What Do the Data Tell Us About Inflation Expectations?

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Inflation Expectations?[*]

Francesco D'Acunto[†] Ulrike Malmendier[‡] and Michael Weber[§]

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Abstract

Inflation expectations are central to economics because they affect the effectiveness of fiscal and monetary policy as well as realized inflation. We survey the recent literature with a focus on the inflation expectations of households. We first review standard data sources and discuss their advantages and disadvantages. We then document that household inflation expectations are biased upwards, dispersed across individuals, and volatile in the time series. We also provide evidence of systematic differences by gender, income, education, and race. Turning to the underlying expectations formation process, we highlight the role of individuals' exposure to price signals in their daily lives, such as price changes in groceries, the role of lifetime experiences, and the role of cognition. We then discuss the literature that links inflation expectations to economic decisions at the individual level, including consumption-savings and financial decisions. We conclude with an outlook for future research.

JEL classification: C90, D14, D84, E31, E52, E71, G11

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I Introduction

Subjective expectations are a key determinant of virtually all forward-looking decisions households and firms make. Within the set of subjective expectations, inflation expectations play a special role because they determine households' savings and consumption decisions via the consumption Euler equation, which describes the relationship between perceived real interest rates and consumption. Inflation expectations also drive agents' wage bargaining, durable investment including housing and mortgage choices, and portfolio choices (Bernanke, 2007). Because inflation expectations affect the decisions and actions of many economic actors, they also affect aggregate economic outcomes. The New Keynesian Phillips curve—a leading theory that explains the determination of realized inflation—attributes an important role to inflation expectations.

Central banks around the world actively try to manage inflation expectations. In normal times, when no constraints on nominal policy rates bind, many central banks operate under the assumption that inflation expectations are well anchored and that changes in nominal policy rates transmit one-for-one to perceived real interest rates based on the Fisher equation. In times when an effective lower bound on nominal policy rate binds, the management of inflation expectations becomes especially important because it remains one of the only tools available to central banks to affect agents' perceived real interest rates and hence their consumption, savings, debt, and investment decisions.

Given the important role of inflation expectations for households' economic choices and aggregate outcomes, we might expect economists and central bankers to have a deep understanding of the properties of households' inflation expectations, their formation process, and how expectations transmit into economic decisions. And yet, after the rational-expectations revolution of the 1970s, economists seemingly lost interest in studying the actual expectations formation process. Instead, most of the literature adhered to the postulate that in a rational-expectations setting, the economic model implies the representative agent's expectations directly. Moreover, full information rational expectations (FIRE) models predict no dispersion in the subjective expectations across economic agents.

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These theoretical predictions stand in stark contrast to a growing literature documenting systematic deviations from the FIRE paradigm. For instance, households' inflation expectations are upward biased relative to ex-post outcomes and the inflation rates central banks target. Forecast errors are predictable by publicly available data. And the dispersion in inflation expectations across households is substantial.

This chapter summarizes and discusses critically the body of knowledge about subjective inflation expectations the recent literature has produced based on micro-level survey data.

In the first part, we provide an overview of commonly used sources of survey-based data on inflation expectations. We discuss the pros and cons of their designs and argue that, ultimately, the nature of the economic questions researchers want to ask dictates which source is most appropriate to use.

In the second part, we present a set of facts about households' inflation expectations—the time series, the cross section, and the term structure of inflation expectations. We also compare the most salient features of households' inflation expectations with those of professional forecasters, who are arguably among the most sophisticated agents on which micro-level information about inflation expectations is available. This comparison allows to assess which features of households' inflation expectations are peculiar to the household sector and which are more general regularities.

The most salient regularity in households' inflation expectations is the substantial cross-sectional dispersion, which is systematically correlated with a set of demographic characteristics. Based on this premise, in the third part of this chapter we overview the recent body of work on the determinants of households' inflation expectations. We highlight four sets of findings. First, we discuss the significant role of everyday price signals observed by individuals. Households focus on the price changes of goods they purchase frequently, such as grocery items, rather than the price changes of a representative consumption bundle when forming their inflation expectations. Moreover, households put a higher weight on positive relative than negative price changes when forming inflation expectations, which helps explain the persistent upward bias.

Second, the accumulation of those personal experiences over individuals' lifetimes has

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a significant long-run effect. Personal past inflation experiences, such as the high inflation in the 1970s, affects inflation expectations of those who experienced it for years to come. The influence of personal exposure and past experiences is present even among the most sophisticated professionals, such as the members of the Federal Open Market Committee (FOMC). This role of personal experiences goes beyond mere over-extrapolation from recent observations and explains persistent differences across cohorts.

These two sets of findings suggest agents use the prices they directly observe in their daily lives to form expectations about aggregate inflation, exactly as posited by Lucas (1972, 1973) in his seminal islands model. It turns out that Lucas provided a more literal description of reality than he probably intended.

Third, we discuss the role of cognition in explaining the accuracy of individual-level subjective expectations, their cross-sectional variation, and the time-series properties. We also discuss recent research that documents and quantifies how heterogeneous cognitive abilities have aggregate effects by muting the transmission of monetary and fiscal policies because limited cognition results in biased expectations formation and suboptional economic choices.

Fourth, we review research on how individuals gather and process economic information, how information feeds into their beliefs, and how the transmission of economic policies could be enhanced by using communication to the general public as a policy tool on the part of central banks and governments.

In the last part of the chapter, we provide an overview of how households' inflation expectations relate to their economic choices based on micro-level data. We discuss evidence on the effects of inflation expectations on households' intertemporal consumption choices and on the financing of such decisions—mortgages and debt to finance housing and other current consumption as well as financial investments to finance future consumption through current savings. We stress that understanding how inflation expectations affects choices in the field begets substantial follow-up research on both empirical and theoretical levels.

We conclude the chapter with a review of open questions in the area of households' subjective expectations and how researchers can lever existing data sets as well as

new ad-hoc surveys. We argue that further research might also inform advances in theoretical research on models with heterogeneous beliefs and novel models of expectations formation.

II Data Sources

In this section, we introduce the most common data sources on households' inflation expectations. We emphasize the differences in terms of sample periods, the surveyed populations, the design of survey questions, and the availability of cross-linked information.

A. Michigan Survey of Consumers

The Michigan Surveys of Consumers (*MSC*) is one of the longest running household surveys in the world. It is conducted by the Survey Research Center at the University of Michigan since 1946, initially three times per year, then quarterly (1960-1977) and finally monthly (since 1978; see Curtin (1982)). Each wave contains about 50 core questions and has around 500 survey participants representative of the US population. It has a rotating panel component: each month about 60 percent of interviewees are first-time respondents, whereas 40 percent were interviewed six months prior.

Data on inflation expectations are available since 1953.[1] The survey elicits inflation expectations through a two-step procedure. First, it asks respondents whether they think *prices in general* will increase, decrease, or stay the same over the next twelve months. Second, the survey asks those who answered "increase" or "decrease" "By about what percent do you expect prices to go (up/down) on average?" (The early survey waves only contain the categorical questions.) In many periods, the survey includes the same set of questions for a longer, five-to-ten year horizon. Since March 1982, the survey includes a follow-up question to those responding "stay the same" in the first step as

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[1]The 1953-1977 surveys are available from the Inter-University Consortium for Political and Social Research (*ICPSR*) at the University of Michigan. From 1959 to 1971, the winter-quarter Survey of Consumer Attitudes were administered as part of the Survey of Consumer Finances (*SCF*), also available at the *ICPSR*. The data from 1978 onward are available via the University of Michigan Survey Research Center.

the administrators of the survey had found that such respondent often meant to say that the inflation rate stays the same. The *MSC* elicits a broad set of motivations underlying households' reported inflation expectations. The wealth of belief elicitations and demographic information in combination with the long time series allows researchers to assess the effects of aggregate shocks on households' inflation expectations.

On the negative side, responses larger than 5% are probed and interviewers asks respondents whether the response is correct. This probing might alert households to think hard about their answers, possibly biasing the resulting distribution of numerical inflation expectations. Moreover, by asking about changes in prices in general, rather than inflation rates, the survey might induce individuals to think about grocery prices, which are not representative of the overall consumption bundle (see Van der Klaauw et al. (2008); de Bruin et al. (2011)). Finally, the *MSC* has a smaller number of households than other surveys and only a small panel component, with limited the scope to analyze demographic and spatial heterogeneity.

B. New York Fed Survey of Consumer Expectations

The Survey of Consumer Expectations (*SCE*) by the Federal Reserve Bank of New York is a more recent widely used data source. The *SCE* is a nationally representative monthly rotating panel, which started in June 2013. 1,300 household heads participate up to twelve times. The core module elicits subjective expectations about personal and aggregate outcomes such as income, inflation, and unemployment. The survey also contains special modules that are either fully ad-hoc or repeated regularly (such as modules on credit access, labor markets, and spending). The *SCE* elicits numerical expectations as well as full subjective probability distributions. Bruine de Bruin et al. (2022) contains a detailed description of these data.

The SCE uses two elicitation methods. First, it asks households whether they think that there will be inflation or deflation and then elicits a point estimate. Second, it elicits a subjective probability distribution for inflation by asking for the percent chance that inflation might take values in each of a set of pre-defined non-overlapping bins centered around zero. The bin width is larger for bins farther from zero, up to open intervals of $\pm$

12% or more. Warning messages alert respondents if the sum of the probabilities differs from 100.

