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WHY SURVEY-BASED SUBJECTIVE EXPECTATIONS ARE MEANINGFUL AND
IMPORTANT

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Why Survey-Based Subjective Expectations are Meaningful and Important
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ABSTRACT

For decades, households' subjective expectations elicited via surveys have been considered
meaningless because they often differ substantially from the forecasts of professionals and ex-
post realizations. In sharp contrast, the literature we review shows household characteristics and
the ways in which households collect and process economic information help us understand
previously-considered puzzling facts about their subjective expectations. In turn, subjective
expectations contribute to explain heterogeneous consumption, saving, investment, and debt
choices as well as different reactions by similar households to the same monetary and fiscal
policy measures. Matching microdata on households' characteristics with the price signals the
same households observe, their subjective expectations, and their real-world economic decisions
is crucial to establishing these facts. Our growing understanding of households' subjective
expectations inspires several theoretical and empirical research directions and begets the design
of innovative and more effective policy instruments.

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I Introduction

Theoretically, households' subjective expectations and especially their inflation expectations are a key ingredient of modern macroeconomic models. For instance, the consumer Euler equation emphasizes how households' inflation expectations shape intertemporal consumption choices via changing households' incentives to save. For decades, central banks and researchers alike have largely adhered to the paradigm of full information rational expectations (FIRE), under which expectations are model-implied and identical for all households. And yet, household-level subjective inflation expectations elicited through surveys around the globe depart dramatically from this paradigm: they are highly dispersed, upward-biased, and volatile in the time series (Armantier et al. (2013a); Weber et al. (2022); D'Acunto et al. (2023)).

Faced with this evidence, many economists have argued that survey data on households' subjective inflation expectations should be ignored because their dramatic departure from model-implied beliefs and ex-post realizations is "prima facie" evidence that they are meaningless. Famously, Edward Prescott argued that "Like utility, expectations are not observed, and surveys cannot be used to test the rational expectations hypothesis" (Prescott, 1977). For this reason, most researchers in macroeconomics and finance have dismissed the measurement and understanding of subjective expectations for decades.[1]

In this paper, we start by reviewing a recent but prolific strand of research demonstrating that many facts about survey-based inflation expectations that macroeconomists have deemed puzzling are in fact explained by household-level characteristics and by the ways in which households collect and process economic information. Perhaps ironically, some of these results are consistent with the assumptions behind the acclaimed model of one of the fathers of FIRE, the Lucas islands model (Lucas (1975)), in which economic agents, when forming subjective expectations, use the information they gather from their own local environments rather than economy-wide information.

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[1]Note that Prescott's argument was not unanimously accepted even among his contemporary peers. For instance, Lovell (1986) critiques the notion that subjective expectations cannot be measured or that the rational-expectations hypothesis cannot be tested using directly-elicited data on subjective expectations.

This recent literature shows that households' subjective expectations are meaningful in the sense that observable household characteristics help explain them. Households do not conform to FIRE because they form expectations in ways that depart from the prescriptions of neoclassical models: they use rules of thumb, acquire and use limited information, which often relies on volatile and heterogeneous but easy-to-observe price signals, and process the information they acquire in ways that depart from the assumptions of standard models. This line of research collectively stresses the importance of embracing survey-based subjective expectations and studying their drivers to understand how households—i.e., the economic agents that ultimately determine aggregate demand and the effectiveness of economic policies with their choices—behave rather than dismiss them because they do not conform to our theoretical models. We outline several broad and open directions to deepen our understanding of subjective expectations that beget inquiry in terms of both theoretical and empirical research.

In a second step, we review evidence that households use their subjective expectations when making economic decisions and that heterogeneous subjective beliefs contribute to explaining households' heterogeneous choices and reactions to the same economic shocks. For these reasons, survey-based subjective expectations are important: they allow us to understand the shortcomings of standard approaches to monetary and fiscal policy and to design more effective policy tools that embrace predictable heterogeneous reactions based on known drivers of subjective expectations.

In the third part of the paper, we discuss the implications of our improved understanding of subjective expectations for the design of effective economic policies. Some of these innovations relative to traditional policymaking are being promoted at the highest levels. For instance, direct communication of policy aims and actions tailored to households on top of the traditional communication with financial markets has been recently advocated by ECB President Lagarde in her Opening Statement to the European Parliament in September 2019, when she argued that "[t]he ECB [...] needs to be understood by the people whom it ultimately serves." This approach is diametrically different from the traditional view of monetary policy communication, which in 1987 led the back-then Chair of the Federal Reserve of the United States Greenspan to state that

"If I seem unduly clear to you, you must have misunderstood what I said."

We conclude by outlining a set of research questions the literature on subjective beliefs opens. For instance, how does the interaction between subjective expectations about different variables, such as inflation and income, shape consumers' reaction to economic shocks? How do consumers adjust their labor supply, wage bargaining, and investment decisions to changes in their subjective expectations? If consumers do not interpret macroeconomic variables and policy interventions through the lens of standard macroeconomic models, what mental models and rules of thumb do they use instead? Does reliance on different models correlate with observable households' characteristics and, if so, can we improve the effectiveness of monetary and fiscal policies by incorporating these heterogeneities at the stage of policy design? Tackling these questions is important not only for the design of policies but also from the perspective of redistribution across households and inequality.

Methodologically, the research we discuss has a common theme: it uses household-level microdata that allow observing at the same time households' subjective expectations elicited through surveys, their characteristics, and their actual economic choices in the field. These rich empirical settings also allow the design of causal tests of the effects of subjective beliefs on choices through information survey experiments and randomized control trials (RCTs). We explain why the use of aggregate proxies of household expectations based on averages of consumer or investor beliefs can lead to misleading conclusions regarding the relevance of subjective expectations and their role in explaining heterogeneous choices and policy outcomes.

What the paper purposefully omits is a detailed discussion about how to elicit subjective expectations and which data sources are available for researchers in this area because both topics are covered in other recent review articles (Armantier et al., 2013b; D'Acunto et al., 2023; Weber et al., 2022). Even if not discussed in this article, eliciting subjective expectations appropriately is crucial to interpret the results of research on the formation, update, and use of subjective expectations. Far too often, surveys feature consequential design deficiencies, which contributes to creating confusion regarding the role of subjective beliefs in households' choices. A prominent example is the Michigan

Survey of Consumers' probing of answers about inflation expectations that are deemed implausible by the survey designers, which results in biased and likely invalid measures of subjective expectations. Careful survey design is crucial for the validity of any study in this area. See, for instance, the seminal work discussed in Manski (2004, 2018) and recent advances such as Binder (2017) as well as the literature on subjective expectations elicitation across different economic contexts reviewed comprehensively by Attanasio (2009); Delavande et al. (2011); Delavande (2014).

To learn more about the design of household-level surveys and how to run information provision survey experiments readers can consult recent overview articles by Fuster and Zafar (2023); Haaland et al. (2023); Stantcheva (2022). An exciting direction for future research in this area is the use of open-ended questions that allow measuring not only households' subjective expectations about macroeconomic variables but also how households think economic variables relate to each other rather than imposing the same macroeconomic model on all households (Andre et al. (2023); Beutel and Weber (2022)).

II "Puzzling" Facts About Subjective Inflation Expectations

Households' survey-based subjective inflation expectations display a set of recurring features across space and over time that macroeconomists have often deemed puzzling (Weber et al., 2023; D'Acunto and Weber, 2023c). Before moving on to discuss how recent research makes sense of these patterns, we summarize them using US microdata from the New York Fed Survey of Consumer Expectations (Crump et al., 2022), which was the first large-scale panel that elicited the full subjective probability distribution.

In Figure 1, we compare the time series of the mean and percentiles of households' 12-month-ahead inflation expectations with the lagged ex-post realized CPI inflation rate, which is the aggregate variable households are asked to forecast in the survey. We can see that during times of low and stable inflation, such as the period between 2013 and the end of 2019, the average household expects a substantially higher inflation rate relative to what is realized. The figure reveals that a fat right tail drives this average upward

bias: the median inflation expectation is about 2.24 percentage points (pp.) lower than the mean. Moreover, at any point in time, subjective inflation expectations are highly dispersed with ranges between the 10th and 90th percentiles of up to 15 pp. Expectations also appear to react to the same shocks differently: for instance, in the initial weeks of the COVID-19 pandemic, many households updated their inflation expectations upwards but those at the bottom of the distribution *lowered* their inflationary outlook thus increasing the cross-sectional dispersion. These patterns are robust across countries and over time (Armantier et al., 2021; Georgarakos and Kenny, 2022; D'Acunto and Weber, 2023c)).

The dispersion of subjective inflation expectations relates to systematic differences across demographic groups. We summarize these cross-sectional demographic patterns in Figure 2. Panel A shows one of the most robust demographic "puzzles" about subjective inflation expectations, which was initially documented in Sweden by Jonung (1981): Although both men and women have upward-biased expectations relative to ex-post realizations, the bias is substantially larger for women (Bryan and Venkatu, 2001; Bruine de Bruin et al., 2010; Armantier et al., 2016; Bańkowska et al., 2021). This gender gap was deemed puzzling because inflation is a macroeconomic variable that has no gender connotation.

