Exposure to Daily Price Changes and Inflation Expectations*

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Abstract

We show that, to form aggregate inflation expectations, consumers rely on the price changes they face in their daily lives while grocery shopping. Specifically, the frequency and size of price changes, rather than their expenditure share, matter for individuals' inflation expectations. To document these facts, we collect novel micro data for a representative US sample that uniquely match individual expectations, detailed information about consumption bundles, and item-level prices. Our results suggest that the frequency and size of grocery-price changes to which consumers are personally exposed should be incorporated in models of expectations formation. Central banks' focus on core inflation—which excludes grocery prices—to design expectations-based policies might lead to systematic mistakes.

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

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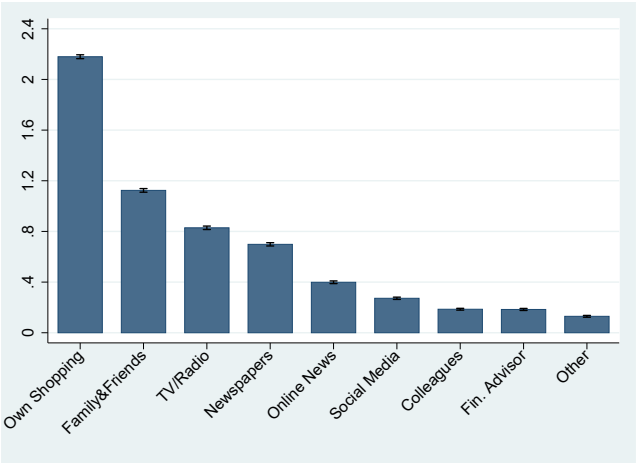
I Introduction

In his seminal islands model, Lucas (1972, 1973) posited that agents use the prices they directly observe in their daily lives to form expectations about aggregate inflation. As he discusses in Lucas (1975), "[T]he history of prices [...], observed by an individual is his source of information on the current state of the economy and of the market z in which he currently finds himself; equivalently, this history is his source of information on future price." Although Lucas did not aim to provide a literal description of reality, this assumption triggered a debate about its logical consistency and realism. Critics argued that consumers could easily access aggregate inflation statistics, and that no empirical support for this assumption existed in field data. Yet, when we fielded a survey among a representative sample of US consumers and asked how they form inflation expectations, they cited the price changes observed while grocery shopping as the most important source of information (see Figure 1).

In this paper, we propose novel data on individual expectations, consumption bundles, and item-level prices to document that consumers use grocery-price changes they face in their daily lives to form expectations about aggregate inflation. Crucially, our detailed data on household-specific consumption bundles allow us to make progress on uncovering the underlying process of belief formation, which informs theories on how to enrich the standard rational-inattention framework: Not only do consumers rely on household-specific grocery-price changes, rather than representative bundles, but the price changes of those goods that they purchase more frequently drive the association with aggregate inflation expectations. Moreover, larger price changes have a stronger effect on expectations, making infrequent shoppers, who tend to observe larger changes across shopping trips, respond more to the grocery-price changes to which they are exposed.

Tackling these questions had not been possible prior to this research because of the lack of data linking the price changes consumers face in their own consumption bundles across several shopping trips to their inflation expectations at the time they purchase such bundles. To the best of our knowledge, this study is the first that observes at the same time both multiple consumption bundles at the household level over time and

Figure 1: **Sources of Information for Individual Inflation Expectations**



Notes. This figure shows the average ranks of information sources that survey respondents indicate they rely on when forming inflation expectations. Respondents have to select the three most relevant sources that come to their minds (from a list). The first source coming to mind is assigned a value of 3, the second a value of 2, the third a value of 1, and all other sources a value of 0. Respondents can list less than three (or no) sources.

beliefs for a large and representative sample of consumers. Alongside inflation, our data also cover expectations of other aggregate outcomes, individual consumption, saving, and investment plans, as well as detailed demographics, financial literacy, numeracy, and risk aversion. We use this information to show that inflation expectations, in turn, affect individual beliefs about wage and house-price inflation, and influence mortgage borrowing and savings decisions.

The combination of consumption and expectations data, and the evidence on consumers' reliance on household-specific price changes, has economically sizable implications because the cross-sectional variation in household-level inflation, and hence in the price signals individuals observe, is substantial. Kaplan and Schulhofer-Wohl (2017) document that households differ significantly in the grocery prices they pay despite similar consumption bundles, generating an interquartile range of realized inflation between 6.2% to 9.0% at the household level. In the language of Lucas, the price signals consumers observe on their islands vary dramatically even though they eat the same fruits. Our findings thus imply expectations should vary substantially in the cross-section.

And, indeed, the average interquartile range in one-year-ahead expected inflation in the Michigan Survey of Consumers is 3.8% since 1999, and many respondents report inflation expectations as high as 50% and as low as -30% (Bachmann, Berg, and Sims (2015)).

The influence of grocery shopping on expectation formation is particularly striking because the inflation index on which US policy makers mainly focus, the Core Consumer Price Index, excludes grocery prices.[1] The rationale for the exclusion of food (and energy) prices is that those categories are particularly volatile, reflect supply shocks that are unrelated to trend changes in the economy's overall price level, and tend to reverse quickly. An ongoing debate at least since Motley (1997) questions this rationale, arguing that short-run movements contain useful information about incipient inflation. Our findings suggest another reason why economists and policymakers should focus more on non-core inflation: It offers insights into households' expectations-formation process. Our results challenge the premises behind inflation targeting and expectations-management policies as they are currently implemented in the US and abroad (Del Negro, Giannoni, and Patterson (2012); D'Acunto, Hoang, and Weber (2019)).[2]

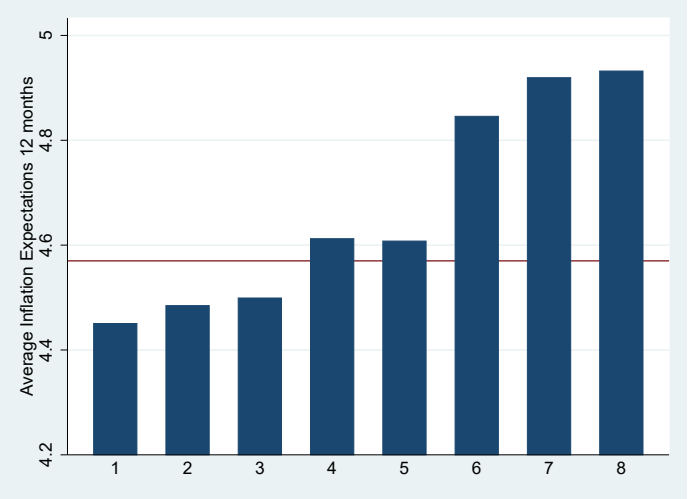
To analyze the role of household-specific price changes on beliefs, we combine information about the quantity and prices of the non-durable consumption baskets of more than 90,000 households in the *Kilts Nielsen Consumer Panel* (KNCP) with new survey data on expectations that we elicited from all members of the Nielsen households. We fielded two waves of the *Chicago Booth Expectations and Attitudes Survey* in June 2015 and July 2016. We use these unique data to construct measures of observed price changes at the household level, match them with the inflation expectations of each survey participant at the time they shopped for groceries, and perform tests to understand the underlying mechanisms and inform models of rational inattention.

Our first measure of observed price changes, the *Household CPI*, is constructed like the Consumer Price Index (CPI) but for each household's non-durable consumption basket

[1] See www.bls.gov/opub/hom/pdf/homch17.pdf for the Handbook of Methods, chapter 17, p. 103. The categories "food at home" and "other food at home" are excluded from the Core CPI.

[2] Some US policy makers have recognized that the extensive focus on core inflation of a representative consumption bundle might produce substantial policy mistakes. For instance, according to Mr. J. Bullard of the St. Louis Fed, "With trips to [...] the grocery store being some of the most frequent shopping experiences for many Americans, it is hardly helpful for the Fed credibility to appear to exclude all those prices from consideration in the formation of monetary policy."

Figure 2: **Inflation Expectations by Bins of Household CPI**



Notes. Inflation expectations are from the customized *Chicago Booth Attitudes and Expectations survey* in 6/2015 and 6/2016. Household CPI is constructed using micro data from the Nielsen homescan panel to measure household-level grocery-bundle inflation, cf. Section II.*C*. We use the 12 months before the June of the survey wave to measure price changes and the 12 months before that period as the base period.

instead of the representative consumption basket.[3] We find that the Household CPI is a significant predictor of 12-month-ahead inflation expectations. For example, when we average expected inflation within eight equal-sized bins of Household CPI (Figure 2), the range from the lowest to the highest Household CPI bin is associated with a 0.5-percentage-point difference in expected inflation, which is economically sizable given an inflation rate of around 1% during the same period.

These results continue to hold when we condition on a rich set of demographics including age, income, gender, marital status, household size, education level, employment status, and risk tolerance. Moreover, within-individual analyses across the two survey waves also confirm our baseline results, which suggests individual-level time-invariant characteristics, such as cognitive abilities or sophistication, cannot explain our findings.

Why do consumers make use of grocery-price changes when forming inflation expectations? One possibility is that individuals face cognitive constraints when gathering

[3] Specifically, we create a Laspeyres index for the first wave, using the expenditure shares in the period from June 2013 to May 2014 and the price changes from June 2013 to May 2015, the month before the first wave of our survey. We proceed similarly for the second wave of the survey.

information about overall inflation. They rely on the price changes they observe in their daily lives as the cheapest source of information. An alternative explanation is that individuals form beliefs relying on processes that differ from the standard rational-inattention framework and hence call for enriching such a framework to explain the set of facts we document. For instance, research in cognitive psychology such as Watanabe et al. (2001) and Seitz and Watanabe (2005) documents that frequent stimuli affect perceptual learning irrespective of individuals' attention to such stimuli. Specific to our context, Georganas et al. (2014) provide laboratory evidence that when forming expectations, individuals weigh more those price changes to which they are exposed frequently.