The relatively short time series currently available is arguably the SCE's main shortcoming. Answers' anchoring is limited to the pre-set symmetric bins around 0 and the narrower bin width for smaller values of inflation. Moreover, an increase in average inflation expectations due to a spike in expected inflation rates of more than 12% cannot be detected.

C. European Commission Consumer Survey

Internationally, the European Commission (EC) has pioneered the elicitation of households' inflation and other macroeconomic expectations from representative samples across different countries. Since 1972, the Directorate General for Economic and Financial Affairs (DG ECFIN) coordinates the *EC Consumer Survey* with harmonized questions translated in national languages. The monthly survey consists of repeated cross sections. The sample size is currently 31,810 household heads and ranges from 600 participants in Cyprus to 2,000 in Germany, Italy, Spain, and Belgium. Data are collected by national institutions, which have to approve access to their country-level micro data for research purposes.

The EC Consumer Survey provides a long time series and a large cross-section of households. One disadvantage is that not all countries participated throughout the sample period. Moreover, quantitative expectations were not elicited until 2003. As with the *MSC*, researchers have proposed approaches to leverage the qualitative responses. For instance, D'Acunto et al. (2021) show that the share of households who expect inflation to increase approximates subsequent realized inflation much more closely than average quantitative point estimates and with less noise and is a strong predictor of households' consumption choices.

D. Ad-hoc Surveys

Other recent surveys have been fielded on an "ad hoc" basis, both in the US and internationally. These surveys are typically designed with the purpose of matching the responses to existing micro-level data about the same households and their economic choices in the field.

The *Chicago Booth Expectations and Attitudes Survey* (*CBEAS*), for instance, was first fielded in July 2015 on about 60,000 households from the Kilts-Nielsen Consumer Panel (*KNCP*). The *KNCP* records the non-durable consumption bundles of these households through itemized scanner data. The *CBEAS* was originally designed to test whether price changes of nondurable goods help explain households' inflation expectations and economic choices in other domains, such as durable spending, investment, and labor supply. The survey includes 44 questions and obtained responses from 92,511 individuals across two waves. It elicits demographic information such as education levels, employment status, occupation, rent, mortgages, and other expenses. It then elicits numerical perceived inflation (over the previous 12 months) and expected inflation (over the next 12 months), in terms of both point estimates and probability distributions. To avoid framing effects, the *CBEAS* randomizes between an *MSC*-inspired question about the prices of things on which respondents spend money and the *SCE* question about general consumer inflation.

Since 2018, quarterly waves have been fielded to allow for information-provision experimental treatments on the effects of monetary and fiscal policy communication on households' inflation expectations (Coibion et al., 2019, 2020, 2021). Later waves assess households' expectations during the COVID-19 crisis, the effectiveness of policy communication during a pandemic, and the use of stimulus payments (Coibion et al., 2020a,b,c,d).

Other ad-hoc surveys have targeted single cross sections and often include randomized information treatments. For instance, Andre et al. (2019) access a representative US cross section through *Lucid* to assess how households process economic information and think about the relationship between macroeconomic expectations and economic decision-making. D'Acunto et al. (2021) run a one-wave expectations-elicitation survey

through *Qualtrics* on a representative US cross section to assess the effects of FOMC diversity (or lack thereof) on consumers' macroeconomic expectations and trust in the Fed. Coibion et al. (2020e) also run a survey through *Qualtrics* to study how political polarization shapes macroeconomic beliefs and how the provision of polling data shapes expected election outcomes and macroeconomic beliefs in the days leading to the 2020 US presidential election. D'Acunto et al. (2020) paired up with *Statistics Finland* to elicit Finnish households' inflation expectations and the effect of different types of communication about the ECB's interventions during the COVID-19 pandemic crisis.

Online platforms such as Amazon Mechanical Turk (*mTurk*) have also become standard platforms for ad-hoc surveys. This approach allows to garner just-in-time information around or immediately after specific economic shocks. For instance, Binder (2020) provides a timely assessment of how the COVID-19 pandemic affected US households' macroeconomic expectations right at the time of the shock. These platforms offer great flexibility and immediate fielding although the lack of representativeness and the presence of bots on the platform are caveats. Best practices to reduce these concerns include using *mTurk*-provided filters of the survey pool as well as including attention-verification and typing questions to identify potential bots (for instance, see D'Acunto (2018)). Online platforms have also been used to provide ancillary analyses of specific effects and economic channels when re-accessing the main survey population would be impractical (for instance, see Cavallo et al. (2017), D'Acunto et al. (2021), and D'Acunto et al. (2021)).

E. **Comparing Elicited Inflation Expectations Across Surveys**

Varying survey features—eliciting point estimates vs. probability distributions, asking about different prices, or adding probing follow-up questions after unusual answers—are likely to generate differences in responses. The differences between eliciting point estimates or probability distributions has attracted attention. Point estimates leave households free to report any level of inflation expectations they deem likely. Probability distributions, instead, impose more structure on the elicitation process along at least four dimensions. First, researchers choose upper- and lower-bounds for expected levels

of inflation between which they partition the distribution in intervals. Households are likely to infer that levels of inflation in the open intervals above and below the limits are deemed implausible by the researchers. Second, researchers choose the intervals between the bounds, which are usually symmetric around zero. In response, households might be more likely to anchor their expectations closer to zero, which would reduce the cross-sectional dispersion in elicited expectations. Third, the widths of the intervals are typically narrower for values around 0, possibly resulting in participants inferring that values close to zero are more plausible. And, some of the surveys provide examples of how to fill probability distributions which might anchor answers.[2] Figure 1 shows evidence consistent with these conjectures using the responses elicited via the point-estimate and the probability-distribution questions of the *SCE*.

The average inflation expectations implied by the point-estimate question are systematically higher by about 2 percentage points (pp) than those implied by the probability distributions (Panel A). The dynamics of average inflation expectations is quite similar across elicitation methods, although the higher volatility of point estimates hints at the possibility of higher cross-sectional variation for this type of question. Panel B indeed reveals a standard deviation about 5 pp higher each month for point estimates. A few salient facts about households' expectations dispersion are common across elicitation methods. For instance, in March 2020 disagreement about inflation expectations surged in both cases, with the spike in point estimates being noticeably larger.[3]

Turning to the role of "probing" follow-up questions we compare average point estimates of expected inflation in the *MSC* and the *SCE* in Figure 2. The series display similar variation over time and imply a substantial upward bias relative to ex-post realized inflation, but average expected inflation in the *SCE* is consistently above that in the *MSC*. This systematic level difference likely arises because of two features of the *MSC* we

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[2]Note also that the probability-distribution question requires a set of assumptions to obtain point estimates and within-individual uncertainty measures, especially in case respondents assign the whole probability to one interval or provide disconnected distributions. For detailed discussions, see Armantier et al. (2013); Krüger and Pavlova (2019).

[3]An alternative explanations for the difference in average expectations across the two elicitation methods are that respondents report minimum-loss estimates when answering the point estimates, see discussion in Bruine de Bruin et al. (2022) and Clements et al. (2022).

Figure 1: **Households' Inflation Expectations: Point Estimates vs. Probability Distributions**

Panel A. Mean   Panel B. Standard Deviation
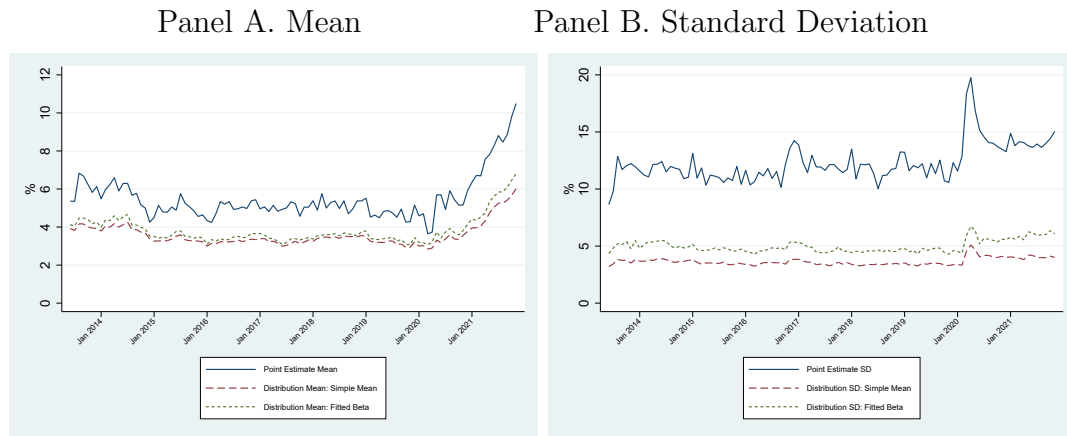
Panel A(B) compares the monthly mean (standard deviation) of households' inflation expectations over time across survey question designs in the New York Fed Survey of Consumer Expectations (SCE). Specifically, we compare the mean from the point estimate question for inflation over the next twelve months (after dropping households that report inflation expectations larger than 100%) to the simple mean from the distribution question and the implied mean from fitting a beta distribution to the distribution question following De Bruin et al. (2011). In the distribution question, each household is asked to provide probability mass to pre-specified bins of possible inflation rates over the next twelve months that has to add up to 100. The bins range from +12% to -12%. To calculate the simple average expected inflation over the next 12 months, we calculate the weighted average of the distribution question using the center of each bin and +/-14% for the extreme bins. The sample period is from June 2013 to November 2021.