Panel B and C report average expected inflation by income and education levels. Expectations decrease monotonically with both income and education (Souleles, 2004; Bruine de Bruin et al., 2010; D'Acunto et al., 2023; Conrad et al., 2022). Panel D considers heterogeneity by age and suggests that the elderly have higher inflation expectations than younger respondents most of the time. Panel E compares the average expectations of Black and White Americans. While the higher volatility of Black Americans' expectations in the time series might be due to the smaller sample size in the survey, across all time periods they expect higher inflation rates than White Americans. And, Panel F shows that financially literate respondents (Lusardi and Mitchell, 2014) have lower average inflation expectations (Souleles, 2004; Burke and Manz, 2014; Bruine de Bruin et al., 2010; D'Acunto et al., 2019, 2022).

Most differences across demographic groups are due to different shares of respondents reporting large positive expectations, which is consistent with the long right tail in the

aggregate distribution of inflation expectations we documented in Figure 1. Related, groups with higher average inflation expectations also tend to have a higher dispersion in expected inflation rates across individuals within groups. An additional systematic "puzzle" in survey-based expectations is the tight relationship between the perception of past inflation and the expectation of future inflation (see Figure 3 and also Jonung (1981); Weber et al. (2022); Candia et al. (2023)).

This chapter focuses on the cross-sectional distribution of subjective expectations, but the literature has also documented regularities about the updating of subjective expectations within individuals. For instance, Dräger and Lamla (2012) use the rotating-panel component of the Michigan of Survey of Consumers and find that agents update their quantitative short-run expectations often but the qualitative elicitation more slowly. Armantier et al. (2017) instead describe the updating process of both first- and second-moments of inflation expectations within individuals.

The patterns we summarized in this section have led many academics and policymakers to ignore subjective inflation expectation under the impression that those expectations represented noise and were a reflection of the impossibility of measuring beliefs through surveys.

By contrast, a recent literature at the intersection of empirical macroeconomics, applied microeconomics, and finance has refuted the dogmatic approach of dismissing real-world data only because they do not conform to standard economic models and assumptions. This literature has been asking whether the apparently puzzling facts about survey-based subjective expectations might be due to the fact that many households do not form their beliefs in line with standard models. To this aim, the literature has focused on how households obtain economic information, how they process it, and how they use such information to form their subjective beliefs and choices. We review these approaches in the next two sections.

III Explaining Survey-based Inflation Expectations 1: What Information and Signals Do Households Use?

To assess if survey-based subjective expectations are meaningful researchers have started to ask how most households, who are not economists, conceptualize abstract concepts such as inflation, obtain and process economic information, and use this information to form their beliefs.

A. Aggregate Information vs. Information from Local Economic Environments

The FIRE paradigm prescribes that households form beliefs taking into account all available information—a postulate that, for many households, is hardly compatible with the "puzzles" we discussed in section II. Households could in principle be close to the theoretical concept of full information if they gathered economic information from sources that report economy-wide aggregated signals, such as official policy reports, newspaper articles and other traditional media, or professional forecasters' expectations. By contrast, a plausible alternative is inspired by Lucas (1975)'s islands model, whereby the price signals agents observe in the local economic environment in which they operate are all the information they have. Under this view of world, heterogeneous local economic environments would translate into heterogeneous inflation expectations, which would be a first step in the direction of explaining the facts in section II.

Empirical assessments of the information structure in Lucas (1975) have been scarce because of the lack of viable microdata and the fact that macroeconomists were not interpreting this assumption as a literal feature of reality. D'Acunto et al. (2021) propose a setting in which this assumption can be directly assessed. They elicit the subjective expectations about inflation and other macroeconomic variables of about 43,000 US consumers through a customized survey on the Kilts-Nielsen Consumer Panel (KNCP). After eliciting numerical expectations, the authors ask respondents to rank a

pre-specified list of information sources based on their importance for forming inflation expectations. D'Acunto et al. (2021) find that the most cited source is respondents' personal shopping activities followed by information provided by family and friends based on their shopping activities. Respondents are three times less likely to mention sources that cover economy-wide aggregate information, such as traditional media outlets (newspapers, television, radio).

This simple but stark evidence that households are more likely to use economic information obtained from the local economic environments in which they operate relates to a period of low inflation. Figure 4 replicates the fact for a representative cross-section of US households interviewed in April 2023 in a high-inflation context. Even in this case, about 45% of respondents report their shopping activities and energy bills are very important sources of information to form inflation expectations. Government reports and television are cited as important by about 25% of respondents and newspapers by 17%, respectively. D'Acunto and Weber (2023a) further show that households' reliance on local economic environments as a source of economic information is a global phenomenon that persists in times of heightened inflation based on a global survey across 47 countries implemented in April and May of 2023.

The fact that households use primarily information from their local economic environments and especially their shopping activities is a promising avenue to understand the large cross-sectional variation in survey-based subjective expectations because a growing literature documents large variation in the realized inflation households face in their non-durable consumption bundles and gas purchases (Kaplan and Schulhofer-Wohl, 2017; Argente and Lee, 2021; Jaravel, 2019; Gelman et al., 2016; Binder, 2018; Jaravel, 2021; Weber et al., 2023). This variation arises because of both heterogeneous consumption bundles and different price changes of the same goods across outlets. Shopping activities in different local environments thus provide rich variation in the economic signals that otherwise similar households observe.

Shopping activities make households face local price signals irrespective of whether they are actively searching for such signals. Local environments also differ in terms of price signals household actively search. For instance, when considering large durable purchases,

such as houses (Armona et al. (2019)), households obtain information about local price changes that shape their expectations about aggregate macroeconomic variables (Kuchler and Zafar (2019)), which in turn feed into expectations about personal outcomes and hence choices (Roth and Wohlfart (2020)).

The results in this section open avenues for research along at least three dimensions. First, a complete mapping of the entirety of local environments from which households gather information that feeds into their subjective expectations about aggregate variables and an assessment of their relative importance is missing. So far, this gap was largely due to the lack of comprehensive micro-level datasets in which the econometrician can observe the price signals households face when purchasing a broad range of goods and services linked to their subjective expectations.

Moreover, understanding the relative importance of local economic environments with respect to aggregate information across households and over time is also an open path of research. Faia et al. (2022) study households' endogenous decision of which information to gather from their local environments and how to process such information when forming their beliefs and choices. Goldfayn-Frank and Wohlfart (2020) study how the formation of subjective expectations changes as households' local economic environment changes when Eastern German households move from a planned economy to a market-based economy. Tracking households that move across local economic environments for exogenous reasons is a promising direction for future inquiries into how local environments and their economic information shape subjective expectations.

On the theoretical side, these results inspire a unifying framework for the formation of subjective beliefs that allows agents to place different weights on two types of signals: aggregate signals that are identical for all agents (e.g., government reports, traditional media, etc.) and signals that cover agents' local economic environment, which are inherently heterogeneous across agents (e.g., shopping activities, family and friends, etc.), with weights on the two sources that possibly vary over time. D'Acunto and Weber (2023a) provide worldwide evidence that these two types of information sources shape inflation expectations and other subjective expectations in opposite directions. This framework could in principle reconcile the expectations-formation processes of agents with

different sophistication: professional forecasters and experts would place a higher weight on aggregate information sources, whereas households focus on information sources from their local environments. The fact that both weights might be nonzero even for expert decision-makers is motivated by recent evidence on the expectations of corporate managers (Coibion et al., 2020), bank officers (Carvalho et al., 2023), and financial analysts (Gerken and Painter, 2023), among others. Extensions of models with information and cognitive frictions are a plausible fruitful avenue for future work (Maćkowiak et al. (2023) provide a comprehensive review of the literature on rational inattention in macroeconomics, which was pioneered by the seminal work of Sims (2003)). These models can accommodate time-varying weights on aggregate versus local signals but prescribe that in times of high and/ or volatile inflation, the weight on aggregate signals should increase and the biases we describe in Section II should vanish, which the data does not support (D'Acunto and Weber, 2023a).

B. **Which Signals Enter Households' Expectations Formation Process?**

The second broad dimension researchers have investigated to explain the observed dispersion in subjective inflation expectations is the possibility that households, even when attending to the same information sources, might use different signals when forming their aggregate expectations. Using an experimental approach, Fuster et al. (2022); Bernard et al. (2023) study how agents endogenously choose among costly signals they could incorporate into their subjective expectations. They find that agents disagree on which signals they want to learn about, which produces dispersion in expectations.

For the case of inflation expectations, D'Acunto et al. (2021) and D'Acunto et al. (2021) exploit an empirical setting in which the source of information—shopping activities—is the same for all households, but the signals to which households are exposed differ across households. They field large-scale surveys eliciting subjective expectations and perceptions of several macroeconomic variables from households in the KNCP in June 2015 and June 2016. The KNCP includes information about households' demographic

characteristics as well as the prices and quantities of each non-durable and small durable item in their consumption bundles, which are recorded via optical scanners similar to those grocery stores use.