Motivated by this evidence, we construct a second, frequency-based measure of personally experienced inflation, the household-level *Frequency CPI*. Here, we use the frequency of purchases in the base period to weigh shopping price changes instead of the expenditure shares as we do in the Household CPI. The positive association between the Frequency CPI and inflation expectations is 20%-40% larger than the association of the Household CPI. When we add both the Household CPI and the Frequency CPI as independent variables in the same specification, the coefficient associated with the Household CPI shrinks to zero and loses statistical significance, whereas the statistical and economic significance of the Frequency CPI barely changes.

All results are robust to different ways of framing the inflation-elicitation questions. Our results are also similar if we focus on a sample in which perceptions of current inflation and expectations differ, so that respondents do not simply anchor expectations to the previously-reported perceptions. Individuals that report inflation expectations of zero and any other rounded value do not drive our results. Finally, all results are robust to sample splits by numerous characteristics previous research associates with inflation expectations.

After verifying that the positive association between the Frequency CPI and inflation expectations is a robust feature of the data, we propose some heterogeneity tests to help assess the extent to which the standard rational-inattention framework with information rigidities might explain the results.

First, the rational-inattention framework suggests consumers rely similarly on the signals about future inflation they obtain from grocery price changes, irrespective of the size of such price changes. Instead, if the salience of grocery-price changes were important, the association between the Frequency CPI and inflation expectations should be higher for consumers who experience extreme price changes, irrespective of the sign of such changes.

To assess these opposite predictions, we split the sample into the third who experience the most negative price changes, the third who experience intermediate price changes, and the third who experience the most positive price changes. We find the association between grocery price changes and inflation expectations is positive and significant for the two extreme groups, whereas it is indistinguishable from zero both economically and statistically for the intermediate group.

A second test to assess how the rational-inattention framework should be enriched exploits variation in the frequency with which consumers grocery shop. In the rational-inattention framework, agents rely on the price changes observed while grocery shopping, because they can gather price signals during shopping trips more cheaply than other signals about inflation. From this perspective, frequent shoppers gather more frequent and hence more precise signals than infrequent shoppers, because they observe prices more often.

Contrary to this prediction, we find that infrequent shoppers, who observe larger price changes across shopping trips (Eichenbaum, Jaimovich, and Rebelo (2011)), rely more on the Frequency CPI than do frequent shoppers. This result holds when we consider several proxies for the frequency of grocery shopping, including whether the respondent is the primary grocery shopper for the household, whether the respondent grocery shops at least once a week, as well as respondents' travel time to their primary shopping outlet. Although these cross-group differences are not always statistically significant, the economic magnitude of the estimated associations between Frequency CPI and inflation expectations is systematically larger and highly significant for infrequent shoppers.

At the same time, our empirical results do allow for a role of information frictions in explaining consumers' reliance on grocery-price changes. For instance, the ease of reading news about inflation in the media was at the core of the debate the Lucas islands

model triggered. When we zoom into the subsample of consumers who rely on the media to form expectations, the effect of the Frequency CPI becomes small and insignificant, whereas the effect is four times as large and highly significant for the rest of the sample. Instead, respondents who rely on their own shopping as a source of information about inflation display a strong positive association between the Frequency CPI and inflation expectations. Overall, both sides of the debate have merits. On the one hand, consumers who read economic news do not rely on their household-specific grocery-price changes when forming expectations. On the other hand, though, a large fraction of consumers does not access the media or other sources of information about aggregate inflation, and hence they rely substantially on the household-specific grocery-price changes they face when forming expectations.

In the final step, we show our outcome variable, the cross-sectional variation of inflation expectations, is economically important in that it is associated with other expectations and real outcomes in a way that is consistent with economic theory. Earlier research has already shown this point for housing and mortgage choices (Malmendier and Nagel (2015a); Armona et al. (2018)) and consumption and saving decisions (D'Acunto et al. (2016)). We expand this evidence to other outcomes.

First, we show that consumers whose inflation expectations are higher also have higher wage and house-price inflation expectations. Both are tied to important economic decisions. Expectations about future wage growth drive labor-supply decisions and determine firms' marginal costs of production through wage-level negotiations. House-price expectations are important to households' investment choices—housing is typically the largest asset US households own—as well as aggregate business-cycle patterns (Piazzesi and Schneider (2009) and Glaeser and Nathanson (2017)).

Second, we consider real outcome variables available in our data that relate to households' inflation expectations. Consumers with higher inflation expectations hold larger (fixed-rate) mortgages. Conditional on holding any investments, consumers with higher inflation expectations also invest more in real assets such as real estate, whose value is less affected by inflation. Based on the Euler-equation logic, consumers with higher inflation expectations should also save less, which we confirm in the data.

An important implication of our results is the discrepancy between the processes most consumers use to form inflation expectations and the consumer price inflation of a representative consumption bundle policy makers commonly target. By construction, a representative-bundle inflation rate abstracts from any heterogeneity in consumers' perceived inflation. Moreover, as discussed above, the Core CPI on which US policymakers mainly focus disregards grocery prices. Statistical agencies often exclude "extreme" values when reporting average household expectations under the presumption that these values are meaningless. Our results suggest that such "extreme" expectations in surveys are not noise to disregard but to the contrary are meaningfully related to the information households access and influence households' economic choices.

Related Literature. Our paper contributes to several strands of literature. A recent and growing body of work shows subjective expectations of macro variables deviate substantially from the full-information rational-expectations benchmark. So far, most researchers have focused on the expectations of experts, such as professional forecasters (e.g., see Coibion and Gorodnichenko (2012), Coibion and Gorodnichenko (2015a), Fuhrer (2017), and Bordalo et al. (2018)).

For individual inflation expectations, the evidence shows a large degree of disagreement across individuals. We study a setting in which the daily-life experiences of consumers shape their economic expectations. For this endeavor, we build on Kuchler and Zafar (2019), who show individuals extrapolate from local house-price changes they observe in their counties to expectations about US-wide real estate inflation. We augment their setting by observing directly the prices consumers pay and the price changes they face in their consumption bundles, which allows us to test for the mechanisms through which consumers use household-specific price changes to form aggregate expectations. Related experimental research by de Bruin et al. (2011) shows that, when households form expectations about aggregate variables, they tend to have the prices of specific goods and services in mind and (over-)extrapolate from such prices.[4]

Our paper also build on Cavallo, Cruces, and Perez-Truglia (2017), who study

[4]Also, Adam (2007) shows experimentally that individuals use "simple" forecast functions to form inflation expectations that deviate from the rational forecasts.

the formation of inflation expectations in high- and low-inflation countries, and provide evidence that both rational inattention and cognitive abilities are important determinants of information frictions. The authors record one grocery bundle for a cohort of grocery shoppers. They find that recall of prices shapes inflation expectations in a high-inflation setting, and that individuals tend to have biased memory. We generalize this work along a set of dimensions. First, we observe household-level shopping bundles for several years and multiple shopping trips, which allows us to create several measures of realized inflation at the household level. Second, we observe both the realized inflation and expected inflation rate within individual over time, which allows us to abstract from time-invariant individual characteristics when relating these two dimensions. Third, we observe the frequency of purchase and other characteristics of the components of shopping bundles, which allows us to investigate the channels through which household-level realized inflation relates to individual inflation expectations.

An important feature of our results is that the frequency and size of the stimuli consumers observe is important for the effect of such stimuli on economic expectations. To the best of our knowledge, this paper is one of the first to proposes a field test for the effects of salient stimuli on economic beliefs, whereas most research to date has run experimental tests in the laboratory (e.g., see Bordalo et al. (2016); D'Acunto (2018a); D'Acunto (2018b); Frydman and Mormann (2018); Landier et al. (2017)). Our results based on field data help inform theorists by providing evidence of which features of the expectations-formation process are robust in a large, representative population and for real-world choices.

Empirically, we build on Kaplan and Schulhofer-Wohl (2017) and use the Nielsen homescan data to construct inflation rates at the household level. Other recent papers that use Nielsen data are Argente and Lee (2017), who study the cost of living inequality during the recent Great Recession; Jaravel (2018), who studies the differences in inflation that households experience due to product innovation; Stroebel and Vavra (2019) who study the causal impact of local house-price changes to local retail prices; and Broda and Weinstein (2010), who study the role of product creation and destruction on several proxies for households' cost of living.

Recent work on the determinants of cross-sectional variation in inflation expectations includes, among others, Malmendier and Nagel (2015a) find cohorts differ in their average inflation expectations because they learn from their different lifetime inflation experiences and react differently to the same macroeconomic shocks. D'Acunto, Malmendier, and Weber (2018) show traditional gender roles help explain the systematic differences in inflation expectations across genders. Carvalho and Nechio (2014) find most individuals do not form expectations consistent with a tenet of monetary policy—the Taylor rule. D'Acunto et al. (2019a,b,c) show cognitive abilities are strongly correlated with forecast accuracy for inflation, uncertainty about future inflation, and the propensity to consume and take out loans to changes in inflation expectations and nominal interest rates. Coibion, Gorodnichenko, and Weber (2018) show central-bank communication impacts inflation expectations, which differ across demographic groups.

Our paper also builds on the recent literature that uses micro-level data to study the relationship between inflation expectations and households' readiness to purchase consumption goods (Bachmann et al. (2015); Crump et al. (2018); D'Acunto, Hoang, and Weber (2016); D'Acunto, Hoang, and Weber (2018); Goldfayn-Frank and Wohlfart (2019)). We also relate to papers that design surveys to elicit macroeconomic expectations, and relate such expectations to actual choices. Armantier, Bruine de Bruin, Topa, Van Der Klaauw, and Zafar (2015) document individuals make financial decisions in line with their inflation expectations reported in surveys. Roth and Wohlfart (2019) study the causal link between macroeconomic expectations, consumption plans, and stock investments. Ameriks, Kézdi, Lee, and Shapiro (2019) and Maggiori, Stroebel, Giglio, and Utkus (2019) elicit stock return expectations and relate them to portfolio choice. Adelino, Schoar, and Severino (2018) find the perception of house-price risk is an important determinant of housing choices.

II Survey and Consumption Data

The novel source of data we employ in this paper is the *Chicago Booth Expectations and Attitudes Survey*, which we fielded online in two waves in June 2015 and June 2016.