Figure 2: **Households' Inflation Expectations: SCE vs. MSC**
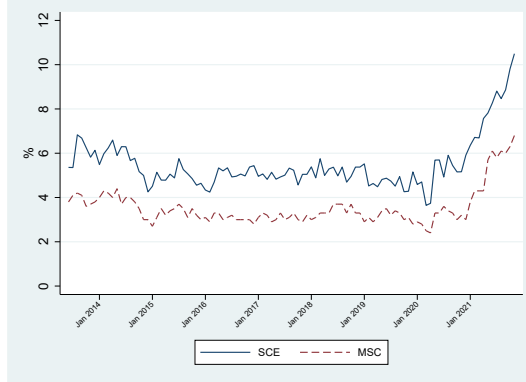
This figure compares the monthly mean of households' inflation expectations from the New York Fed Survey of Consumer Expectations (SCE) and the Michigan Survey of Consumers (MSC) over time. The MSC elicits point estimates for monthly expected changes of prices in general over the next twelve months. For the SCE, we use the point estimate question for inflation over the next twelve months after dropping households that report inflation expectations larger than 100%. The sample period is from June 2013 to November 2021.

discussed above, that is, follow-up probing and truncation of answers above 95%.[4]

Ultimately, the choice of question format depends on the economic questions researchers tackle. Without a probability distribution no questions about subjective uncertainty can be answered. Moreover, eliciting probability distributions reduces the noise in the data on quantitative inflation expectations. At the same time, if respondents do not understand probabilities they might report values that do not correspond to their actual expectations, which is especially problematic if understanding probabilities correlates with demographic characteristics that also predict inflation expectations. The guiding role of pre-set intervals might also hinder respondents from reporting extreme values.[5]

We conclude this section by comparing households' inflation expectations in the US (*SCE*) and internationally (EC Consumer Survey). Figure 3 compares the average expected inflation rates at the quarterly level to harmonize survey frequencies. Two facts are noticeable. First, average expected one-year-ahead inflation is consistently above

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[4]Hudomiet et al. (2022) discuss additional details on the possible role of survey question wording, nudging, and other design features on respondents' answers.

[5]Bruine de Bruin et al. (2022) and Delavande (2022) discuss the issue of bin selection on subsequent responses.

Figure 3: **Households' Inflation Expectations: US vs. EU**
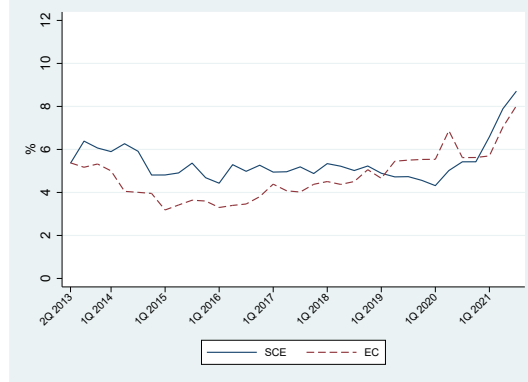
This figure compares the quarterly mean of households' inflation expectations from the New York Fed survey of consumer expectations (SCE) and European Commission Consumer Survey (EC) over time. The EC elicits point estimates for monthly expected inflation rates over the next twelve months at the quarterly frequency for households in all European Union member countries and several applicant countries. For the SCE, we use the point estimate question for inflation over the next twelve months after dropping households that report inflation expectations larger than 100%. The sample period is from Q2 2013 to Q3 2021.

realized inflation in each of the two monetary areas (around or below 2% before the Covid-19 pandemic). Second, US average inflation expectations are less volatile than EU ones. Also, contrary to US expectations, EU expectations have consistently increased from 2015 until the end of 2019 and hence before the Covid-19 pandemic started. The changing composition of countries included in the EC Consumer Survey complicates the interpretation of this drift. This last set of facts is important in light of the often US-centered discussion of beliefs formation. In the next section, we will provide such US-based stylized facts about households' inflation expectations keeping in mind that, internationally, baseline features are similar but their extent might differ.
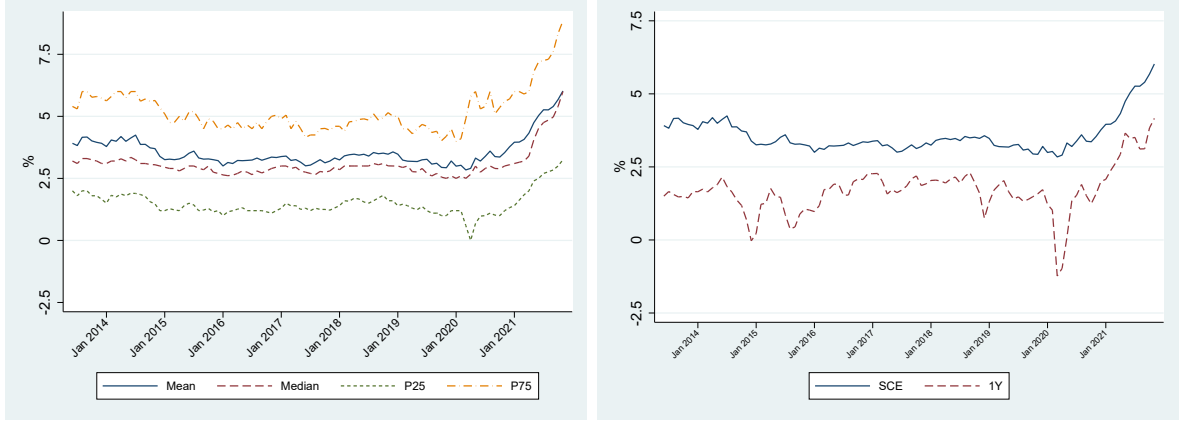
III Stylized Facts

In this section, we discuss the main facts economists have learned from data on the inflation expectations of households and experts. We focus on households in the *SCE* to maintain consistency across samples.

Figure 4: **Households' and Financial Markets' Inflation Expectations**

Panel A. Percentiles   Panel B. Households vs. Inflation Swaps

Panel A plots the mean and the 25th, 50th, and 75th percentiles of households' inflation expectations over time. We use the distribution question in the New York Fed Survey of Consumer Expectations (SCE) to measure inflation expectations over the next 12 months. In this question, each household is asked to provide probability mass to pre-specified bins of possible inflation rates over the next twelve months that has to add up to 100. The bins range from +12% to -12%. To calculate the average expected inflation over the next 12 months, we calculate the weighted average of the distribution question using the center of each bin and +/-14% for the extreme bins. Panel B compares average expected inflation from the SCE with breakeven inflation rates obtained from inflation swaps. Month-end prices of zero-coupon US dollar inflation swaps for a 1-year duration are obtained from Bloomberg. The sample period is from June 2013 to November 2021.

A.   Time-Series Facts

Figure 4 plots the distribution of the mean of US households' 12-month-ahead numerical inflation expectations from subjective distributions.[6] In Panel A, we report the average numerical expectation as well as the 25th, the 50th, and the 75th percentiles. Panel B compare households' mean with a proxy for the 12-month-ahead market participants' inflation expectations based on data on inflation swaps.

First, households' inflation expectations are systematically higher than the inflation expectations of financial market participants (Panel B), and this phenomenon is not driven by outliers who report implausibly high values (Panel A). Rather, most of the distribution of households' inflation expectations lies above market participants' expectations. Only

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[6]We calculate the implied mean of the distribution, assigning values of +14% and -14% to the extreme bins.

households at or below the 25th percentile hold numerical inflation expectations that are consistent with those of market participants.

Second, the distribution of households' inflation expectations is systematically skewed with the mean monthly expected inflation rate being about 1pp higher than the median. This skewness stresses the importance of understanding whether specific demographic characteristics predict systematically higher inflation expectations.

A third feature relates to disagreement over time (Mankiw et al. (2003)). In times of relatively stable economic conditions (between June 2013 and early 2020) households across the distribution report changes in inflation expectations that are directionally similar from one month to the other. In times of large negative economic shocks such as the onset of the Covid-19 pandemic in February and March 2020, though, disagreement arises: the $25th$ and $75th$ percentiles move in opposite directions. Higher disagreement did not fully revert by September 2020. Households at the 25th percentile behave similarly to financial market participants and display deflationary expectations in March 2020, but revert to the pre-Covid-19 levels immediately afterwards. By contrast, households at the 75th percentile (and to a lower extent median households) increase their inflation expectations and do not revert them for several months.[7]

B. Cross-Sectional Facts

Figure 4 reveals substantial cross-sectional heterogeneity and dispersion in households' inflation expectations: The interquantile range of 12-month-ahead expectations is consistently around 3pp, even though realized annual inflation has been at or below the Fed inflation target of 2% until the onset of the Covid-19 pandemic. To dig deeper into this cross sectional heterogeneity, we consider different demographic groups.[8]

In Figure 5, the top left panel compares respondents of different genders and confirms a fact about inflation expectations that has been documented consistently across data sets and time periods at least since Jonung (1981): Women hold systematically higher inflation

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[7]These facts are consistent with Armantier et al. (2021) and Weber et al. (2022). Weber et al. (2022) show that realized inflation at the household level also increased substantially at the onset of the pandemic.

[8]See also Bruine de Bruin et al. (2010) and Weber et al. (2022) for demographic differences in inflation expectations.

expectations than men. We discuss recent explanations in Section IV.

The middle top panel of Figure 5 considers three age groups—below 40, between 40 and 60, and above 60. Younger respondents tend to have lower average inflation expectations than older respondents.