D'Acunto et al. (2021) measure realized inflation at the household level (*Household CPI*) following the standard definitions by statistical agencies but using household-specific consumption bundles and household-specific prices rather than a representative basket of goods and services and homogeneous prices. Individuals who face a higher Household CPI over the previous 12 months expect higher aggregate US CPI inflation. In terms of economic magnitudes, a one-standard deviation increase in the realized inflation is related to 0.2 pp. higher aggregate inflation expectations—a sizable effect considering the overall inflation rate was between 1.3% and 1.9% over their sample period. This association is robust to the inclusion of a rich set of controls and fixed effects and holds within households over time: households that faced an increase in own realized inflation from one year to the other also increased their inflation expectations over time accordingly. This association between households-specific realized inflation and aggregate inflation expectations is in stark contrast to central banks' tendency to ignore the price changes of non-core consumption items such as food and energy (Aoki, 2001) given that these price changes help us understand households' aggregate inflation expectations.

C. How Do Households Use Personal Price Signals to Form Subjective Expectations?

The use of good-specific price-change signals from non-durable consumption goods is not the only dimension under which households depart from the ways in which economists, policy institutions, and statistical agencies compute inflation rates and forecast future inflation. Households also do not use expenditure shares across goods to weigh price changes.

To build intuition for this point, Figure 5 shows the result of asking a representative cross-section of US households in April 2023 to report which, if any, goods or services respondents thought about when forming their aggregate inflation expectations. Fuel and

frequently-consumed produce and fresh non-durables, such as eggs, meat, and milk, are most often mentioned. All these are goods on which households tend to spend lower shares of their disposable incomes relative to shelter, services and durable goods such as rent, clothing, or travel. These latter goods instead are all less likely to be important for the formation of subjective inflation expectations.[2]

To compare the relative importance of purchase frequency (and hence repeated exposure to the same source of price-change signals) and expenditure shares, D'Acunto et al. (2021) also define a measure of household-level inflation that weighs price changes based on the goods' purchase frequency rather than good-specific expenditure shares (*Frequency CPI*). Both Household and Frequency CPI individually are strong predictors of cross-sectional differences in overall inflation expectations. In a horse race, D'Acunto et al. (2021) find the predictive power of the Household CPI for subjective inflation expectations drops to zero, whereas the Frequency CPI remains a strong predictor of subjective inflation expectations. The authors also find that respondents put a higher weight on price increases relative to price cuts, confirming previous evidence documented by Jungermann et al. (2007) around the time of the introduction of the Euro currency.

D. Information Sources, Price Signals, and the Cross-Section of Subjective Expectations

As discussed above, a striking but unexplained fact about survey-based inflation expectations is the systematic gender bias. D'Acunto et al. (2021) show that agents' reliance on the price changes observed in their households' consumption bundles paired with the higher weight attached to frequently-observed signals helps to explain this fact.

D'Acunto et al. (2021) survey both male and female heads of the same households and elicit the allocation of shopping chores within the household. This within-household analysis allows D'Acunto et al. (2021) to keep constant dimensions such as housing and borrowing choices, family size, and disposable income, among other possible determinants of inflation expectations. Even within household, an unconditional average gap between

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[2]This "frequency bias" has also been observed in laboratory studies of inflation expectations, see Georganas et al. (2014).

female and male household heads' inflation expectations arises. Crucially, the gap is about 40% higher for households in which the male head never partakes in grocery shopping, whereas it shrinks to zero and is no longer statistically significant when the male head engages in grocery shopping at least occasionally. The gap closes because the male heads who are exposed to grocery price-change signals also form higher inflation expectations. The authors find that, in most households, women are the sole grocery shoppers and hence the findings in D'Acunto et al. (2021) can help explain the unconditional gender gap in inflation expectations.[3]

Section II documents other systematic differences in average expected inflation rates across different subgroups such as the fact that higher income consumers having lower inflation expectations. Weber et al. (2023) show that exposure to price signals and perceived rates of inflation can also partially rationalize differences in expected inflation rates by income, education, and race.

The higher weight households assign to price increases relative to equal-sized price cuts paired with the lower occurrence of price decreases in an environment with positive trend inflation like grocery shopping can also rationalize why barely any household reports deflation expectations in most surveys (Gorodnichenko and Sergeyev, 2021). More recently, Weber et al. (2023) document a large increase in the dispersion of households' inflation expectations after March 2020, which they show coincided with a large increase in the dispersion of realized inflation across households. They also show that the dispersion in inflation expectations across demographics groups that we discuss above also widened during this time period, also largely driven by a dispersion in realized inflation and hence signals across these groups. Once again, the signals individuals observe in their local economic environments shape their subjective beliefs.

Differences in how people think about specific goods or categories of goods are also relevant. Dietrich et al. (2022) elicit aggregate inflation expectations and expectations for each of eleven subcategories that jointly comprise the expenditure basket of the personal consumer expenditure price index. Aggregate inflation expectations are on average higher than any category-specific expected inflation rate. A measure of

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[3]These authors also show that the gender gap is weaker in samples in which women have higher financial literacy, consistent with evidence in Bruine de Bruin et al. (2010).

aggregated inflation expectations based on the category-level inflation expectations that uses perceived expenditure shares or subjective importance weights explains the cross section of consumption plans better than aggregate inflation expectations. In particular, because most consumers put a larger focus on food and energy compared to their weights in average consumption bundles, Dietrich (2023) shows through the lens of a model that the results in Dietrich et al. (2022) imply that the conventional practice of focusing on core inflation to guide policy making can result in substantial welfare losses.

IV Explaining Survey-based Inflation Expectations 2: Mistakes in Households' Expectations-Formation Process

The results discussed so far assume that households have perfect recall of the price-change signals they observe in their local economic environments and use the same rule to aggregate such price changes into inflation perceptions and expectations. Recent work has relaxed these assumptions with the aim of further deepening our understanding of survey-based subjective expectations.

A. Limited Cognition and Predictable Mistakes in the Expectations-Formation Process

Behavioral macroeconomics has started exploring the implications of non-standard models of expectation formation. Modeling devices include agents with finite planning horizons Woodford (2019), agents with level-k thinking Farhi and Werning (2019), other forms of bounded rationality Gabaix (2020); Ilut and Valchev (2023), among others. Whereas the micro-foundations of these theories differ, they have all in common that agents have limited cognition. On the empirical side, a rich strand of literature has documented that financial and economic literacy shape how people form inflation expectations. Bruine de Bruin et al. (2010) document that once they control for measures of financial literacy the association between inflation expectations and several demographic variables is muted.

Inspired by these theoretical and empirical results, a recent strand of empirical work asks whether measurable proxies for the extent to which households are likely to make mistakes when conceptualizing probabilities and forming beliefs could help explain why the subjective expectations of some households depart more than others from the expectations implied by FIRE.

D'Acunto et al. (2019, 2022) use data from Finland to empirically document the role of cognition for how individuals form inflation expectations. The authors use administrative data from the Finnish Defence Forces on IQ scores for the quasi universe of the male population and merge it at the individual level with the micro data underlying the European Commission Consumer Survey for Finland, a repeated cross section of around 1,500 Finns that is representative of the overall Finnish population. The survey includes questions on subjective macroeconomic perceptions and expectations. In this setting, the authors can also observe a wealth of administrative data on income and household balance sheets.

They find the average absolute forecast errors for inflation decrease monotonically with individuals' IQ scores. Men in the bottom of the IQ distribution have mean absolute forecast errors that are around 4.5 pp. for a sample between 2001 and 2015 when average realized inflation was below 2%. But even men with the highest measured IQ still have mean absolute forecast errors of around 2 pp. The monotonic decline holds in the raw data but also when the authors condition on income and formal education as well as a host of other possible determinants of inflation expectations such as family structure, household debt, or location.

To better understand the channels through which cognition mediates the formation of inflation expectations, the authors designed a customized survey to isolate three non-mutually-exclusive potential mechanisms. The first is the possibility that IQ relates to agents' ability to forecast a random variable similar to inflation. They find that individuals with higher IQ scores have lower mean absolute forecast errors only for data-generating processes with a low amount of noise. This result is consistent with the evidence in D'Acunto et al. (2022) that low- and high-IQ individuals differ in the accuracy of their inflation forecasts especially in times of less volatile inflation.

As a second channel, the authors assess if variation in IQ captures variation in how consumers conceptualize the concept of aggregate inflation. To do so, they design an association game based on Leiser and Drori (2005) and ask respondents to choose three words they associate with the concept of aggregate inflation out of a list of six words provided in the game. Lower-IQ consumers are more likely to associate the concept of inflation with concrete consumption goods, such as groceries and online purchases, whereas higher-IQ individuals are more likely to associate inflation with abstract concepts, like overall prices and wages.

Finally, these authors study whether agents think differently about the implications of inflation for the economy. Lower-cognition consumers are more likely to consider persistent deflation as a desirable outcome and think that unexpected inflation benefits savers. These results suggest that cognition could be important to explain why otherwise observationally similar households who have the same inflation expectations react differently to their expectations when making economic choices, an important issue we will delve into below.