We invited participation by all household members of the *Kilts-Nielsen Consumer Panel* (KNCP). We also rely on the KNCP for all the information related to households' non-durable consumption baskets. Below, we describe the characteristics of these two data sets with a focus on the new survey our paper introduces to the literature.

A. Kilts-Nielsen Consumer Panel (KNCP)

The KNCP is a panel of about 40,000-60,000 households. These households report two types of information to Nielsen. First is their static demographic characteristics, such as household size, income, ZIP code of residence, and marital status. Panelists update their demographic information at an annual frequency to reflect changes in household composition or marital status. The second type of information panelists report is the dynamic features of their purchases. These features include categorizations of the products they purchase, information on the outlets at which the products are purchased, and information about the per-unit price households pay for each item. To avoid measurement and reporting errors, each panelist obtains an optical scanner at home that is similar to the scanners grocery stores use to read barcodes. Households scan each item they purchase after each trip to a grocery store as well as the items they purchased online.

The sample period for which Nielsen has detailed purchase information from households cover the years 2004-2017. Geographically, the sample spans through 52 major consumer markets and nine census divisions. Nielsen estimates the dataset covers approximately 30% of overall household consumption in the US. Nielsen attempts to balance the panel's demographics to make it representative of the US population along nine dimensions: household size, income, age of the male and female household heads, education level of the female household head, education level of the male household head, presence of children, race, hispanic ethnicity, and occupation of the household head. Nielsen recruits panelists online but balances the panel using traditional mailing methods. Nielsen checks the sample characteristics on a weekly basis and performs adjustments to guarantee balancing whenever deemed necessary. The KNCP has an annual retention rate of more than 80%. The KNCP filters out households that do not report a minimum amount of spending over the previous 12 months.

Nielsen provides respondents with several incentives to guarantee the accuracy and completeness of the information respondents report. For instance, Nielsen organizes monthly prize drawings, allows households to accumulate reward points for each instance of data submission, and engages in ongoing communication with households. Panelists can use the reward points they accumulated to purchase gifts from a Nielsen-specific award catalog. Nielsen structures the incentives to not bias the shopping behavior of their panelists, and validates the reported consumer spending with the scanner data of retailers on a quarterly frequency to ensure high data quality.

The KNCP dataset contains summary information for each shopping trip households make, such as the date of the trip, the retailer code, the retailer ZIP code, and the overall dollar amount spent. For each trip, the dataset also contains detailed information on the individual goods purchased (12-digit Universal Product Code (UPC)), quantities, prices, and the potential use of coupons and discounts that change the price the household pay for the goods). Nielsen classifies products hierarchically into different categories with finer granularities: department (10), product group (125), product module (1,075), and UPC. For each UPC, the datasets contains information on package size, brand, and other product characteristics. The KNCP contains 1.5 million unique products. The goods in the datasets include groceries, drug products, small appliances, and electronics.

After each shopping trip, panelists scan the goods they purchased. The system then asks the panelist for the quantity. If the panelists purchased the good at a store for which Nielsen has a point of sales information (POS), the system automatically uses the average price for the UPC during the week of purchase to minimize the data-entry burden for the panelist. If the panelist shopped at a store without POS information, the system asks for the price of the goods before any discounts or coupons are applied. Lastly, the system asks the panelist to indicate explicitly whether the good was purchased on discount and the amount of the discount.

B. Chicago Booth Expectations and Attitudes Survey

Nielsen runs short surveys on a monthly frequency on a subset of panelists of the KNCP, the online panel, but also offers customized solutions to corporations and research

institutions for designing longer ad hoc surveys.

During the Spring of 2015, we designed a customized survey consisting of 44 questions in cooperation with Nielsen—the *Chicago Booth Expectations and Attitudes Survey*. A central feature of the survey is that we target all household members of the KNCP. The survey consists of three sections, which build on the Michigan Survey of Consumers, the New York Fed Survey of Consumer Expectations, the Panel on Household Finances at the Deutsche Bundesbank, as well as the pioneering work of de Bruin et al. (2011) and Cavallo, Cruces, and Perez-Truglia (2017).

Nielsen fielded the first wave of the survey in June 2015 and the second wave in June 2016. The final overall survey sample included 92,511 households. In the first wave, 49,383 individuals completed the survey from 39,809 unique households, which amounts to a response of 43%. The average response time was 14 minutes and 49 seconds, which is close to our estimate of a response time of about 15 minutes. The second wave had 43,036 unique respondents from 36,758 unique households. The second wave included a few additional questions and response times were consistently slightly longer – the average response time was 18 minutes and 35 seconds.

The first section of the survey asked a series of questions about respondents' demographic characteristics, which were more detailed than the basic demographic information the KNCP provides. We collected information on narrow college majors, employment status, current occupation, income expectations, rent and mortgage, and medical expenses, and we identified the primary shopper of the household among all the responding members.

The second section of the survey contains questions on respondents' expectations about prices and inflation. We randomize between two sets of questions. The first set follows the design of the Michigan Survey of Consumers (MSC), and asks survey participants about the prices of things on which they typically spend money. The second set of questions uses a design inspired by the New York Fed Survey of Consumer Expectations (SCE), and asks specifically about inflation.

We first ask individuals about their perception of past inflation, that is, inflation over the previous 12 months. We then ask them about their expectations for 12-month-

ahead inflation. In addition to asking for point estimates of the expectations, we elicit a full probability distribution of expectations by asking participants to assign probabilities to different possible inflation rates or changes in prices, depending on the group. The distribution also allows us to check that respondents do not merely anchor the value they report for the point estimate of inflation expectations to the one they reported for the point estimates of inflation perceptions. To further guarantee our results are not driven by households thinking about perceived inflation and then anchoring all expectations to the first one they reported, we show our results are robust to excluding respondents who report the same values for perceptions and expectations of inflation.

We start both blocks of questions with a short introduction: "In the next four questions, we will ask for your opinion on a few topics. It is important to us that you reply without any external influence. In particular, please do not search the internet or other sources while going over the following questions."

For all numerical questions that elicit a point estimate of inflation, such as the perceived inflation rate and the expected inflation rate, we allow for answers from -100 to 100 and permit up to two decimal points. The question that elicits the distribution of inflation expectations follows the design in the SCE and allows us to ensure that those responding with extreme values to the point-estimate question do not drive any results.

The third section of the questionnaire combines questions about the general economic outlook, consumption, and savings with the elicitation of risk aversion and numeracy. The economic-outlook questions center around expectations for GDP growth, unemployment, and personal income expectations. We use this information to condition all our analyses on households' macroeconomic expectations, because Bachmann et al. (2015) and Mian, Sufi, and Khoshkhou (2015) document households' general sentiment about the state of the economy is important for inflation expectations and consumption decisions. The questions on risk aversion and numeracy follow the design in Lusardi and Mitchell (2007).

C. Summary Statistics

We report a set of summary statistics and descriptives of our data in Table 1. To avoid the possibility of severe outliers driving any of our results, we winsorize all continuous

variables at the 1% and 99% levels. Across the two survey waves, we have a running sample of 59,126 individuals for whom we observe complete data from both the KNCP and survey responses for expected inflation, demographics, and economic expectations.

The average age of the survey respondents is 61. About two thirds of the respondents are women. Both statistics are consistent with the composition of the KNCP, which, as discussed in earlier research, includes a higher proportion of women and retirees than in the US population (e.g., see Kaplan and Schulhofer-Wohl (2017)). To address the concern that any specific subpopulations drive the facts we document in the paper, we will provide evidence on the robustness of our baseline results by demographic groups.

Five percent of respondents are unemployed, and almost three quarters of them own a house. The average household size is 2.2 and almost half of the survey participants hold a college degree. Survey participants expect, on average, stable household income over the following 12 months. They are mildly positive about the economic outlook for the US, and expect the economic situation of the household to stay the same. The median income bracket is between USD 45,000 and USD 60,000. In terms of racial and ethnic composition, 85% of the respondents are white, 8.5% are black, and 3.1% Asian.[5]

Overall, our survey respondents appear to be more educated and wealthier than the average US individual. These features of the survey population are important, because researchers have criticized household surveys asking about inflation expectations on the basis that too many households do not know or understand the concept of inflation. To the extent that higher education is related to a higher understanding of concepts such as inflation, our pool of respondents is less prone to this criticism.

Moving on to the statics for inflation expectations, the participants expect, on average, one-year-ahead inflation of 4.67%, which is slightly higher than the average perceived inflation over the previous 12 months of 4.4%. Panel A of Figure 4 is a histogram of the 12-month-ahead expected inflation rates. We see substantial mass between 0% and 5%, but also bunching at values that represent multiples of 5%. Previous research based on the MSC has argued individuals that are uncertain about inflation report expectations

[5]We use income-group fixed effects and race fixed effects in all our empirical analyses to absorb time-invariant systematic differences in the consumption bundles and expectations across income groups and racial groups.

for inflation at rounded thresholds (e.g., see Binder (2017)) and the respondents to our survey seem to behave in a similar fashion. Lastly, consistent with evidence from the MSC and SCE, we find large dispersion in expectations across individuals ranging from -20% to +45%.

III Conceptual Framework

Inflation expectations are central to the conduct of monetary policy and determine the effectiveness of fiscal and monetary policy. Hence, we review the recent revival of the interest in subjective expectations, discuss the current conduct of monetary policy and the measurement of inflation expectations, and introduce our baseline measure of realized inflation at the household level.

A. Realized Inflation and Inflation Expectations

The relevance of subjective expectations for aggregate outcomes has been revived recently in economics research. Bernanke (2007) motivates this agenda arguing inflation expectations drive consumers' consumption, saving, and borrowing decisions, as well as workers' wage bargaining with firms and managers' price-setting decisions, which in turn determine the effectiveness of fiscal and monetary policy, among other outcomes. In the words of Janet Yellen, "with nominal short-term interest rates at or close to their effective lower bound [...], the broader question of how expectations are formed has taken on heightened importance. [...] many central banks [...] [are] adopting policies that are directly aimed at influencing expectations of future interest rates and inflation" (Yellen (2016)).