In the right top panel, we consider three racial groups—Blacks, Whites, and Asian American. The number of Black and Asian-American respondents in the *SCE* is substantially lower than the number of White respondents, hampering the interpretation of differences in the time-series volatility across racial groups averages. We can, however, assess differences in average inflation expectations: The average twelve-month-ahead inflation expectations of Blacks tend to be above those of Whites and Asian-Americans with notable exceptions at the beginning and end of the sample.

The panels in the bottom part of Figure 4 consider univariate sample splits based on respondents' income (bottom left), education levels (bottom center), and the region of residence (bottom right).

For income, we see a clear negative correlation: the lower the income is, the higher are inflation expectations. Average inflation expectations of respondents who earn less than $50K per year are about 1pp higher than for respondents who earn more than $100k. In terms of education levels, college-educated respondents differ from others: Their inflation expectations are about 3% before the Covid-19 pandemic, whereas respondents who never attended college expect inflation around 4% in most months. The latter groups also displays more volatile expectations, even if the smaller size of this subsample might at least in part explain this feature. We then consider US Census regions—Midwest, Northeast, South, and West—to capture local business-cycle-driven inflation dynamics (Beraja et al., 2019). Respondents in the US West have higher average inflation expectations than others in most, though not in all months.

Overall, the cross-sectional facts highlight the importance of individual-level drivers of inflation expectations, [9] and suggests that traditional models of beliefs formation, which target the mean, median, or otherwise representative household expectations, fail

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[9]Indeed, using panel data from the Netherlands, Vellekoop and Wiederholt (2019) provide direct evidence that individual fixed effects strongly determine individuals' inflation expectations in the cross section.

Figure 5: **Households' Inflation Expectations by Demographic Characteristics**
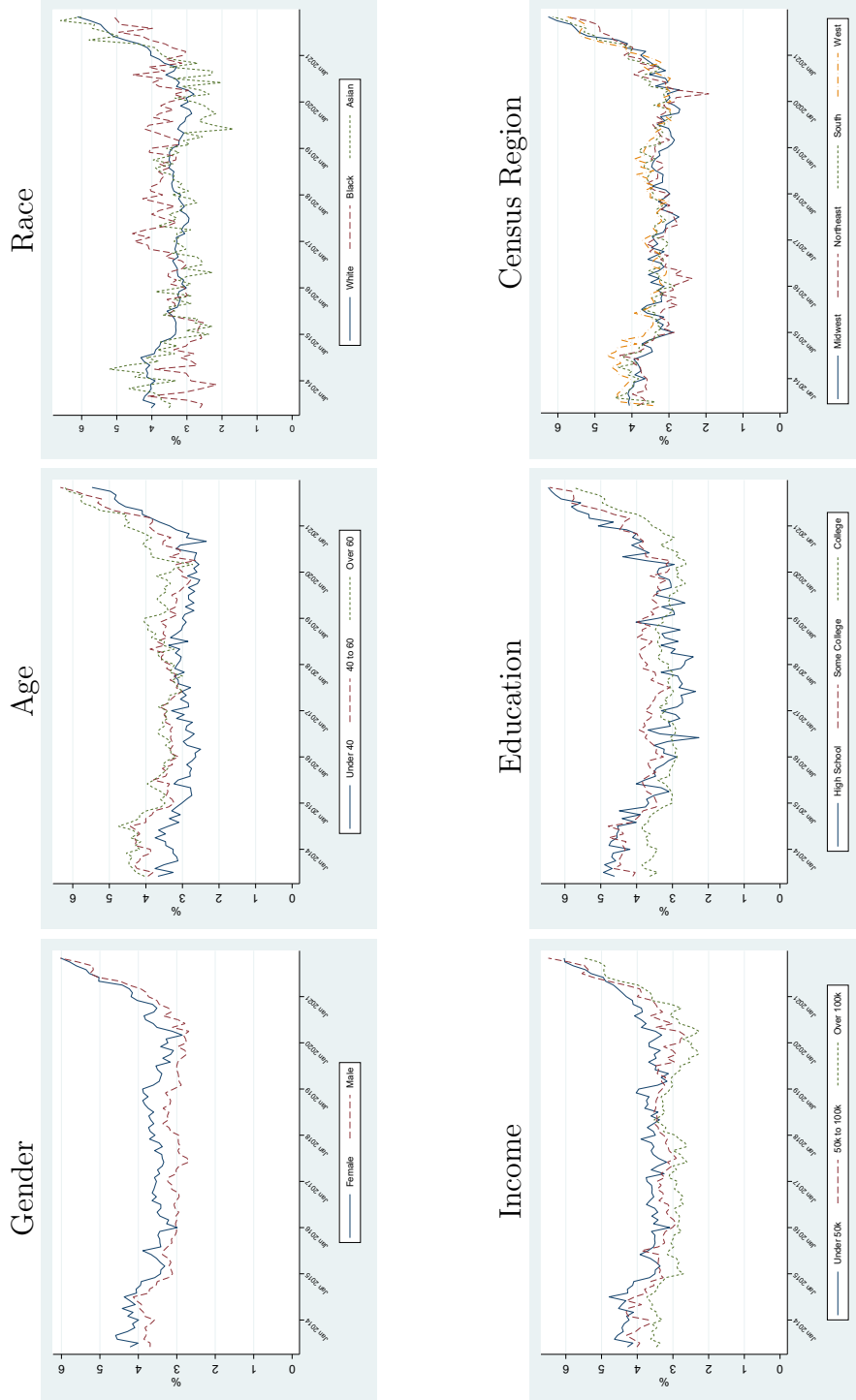
This figure plots households' average inflation expectations over time for several subsamples of socioeconomic characteristics indicated on top of each subplot. We use the distribution question in the New York Fed Survey of Consumer Expectations (SCE) to measure inflation expectations over the next 12 months. In this question, each household is asked to provide probability mass to pre-specified bins of possible inflation rates over the next twelve months that has to add up to 100. The bins range from +12% to -12%. To calculate the average expected inflation over the next 12 months, we calculate the weighted average of the distribution question using the center of each bin and +/-14% for the extreme bins. The sample period is from June 2013 to November 2021.

Figure 6: **The Term Structure of US Households' Inflation Expectations**
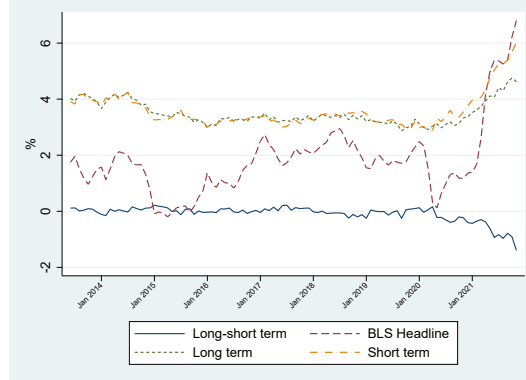
This figure plots the monthly mean difference of households' inflation expectations over the 12 months starting in 24 months and the next 12 months over time and the realized CPI inflation rate over the last twelve months. We use the distribution question in the New York Fed Survey of Consumer Expectations (SCE) to measure inflation expectations over the next 12 months. In this question, each household is asked to provide probability mass to pre-specified bins of possible inflation rates over the next twelve months that has to add up to 100. The bins range from +12% to -12%. To calculate the average expected inflation over the next 12 months, we calculate the weighted average of the distribution question using the center of each bin and +/-14% for the extreme bins. The sample period is from June 2013 to November 2021.

to account for the most notable empirical features of inflation expectations.

C. Term-Structure Facts

So far, our evidence has focused on households' 12-month-ahead inflation expectations, but several surveys also elicit medium-term inflation expectations. We thus describe the term structure of households' inflation expectations.

Arguably, the most salient fact here is that barely any term structure exists—short- and long-run expectations are consistently close to each other (see Figure 6). The Covid-19 pandemic stands out as an exception: households expected higher short-run than long-run inflation. As we saw when discussing the time-series of households' expectations, March 2020 was a time of substantial disagreement about short-run inflation and, on average, spiking short-run inflation expectations, explaining the negative term structure, with the gap building up over time.

Figure 7: **Households vs. Professional Forecasters**

Panel A. Professional Forecasters   Panel B.Households and Professional Forecasters
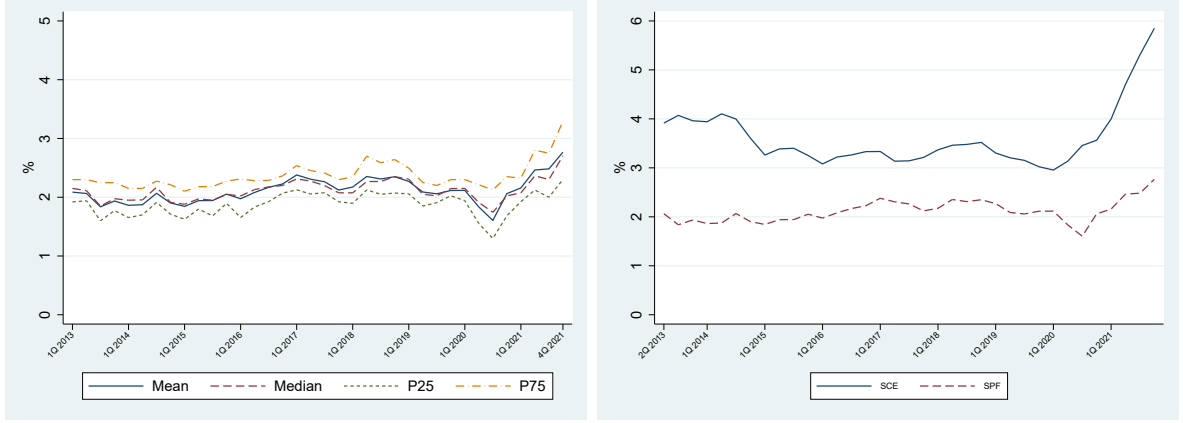
Panel A plots the monthly mean and the 25th, 50th, and 75th percentiles of professional forecasters' inflation expectations over time. We use the micro data underlying the official Philadelphia Fed Survey of Professional Forecasters (SPF) to measure inflation expectations. Professional forecasters are asked to give point estimates for the expected quarter-on-quarter inflation rate for the current and the next 4 quarters. Using these quarter-on-quarter inflation rates, we calculate the expected inflation rate over the next 4 quarters for each forecaster. The sample period is from Q1 2013 to Q4 2021. Panel B compares the mean inflation expectations of professional forecasters and households over time. We use the distribution question in the New York Fed Survey of Consumer Expectations (SCE) to measure inflation expectations over the next 12 months. In this question, each household is asked to provide probability mass to pre-specified bins of possible inflation rates over the next twelve months that has to add up to 100. The bins range from +12% to -12%. To calculate the average expected inflation over the next 12 months, we calculate the weighted average of the distribution question using the center of each bin and +/-14% for the extreme bins. The sample period is from Q2 2013 to Q3 2021.