B. **Imperfect Recollection of Observed Price Signals**

What if, in addition to an "imperfect" expectations-formation process, some consumers also made mistakes in recalling the price signals they use when forming their subjective expectations? Could these mistakes further help us understand the cross-section of subjective inflation expectations? And, are they predictable?

D'Acunto and Weber (2023b) aim to tackle these questions. In a customized survey on the KNCP in January 2022, they first elicit individuals' expectations about future CPI inflation. Subsequently, they elicit perceptions of the current price of the milk respondents typically purchase. They also ask respondents to provide their best guess for the recalled price of the same milk 12 months earlier. Crucially, the KNCP allows the econometrician to observe the actual prices households paid. D'Acunto and Weber (2023b) find that consumers on average recall they paid a lower price of milk 12 months earlier relative to the price they actually paid based on the scanner data in the KNCP, which results in upward-biased perception of milk inflation. In turn, the authors find that those respondents who

overestimate past milk inflation also form higher aggregate inflation expectations for the following 12 months.

These findings are in line with evidence in Cavallo et al. (2017) who show experimentally that consumers in low inflation environments often put weight on irrelevant statistics when forming inflation expectations, such as the memory of past prices. Moreover, the results in D'Acunto and Weber (2023b) also shed light on the findings in De Bruin et al. (2011) who document that consumers who thought about specific goods when answering questions on inflation expectations reported on average higher expected rates of inflation.

The systematic downward bias in recalled past paid prices, which was also documented in specific contexts at the time of the introduction of the Euro currency (see, for instance, Cestari et al. (2008)), further helps us understand why consumers on average have upward-biased inflation perceptions and expectations.

C. Limited and State-Contingent Attention to Economic Information

Models of rational inattention Sims (2003); Maćkowiak and Wiederholt (2009) can explain deviations from FIRE and large dispersion in perceived and expected inflation rates across households if not all agents acquire all the available information before forming their inflation expectations.[4] The fact that so many consumers rely on the price signals they observe in their local economic environments when forming aggregate inflation expectations supports this assumption of rational-inattention models.

These models also predict that consumers become better informed about inflation in an environment in which it is more costly to be poorly informed or when acquiring signals becomes cheaper. We would therefore expect that individuals make smaller forecast errors in times of high inflation. Figure 6 plots mean forecast errors for inflation over time from the New York SCE and shows that expectations errors are on average smaller during the

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[4]Sticky-information models in the tradition of Mankiw and Reis (2002) can also rationalize heterogeneous expectations across individuals, but when individuals do update their information set, they have perfect information and form expectations rationally.

recent surge in inflation compared to the previous period but started to rise again 2021.

Cavallo et al. (2017) directly test one implication of rational inattention models by comparing how consumers in Argentina, which had a history of high and volatile inflation around the time of their survey, and in the U.S., which experienced low and stable inflation at that time, updated their beliefs to new information. Given the inflation environment in Argentina, it is more costly for consumers to be uninformed and hence consumers should already have acquired signals about inflation and update less to information compared to U.S. consumers. Consistent with this prediction, they find that U.S. consumers update their beliefs by 50% to 90% more to similar information compared to consumers in Argentina. Consistently, Pfäuti (2021) shows that the inflation expectations of U.S. consumers are more sensitive to past forecast errors in times of higher inflation.

Another implication of rational inattention models is that consumers should search actively for more information when it becomes costlier for them to be uninformed. Bracha and Tang (2022) test the idea that individuals should be less likely to choose the answer option "Don't know" during times of high inflation. They show that the share of survey participants choosing this answer option is indeed decreasing when realized inflation is higher. Consistently, Korenok et al. (2022) show that the Google search volume for the term inflation increases when realized inflation passes 4%.

Weber et al. (2023) extend this work and show within and across countries that households and firms react less to identical information in high relative to low inflation environments. To do so, they assemble data from a series of information provision experiments on US and Euro-Area households as well as firms in the US, Italy, New Zealand, and Uruguay. For US households, they find that consumers put less weight on the signal, either current inflation, the inflation target of the Fed, or an inflation forecast, and more weight on their prior forecast during high inflation times as compared to low and stable inflation times. For European households, they find similar results but also show that those survey participants that report paying more attention to inflation during high inflation times are indeed better informed about current inflation and update their expectations by less. Finally, using firm data, they confirm these patterns for firms in the US and Italy, but also show that firms are always inattentive in New Zealand, which did

not experience a surge in inflation during their sample period. At the same time, firms in Uruguay were always attentive and faced high inflation throughout the sample period.

Taken together, these papers document that households' inflation expectations are upward biased, dispersed in the cross section, but also vary systematically across demographic groups. Models in which attention is costly and constrained can rationalize these stylized facts but also their time variation, both within and across countries. Consistently, easy to obtain signals such as prices while grocery shopping shape ordinary consumers inflation expectations around the world and cognitive abilities play an important role for the expectations formation process.

V From Subjective Expectations to Economic Choices

Although the processes through which households form expectations about economic variables is of interest to researchers in several fields, such as economics, psychology, cognitive sciences, and marketing, ultimately these processes are relevant to understanding aggregate economic outcomes and to designing effective economic policies only if households use their subjective expectations when making their individual economic decisions.

Macroeconomic theory does postulate an important role for households' inflation expectations: The consumer Euler equation prescribes that, when expecting higher inflation, consumers increase their current consumption before goods become more expensive in the future. This intertemporal substitution channel is at the core of the New Keynesian model, which all leading central banks use to design monetary policy.

The link between inflation expectations and spending is more complicated than what the consumer Euler equation suggests, though. Empirically, higher inflation tends to coincide with higher inflation uncertainty, which increases consumers' precautionary savings motive when consumers expect higher inflation (Coibion et al., 2021). Moreover, inflation is a tax on nominal assets and hence redistributes wealth from consumers with large positive net nominal positions to consumers with large negative net nominal positions

(Doepke and Schneider, 2006; Auclert, 2019; Schnorpfeil et al., 2022). Furthermore, some consumers might have a Taylor rule in mind and expect higher real interest rates when their inflation expectations increase, because they expect nominal interest rates increase more than the increase in expected inflation (Carvalho and Nechio, 2014).

For decades, macroeconomists have interpreted the weak or inexistent relationship between average household inflation expectations and aggregate consumption as a consequence of these countervailing economic mechanisms and especially the fact that survey-based inflation expectations were too noisy to represent a precise measure of households' actual expectations.

A. Using Micro-data to Account for Heterogeneous Price Signals and Expectations is Crucial

The results we discussed in the paper so far motivate another conjecture for why the relationship between average expectations and average consumption choices might be weak in the data: the substantial heterogeneity in households' inflation expectations is meaningful and needs to be taken into account when assessing the relationship.

In a world in which households form heterogeneous inflation expectations, averaging such expectations or replacing them with the "less noisy" expectations of professional forecasters or financial market participants will ensure that any attempt of studying the relationship between expectations and choices is bound to fail, because a lack of correlation between average inflation expectations and consumption can arise even if every individual made choices based on their subjective inflation expectations. Macaulay and Moberly (2022) document both theoretically and empirically that neglecting this heterogeneity in individual-level expectations results in estimating a substantially lower transmission of inflation shocks to aggregate consumption and lower persistence of the consumption response to inflation shocks than is implied by a model featuring heterogeneous expectations.

Motivated by these considerations, Bachmann et al. (2015) started the recent literature that uses micro survey data to study the relationship between consumption

spending and inflation expectations. They make use of the micro data underlying the Michigan Survey of Consumers, a largely cross sectional survey, and regress people's readiness to purchase durable goods on their reported numerical inflation expectations.[5] For the overall sample, they find no association between individuals' buying intention and their inflation expectations. During the binding zero lower bound on nominal interest rates, when theoretically the association should be strongest because the central bank does not increase policy rates to curb inflationary pressures, the result is in fact slightly negative.

Unfortunately, the facts we described in Section II also complicate the use of purely cross-sectional data on inflation expectations and consumption choices. To see why, consider two individuals A and B who differ in their average inflation expectations, possibly because of heterogeneous consumption bundles and differential weights on aggregate versus local economic signals. Suppose that consumer A usually expects an inflation rate of 2% and consumer B of 10%. Now suppose that consumers A and B observe price-change signals of opposite signs in their local economic environments: A observes price increases and B price decreases. In this case, because A's inflation expectations increase from 2% to, say, 3% for the subsequent 12 months, she will say that her readiness to purchase durable goods is now higher. By contrast, B's inflation expectations will decrease from 10% to, say, 8%, and hence she will say that her readiness to purchase durable goods is now lower. Both behave in line with a subjective consumer Euler equation. If we ran a cross-sectional regression of readiness to spend on inflation expectations, though, we would conclude that the association is negative, because the agent who wants to purchase durables (A) has lower inflation expectations than the agents who thinks it is not a good time to purchase durables (B).