Figure 5 plots average one-year-ahead inflation expectations from the MSC together with the 25^{th} and 75^{th} percentiles as well as the realized core inflation rate that is the main focus of the Federal Reserve from January 2000 until December 2018. Core inflation excludes volatile series such as food at home and groceries. We see that MSC expectations are substantially higher and more volatile than the core inflation rate. Moreover, the average MSC expectations mask large differences in forecasts across consumers. The

average inflation forecast for the 75^{th} percentile is 5.07%, whereas it is only 1.22% for the 25^{th} percentile, implying an interquartile range of 3.85%.

What might explain the difference in the time-series properties of inflation expectations from realizations? Even more than 10 years after the financial crisis policy interest rates remain low and realized inflation and inflation forecasts by the Federal Reserve remain below the official definition of price stability. And yet households still have inflation expectations that are substantially above 2%. Coibion and Gorodnichenko (2015b) document a large rise in inflation expectations of households since 2009 relative to the forecasts of professional forecasters, and argue the sharp rise in gas prices, which are visible and salient (Hastings and Shapiro (2013)), appear to be a natural explanation for this phenomenon. Shwayder (2012) estimates a reduced-form model of expectations formation and finds evidence in line with an extrapolative-bias from gas price changes to overall inflation expectations. Whereas large heterogeneity in gas prices exists across counties in the US, little heterogeneity exists in local gas-price inflation, because the movements in global oil prices determine almost exclusively the changes in gas prices. Hence, gas-price inflation could be a viable candidate to explain parts of the large time series variation in average expected inflation we observe in Figure 5 but seems unlikely to help explain large parts of the differences in expected inflation across individuals. Moreover, Binder (2018) notes that most of the literature studies the association between the level of gas prices and inflation expectations. Studying jointly the expectations of overall and gas-price inflation, she finds no evidence of a systematic bias in how average expectations are formed.

The large differences in expectations across consumers suggest consumers might make vastly different consumption and savings decisions (D'Acunto et al. (2016)). Despite recent theoretical attempts to rationalize variation in forecasts over time across different demographic groups, we still have little knowledge on what drives these differences across similar consumers at any given point in time. Kaplan and Schulhofer-Wohl (2017) find substantial variation in household-level realized inflation rates. We build on this framework to investigate if and how consumers might use the price changes they face when forming aggregate inflation expectations.

B. Current Conduct of Monetary Policy and Measurement of Inflation Expectations

A long debate exists on which price series central banks should target. A conventional reason for why most inflation-targeting central banks focus on core inflation that excludes food and energy prices is their high volatility, the temporary nature of price changes, and the conviction that central banks have few tools to directly stabilize these prices.

Goodfriend and King (1997) and King and Wolman (1999) support this view and argue that an inflation-targeting central bank with perfect credibility should define its policy target with respect to core inflation. Cavallo (2008) and Harris et al. (2009) instead argue that policy makers should include these volatile price series in the definition of price stability to the extent that decision markers, households and firms, respond excessively to these price series in their inflation expectations. Excessive in this context means putting more weight on the price change than the weight in the representative consumption basket.

Recently, policy makers have realized the possible concerns for central-bank credibility and policy effectiveness when decision-makers focus on salient price changes in the formation of inflation expectations. St. Louis Fed President James Bullard (2011) argues, "With trips to [...] the grocery store being some of the most frequent shopping experiences for many Americans, it is hardly helpful for the Fed credibility to appear to exclude all those prices from consideration in the formation of monetary policy." Yet, not all policymakers share this view. The President of the Chicago Fed, Charles Evans, together with the Director of Macroeconomic Research, Jonas Fisher, study empirically the implications of rising commodity prices for inflation and monetary policy, and conclude, "If commodity and energy prices were to lead to a general expectation of a broader increase in inflation, more substantial policy rate increases would be justified. But assuming there is a generally high degree of central-bank credibility, there is no reason for such expectations to develop" (Evans and Fisher (2011).

Not only policymakers target specific price indexes that exclude extreme price movements; even officially released measures of consumer inflation expectations only report median estimates instead of average inflation expectations, because the latter tend

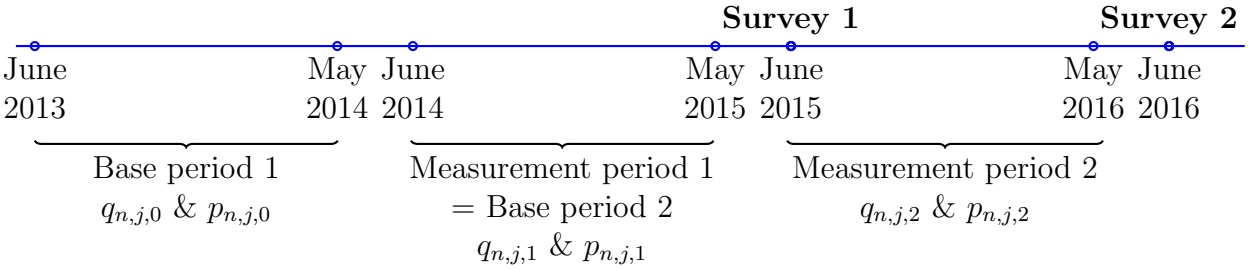
to be more volatile and are substantially higher. For the MSC, the average expected inflation rate is 4.4% for a sample from January 1978 until May of 2019, which is 0.8 percentage points higher than the median expected inflation rate. Yet, only the median expected inflation rate is prominently displayed on the survey web page and widely distributed via the Federal Reserve Economic Data data page of the St. Louis Fed. Similarly, the New York Fed only covers the median inflation expectations over time, which averages to 2.85%, whereas D'Acunto et al. (2018) find an average expected inflation rate of 5.68% for a sample period between June 2013 until April 2018.

The higher average expected inflation rate in the SCE compared to the MSC can be explained by several survey design features of the Michigan Survey. First, the survey truncates all responses larger than 95% in absolute value when transcribing the responses. Second, the survey truncates reported expectations at -10% and +50% when reporting mean inflation expectations. Finally, the interviewer probes each survey participant that reports a one-year-ahead expected inflation rate of more than 5%, but not other respondents with "Let me make sure I have that correct. You said that you expect prices to go (up/down) during the next 12 months by (X) percent. Is that correct?"

Possibly even more worrisome is the current code of conduct in the EU. The Directorate General for Economic and Financial Affairs of the European Commission conducts regular harmonized consumer surveys also eliciting questions on changes in prices since 1985. Until recently, however, the European Commission only published qualitative inflation expectations and not the quantitative expectations, because of concerns that the high average level of expected inflation would indicate unanchored inflation expectations and would be a sign of little central-bank credibility. For the overall EU, the average expected inflation rate was 6.6% for a sample between the first quarter of 2004 and the second quarter of 2019, the median expected inflation rate was 4.4%, but the average perception of current inflation over the same period was 9.2%.

Taken together, the current conduct of monetary policy excludes volatile price series and statistical agencies and offices exclude "extreme" inflation expectations, either because they consider these expectations outliers or because they would undermine the credibility of central banks. In the paper, we find that consumers base their "extreme"

Figure 3: **Timeline of Inflation Measurement and Surveys**



inflation forecasts on meaningful variation in prices to which they are exposed. We also show they make economic decisions based on such expectations. Thus, central banks' focus on core inflation might result in large policy mistakes and the current convention of statistical offices to truncate extreme observations or not even release the data might be misguided.

C. Household-level Observed Inflation: Household CPI

We use the information on the prices and quantities in the KNCP households' consumption baskets to compute measures of household-level inflation. For the first wave of our data, we use price changes from the period between June 2013 and May 2014 to the period between June 2014 and May 2015, which is the month before we fielded the first wave of our survey. The timing varies accordingly for the second wave, which we ran in June 2016. Figure 3 summarizes the timing.

We define Household CPI, a measure of household-level consumer price inflation, as the weighted average of the log price changes that households face in their consumption bundles:

$$CPI_{j,t} = \frac{\sum_{n=1}^{N} \Delta p_{n,j,t} \times \omega_{n,j}}{\sum_{n=1}^{N} \omega_{i,j}}, \tag{1}$$

where $\Delta p_{n,j,t}$ is the log price change of good n faced by household j at time t, and $\omega_{n,j}$ is the weight of good n in the inflation rate for household j.

Household CPI mimics the actual CPI that national statistical offices build all over

the world. The typical CPI uses the consumption basket of a representative household in the economy. We define the Household CPI, instead, as a Laspeyres price index that uses the expenditure shares for each item in the Nielsen data purchased by the individual household in the base period as the weights:

$$\omega_{n,j} = p_{n,j,0} \times q_{n,j,0},$$

where $q_{n,j,0}$ is the amount of good n household j purchased in the base period. In our case, we use all goods a household purchased in the base period, that is, June 2013 to May 2014 for the first wave of the survey, to construct the expenditure shares.

Defining the expenditure shares and the relevant base period at the household level poses a set of conceptual and empirical challenges that do not arise in a representative-bundle setting. First, household consumption spending is highly seasonal and households purchase certain goods throughout the year, and other goods only rarely. To deal with these issues, we first calculate volume-weighted average prices during both the base year, $p_{n,j,0}$, and the year over which we measure inflation, $p_{n,j,1}$, following Kaplan and Schulhofer-Wohl (2017).

Another issue in defining a CPI at the household level is that individual households might decide to stop purchasing certain products over time, an issue that does not arise at a high frequency when the CPI is based on a representative consumption bundle. In the case of discontinuity in purchases, we impute the prices households would have paid had they purchased the good. To impute prices, we first look for the price of the good in the county in which the household resides. If the good was not sold in the county, we look for it in the state of residence. If the UPC was not sold in the state, we look for the average US price. If we still can't find the price, we assume a zero price change.[6] All the results are virtually identical if we assume a missing price or do not do any imputations. For the second wave, we move the base period forward by one year. For individuals that stay in the survey, we can thus interpret the Household CPI as a chained Laspeyres index.

[6]The last two steps virtually never arise in our setting.

IV Grocery-Price Changes and Inflation Expectations

In this section, we study the systematic association between the inflation individuals face in their households' shopping bundles and individual expected inflation.