D.   Households versus Professional Forecasters

In the last part of this section, we compare households' inflation expectations to those of professional forecasters from the *Survey of Professional Forecasters*, who likely display the highest level of sophistication in the formation of inflation expectations.

Panel A of Figure 7 reports the inflation expectations of professional forecasters over time. Similarly to the plot for households, we report the average numerical expectation in each quarterly sample as well as the 25th, 50th, and 75th percentiles.[10]

Professionals' expectations differ substantially from those of households. First, they expect inflation below 2.5% before the Covid-19 pandemic, whereas only the bottom

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[10]Note that the frequency of the *Survey of Professional Forecasters* is quarterly and hence we do not observe monthly cross sections as we do for the households in the *SCE*.

quarter of households does. To appreciate this difference, we compute the average quarterly (rather than monthly) expected inflation rate for households. We see in Panel B of Figure 7, the mean expected inflation rate fluctuates around 4% for households, whereas it varies around 2% for professional forecasters—a value that is close to realized inflation rates during most of our sample period.

Second, we detect no skewness in the expectations of professional forecasters, because the cross-sectional distribution is rather symmetric, with the mean and the median overlapping throughout the sample period.

Third, the distribution of professional forecasters' inflation expectations is tight. The interquantile range is typically below 0.5 pp, and thus substantially less dispersed around the mean than for households.

Lastly, professional forecasters reacted to the onset of the Covid-19 pandemic differently than households. In the second and third quarter of 2020, virtually all professional forecasters revised their twelve-month-ahead inflation expectations downwards, including those at the 75th percentile of the distribution.

The comparison of household and professional forecasters' inflation expectations over time suggests a set of interesting directions to consider for future research. To begin with, only a fraction of households—those whose level of expectations is up to the 25th percentile of the distribution—have expectations that are consistent with those of sophisticated agents. Proxies for sophistication are thus likely to help explain the cross-sectional variation in households inflation expectations at each point in time. Moreover, the high dispersion of households' inflation expectations suggests that the sources of information households use to form their expectations might differ from those used by forecasters. Even more interestingly, the disagreement in households' but not forecasters' reaction to major economic shocks suggests heterogeneous processing of economic news by households. We return to this observation when discussing how individuals' exposure to selected price signals drives their belief-formation process in Section IV.

IV Determinants of Inflation Expectations

We now discuss how existing research informed by the facts documented in Section III has dug deeper into understanding the determinants of households' inflation expectations.

A. Exposure to Price Signals

Lucas (1975) might have provided a closer description of reality than he anticipated when writing that "the history of prices [. . .] observed by an individual is his source of information on the current state of the economy and [. . .] of information on future price." Indeed, Lucas (1975) is often cited as a foundation for models of information frictions such as rational inattention that play an important role to understand the real effects and transmission of monetary policy (Sims, 2003). Recent research has provided empirical support for models of sticky information (Mankiw and Reis, 2002), in which agents update their information infrequently and noisy information models (Mackowiak and Wiederholt, 2009), in which agents receive noisy signals (Coibion and Gorodnichenko, 2015a).[11]

As it turns out, the prices consumers observe when shopping indeed are their main source of information to form expectations about aggregate inflation rather than simply looking up inflation statistics. A powerful example is the "gender expectations gap." Since Jonung (1981), one of the longest standing puzzles in individuals' inflation expectations is the difference in inflation expectations across genders. Although both men and women's average inflation expectations are upward biased, those of women are systematically higher. This stylized fact is a robust feature of households' inflation expectations across time periods, surveys, and countries. While prior literature had relied on survey participants from different households, D'Acunto et al. (2021) establish these gender differences within members of the same household. Hence, systematic differences across households such as family structures, wealth, income or financial choices cannot drive this difference.

To establish this fact, D'Acunto et al. (2021) exploit a unique feature of the

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[11]See also the discussion in Candia et al. (2022).

CBEAS, which we discussed in Section II: researchers can observe all grocery purchases of participating households, including product categories, shopping outlets, and the per-unit prices, alongside the expectations of general inflation of several household members. Using this unique empirical setting, D'Acunto et al. (2021) show that the gender expectations gap is robust to a host of observable characteristics such as income, education, and occupation, but also preference parameters such as patience and risk aversion, which they elicit in the CBEAS.

So what explains the gender expectations gap? D'Acunto et al. (2021) find the gap only arises within households in which women are solely responsible for grocery shopping. In households in which both male and female household heads partake in grocery chores, the gap entirely disappears. In other words, exposure to systematically different price signals (grocery versus non-grocery) appears to strongly predict beliefs about the aggregate inflation rate.

But why does exposure to grocery prices bias inflation expectations systematically upwards? Grocery prices are more volatile than other prices and price changes typically revert more quickly. These features are one reason why many central banks focus on measures of core inflation, which exclude the price changes of groceries (and gas and energy), to analyze inflationary pressures in the economy. By doing so, though, central banks miss the powerful influence of daily price stimuli on inflation expectations.

In a related study, D'Acunto et al. (2021) provide details on the underlying mechanism. Via the *CBEAS*, they run two customized surveys on the *KNCP* in June 2015 and 2016 to elicit inflation expectations as well as to create measures of realized inflation at the household level following Kaplan and Schulhofer-Wohl (2017). They find households that witnessed the highest realized inflation in their grocery bundle have higher inflation expectations than others and this relationship is monotonic.

Furthermore, measures of realized inflation that overweigh frequently-purchased goods or positive price changes drive the baseline association between realized inflation and inflation expectations at the individual level. Other determinants of price changes such as their volatility, recency, or alternative weighting schemes do not add explanatory power. These associations are likely causal because they hold up in within-individual

analyses exploiting changes in realized inflation and inflation expectations within individual across the two survey waves. The within-household analysis also rules out that time-invariant individual characteristics, such as cognitive abilities or financial sophistication, might explain the findings.

These results suggest that the salience of observed price signals, including the frequency of exposure, exerts a strong influence on individual expectations. Related work confirms this insight. For example, Brachinger (2008) shows in aggregate time series that overweighing the inflation of goods consumers purchase frequently helps explain the aggregate perceived inflation of German households. Coibion and Gorodnichenko (2015b) show that the substantial rise gas prices can explain the missing disinflation during the Financial Crisis of 2007 to 2009 because of the large resulting spike in average inflation expectations. And, Cavallo et al. (2017) show that the price changes of specific grocery goods consumers purchase influence their inflation expectations.

In summary, both the high average level of inflation expectations and their dispersion by gender are tightly linked to the heterogeneous price signals individuals observe in their daily lives. And, this influence is not eliminated by financial sophistication, education levels, income, or other time invariant and time-varying individual characteristics.

B.   The Role of the Lifetime Experiences and Neuroplasticity

Turning from gender to another demographic characteristic, age, Section III showed fluctuations in the relative positions of older and younger cohorts' inflation expectations over time. Understanding this heterogeneity is of first-order importance given the vastly different consumption and saving decisions agents make at different stages of their life cycles and given the systematically different roles of younger and older cohorts on the borrowing and lending side of financial markets.

It turns out that cohorts' personal lifetime exposures to price signals ("experience effects") can explain the magnitude of these age differences, cohorts' relative position, and its evolution over time. Malmendier and Nagel (2016) find that a (weighted) average of personal inflation experiences over individuals' lives strongly predicts individual inflation expectations. Their model of experience-based learning also helps to understand the

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Figure 8: **The Implied Weighting of Experienced Data**
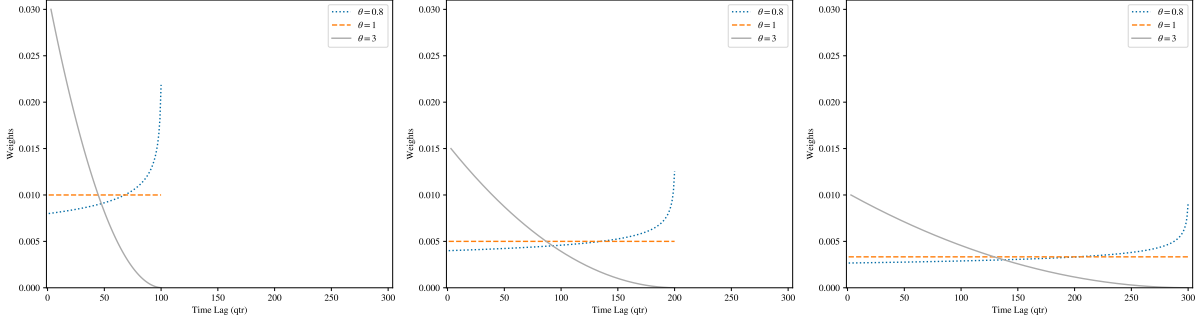
The figure shows the implied weights on past inflation rates for a young (below 40, left), mid-aged (between 40 and 60, middle), and old (above 60, right) individual for different values of θ, which modulates a differential weighting across time periods.

differential reaction of younger and older cohorts to the stark increase in inflation in 2020-21.