Indeed, Bachmann et al. (2015) find evidence that is consistent with this interpretation. Conditioning on survey participants that are "reasonable" inflation forecasters, in the sense that they expect an inflation rate that is close to the ex-post realized rate, they recover a significantly positive association between inflation expectations and willingness to buy larger ticket items. Vellekoop and Wiederholt (2019)

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[5]See Weber et al. (2022) for a discussion of design issues in the Michigan Survey question on inflation expectations.

underscore the relevance of being cognizant of the data structure using panel data on inflation expectations and asset and debt holdings in the Netherlands. They first document that personal fixed effects explain a large part of the cross-sectional variation in individuals' inflation expectations. They then show that consumers expecting higher inflation save less once they add individual fixed effects, consistent with the consumer Euler equation.

D'Acunto et al. (2018, 2022) instead tackle this question using the micro data underlying the European Commission Consumer Survey for Germany, France, Sweden, and the UK. Instead of using quantitative inflation expectations, they focus on the qualitative elicitation of inflation expectations relative to the perceived inflation rate over the last 12 months. This wording allows focusing on expected changes in inflation within individuals even if using purely cross-sectional data and hence overcoming the issue explained above. The authors recover patterns consistent with a subjective consumer Euler equation in all four countries. That is, they find that households that expect inflation to increase in the following 12 months relative to the previous 12 months are more likely to state that now is a good time to purchase larger ticket items.

Using data from the pilot phase of the New York Fed Survey of Consumer Expectations, Burke and Ozdagli (2021) confirm the zero relationship of Bachmann et al. (2015) between expected inflation and non-durable consumption, likely because consumers also expect higher unemployment when they expect higher inflation, which is prevalent in survey data (Kamdar et al., 2018) and is sometimes interpreted as consumers having a supply-side view of inflation. Alternatively, the average consumer might use heuristics such as a good-bad heuristic and associate high inflation with high unemployment Andre et al. (2022). Using the panel data from the New York Fed, Crump et al. (2022) instead find consumers with higher inflation expectations express a stronger planned non-durable consumption growth. Dräger and Nghiem (2021) confirm the positive link between current spending and inflation expectations using German survey data, whereas Galashin et al. (2020) use credit card spending data paired with a survey of inflation expectations in India and do not find a link between the two.

B. Limited Cognition and the Relationship between Subjective Inflation Expectations and Choices

D'Acunto et al. (2022) provide another way to reconcile the different results in the literature: the varying degree of cognition in the survey population, which might capture the extent to which consumers understand the theoretical link between inflation expectations and the incentives to consume.

The authors use data from Finland in which they merge at the individual level inflation expectations, registry data, and measures of IQ. In the full sample, the authors detect a small positive but statistically insignificant relationship between individuals' inflation expectations and their willingness to purchase durable goods. This unconditional result, however, camouflages large heterogeneity in the association across agents. In particular, agents at the bottom of the IQ distribution do not plan to substitute intertemporally when they expect higher inflation, which is also true for those low IQ survey participants whose inflation forecasts are ex-post accurate. This result is consistent with Armantier et al. (2015), who find that the economic choices of individuals with low financial and economic literacy or low levels of formal education cannot be rationalized with standard economic theory. In stark contrast, consumers with higher IQ levels behave in line with the consumer Euler equation: they are more likely to be ready to purchase durable goods when they expect higher inflation and this positive association is both economically and statistically significant.

C. The Issue of Causality: Information Provision Experiments

With the exception of D'Acunto et al. (2022), the results we discussed so far are correlational in nature. One way to establish causality in this relationship is through RCTs that recently became popular in macroeconomics. The typical structure in these information provision experiments is to first elicit survey participants' prior inflation expectations. In a second step, the researchers split the sample randomly into a control arm that does not receive any (relevant) information and a set of treatment arms. Subjects in the treatment arms receive information about future inflation, such as the inflation

target of the central bank or the current inflation rate. This step aims to provide an exogenous shock to subjects' inflation expectations. In the final step, posterior inflation expectations are elicited, which act as a manipulation check that the shock affected expectations, and finally researchers measure consumption attitudes and other outcomes.[6]

Coibion et al. (2022) implement such an RCT in 2018 on the KNCP. Levering the large cross section of more than 25,000 survey participants, they are able to field several treatments jointly. First, they show that ex-ante individuals have upward-biased inflation expectations, consistent with the facts in Section II. They then find that pointed information such as the current inflation rate, the Fed's inflation target, and an official inflation forecast have large effects on individuals' posterior inflation expectations and result in downward revisions of between 1 to 1.5 pp. Reading the full Federal Open Market Committee (FOMC) press release, which contains the same summary statistics but also a host of additional information aimed at a specialized audience results in forecast revisions of similar magnitudes. Survey participants in the treatment arm that received a short summary of the same FOMC meeting from a newspaper article, which also contained a host of additional information but was written for ordinary consumers resulted in forecast revisions of only half the magnitude. The authors can show that the latter occurs because individuals in the U.S. systematically down-weight information from newspapers due to a low perceived credibility.

Coibion et al. (2022) then use the information treatments as instruments for posterior inflation expectations and show that non-durable consumption in the three and six months after the information provision experiment is higher for those survey participants that had exogenously higher inflation expectations induced by the treatments. These results hold using consumption elicited through follow-up surveys as well as using actual spending data elicited via scanners. Another notable finding in Coibion et al. (2022) is the fact that treatment effects fade over time: three months after the intervention about two third of the treatment effects on inflation expectations had dissipated. Part of this result is due

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[6]The structure of the survey, the design of survey questions and treatment information, and the elicitation of priors and posteriors requires care to ensure mechanical experimenter demand effects do not drive any results, see Weber et al. (2022), Fuster and Zafar (2023), Haaland et al. (2023) for detailed discussions.

to consumers forgetting the information they were initially given. Another part is in line with the results we discussed above. Individuals observe many idiosyncratic price-change signals in their local environments, which contributes to dissipating the treatment effects over time.

D. Other Economic Choices

While the consumer Euler equation is at the core of all intertemporal models of consumption and is the central equation in standard New Keynesian models, other economic decisions of households also depend on inflation expectations especially once we consider the heterogeneity of consumers' nominal asset positions. Studying these other dimensions require the design of ad-hoc information provision experiments paired with observed households' balance sheets and real-world choices.

One example is erosion of nominal assets and liabilities through unexpected inflation (Fisher, 1933; Bhamra et al., 2023), redistributing wealth from nominal savers to borrowers (Auclert, 2019; Doepke and Schneider, 2006). Based on this argument, Schnorpfeil et al. (2022) first show that most ordinary households are unaware of this redistribution channel of surprise inflation but once they learn about it through an information provision experiment on customers of a large bank, they update their perceived and expected real net worth, and the update is larger the larger is their nominal exposure which the authors observe directly in survey but also administrative bank account level data.

The authors then use the information treatments as instruments for agents' posterior subjective real net worth to show both in survey but also in actual account data that treated consumers that have exogeneously higher real net worth perceptions and expectations increase their consumption in the weeks after the intervention. Treated subjects are also more likely to finance a hypothetical real estate transaction with more leverage and prefer a longer fixation period for the mortgage interest rate.

Malmendier and Wellsjo (2023) provide related evidence showing that consumers mention inflation protection as a key reason for homeownership but also show higher homeownership for European countries with histories of high inflation. Similarly, Botsch and Malmendier (2023) argue that historically high inflation results in individuals'

expecting higher future nominal interest rates, resulting in an aversion towards adjustable rate mortgages. Finally, Braggion et al. (2023) show that current Germans with higher inflation expectations, instrumented by local inflation rates during the German hyperinflation of the 1920s, are less likely to save in nominal savings accounts.

A key take away from this literature is that researchers need to observe high-quality micro data on expectations of inflation, other macroeconomic and personal economic variables, and ideally actual economic choices to be able to meaningfully investigate the relationship between subjective expectations and economic decision-making. Using simple time series methods that correlate average inflation expectations, possibly not even by households but implied by financial-market prices or elicited from professional forecasters, with consumption growth or other aggregate time series is an avenue which is bound to fail.

VI   Implications for Monetary Policy

An implication of the fact that households use the signals they observe in their local economic environment to form their subjective inflation expectations is that the same households tend to not pay much attention to news about aggregate inflation and monetary policy or to not use such information, even when exposed to it, to form their subjective expectations during normal times.

Coibion et al. (2022) provide direct evidence for this lack of knowledge: they find that around 40% of 25,000 U.S. consumers in 2018 thought that the Federal Reserve tried to achieve an average inflation rate of more than 10% over longer periods of time. Moreover, recent research shows that consumers do not appear to expect that short-run shocks to inflation might be counteracted by monetary policy actions: no term structure in consumers' inflation expectations across horizons exists (D'Acunto et al., 2023) during periods of stable inflation and when consumers update their short-run inflation expectations, they change their long-run expectations in tandem (Weber et al., 2022).

A. Communication to Consumers as a Monetary Policy Tool

These facts raise the question if and how central banks can reach ordinary people through communication and in so doing manage their expectations and choices, thus transforming communication into an additional monetary policy tool. The literature on information-provision experiments provides promising results: the strong effects of information treatments using publicly available information in times of low inflation show that consumers typically have weak priors about inflation but then put lots of weight on whichever news they acquire and receive.

