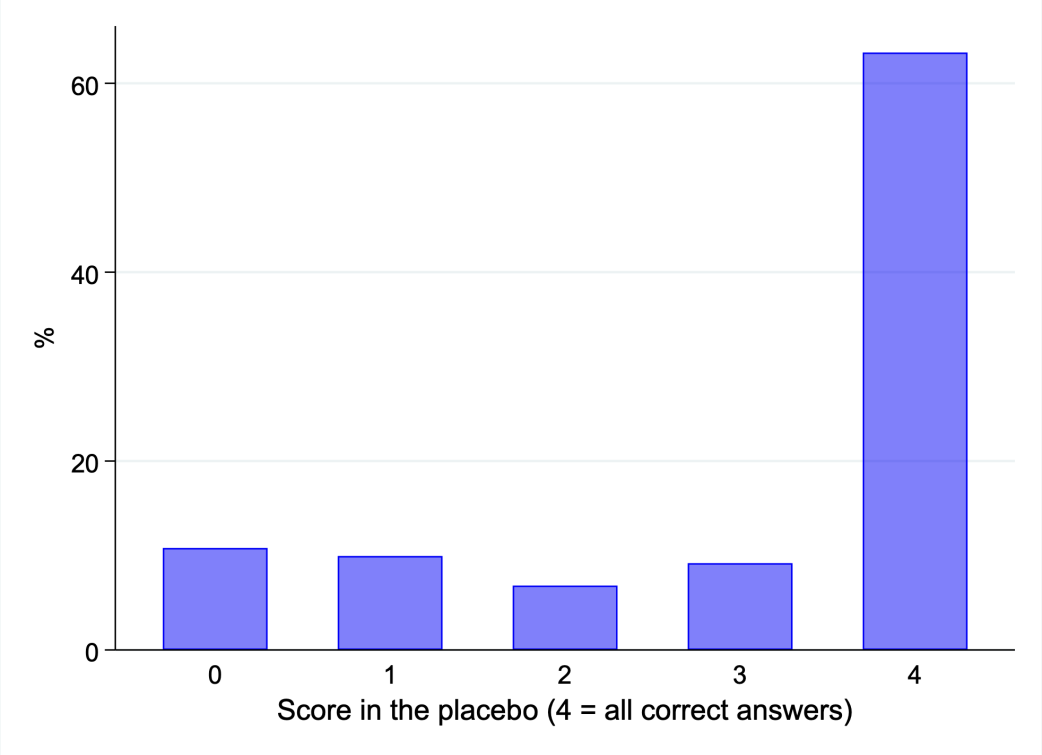

Figure 11: **Placebo score.** Score ranging from zero to four. Scenario: Discovery of a copper mine in Australia. Questions about variations in the cost of companies, households' expenditures, prices of goods, unemployment in the Netherlands. One point attributed to "no change" (all questions), "reduction in cost of companies", "reduction in prices of goods".

	Placebo score
Education above median	0.327***
	(0.099)
Controls	Y
R-squared	0.03
Observations	993

Table 11: **Placebo score: Correlation with education.** Correlation of placebo score with education. Education is a dummy variable that equals 1 when the individual has education equal to college or above college level, and 0 otherwise. Controls include gender, age, marital status, number of children, net monthly income, employment status, homeownership, sentiment.

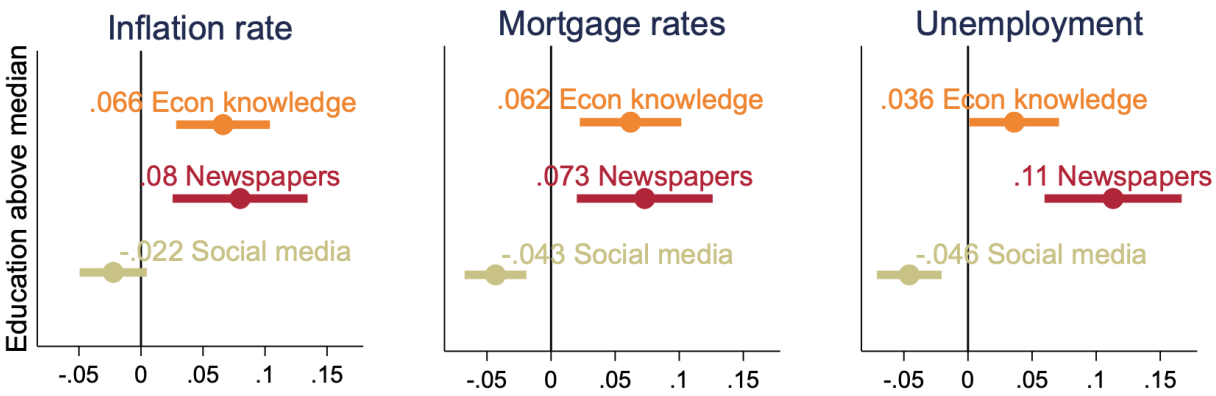

Figure 12: **Effect of high education on the probability of drawing information from a given source.** Probit regression conducted with the dependent variable defined as a dummy that equals 1 if an individual obtains information from a specific source and 0 otherwise, considering each information source at a time. Controlling for: gender, age, marital status, number of children, net monthly income, employment status, homeownership, sentiment, placebo score.