How does experience-based learning work? The authors builds on adaptive learning by assuming that individuals form expectations based on historical data (Marcet and Sargent, 1989; Evans and Honkapohja, 2001). Individuals try to estimate an AR(1) process as the perceived law of motion (e.g., Orphanides and Williams (2004)) recursively from past data. Malmendier and Nagel (2016) depart from prior models by allowing individuals to put more weight on data experienced during their lives than on other historical data. Figure 8 illustrate the effects of making the implied weight individuals assign to recent news dependent on age for a hypothetical 25-, 50-, and 75-year old person.[12] We see the difference in the lengths of the past time series that obtains additional weights, and that recent realizations obtain higher weights from younger than older generations. The figure shows that if $\theta = 1$ then individuals equal weight all life-time experiences; if instead $\theta > 1$, a recency bias emerges. In either case, beliefs do not converge. The weights on historical realizations diminishes over time and perpetual disagreement arises.

Empirically, Malmendier and Nagel (2016) use data from the *MSC* and estimate θ

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[12]The weights are also a function of the parameter θ, which modulates a differential weighting across time periods.

to be 3.044, implying recency-biased weights (see Figure 8). Moreover, they find a strong relationship between past experiences and current expectations: for each 1pp difference in learning-from-experience forecast, the model predicts a 0.672pp difference in one-year inflation expectations.

The experience-effect estimates capture much of the fluctuating relative positions of older and younger cohorts (see Figure 9, updated from Malmendier and Nagel (2016)). The figure reports both the raw data and fitted values based on the model estimates for young (below 40), mid-aged (between 40 and 60), and old individuals (above 60), but expressed as deviations from the cross-sectional mean expectation (across all ages) in each period. The data reveal not only the disagreement and fluctuating relative positions of different generations, but also large dispersion across age groups, up to almost 3pp during the high-inflation years of the 1970s and early 1980s.

The fitted lines reveal that learning-from-experience explains a large degree of the differences in inflation expectations, such as the sizable difference in the late 1970s and early 1980s, including the double-spike. It also captures all the low-frequency reversals in the expectations gap across cohorts.

One key implicate of experience-based learning is thus that, at any point in time, older individuals are affected by a longer lifetime history of inflation realizations than younger individuals, and hence the different age groups will disagree about future inflation paths. For example, before the increase in inflation during the Covid-19 pandemic, younger generations in the US had never experienced high inflation, whereas older generations did in the 1970s and 1980s. And, indeed, those aged 60 and above had persistently higher inflation expectations over the last decade. If the high levels of inflation persist, experience-based learning predicts that the expectations of younger cohorts will approach and ultimately cross those of the older generations. For the most recent data, this reversal has already happened for the middle-aged group. For the younger cohorts the reversal is slowed down by the second key component of experience-based learning, perceived persistence. Because the persistence parameter is around 0 for younger cohorts but higher for older cohorts (around 0.2 at the end of the time series in Malmendier and Nagel (2016)), older cohorts do update more strongly immediately after an increase in inflation sets in.

Figure 9: **Fitted Experience-based Expectations**
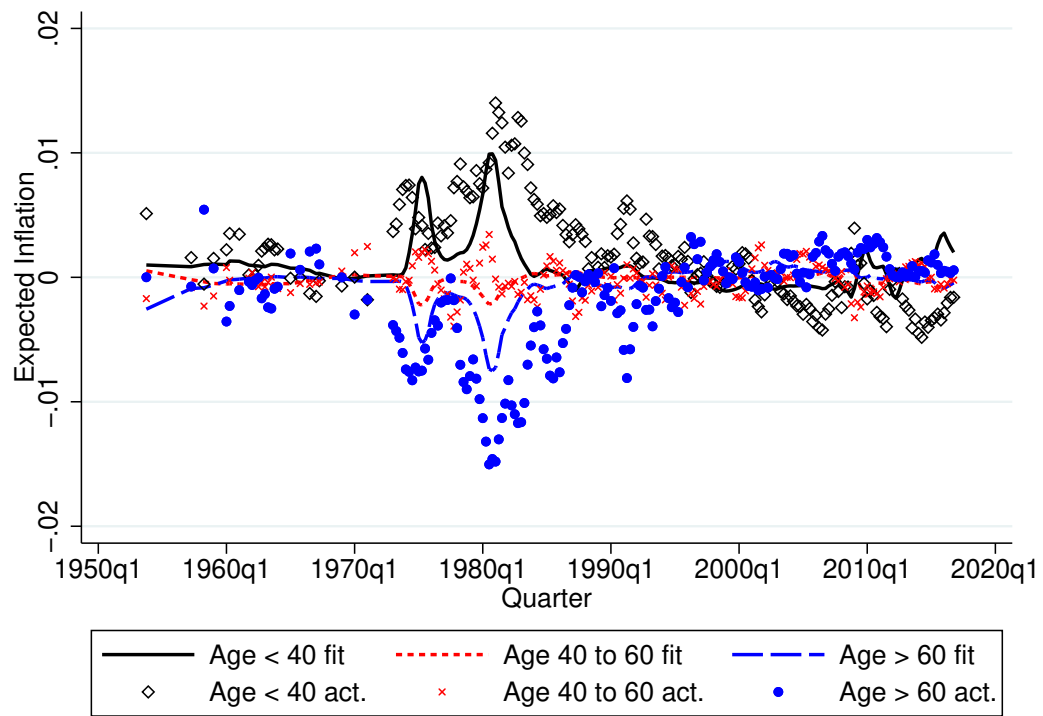
The figure shows both the raw MSC data and the fitted values based on the model estimates for the four-quarter moving averages of mean 12 months inflation expectations of young individuals (below 40), mid-aged individuals (between 40 and 60), and old individuals (above 60), expressed as deviations from the cross-sectional mean expectation across all age groups in each period.

Overall, lifetime experiences appear to be powerful predictors of expectations because individuals assign extra weight to personal past experiences, with an embedded recency bias (higher weights on the more recent experiences).

Personal experiences affect not only the expectations of households, but also those of sophisticated professionals. For example, Malmendier et al. (2021) document that members of the FOMC who have personally experienced higher inflation during their lifetime are more likely to indicate higher inflation expectations in their semi-annual Monetary Policy Reports to Congress. These differences in beliefs feed into actual votes: those with higher experienced inflation are more likely to dissent from the chairperson's proposal, and their dissent is more likely to be hawkish.

The findings on lifetime experiences are just examples from a growing body of work on experience-based learning that suggests that the effect of prolonged exposure to certain price stimuli might be best thought of inducing a "re-wiring" of the brain's hardware rather than information processing via the brain's (unbiased or biased) software. As discussed in Malmendier (2021a,b), the excess weight assigned to personally experienced outcomes mirrors the underlying neurological process of synapse formation and reflects the modern understanding of neuroplasticity, that is, of the brain's lifelong ability to change and adapt as a result of experience. The brain forms stronger connections between neurons that are used more frequently, while those that are not used eventually die over time.

C. The Role of Cognition and Human Frictions

But how can we reconcile the large differences between households and professional forecasters' expectations? Forecasters' expectations, as we discussed in Section III, are much closer to actual realizations and less dispersed than the expectations of households.

One route is noting that forming expectations and beliefs is a cognitively demanding task.[13] Agents have to think about various future inflation scenarios and assign probabilities to each. Professional forecasters are used to perform this task, but average

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[13]Trust in central banks might increase individuals' willingness to anchor their expectations to the official figures and avoid the need to form expectations on their own (D'Acunto et al., 2021). Evidence for the US, though, where inflation was low for decades, shows that many households do not have well-anchored inflation expectations: Coibion et al. (2019) find that 40% of a large sample of Americans think the Fed inflation target is higher than 10%.

consumers are not. Thinking about the potential price changes of frequently-purchased goods might help consumers assess future states of the world, but does not help with assessing the probabilities of each state.[14]

To assess if and how the cognitive burden of the expectations-formation process plays a role that is quantitatively relevant, D'Acunto et al. (2019a, 2021) relate individuals' cognitive abilities to the formation of inflation expectations in uniquely rich Finnish micro data, which combine administrative information on individual cognitive abilities, income, wealth, as well as individuals' actual consumption and saving choices and survey-based economic expectations and plans. They find that cognitive abilities (IQ) predict individuals' inflation expectations above and beyond the direct effects of income, education levels, wealth, and other proxies for economic sophistication: forecast errors for inflation are monotonically declining in IQ. Moreover, high-IQ individuals do form inflation expectations in line with existing models of beliefs formation—in particular, extrapolative beliefs best explain their expectations-formation process—whereas the expectations-formation of low-IQ individuals is inconsistent with extant theoretical models.