Traditionally, central banks have focused their communication efforts on financial market participants and professional forecasters. A key takeaway from the literature is that these players update their expectations immediately to central bank announcements. Central banks' rationale is that by adjusting the interest rates consumers face, market participants transmit the shock to consumers' decisions irrespective of whether consumers pay attention to news about inflation or even understand the relationship between inflation expectations and intertemporal consumption choices. This reasoning misses the point that many consumers are insensitive to changes in interest rates, because they do not understand how their economic incentives change for example with changing interest rates (D'Acunto et al., 2021).

The recent literature using information provision experiments has made some progress on understanding which messages, via which medium, and through which messenger could manage households' inflation expectations successfully,[7] not only using field data but also using laboratory experiments (Kryvtsov and Petersen (2021); Rholes and Petersen (2021)), which is also a promising direction for future work.

A recurring theme in this literature is the role of simplicity, see, e.g., Haldane and McMahon (2018), which should not come as a surprise given the role of cognition for the formation of inflation expectations. D'Acunto et al. (2022) consider forward guidance as an example: according to theory, promises to keep interest rates low until after the times that it is warranted by a conventional interest rate reaction function will trigger inflation in the future, hence the forward-looking agent in the model already increases her inflation

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[7]Blinder et al. (2023) provide a detailed review of this line of work.

expectations today and goes on a spending spree. When studying how consumers reacted to the first explicit forward guidance announcements by the European Central Bank, the authors find that nobody reacted to these announcements, neither in their subjective inflation expectations nor purchasing propensities. Moreover, no reaction was observed with a delay, which would be expected if, despite households' lack of understanding of the policy action, transmission happened through changing incentives based on the reaction of financial-market participants and institutions.

Coibion et al. (2022) confirm that simple messages are a powerful tool to manage the inflation expectations of consumers through information provision experiments. Coibion et al. (2023), instead, study how treatments about the future path of interest rates shape inflation, interest rate, and other expectations. A key result in the paper is that individuals update their expectations jointly, in their case individuals update upwards their inflation expectations when they receive information about higher future nominal interest rates which also triggers an upward revision in nominal interest rate expectations. Hence, expected real interest rates move by less than one would infer from only observing nominal interest rate expectations. Their result also helps us understand some of the otherwise surprising results on how individuals adjust their consumption to their inflation expectations. Moreover, they find that providing information about the whole future path of monetary policy rates does not change consumers' subjective expectations differently compared to just providing forecasts for the next twelve months.

Another aspect Coibion et al. (2022) highlight is the role of the medium. They find that simple communication via traditional print media in the US is less effective in managing the inflation expectations of consumers as compared to not providing the source of the message or even dense communication from FOMC statements, because consumers systematically discount news coming from newspapers given a perceived lack of credibility.

To better understand the role of the type of message central banks send, D'Acunto et al. (2020) run an information provision experiment in Finland keeping constant the sender of the message (Olli Rehn, governor of the Finnish central bank) and the medium (his official Twitter account). They study two types of messages, i.e. target and

instrument communication. Instrument communication specifies the concrete steps that a central bank plans to implement to reach an objective. Target communication instead focuses on telling consumers the ultimate aim of the policy, without specifying the concrete steps to achieve it. The authors find that simple central bank communication via targets are very powerful in moving consumers' expectations, especially for those with most pessimistic outlooks and the least informed, whereas barely anymore react to the more technical communication about central bank instruments.

Finally, D'Acunto et al. (2021) study the role of the sender in monetary policy communication. We saw in Section II that women and Black Americans have higher and more volatile inflation expectations as compared to men and White Americans. D'Acunto et al. (2021) study whether making salient the presence of women or Black Americans on the FOMC might increase the extent to which women or Black Americans incorporate forecasts from central banks into their own expectations. They do so through an information provision experiment in which they show all treatment groups identical forecasts from the Summary of Economic Projections but vary the picture of the policymaker associated with the forecast. Some survey participants see a white male, some a white female, some a Black male policymaker. All three were regional Fed presidents and non-voting members at the meeting from which the authors gathered their forecasts.

The authors find that women and Black survey participants are substantially more likely to update their own forecasts to the provided numbers when the forecast is associated with the female or Black male policymaker as compared to seeing the same forecast but associated with a white male policymakers. They also show that women and Black survey participants increase their level of trust in the central bank and are more interested in actively acquiring information about monetary policy in a follow-up survey when the news is about a non-white male policymaker.

Taken together, these and other papers show that central banks can directly manage the expectations of ordinary consumers. Yet, treatment effects in low inflation times often dissipate over time, which is, however, totally expected given that consumers face many other signals about prices in their daily life to which they react. Hence, successful central bank communication has to repeatedly send messages that are simple, relevant

to consumers, focus on targets rather than the instruments through which they aim to achieve those, and think carefully about the identity of the messenger.

Above and beyond understanding the specific channels through which policy communication can manage expectations and choice, the biggest challenge central banks face is reaching ordinary consumers in the first place (Lamla and Vinogradov, 2019). Attending talk shows, the use of social media, and partnering with personalities ordinary consumers know and follow seem fruitful avenues central banks should pursue. Moreover, the ubiquitous presence of personal devices in consumers' daily lives make recent advances on robo-advice (D'Acunto and Rossi, 2021, 2023), which have so far mostly been implemented by the private sector D'Acunto and Rossi (2022), a potentially viable and cheap direction to enhance the effectiveness of monetary policy communication.

The recent surge in inflation paired with time varying attention to signals about prices also raises the possibility of a central bank communication conundrum (Weber et al., 2023): when inflation is low and stable, central banks face the challenge of reaching consumers with their communication but conditional on reaching them, simple message are very powerful in shifting consumers' outlook for inflation. During high inflation times instead, households actively attempt to acquire more information about inflation and possibly become more willing to listen to central bankers but just conveying simple messages like current inflation rates are less likely to shift individuals' inflation expectations, given that ordinary consumers are most likely already informed about these numbers.

Assessing the methods that allow central-bank communication to reach consumers in the field and manage their expectations and choices, their costs and benefits, and their viability is a wide open and fruitful avenue for future research in this area.

VII   Implications for Fiscal Policy

The importance of simplicity for the design of policies that effectively manage households' subjective expectations and hence their choices has also been studied in the realm of fiscal policy.

D'Acunto et al. (2022) also study a simple form of unconventional fiscal policy in addition to forward guidance, i.e. an unexpected and pre-announced increase in future consumption taxes that makes the fact that inflation will be higher in the future and the incentives in terms of intertemporal substitution of consumption very clear and salient to consumers: even without knowledge in economics, it is straight forward for consumers to understand that the increase in valued added taxes will raise the price level and to go out and purchase larger ticket items before the price increase materializes (D'Acunto et al., 2018).

To design a causal test, the authors consider German households, which were exposed to this announcement of unconventional fiscal policy in 2005, which represented a quasi-exogenous shock to German households' inflation expectations. The authors create a counterfactual to German households using a matching procedure with observationally-similar households in other Euro Area countries, which were not subject to the shock but faced the same interest-rate environment, and a difference-in-differences analysis to document the causal link from inflation expectations to durable spending. The authors find that this simple and understandable form of unconventional fiscal policy effectively manages households subjective expectations and choices. Exploiting an immediate, temporary cut in consumption taxes, Bachmann et al. (2021, 2023) confirm the results using both survey- and scanner-based consumption data.

Other recent studies showing how information of fiscal variables shifts beliefs and possible consumption choices are Coibion et al. (2021) who show how news about forecast of future increases in federal debt raise consumers inflation expectations and Coibion et al. (2020) who find that political polarization colors the inflationary outlook of partisan consumers, among others.

Understanding what features of fiscal policies make them simple and understandable to all consumers and hence induce a reaction by all non-constrained households is an important and yet open question in this area. D'Acunto et al. (2021) provide examples of fiscal policies whose effects on incentives to consume and save might appear trivial and hence understandable by everybody, but that do not induce a homogeneous reaction by all non-constrained households. They consider a cash-for-clunkers policy whereby

governments aim to stimulate aggregate durable spending by providing a monetary transfer to households who retire an existing fuel-inefficient car. The authors consider such a policy in Finland at a time when they can observe, for the same consumers, individual characteristics, including IQ levels, registry-based car ownership and transactions of old and new cars, as well as complete balance sheets and income information, which allows identifying financially-constrained households. The take up of this policy depends substantially on consumers' IQ levels: even among unconstrained households, low-IQ consumers are half as likely as others to react to this policy. The authors exploit unique survey-based data on consumers' intentions to show that low-IQ consumers do not fully understand the incentives that this policy creates, in addition to finding the take-up of this policy complex in terms of the long list of bureaucratic steps consumers have to perform in order to be eligible for the subsidy.

Overall, the authors interpret limited cognition as a form of "human frictions" that add to financial frictions when assessing the effectiveness of the transmission of fiscal but also monetary policy. Understanding the channels through which human frictions operate and hence how policies could be designed to overcome such frictions is a broadly open area for future research.

VIII   Future Directions for Research

Survey-based subjective expectations of households appear to behave wildly when compared to the benchmark of full information rational expectations, which makes this benchmark a bad description of reality. Contrary to broadly held convictions about the fact that survey-based subjective expectations should be dismissed as meaningless and irrelevant due to a set of apparently puzzling properties, an up-and-coming strand of research at the intersection of macroeconomics, applied microeconomics, and finance shows that these expectations are both meaningful and important.