A. Household CPI and Inflation Expectations

In our baseline analysis, we study the association between the measures of household-level inflation and households' expectations regarding general inflation in the subsequent 12 months. We estimate the following linear specification by ordinary least squares:

$$\mathbb{E}\,\pi_{i,t\to t+1} = \alpha + \beta \times \pi_{i,t-1\to t} + X_i'\gamma + \mathbb{E}_i'\,\gamma + \eta_w + \eta_q + \eta_i + \eta_I + \epsilon_i, \tag{2}$$

where $\mathbb{E}\,\pi_{i,t\to t+1}$ is the numerical inflation rate individual i expects for the following 12 months and is measured in percentage points; $\pi_{i,t-1\to t}$ is the Household CPI computed based on household shopping bundles over the previous 12 months;[7] X_i is a vector of characteristics of individual i, which include age, the square of age, sex, employment status, home-ownership status, marital status, household size, college dummy, race dummies, and risk tolerance as elicited through survey questions; $\mathbb{E}_i$ is a vector of individual qualitative expectations about household income, the aggregate economic outlook, and the personal financial outlook for the following 12 months; η_w is a survey-wave fixed effect to allow for systematic differences in levels of expected and realized inflation between June 2015 and June 2016; η_q is an inflation-question fixed effect to allow for systematic differences in the means of inflation expectations for the case in which we ask individuals about inflation or about changes in prices; η_i is an individual fixed effect that we include in some specifications to absorb any systematic time-invariant differences across individuals; and η_I is a set of 16 income dummies we obtain from Nielsen.[8] We cluster standard errors at the household level to allow for correlation of

[7] We assign the same value of the Household CPI to all survey participants i within each household j and explore heterogeneity by shopping frequency below.

[8] We do not observe the exact level of labor income as a continuous variable but rather income brackets.

unknown form of the residuals across respondents in the same household, for all of whom the measures of household-level inflation are the same.

Columns (1)-(3) of Table 2 report the results for estimating equation (2) using the Household CPI as the main explanatory variable of interest. In column (1), we only absorb the question-design and survey-wave fixed effects. We find a positive and statistically significant correlation between expected inflation and the Household CPI. A one-standard-deviation increase in the Household CPI is associated with a 0.17% increase in expected inflation. Column (2) shows the association barely changes when we partial out a rich set of demographics, individual expectations, and county fixed effects. In column (3), we restrict the variation in inflation expectations and Household CPI within individual and over time. In this specification, the baseline coefficient is only identified by those individuals that respond to both waves of the survey. The within-individual association is slightly higher than the estimate when allowing for systematic cross-sectional variation when estimating the specification. This result is assuring because it suggests that unobserved characteristics that vary systematically across individuals and might shape, for instance, both the types of goods individuals purchase and their inflation expectations, are unlikely to explain our findings.

B. Overweighing Goods Purchased Frequently: Frequency CPI

As we discussed in the introduction, research in cognitive psychology suggests more frequent stimuli have a larger influence on individual perceptions of signals relative to less frequent stimuli, irrespective of the attention individuals pay to such stimuli (e.g., Watanabe et al. (2001) and Seitz and Watanabe (2005)). Moreover, individuals might face cognitive constraints and use signals they observe in their daily lives to form expectations about overall inflation. Individuals might perceive more frequently observed price changes as being more precise, and optimally put a larger weight on these price changes when forming expectations (see Angeletos and Lian (2016) for an overview). We might thus expect the price changes of the goods consumers purchase more frequently to have a larger impact on individuals' inflation expectations, either because they are more representative and more likely to come to mind than the price changes of other goods, or because

individuals think these price changes have a higher signal-to-noise ratio.

The Household CPI we used above assigns weights according to goods' expenditure shares in the base period. To test our conjecture, we now propose a second measure of household-level inflation, the Frequency CPI. The Frequency CPI uses the number of times household j purchased good i in the base period as the weight of observed price changes in the household's consumption basket (see equation (1)):

$$\omega_{i,j} = f_{i,j,0\to1},$$

where $f_{i,j,0\to1}$ is the frequency of purchase, that is, the number of times the household purchases the good throughout the 12-month base period.

We find, indeed, that the cross-sectional variation captured by the Frequency CPI differs from the one captured by the Household CPI. In Panel B of Figure 4, we see for both measures large mass around 0, with slightly more mass concentrated in this area for the Frequency CPI. At the same time, there is also mass in the tails – more in the right than in the left. The tails are fatter for the Household CPI than for the Frequency CPI, although this slight difference is not detectable statistically.

Moreover, Panel C of Figure 4 sorts survey respondents across bins by their realized Household CPI and Frequency CPI. The y-axis reports the average expected inflation rate within each bin. Individuals with the lowest realized Household CPI expect an average inflation rate of 4.4%. Average expected inflation increases monotonically as the Household CPI increases and reaches an average expected inflation rate of slightly more than 4.9%. The range between the expected inflation rates of the highest and lowest levels of the Household CPI is 0.5 percentage points, which is about 11% of the average expected inflation rate and about 33% of the representative-bundle realized inflation rate in the period we consider. For the Frequency CPI, we see similar patterns, but the spread in average expected inflation rates between low and high realized Frequency CPI is magnified to more than 0.7 percentage points, which suggests the dispersion in expected inflation the Frequency CPI predicts is higher than the dispersion the Household CPI predicts.

After showing the two measures might capture different sources of variation in our

sample, we replicate the baseline analysis discussed above considering the Frequency CPI as the covariate of interest, which overweighs the price changes consumers observe for the goods they purchase more often. Columns (4)-(6) of Table 2 show the estimated associations with inflation expectations are between 20% and 50% larger for the Frequency CPI than for the Household CPI.

In columns (7)-(9) of Table 2, we compare the extent to which our two measures of household-level observed inflation contain independent information that helps explain inflation expectations. On the one hand, individuals might focus more on the price changes of the goods on which they spend relatively more money when making inferences about general inflation. On the other hand, consistent with the cognitive psychology literature and possibly new models with information rigidities, individuals might focus on the price changes of the goods they purchase frequently. Across the specifications in columns (7)-(9), we see the coefficient on the Household CPI shrinks towards 0 and is no longer statistically significant. The point estimate on the Frequency CPI, instead, barely changes compared to the corresponding specifications in columns (4)-(6), and remains highly statistically significant in all cases. Taken together, individuals appear to use the price changes they observe during their shopping trips to form inflation expectations and this pattern is especially strong for goods households purchase frequently. The latter finding hints at a role for memory, salience, and attention in explaining this phenomenon.

In the rest of the paper, we only report results for the Frequency CPI because the results are similar for the Household CPI. Armed with the Frequency CPI, we want to dissect the features of our baseline results and dig deeper into the channels that might help explain them.

C. Assessing the Economic Magnitudes

To better understand whether experienced inflation in the shopping bundle is an economically relevant predictor of individuals' inflation expectations, we now compare the sizes of the association between household-level inflation and inflation expectations to the sizes of the associations between relevant demographics and inflation expectations.

Individuals whose Frequency CPI is above the median of the distribution have, on

average, inflation expectations that are 0.3 percentage points higher than individuals below the median of the distribution. Malmendier and Nagel (2015b) document lifetime inflation experiences matter for individuals' inflation expectations. In our survey, the oldest 50% of survey participants have inflation expectations that are, on average, 0.075 percentage points higher than the inflation expectations of the youngest 50%. The smaller difference by age is not inconsistent with the findings in Malmendier and Nagel (2015b), who mainly focus on how inflation expectations differ across cohorts over time based on lifetime-experienced inflation and how different cohorts react to the same inflationary shocks. In fact, learning from experiences predicts small differences in expected inflation in the low and stable realized inflation environment of the last decades. In related work, Goldfayn-Frank and Wohlfart (2019) find East Germans expect 0.4% higher inflation than West Germans decades after the reunification because of the inflationary shock that only occurred in former Eastern Germany after the reunification.

Gender is one of the strongest demographic predictors of inflation expectations. We find in our survey that women have inflation expectations that are, on average, 0.54 percentage points higher than the inflation expectations of men. D'Acunto et al. (2018) document that differences in shopping behavior can explain in large part the gender differences in inflation expectations.

Das et al. (2018) document that income and socioeconomic status help predict individuals' macroeconomic expectations such as business conditions, the national unemployment rate, and stock returns. As for inflation expectations, we find unemployed survey participants have inflation expectations that are 1.15 percentage points higher than the inflation expectations of employed individuals. High-income individuals have inflation expectations that are, on average, 0.85 percentage points lower than the expectations of the participants in the bottom 50% of the income distribution. Income and employment status are conceivably correlated with consumption bundles and hence the prices individuals who differ along these dimension see during their shopping trips (see Argente and Lee (2017) and Kaplan and Schulhofer-Wohl (2017) for differences in experienced inflation by income).

Household size only predicts differences in expected inflation of 0.15 percentage

points, and college-educated survey participants have average inflation expectations that are 0.38 percentage points lower than survey participants without a college degree.

Taken together, shopping experiences predict differences in inflation expectations that are sizable and of comparable magnitudes to other possible demographic determinants. To ensure none of these alternative determinants of inflation expectations drive our findings, we always condition on a rich set of observables.

D. Robustness

We run specifications excluding individuals that expect exactly zero inflation for the following 12 months. In the first three columns of Table A.1, the correlation between the Frequency CPI and expected inflation is similar in magnitude to the baseline associations, both unconditionally as well as conditional on a rich set of demographics and after absorbing individual fixed effects.

Inspired by the work at the New York Fed, we elicited probability distributions of expected inflation in addition to point estimates. Given the question design for the probability distributions requires us to include a finite number of bins, we observe substantially less dispersed average expectations across individuals in this question compared to the point estimates. For this reason, we would expect smaller coefficients when estimating equation (2) relative to when we use the point estimates directly. Consistently, columns (4)-(6) of Table A.1 document a statistically significant, positive yet smaller association between expected inflation and the Frequency CPI when we use the average of the full distribution instead of the point forecast. A one-standard-deviation increase in the Frequency CPI is associated with a 0.1% increase in expected inflation.