The authors also find that the direct effect of cognitive abilities on the accuracy of inflation expectations feeds into actual and planned consumption and saving choices, because high-IQ individuals behave in line with the consumer Euler equation, whereas those below the median of the population by IQ, even when not facing any financial or liquidity constraints, do not behave in line with any standard model of intertemporal consumption optimization.

The role of cognitive abilities in driving inflation expectations and hence economic choices is not only important to our understanding of micro-economic mechanisms, but has also important aggregate implications. D'Acunto et al. (2019b) show that the aggregate effects of fiscal and monetary policies are substantially reduced by the fact that many households, due to heterogeneous cognitive abilities, do not form expectations and plans in line with economic incentives. These understudied frictions to the transmission of economic policies, which the authors label "human frictions," have effects of similar

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[14]Note that agents do not need a formal knowledge of the concept of probability to form beliefs. They only need to assess, even qualitatively, how likely they expect different future scenarios.

magnitude as financial frictions and other supply-side forces that a large body of work in economics and finance has been studying for decades.

In addition to deepening our understanding of how human frictions affect beliefs formation, economic choices, and the effectiveness of policy interventions, a big open question is how such frictions could be overcome by policy makers to increase the effectiveness of their actions. Cognitive abilities are for the most part an endowment of individuals that can only marginally be improved over time. Rather than aiming at reducing these frictions, a promising avenue is the design of simple policies as well as simple and targeted communication about policies. D'Acunto et al. (2021) and D'Acunto et al. (2020) provide observational and experimental evidence that scratches the surface of our understanding of which types of policies and which forms of policy communication can effectively influence the beliefs and choices of all consumers in the economy.

D. The Role of the Media and Communication

A third dimension that matters for individuals' beliefs formation is the availability of information about the economy, which they might gather from the media or the communication of central banks and governments. In fact, researchers consistently find that individuals do not gather and/or process readily available information that would be relevant to their beliefs and choices. For instance, Dräger (2015) shows that media reports on inflation have a small role in explaining average inflation expectations of a nordic population. Coibion et al. (2020) document that one of the most dramatic policy announcements in recent decades, the 2020 Federal Reserve's change in policy framework, was entirely unnoticed by most US households. Moreover, Lamla and Vinogradov (2019) show that less salient FOMC announcements do not change individuals' inflation expectations either (see also De Fiore et al. (2021)). The muted role of official communication is consistent with households focusing on own shopping experiences when forming inflation expectations D'Acunto et al. (2021).

A recent line of research investigates the roots of this lack of response to news through "information-provision experiments" (Haaland et al. (2021)). Such experiments elicit prior inflation expectations, then provide pieces of economic information to different subsets

of respondents, and finally elicit posterior beliefs. The updating in inflation expectations relative to the control group that does not receive any (relevant) information shows the causal effect of the information provision. Several experiments have documented that information can affect inflation expectations when it reaches individuals. For example, Armantier et al. (2016) and Cavallo et al. (2017) find that individuals update their expectations to information about past inflation or professional inflation forecasts. Coibion et al. (2019) provide information in three different formats: (1) simple summary statistics of inflation, (2) full FOMC press releases, and (3) media coverage of FOMC releases in the USA Today. They find that formats (1) and (2) generate large average revisions of inflation expectations of 1 to 1.5pp, while the effect of (3) is smaller. Traditional news media (including USA Today) rank low in terms of credibility and trust, which might explain the differential effects. Although trust in central banks is generally high (Ehrmann et al., 2013; Christelis et al., 2020), many consumers do not know who runs the central bank (Kumar et al., 2015) and 40% of Americans think the Federal Reserve aims to target an inflation rate of more than 10% (Coibion et al., 2019).

Why the information provided by trusted institutions is ignored by decision-makers is an open puzzle, especially given the powerful role such communication plays in standard macroeconomic models (Del Negro et al., 2012). Recent work suggests that information is ignored when policies are hard to understand by consumers. D'Acunto et al. (2021), for instance, show that German households sharply increased their average inflation expectations following the pre-announcement of a future increase of the value added tax (*unconventional fiscal policy*, see D'Acunto et al. (2018)), whose effect on future prices is obvious. Instead, the same households' inflation expectations did not adjust to any forward guidance announcements by the European Central Bank, whose implications for future inflation is obscure to anybody who is not sophisticated in economic matters. Moreover, D'Acunto et al. (2021) show that gender and racial diversity on the FOMC increases the effectiveness of policy communication and consumers' willingness to acquire information about monetary policy. These findings could be driven by the principle that the experiences of others "similar to me", including role models, affect belief formation (D'Acunto et al., 2019; Malmendier and Veldkamp, 2022).

Understanding how innovative and engaging communication formats such as the reggae songs by the Central Bank of Jamaica or the use of Twitter as a policy tool might increase policy effectiveness is an exciting open area of research (D'Acunto et al., 2020).

V Inflation Expectations and Economic Choices

The patterns in expectation formation and underlying mechanisms documented above have relevant implications only if agents' inflation expectations help explain their economic decisions. Despite recent disagreement on the interpretation of such patterns (Rudd, 2021), a growing body of work using high-quality micro data convincingly shows that inflation expectations do guide the economic choices of households and firms.

Below, we discuss the empirical research that has documented a direct role of inflation expectations in shaping consumption, financing, and savings decisions.

A. Intertemporal Consumption Choices

Virtually all modern model of the intertemporal consumption decision attributes a fundamental role to subjective inflation expectations. Inflation expectations can affect the consumption-savings nexus through various channels. On the one hand, higher subjective inflation expectations reduce perceived real interest rates (via the Fisher equation) and hence the incentives to save, which increases current consumption (via the consumer Euler equation). On the other hand, higher inflation is a tax on nominal assets, and hence a negative wealth effect in addition to negative income effects can counteract the positive influence of inflation expectations on current consumption. Some households might also expect nominal policy rates increasing more than one for one (via the Taylor rule) when their inflation expectations increase (Carvalho and Nechio, 2014), again implying a decrease rather than an increase in current consumption. Moreover, if the second moment of subjective inflation expectations, that is, inflation uncertainty, increases, agents' precautionary-saving motive increases, which further reduces current consumption (D'Acunto et al., 2020; Coibion et al., 2021). Finally, individuals might

have a supply-side view of the economy and associate higher inflation with bad economic times (Kamdar et al., 2018; Andre et al., 2019; Coibion et al., 2020).

Empirically, researchers find evidence consistent with these different mechanisms. Bachmann et al. (2015) find no significant relationship between inflation expectations and consumption for participants in the *MSC*, except for those whose expectations lie within 1pp of the ex-post realized inflation rate. For the latter subset, higher inflation expectations predict higher current consumption, which corroborates the predictions of the Euler equation. Burke and Ozdagli (2021) confirm these results for non-durable spending. Similarly, using micro-data on inflation expectations, spending plans, and individuals' cognitive abilities, D'Acunto et al. (2021) show that only high-cognition consumers, who form inflation expectations closer to ex-post realized inflation rates, behave in line with the consumer Euler equation. Binder and Brunet (2020) and Ichiue and Nishiguchi (2015) also find a positive association between inflation expectations and consumption spending during the beginning of the Korean War and in Japan, two episodes in which nominal rates were held constant.

The lack of empirical evidence in support of the consumer Euler equation for agents whose inflation expectations are inaccurate might indicate that the large cross-sectional dispersion in quantitative inflation expectations obfuscates the relationship between inflation expectations and consumption. In fact, when using qualitative expectations data and spending plans from the EC Consumer Survey, D'Acunto et al. (2018, 2021) find strong economic and statistical evidence that households who expect higher inflation over the following twelve months have a higher current propensity to purchase durable goods. Using customized survey data from Germany, Dräger and Nghiem (2021) confirm the positive association between inflation expectations and current spending. Crump et al. (2022) also find a positive relation in the SCE data.

More recently, researchers have turned to assessing whether the relation between inflation expectations and current consumption is causal. To this aim, D'Acunto et al. (2021) exploit a natural experiment in Germany: In November 2005, a newly-elected government pre-announced an increase in the value added tax to be effective in 2007. The announcement increased German consumers' inflation expectations independent of

their levels of income or education. Using a difference-in-differences strategy, the authors document a contemporaneous increase in consumers' readiness to purchase durable goods immediately after the announcement, compared to their willingness before and to the change in the willingness to spend of observationally similar households in France, Sweden, and the UK and show a large positive treatment effect of the announcement on spending. Bachmann et al. (2021) exploit an unexpected temporary cut in the value added tax combined with customized survey and household scanner data, to show large effects on household spending via intertemporal substitution, that is, individuals' inflation expectations.

Another path to establish causality is the design of randomized information-provision experiments. After the random provision of information about inflation, Coibion et al. (2019, 2020) find a positive effect of inflation expectations on non-durable spending in survey and household scanner data that lasts up to six months, though they do not detect a positive effect for durables. Coibion et al. (2019) estimate a small effect of inducing higher inflation expectations on non-durable spending among Dutch households and a *negative* effect on durable spending. They rationalize this result with a sharp decrease in real income and aggregate demand expectations for households who update upwards their inflation expectations, which is consistent with the findings of Kamdar et al. (2018) and Andre et al. (2019).

B. Financing Current Consumption: Mortgages and Borrowing

Inflation expectations are also a key determinant of financing decisions, and especially for larger durable goods such as housing.