Subjective expectations are meaningful because their cross-sectional variation does not represent noise. Households' characteristics and the ways in which households gather and process economic information help to explain their cross-sectional variation. For

instance, instead of focusing on forecasts by central banks or gathering information about the price changes of a representative consumption bundle, most households use the price changes they observe in their local economic environments and especially the price changes they observe most frequently to form inflation expectations. Also, households put a higher weight on price increases relative to equal-sized price cuts when forming their subjective expectations, which contributes to explaining the volatility and upward bias of subjective expectations. Variation in households' cognition helps to explain why households whose expectations-formation processes are closer to the FIRE paradigm and households that use predictable rules-of-thumb that depart from FIRE coexist in the economy.

Survey-based subjective expectations are also important: they are highly informative about the economic choices households make, such as their intertemporal consumption-saving decisions. Assessing if a relationship between subjective expectations and choices exists requires the use of micro data on subjective expectations linked at the individual level to survey-based economic plans or, even better, transaction-level or registry-based data on actual choices. Alternatives such as proxying households' expectations with market-implied beliefs or using average expectations from household and professional forecasters are unviable because they miss the heterogeneity of the signals and processes different households use to form their subjective expectations.

Because survey-based subjective expectations help to explain households' choices and hence ultimately aggregate demand, understanding them is crucial to assess the effectiveness of monetary and fiscal policies that require households' active participation. The use of tailored communication for monetary policy is a direction the literature has been studying lately. On the fiscal policy side, the design of simple and salient policies has also been shown to increase the effectiveness of policy transmission. Much remains to be investigated in terms of the optimal design of policy communication both theoretically and empirically.

Researchers should also dig deeper into how subjective expectations about other macroeconomic and personal variables correlate with inflation expectations to further understand households' economic decisions. The frontier of this literature establishes causal effects through information provision experiments in which researchers provide

information in a randomized fashion to a subset of individuals to establish causal effects on expectations and then use the treatment-induced variation to study how consumers change their behavior, ideally on administrative data. A recent example is Hajdini et al. (2023), who study the dual direction of causality between inflation expectations and wage expectations using survey-based information experiments.

On the theoretical side, recent advances in behavioral macroeconomics that incorporate diagnostic expectations into standard macroeconomic models (Bianchi et al. (2023); L'Huillier et al. (2023)) appear a promising direction for further inquiry, because of recent evidence consistent with an important role for diagnostic expectations and its transmission to household choices (Pedemonte et al. (2023); D'Acunto et al. (2023); Beutel and Weber (2022)).

The avenues for future empirical research are broad and promising. For instance, can subjective expectations trigger wage-price spirals and if so, how? How do subjective inflation expectations affect the labor supply, investment in real and financial assets, and borrowing decisions of households that are observationally similar in terms of demographics but might be exposed to different economic signals through their different local economic environments? And, based on the answers to these questions, how can fiscal and monetary policies be tailored to heterogeneous households in order to enhance the effectiveness of policy transmission? These and many other questions await to be answered by this vibrant strand of interdisciplinary research in macroeconomics, applied microeconomics, and finance.

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Figure 1: **Time Series of Inflation Expectations**
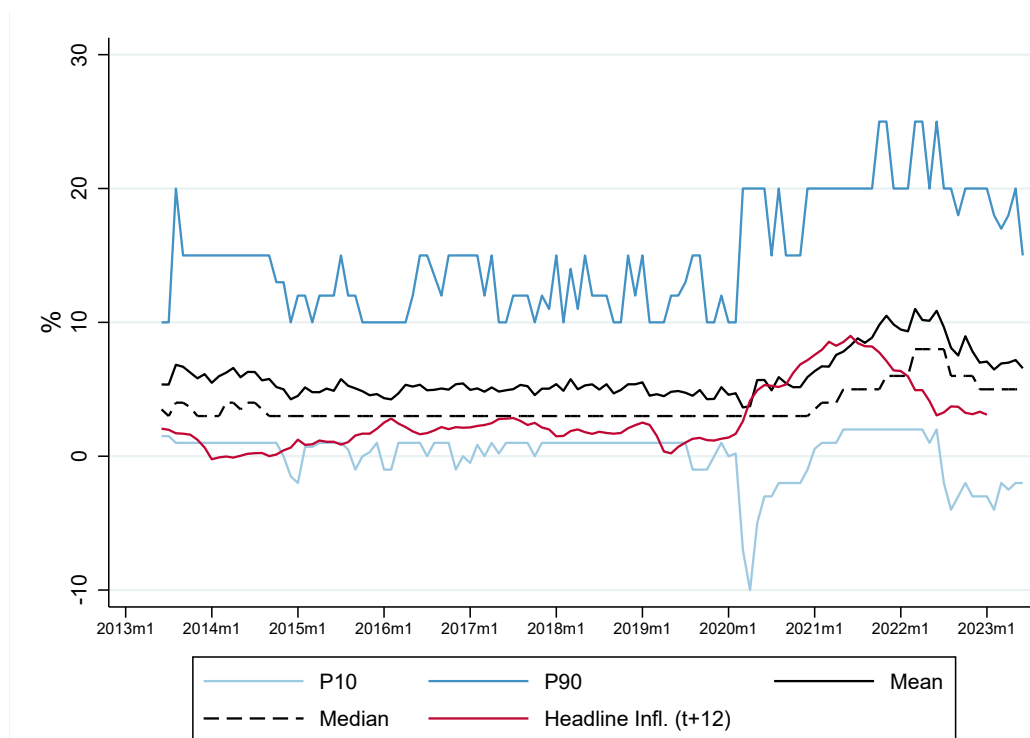
Notes. This figure plots the cross-sectional mean and percentiles of 12-month-ahead inflation expectations from the point-estimate elicitation from the New York Fed *Survey of Consumer Expectations*. Responses larger than 100% in absolute value are dropped. The sample period is June 2013 until June 2023.

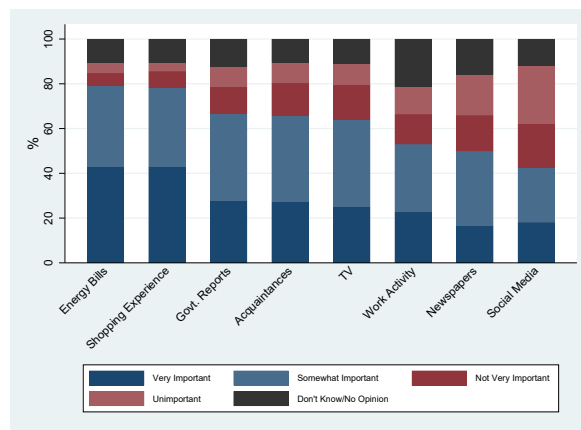Figure 2: **Households' Inflation Expectations by Demographic Characteristics**
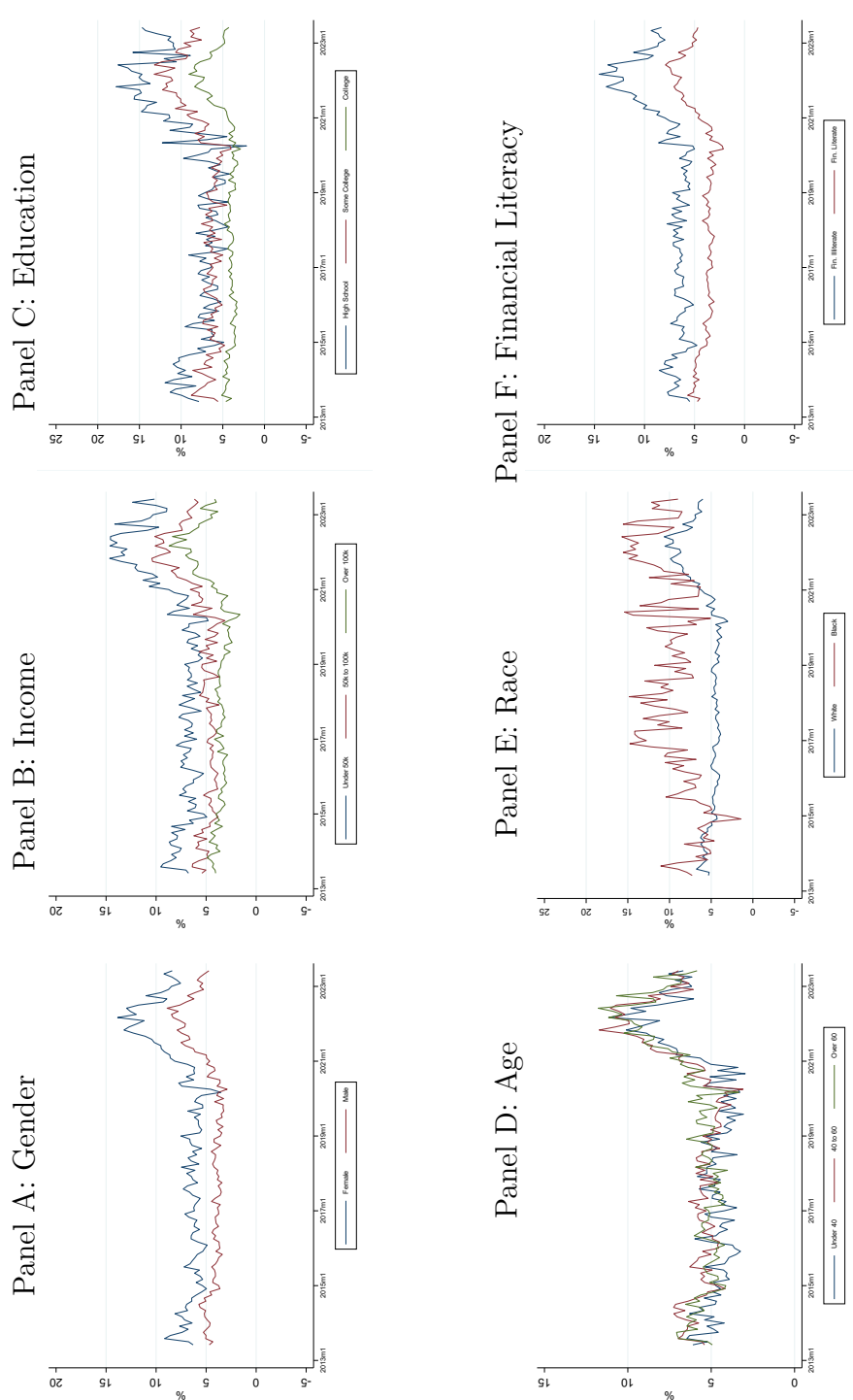
This figure plots households' average inflation expectations over time for several subsamples of socioeconomic characteristics indicated on top of each subplot. We use the point-estimate question in the New York Fed Survey of Consumer Expectations (SCE) to measure inflation expectations over the next 12 months. The sample period is from June 2013 to June 2023.