The perception of past inflation is highly correlated with expected future inflation (see Jonung (1981)). We argue and document below that the price changes in households' shopping bundle help explain variation in inflation expectations because they shape individuals' perceived inflation. A concern is that a spurious correlation between inflation perceptions and expectations might drive our findings. For instance, because respondents provide first their inflation perception for the previous 12 months and then their expectations about future inflation, one might worry they only think about perception

and then anchor all the following answers to the value they chose for perception. In columns (7)-(9) of Table A.1, we report our baseline results when excluding individuals who report the same numerical value for perceptions and expectations. Even for this sample, we confirm the positive association between the Frequency CPI and inflation expectations. Within individual, the effect is no longer statistically significant but still economically large and similar in magnitude to the baseline effect.

Overall, our baseline results do not depend systematically on the method we use to elicit inflation expectations or on any potential mechanical correlation and/or anchoring of inflation expectations to inflation perceptions.

V Understanding the Mechanisms

After having documented the fact that individuals use the price changes of the goods they purchase frequently when forming their general inflation expectations as well as the robustness of this finding, we move on to assess the mechanisms that might explain the baseline results. In particular, we aim to assess the extent to which the standard rational-inattention framework might be consistent with our findings, or, alternatively, in which directions the standard framework should be adjusted to accommodate the findings.

A. Size of Price Changes and Inflation Expectations

The standard rational-inattention framework would suggest consumers learn similarly from the signals they obtain through the price changes they experience while grocery shopping, irrespective of the size of such price changes. By contrast, if the salience of price changes matters, consumers who experience more extreme price changes should rely more on them when forming inflation expectations. In this case, consumers who happen to sample from the tails of the grocery-price-change distribution would react more to the signal they observe relative to consumers who happen to sample from the middle of the distribution. We provide evidence consistent with this latter intuition.

In Table 4, we estimate our baseline specification separately for three mutually exclusive equal-sized subsamples. *Bottom Frequency CPI* includes the third of our

sample that faces the most extreme negative price changes, for which the Frequency CPI ranges from -11.7% to -0.9%. Columns (1)-(2) of Table 4 show a positive association of 0.32 percentage points between Frequency CPI and inflation expectations for this group. This coefficient is about 50% larger than the baseline coefficient for the whole sample we reported in column (5) of Table 2.

Columns (3)-(4) of Table 4 consider the third of the sample with intermediate values of Frequency CPI, ranging between -0.9% and 2.8%. This group includes respondents who face small price changes, either on the positive or negative side. In this case, we estimate an economically and statistically insignificant association between the Frequency CPI and inflation expectations, suggesting those consumers who face moderate price changes barely use such changes when forming expectations.

We then move on to *Top Frequency CPI*—the top third of the sample, based on grocery-price changes. The Frequency CPI ranges from 2.8% to 23.1% for this group, which thus only includes positive price changes. Similar to the opposite extreme—*Bottom Frequency CPI*—respondents in this group display an economically and statistically significant association between experienced price changes and inflation expectations.

Overall, the results in Table 4 suggest respondents who face the most extreme price changes in their consumption bundles, irrespective of the sign of such changes, use them extensively when forming inflation expectations. By contrast, respondents who face moderate price changes do not seem to use them at all when forming expectations.

B. Shopping Frequency and Exposure to Price Changes

A second prediction of the standard rational-inattention framework is that agents should rely on the price changes observed while grocery shopping if these signals are cheaper to gather that other signals about inflation. From this perspective, frequent shoppers should face a lower cost of recalling price information and collect more frequent and hence more precise signals relative to infrequent shoppers. Frequent shoppers should thus rely more on household-level prices when forming expectations.

Recent models that depart from the rational-inattention framework (e.g., see Bordalo

et al. (2019)), instead, generate the opposite prediction: Infrequent shoppers should rely more on the price changes they observe while shopping. This prediction arises because infrequent shoppers observe fewer price changes (due to the lower frequency of shopping), but larger price changes. When infrequent shoppers think about price changes from their shopping trips, they should be more likely to recall large price changes. Frequent shoppers, instead, tend to face only small departures from the "normal price" and experience many small price changes at high frequency (Eichenbaum, Jaimovich, and Rebelo (2011)), because grocery prices change in all directions at high frequencies, including negative changes due to temporary sales, discounts, and coupons (Nakamura and Steinsson (2008)). These facts diminish the surprise and hence the stimulus that would induce automatic retrieval of prior experiences when forecasting inflation (Bordalo et al. (2019); Kahneman and Miller (1986)), thus reducing the role of household-specific prices on expectations.

For our empirical test, we consider three alternative proxies of grocery-shopping frequency. First, we split the sample based on whether the respondent is the primary grocery shopper of the household. By definition, primary grocery shoppers are exposed to grocery prices more often than others. Columns (1)-(2) of Table 5 show the correlation between the Frequency CPI and inflation expectations is 40% higher for respondents who are not their household's main grocery shopper.

Columns (3)-(4) split the sample between individuals who shop more than once a week and others. In column (3), the correlation between the Frequency CPI and inflation expectations is about 40% higher for respondents who shop less than once a week. Because the sample of respondents who shop less than once a week is small (N=4.745), though, the statistically significant coefficient is estimated with noise, and we fail to reject the null that this coefficient equals the one for respondents who shop at least once a week.

The survey did not distinguish within the group of respondents who shop at least once a week, and the vast majority of the sample falls into this group. In a third test, we thus also consider the respondent's distance (in minutes) from the household's primary shopping outlet. Here, we conjecture that respondents who live close to their shopping outlet might grocery shop often, and possibly several times in a week, whereas individuals living farther away might only shop infrequently. In columns (5)-(7) of Table 5, we find the

association between the Frequency CPI and inflation expectations increases monotonically with respondents' distance from their main shopping outlet, ranging from 0.14 for those who live less than 20 minutes from the store to 0.80 for those who live more than one hour away.

All three tests in Table 5 provide results consistent with the conjecture that a lower frequency of exposure to prices correlates with higher reliance on observed price changes when forming inflation expectations. This fact informs theorists on the direction in which the standard rational-inattention framework should be enriched to explain the formation process of macroeconomic expectations.

C. Testing Additional Economic Mechanisms

In the rest of this section, we propose additional tests that add to our understanding of the process through which consumers incorporate household-level price changes into their inflation expectations.

C.1 Perceived Price Changes and Frequency CPI

First, we verify that exposure to price changes relates not only to inflation expectations, but also to consumers' perceptions about the prevailing inflation rate. Verifying this condition helps rule out that unobserved changes in consumers' characteristics affect their consumption baskets as well as their expectations about future macroeconomic variables, including inflation, through a channel that does not involve relying on observed price changes.

We estimate a set of specifications similar to equation (2), in which we regress individual-level numerical inflation perceptions, which we elicited for a horizon of 12 months before the interview, on the Household CPI and Frequency CPI. We report the results of this estimation in Table A.2 of the Online Appendix. The Household CPI (column (1)) and the Frequency CPI (column (2)) are both positively associated with perceived inflation separately, but similar to our baseline results, only the correlation between the Frequency CPI and perceived inflation remains economically and statistically significant when both measures are added to the same specification.

C.2 Exposure to Alternative Information Sources

In the introduction, we argued our results could be interpreted as direct evidence in support of the island-model assumption that observed price changes are agents' source of information about inflation. Our findings do not imply, though, that consumers ignore other direct and indirect sources of information about inflation.

To test whether the role of price changes consumers experience in their daily lives varies systematically based on other sources of information, we asked respondents in the second wave of the survey to choose the three most common sources of information they thought about when they answered the questions on inflation expectations. Choices included the following: Newspaper, Magazine; Radio, Television; Colleagues; Friends & Family; Financial advisors; Social networking websites; Other websites; Shopping experience; Other (specify). We randomized the ordering of appearance of these options to avoid any anchoring effects.

We split our sample based on three sorting variables: (1) a *Media* dummy that takes the value of 1 if the respondent ranks Newspaper, Magazine; Radio, Television; Social networking websites; Other websites among the top three choices; (2) an *Other People* dummy that takes a value of 1 if the respondent ranks Colleagues; Friends & Family among the top three choices; and (3) an *Own Experience* dummy that takes a value of 1 if the respondent ranks Shopping experience among the top three choices.[9]

Table 6 estimates our baseline specification across sample splits. When we consider individuals who obtain information about inflation from the media (columns (1)-(2)), we detect an economically and statistically insignificant correlation between the Frequency CPI and expected inflation. Because the sample size is large, lack of statistical power is unlikely to drive this result. The association is positive for respondents who do not rely on the media. The size of this coefficient is 50% larger than the size of the estimated coefficient for the whole sample (see column (5) of Table 2). Overall, once individuals have access to objective information about overall inflation, the effect of shopping-bundle-experienced price changes on inflation expectations is muted, consistent with the early

[9]Note the survey allows for non-exclusivity in the sources respondents access, and hence the same respondent might at the same time report consulting the media, other people, and/or own experience among the top three sources of information.

critique of the Lucas model.

In columns (3)-(4), we consider respondents who rely on information obtained from other people. This category includes family members, and hence the results might capture the effect of household-level price changes on household members that do not do the grocery shopping directly. This effect would be consistent with Bailey et al. (2018) and Bailey et al. (2019), who document the transmission of experienced house-price changes across social networks. Indeed, we can reject the null that the Frequency CPI in unrelated to inflation expectations for respondents who rely on information obtained through other people.

Finally, we check that our splits are meaningful by considering respondents who report that they rely mainly on their own experience (columns (5)-(6)). In this case, as we would expect, the size of the estimated coefficient is twice as large for respondents who rely on their own experience, and a t-test for whether the two coefficients are equal rejects the null hypothesis below the 10% level of significance.

The last split we consider compares respondents who go to gas stations at least once a week (High) to others (Low). Hastings and Shapiro (2013) show gas-price changes are salient to consumers and drive their consumption choices. Being exposed to gas price-changes frequently might thus reduce the extent to which respondents rely on grocery-price changes when forming inflation expectations, which is what we find in columns (7)-(8) of Table 6.

These results link back to the debate about the assumption in the Lucas model. The positions of both Lucas (1975) and his critics seem to have merits. The majority of our representative sample uses the price changes they face on their "shopping island" to form inflation expectations. At the same time, respondents who access newspapers or other media sources do not rely on such price changes. The key insight our test brings to the debate is that, despite the availability of unbiased information about aggregate inflation, many consumers do not access such information, and hence household-specific price changes from grocery shopping matter in their expectations-formation process.