Empirically, Coibion et al. (2020) show that households revise their inflation and interest rate expectations jointly. Hence, we can trace interest rate expectations to inflation expectations, which are in turn determined by lifetime inflation experiences as discussed in Section IV. Figure 10, replicated from Botsch and Malmendier (2021), illustrates this result using qualitative interest-rate expectations from the Survey of

Figure 10: **Interest-Rate Expectations and Inflation Experiences**
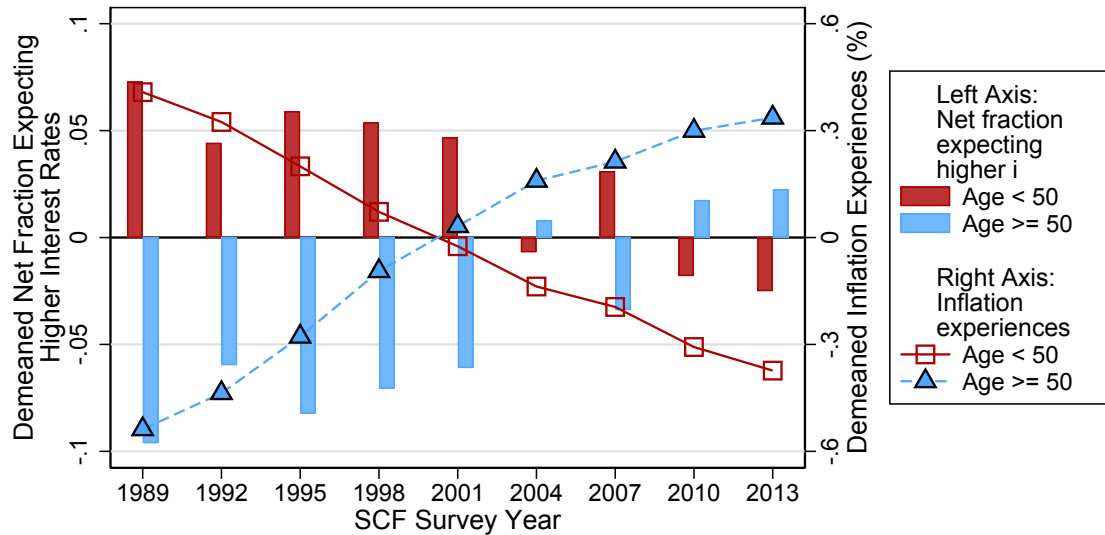
The figure illustrates the cohort-specific time series of answers to the SCF question "Five years from now, do you think interest rates will be higher, lower, or about the same as today?" from 1989 to 2013. Cohorts are split into 'older" and "younger" based on the sample median of age. The graph shows each group's deviations from the survey-year mean (average across implicates) of the net fraction of respondents expecting interest rates to rise (fraction answering "higher" minus the fraction answering "lower").

Consumer Finances (*SCF*).[15] A higher net fraction of the younger cohorts (red bars) than the older cohorts (blue bars) expected higher interest rates during the early *SCF* waves (1989, 1992, etc.), but the relative positions switched in the mid-2000s, precisely when the lifetime inflation experiences of younger cohorts (red squares) switched from higher to lower than those of older cohorts (blue triangles). The reversal reflects young households without Great-Inflation experience coming in and the fading memory of Great Inflation among older cohorts (see Figure 8).

Turning to households financial choices, the most prominent borrowing decision pertains to the financing of housing — whether to take up a mortgage, how much to borrow, and the choice between a fixed- and adjustable-rate contract (FRM versus ARM). Higher inflation expectations tilt the decision towards fixed-rate borrowing as consumers who expect higher nominal interest rates discount the sum of fixed payment obligations by

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[15]The figure is based on the following SCF question: "*Five years from now, do you think interest rates will be higher, lower, or about the same as today?*"

more, lowering its present value. Under an ARM, instead, borrowers with high inflation-and interest-rate expectations expect both higher nominal ARM payments and using a higher discount rate. These two effects offset. As a result, borrowers who expect higher future interest rates perceive FRMs to be relatively cheaper.

Malmendier and Nagel (2016) provide evidence consistent with this channel: *SCF* borrowers with higher past inflation experiences also have a greater inclination to choose a FRM. Botsch and Malmendier (2021) confirm these results in multivariate analyses, and are the first to show directly the inflation-experience–interest-rate channel and its influence on the ARM-versus-FRM choice using the Census Bureau's Residential Finance Surveys (*RFS*). The RFS surveys households as well as mortgage servicers, thus providing both demographic information and mortgage contract terms. Botsch and Malmendier (2021) estimate that 1pp experienced inflation increases a borrower's willingness to pay for an FRM by 6–14 basis points.

Exposure to high past inflation also affects the decision to become homeowner in the first place, as consumers aim to shield against inflation with real assets. For example in a survey of 700 homeowners across European countries, Malmendier and Steiny Wellsjo (2020) find that 72% select concerns about price increases (*protection against inflation* and *protection against rent price increases*) as their motives for homeownership, dominating all other motives such as tax benefits, higher quality of homes to buy, low mortgage rates, and even increasing house prices. Moreover, a third of all respondents, mostly those who experience high inflation, say that inflation concerns directly impacted their personal decision to buy a house. Hence, regardless of whether real estate is a suitable inflation hedge, or not, the inflation-hedge motive is important to homeowners.

Malmendier and Steiny Wellsjo (2020) utilize the vast cross-sectional differences in past inflation experiences across European countries as well as within-country differences (by cohort) to explain the substantial differences in homeownership rates across and within countries. Experience-based forecasts of future inflation, including the "national memory" of past inflationary periods, thus appear to play a significant role in shaping housing markets both across and within countries.

C. Investment and Savings Decisions

The implications of inflation expectations for investment and savings decisions are less explored, and the existing evidence is weaker. Malmendier and Nagel (2016), for instance, test the prediction that investors with higher inflation expectations shy away from fixed-rate bonds in the *SCF*. Their estimations yield a negative albeit insignificant relationship. Armantier et al. (2015) find clearer evidence in an incentivized survey experiment, albeit using hypothetical investment choices. Here, respondents participate more in inflation-indexed savings vehicles when they expect higher inflation. Survey participants with lower numeracy and financial and economic literacy, instead, make choices that cannot be rationalized by standard economic theory. Overall, these findings complement Leombroni et al. (2020), who show that disagreement about future inflation between younger and older households in the late 1970s helps understand household borrowing, lending, and portfolio choices. Advancement on this question require observational data on individual portfolios and fixed-rate investment opportunities.

Better data would also allow testing the effects of inflation expectations on other economic choices, such as business-to-business contracting, price setting, wage negotiations, and labor-supply decisions. All of these arenas are lacking direct evidence of their relation to inflation expectations, largely due to the lack of viable data sources.

VI   Conclusion and Outlook

Inflation expectations determine the effectiveness of fiscal and monetary policy and shape realized inflation (Bernanke, 2007; Galí, 2015; Sims, 2009). Households' inflation expectations are especially important because they determine consumption, financing, and investment choices (Weber et al., 2022). And yet, until recently, our understanding of how individuals actually form inflation expectations was in a state of "relative ignorance" (Armantier et al., 2013).

Over the last decade, departures from the rational-expectations model revived the interest in how subjective expectations of inflation are formed. We now know that agents' inflation expectations are upward biased, dispersed, and volatile. They

differ systematically across demographic groups—gender, race, age, income, and other characteristics—and reflect the specific price changes individuals observe in their daily lives. Personal experiences and cognition mediate the role of abstract knowledge and information and are the best predictors of actual, decision-relevant expectations.

The wealth of new facts in the domains of inflation expectations and other economic and financial expectations indicate a pervasive deviation of subjective expectations from the FIRE paradigm. These facts can help discriminate across existing models of beliefs formation but also inform new models and approaches. New-generation behavioral macro models should not only match salient features of average expectations over time but also depart from the representative-agent modeling framework to be consistent with the substantial sources of heterogeneity documented in the literature (D'Acunto et al. (2021)). Models accounting for heterogeneous past experiences, memory, and context-specific retrieval such as Wachter and Kahana (2019, 2020); Bordalo et al. (2020); Malmendier et al. (2020a) (see the overview in Malmendier and Wachter (2021)) represent a promising avenue because of the recent supporting evidence from the field (D'Acunto and Weber (2022)).

More research is also needed on the impact of inflation expectations on economic choices—a line of inquiry that becomes especially important in times of rising inflation. More data-construction projects that combine survey-based expectations and economic plans with the contemporaneous economic decisions of households and registry-based income and wealth information, such as in D'Acunto et al. (2019b), will be crucial to advance on this front. For instance, how do inflation expectations shape agents' wage expectations, their wage bargaining decisions, and their labor supply? We also know little about how inflation expectations shape portfolio choice decisions due to return expectations and the perceived inflation hedging properties of alternative assets. The possibility of reaching consumers directly with surveys at the time they engage in spending and financial transactions through FinTech apps is a promising direction to obtain rich micro data in a logistically viable fashion (for instance, see D'Acunto et al. (2021) and D'Acunto et al. (2022)).

The mechanisms we discuss in this chapter apply beyond the context of inflation. For

example, personal experiences have a long-lasting effect on stock-market participation (Malmendier and Nagel, 2011), on the dynamics of stock-market trading (Malmendier et al., 2020a), and on patterns of international capital flows such as home bias, fickleness, and retrenchment (Malmendier et al., 2020b). Malmendier and Shen (2020) find that unemployment experiences predict lasting consumer pessimism as well as consumption and saving choices.[16] More individual-level data on previous exposure to price signals and other macroeconomic variables are needed to deepen this area of research.

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[16]See the overviews of economic and financial applications in Malmendier (2021b) and Malmendier (2021a), respectively.

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