Figure 3: **Perceived and Expected Inflation**
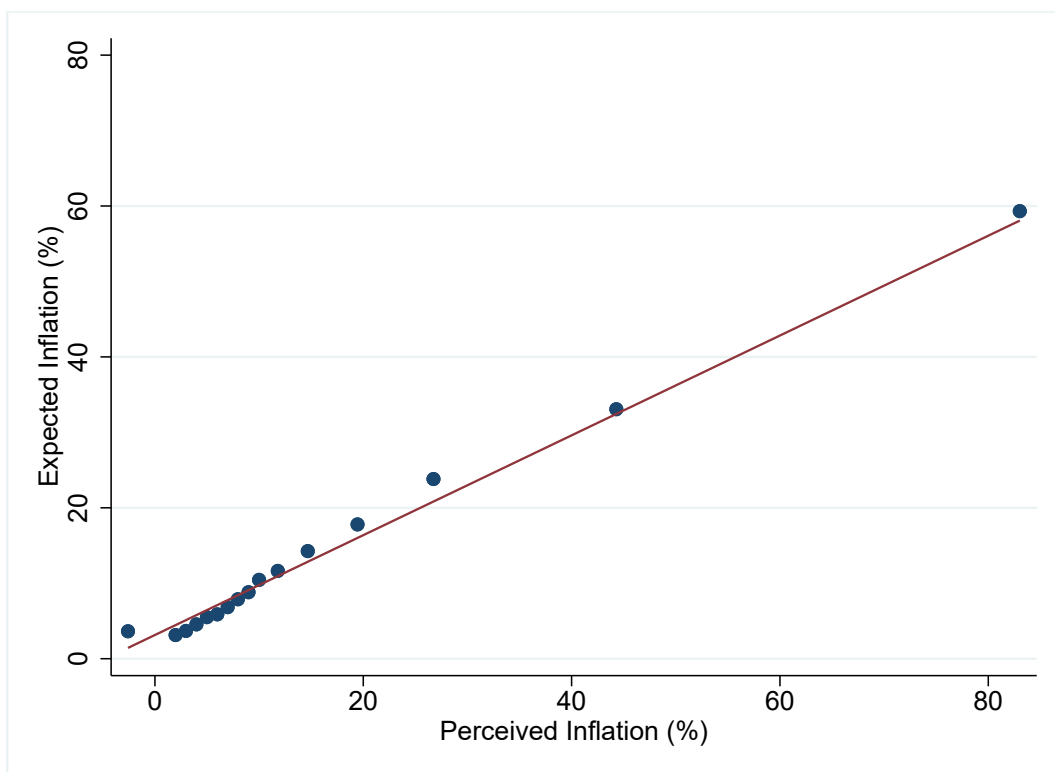
Notes. This figure plots a binned scatterplot of expected inflation over the next 12 months and perceived inflation over the last 12 months. The data are obtained from the customized *Chicago Booth Attitudes and Expectations Survey* fielded in January 2022 (D'Acunto and Weber, 2023b). Respondents could not report levels of perceived and expected inflation exceeding 100% in absolute value.

Figure 4: **Ranking Households' Economic Information Sources**

Notes. This figure plots the reported importance of different information sources for the formation of inflation expectations based on the survey responses of 1,007 US households in April 2023.
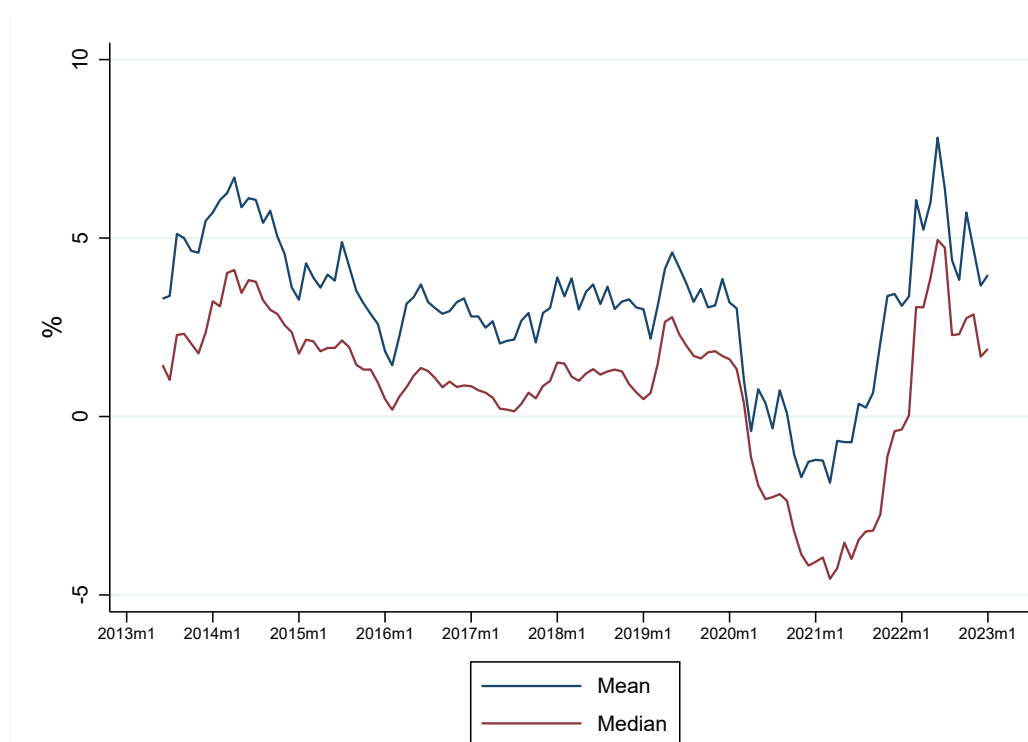
Figure 5: **Reliance on Price-Change Signals Based on Goods' Purchase Frequency**
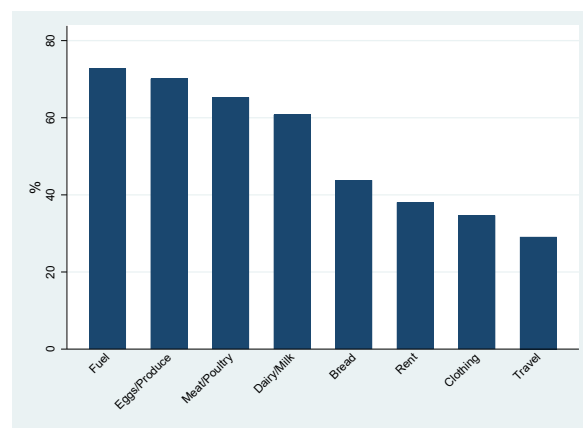
Notes. This figure plots the average reported reliance on the price changes of different goods as being relevant to the formation of the inflation expectations of 1,007 US survey respondents in April 2023.

Figure 6: **Time Series of Forecast Error**

Notes. This figure plots the cross-sectional mean and median of 12-month-ahead inflation forecast error from the point-estimate elicitation from the New York Fed *Survey of Consumer Expectations*. The forecast error is defined as the difference between expected inflation and ex-post realized inflation. Responses on the 12-month-ahead inflation expectation larger than 100% in absolute value are dropped. The sample period is June 2013 until January 2023.