C.3 Cognitive Costs of Accessing Alternative Information Sources

Building on the rational-inattention framework, we also ask whether the cognitive costs consumers face to access information about aggregate inflation might explain the fact they do not access such sources. Such costs could be lower for consumers with higher cognitive abilities and numeracy,[10] as well as for consumers who access economic news for reasons unrelated to their expectations, irrespective of their decision to sort into such information sources, for instance, because they own a mortgage and need to follow the movements of interest rates and house prices.

To assess the relevance of grocery-price changes for inflation expectations based on the costs respondents might face to access unbiased sources of information about inflation, we run the analysis of equation (2) separately across four sample splits. First, we split the sample based on whether the respondent has a college major in a quantitative subject. We define the quantitative major dummy to take a value of 1 for respondents who hold one of the following majors: accounting, economics, finance, computer programming, computer science, data processing, engineering, mathematics, or physical sciences. We focus on quantitative majors, as opposed to any college education, because the curricula of non-quantitative college majors barely include any topics that might strengthen students' numeracy and/or financial literacy skills. Numeracy and financial literacy should reduce respondents' costs of accessing information sources about inflation such as the specialized press. Consistent with our conjecture, in columns (1)-(2) of Table 7, we find a higher association of the Frequency CPI with inflation expectations for respondents who do not hold a quantitative college degree.

The second split we study considers respondents who are exposed to other sources of information about prices even if they do not actively access them with the aim of forming inflation expectations. Because inflation has a big impact on the real value of mortgages, we conjecture that individuals who hold a mortgage might be more exposed than others to specialized sources of information regarding inflation. Consistently, individuals who hold mortgages display a 45% lower association between the Frequency CPI and inflation

[10]For instance, D'Acunto et al. (2019b) and D'Acunto et al. (2019c) document high-IQ men have more accurate inflation expectations and are more likely to make economic decisions in line with theoretical predictions than other men.

expectations relative to non-mortgage holders.

In a similar vein, we compare respondents who participate in the stock market with other respondents. Previous research documented greater stock market participation for more educated and higher-income individuals (D'Acunto, Prokopczuk, and Weber (2019)) who also tend to have more accurate inflation expectations (D'Acunto et al. (2016)). Consistently, in columns (5)-(6), we find stock market participants have an association between the Frequency CPI and inflation expectations that is lower by 30% than do non-participants.

Finally, we consider respondents with different levels of uncertainty of inflation expectations. Respondents with more uncertain inflation expectations might follow rules of thumb when forming inflation expectations (Binder (2017)) and not follow economic news or other sources of information that would anchor their expectations. Following Manski and Molinari (2010) and Binder (2017), we proxy for uncertainty of numerical inflation expectations based on whether respondents report rounded values or non-rounded values when reporting their expectations. Consistent with our conjecture, in columns (7)-(8) of Table 7, we find the association between the Frequency CPI and inflation expectations is more than twice as large for rounders than for non-rounders. Note that these results hold in a multivariate specification in which we control for important determinants of uncertainty in inflation expectations, such as income and education levels, which related to households' socio-economic status (Ben-David et al. (2018)).

VI Inflation Expectations and Other Outcomes

So far, we have studied the relationship between the price changes individuals observe while shopping and their inflation expectations. One might wonder what is the extent to which varying inflation expectations influence economic decisions and are ultimately relevant for real outcomes. D'Acunto et al. (2016) show individuals who expect higher inflation are more likely to purchase durable goods in a representative sample of European households. To shed light on the far-reaching role of inflation expectations for other economic outcomes in the current setting, we test for the association between respondents'

inflation expectations and a set of relevant expectations and choices in domains we can directly observe other than shopping.

As far as expectations of other relevant prices are concerned, we focus on expected wage inflation as well as house-price expectations. Wage inflation, that is, the expectations about future wage growth, are central for the consumption and investment decision of households as well as for their labor-supply decisions. Moreover, these expectations are important because they determine firms' marginal costs of production. Higher inflation expectations might make workers and unions bargain for higher wages to ensure inflation does not lower their real wages, and hence individuals who expect higher inflation might expect a higher future wage growth. Individuals' wage-inflation expectations thus have far-reaching implications for both workers' own long-term wealth accumulation and for firms' factor choices.

House-price expectations are also a central driver of household-level investment choices—housing is typically the largest asset homeowner US households own—as well as aggregate business cycles through variation in observed house-price booms and busts (Piazzesi and Schneider (2009) and Glaeser and Nathanson (2017)). If consumer-price inflation expectations shape house-price expectations, the cross-sectional variation in inflation expectations might help us understand both individual and aggregate housing outcomes.

In terms of economic choices, we first focus on housing-related investment and financing choices, such as the outstanding mortgage balance and the monthly mortgage payments as measures of the size of mortgages, as well as the share of a household's portfolio that is invested in real estate. Given most mortgages in the US are fixed-rate mortgages, we would expect to find larger mortgages for individuals with higher inflation expectations, because these individuals perceive lower real interest rates in the future. Moreover, conditional on holding any investments, individuals with higher inflation expectations should invest more in real assets such as real estate, because inflation will affect the value of these assets less than the value of other assets.

Second, we consider the fundamental intertemporal consumption/saving choice of households summarized by the Euler equation. Individuals with higher inflation

expectations in the cross section perceive lower real interest rates, which implies higher consumption and lower savings at the present date. Therefore, we should observe individuals with higher inflation expectations are less likely to save than other households, ceteris paribus. This implication of the Euler equation is quite important in terms of long-run effects of varying inflation expectations, because fluctuations in inflation expectations can drive the amount of long-run wealth accumulation by individuals. Forgoing saving today due to higher inflation expectations would have consequences on the overall future path of wealth accumulation.

To bring all these predictions to the data, we use the microdata from the Chicago Booth Communication and Expectations survey, which is a different source than the survey we employed in the rest of the paper.[11] We need to rely on this alternative source of data, because our original survey did not elicit information on individual-level wage-growth expectations or house-price expectations. A drawback of using this data set is that we do not see the prices individuals in that survey observed while grocery shopping, because the survey was fielded in 2018 and the individual price-level information for Nielsen is currently not available for any of the two years before individuals answered the survey questions.

Table 8 reports the results for testing the predictions discussed above. Column (1) studies the association between inflation expectations and wage expectations, and column (2) reports the association between inflation expectations and house-price expectations. To measure wage-growth expectations, we use the numerical answer to the following question: "What is your best guess about the rate at which average wages in the economy will change on average over the next 12 months?" To measure house-price expectations, we use the numerical answer to "What is your best guess about the rate at which housing prices in the U.S. will change over the next 12 months?"

In column (1), a one-standard-deviation increase in inflation expectations is associated with an increase in expected wage growth of about 1.6 percentage points. In column (2), a one-standard-deviation increase in inflation expectations is associated with an increase in house-price expectations of 2.5 percentage points. In both cases,

[11] Please see Coibion et al. (2018) for a detailed description of the survey and data. The structure and questions follow a similar setup as the surveys designed for the current paper.

the estimated associations align with the directional prediction of higher wage-inflation expectations and higher house-price inflation expectations for individuals with higher consumer-price inflation expectations as discussed above.

Columns (3)-(6) of Table 8 study the association between inflation expectations and financial choices. Columns (3) and (4) show a one-standard-deviation increase in expected inflation is associated with a 6.2% higher mortgage balance and a 3.6% higher monthly mortgage payment, after controlling for observables and other expectations. In column (5), higher inflation expectations are associated with a 1.4-percentage-point increase in the portfolio share invested in real estate, which corresponds to about 24% of the average portfolio share invested in real estate for those with any real estate investment in our sample. Finally, column (6) shows higher inflation expectations are associated with a 0.9-percentage-point lower likelihood of having a savings account, which corresponds to about 2.5% of the unconditional probability of holding a savings account. Consistent with our conjecture, individuals with higher inflation expectations invest more in a real asset such as housing and finance such investments with larger mortgages. Moreover, individuals with higher inflation expectations are less likely to save, which is consistent with the consumption Euler equation.

VII Conclusions

Household-specific grocery-price changes shape consumers' inflation expectations. This correlation is especially strong for price changes of the goods consumers purchase more frequently. Moreover, the correlation is higher for consumers who face more extreme price changes and for those who shop less frequently, and hence are more likely to observe larger price changes from one shopping trip to the next. The correlation is also higher for consumers who barely access other sources of information for aggregate inflation and those less exposed to gas prices or other specialized information. These features of expectations formation we document for the first time in field data beget theoretical adaptations of the standard rational-inattention framework.

The results in this paper also open additional avenues for policymaking. The current

conduct of monetary policy that large neglects "volatile" price series such as groceries might result in systematic policy mistakes. Policy makers might attempt to anchor and manage households' expectations based on an inflation target that means little to many consumers. Household-level surveys could be the first step for the creation of micro-based indices of perceived inflation at the household level. Such indices would provide largely different information regarding household-level expectations relative to the extant consumer price indices, which are based on a representative consumption basket, and hence by construction eliminate all the variation in salience and perception of price changes at the micro level. Considering this heterogeneity explicitly when designing expectations-based monetary policy measures might ultimately increase the effectiveness of such policies.

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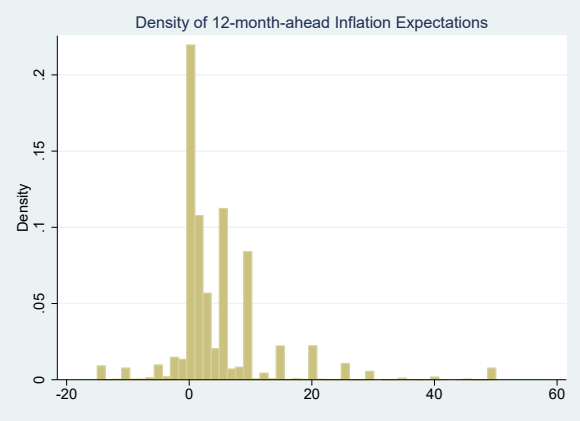
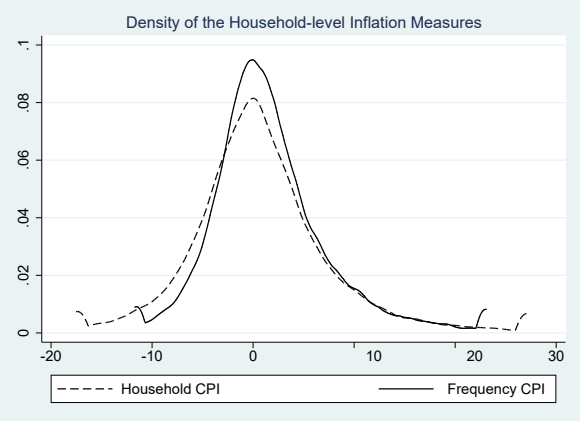
Figure 4: **Grocery Shopping and Inflation Expectations: Raw Data**

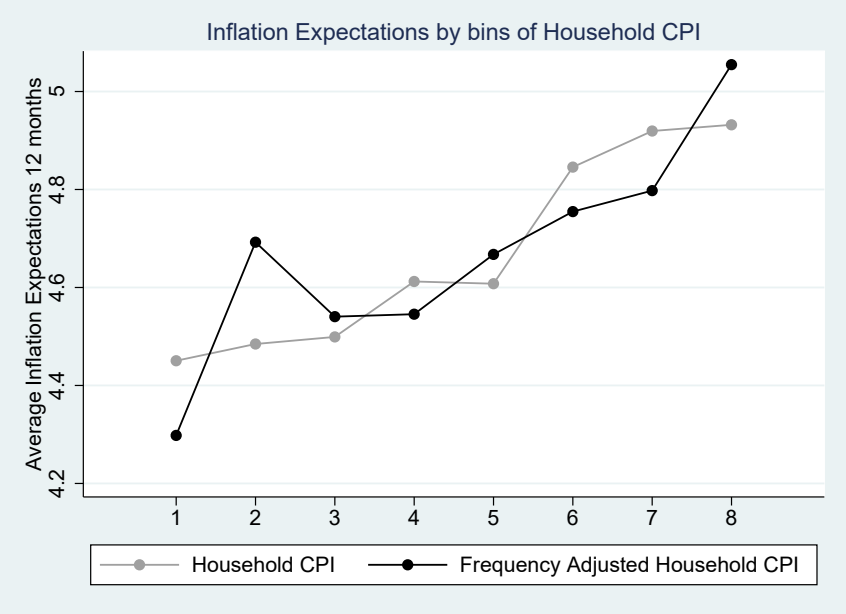
A. Inflation Expectations



B. Observed Grocery-Price Changes

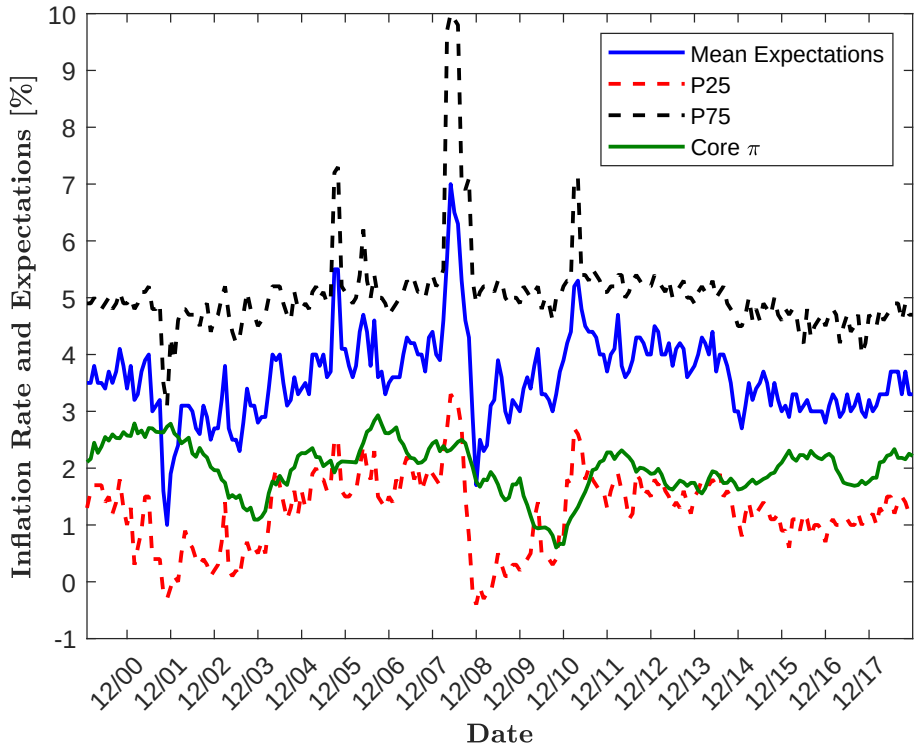


C. Grocery Shopping and Inflation Expectations



Notes. This figure plots the distribution of inflation expectations (Panel A), the distribution of household-level measures of observed price changes (Panel B), and the average of inflation expectations across households in eight equal-sized bins by observed price changes (Panel C). We measure inflation expectations from the customized *Chicago Booth Attitudes and Expectations survey* we fielded in 6/2015 and 7/2016. We use the micro data from the Nielsen homescan panel to create different measures of experienced inflation. We use the 12 months before June of the survey wave to measure price changes, and the 12 months before that period as the base period. Household CPI uses the Nielsen expenditure shares in the base periods as weight, and Frequency CPI uses the frequency of purchases of a given good in Nielsen in the base period as weight. We detail the construction of the indices in section II.*C*.

Figure 5: **Inflation Expectations and Realized Core Inflation over Time**



Notes. This figure plots average inflation expectations over time from the Michigan Survey of Consumers together with the 25^{th} and 75^{th} percentiles as well as the realized core inflation rate for a sample period from January 2000 until December 2018.

Table 1: **Summary Statistics**

Notes. This table reports summary statistics for the main independent and dependent variables in our running sample. Expected Inflation and Perceived Inflation are reported numerical expectations and perceptions of inflation rates for a 12-month period, and are bounded between -100 percentage points and 100 percentage points. Household CPI and Frequency CPI are the measures of household-level grocery inflation based on scanner data from the Nielsen Homescan Panel defined in section II.*C.* Both measures are computed over an horizon of 12 months before the respondent took part in the Chicago Booth Expectations and Attitudes Survey. Income Outlook, Economic Outlook, and Financial Outlook are qualitative respondent expectations on the soundness of income growth, personal financial conditions, and overall economic outlook of the country for the following 12 months, and are bounded between 1 (very bad) and 5 (very good).

	Observations (1)	Mean (2)	St. dev. (3)	Min (4)	25th (5)	Median (6)	75th (7)	Max (8)
Age	59,118	61.4	12.9	21	54	63	70	102
Male	59,126	0.36	0.48	0	0	0	1	1
Unemployed	59,126	0.05	0.22	0	0	0	0	1
Home Owner	59,126	0.74	0.44	0	0	1	1	1
Household Size	56,227	2.19	1.11	1	1	2	3	9
College	59,126	0.48	0.5	0	0	0	1	1
Income Outlook [1-3]	59,126	2.18	0.9	1	1	3	3	3
Economic Outlook [1-5]	59,126	2.69	1.04	1	2	3	4	5
Financial Outlook [1-5]	59,126	3	0.88	1	2	3	4	5
Expected Inflation	59,126	4.67	8.2	-15	0	2	6	50
Perceived Inflation	59,126	4.44	8.27	-20	0	2	5	45
Household CPI	59,126	0.81	7.14	-17.5	-3.17	0.23	4.02	27.16
Frequency CPI	59,126	1.61	5.85	-11.71	-1.91	0.83	4.21	23.08

Table 2: **Grocery Shopping and Inflation Expectations: Multivariate Analysis**

Notes. This table reports the estimates of regressing individuals' inflation expectations on the inflation rates experienced in their household consumption bundle. We measure inflation expectations from the customized Chicago Booth Attitudes and Expectations survey which we fielded in June of 2015 and 2016. We randomize the inflation question asking one half of the survey about changes in prices following the wording in the Michigan Survey of Consumers, and one half directly about inflation, following the wording in the New York Fed Survey. We use the micro data from the Nielsen homescan panel to create different measures of experienced inflation. We use the 12 months before the June of the survey wave to measure price changes and the 12 months before that period as the base period. Household CPI uses the Nielsen expenditure shares in the base periods as weight, and Frequency CPI uses the frequency of purchases of a given good in Nielsen in the base period as weight. We detail the construction of the indices in section II.*C*. Standard errors are clustered at the household level. All regressions include survey-wave and inflation-question fixed effects. Demographic controls include age, square of age, sex, employment status, 16 income dummies, home ownership, marital status, household size, college dummy, four race dummies, and reported risk tolerance. Expectations controls include household income expectations, aggregate economic outlook, and personal financial outlook.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Household CPI	0.17***	0.17***	0.19***				0.05	0.01	0.07
	(0.04)	(0.04)	(0.07)				(0.06)	(0.06)	(0.09)
Frequency CPI				0.20***	0.22***	0.30***	0.16***	0.21***	0.24**
				(0.04)	(0.04)	(0.09)	(0.06)	(0.06)	(0.12)
Nobs	59,126	56,220	56,220	59,126	56,220	56,220	59,126	56,220	56,220
R^2	0.0279	0.0950	0.7758	0.0281	0.0907	0.7758	0.0281	0.0907	0.7758
Demographics		X	X		X	X		X	X
Expectations		X	X		X	X		X	X
County FE		X	X		X	X		X	X
Individual FE			X			X			X

Standard errors in parentheses
$^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$

Table 3: **Grocery Shopping and Inflation Expectations: Robustness**

Notes. This table reports the estimates of regressing individuals' inflation expectations on the inflation rates experienced in their household consumption bundle. We measure inflation expectations from the customized Chicago Booth Attitudes and Expectations survey, which we fielded in June of 2015 and 2016. We randomize the inflation question asking one half of the survey about changes in prices, following the wording in the Michigan Survey of Consumers, and one half directly about inflation, following the wording in the New York Fed Survey. We use the micro data from the Nielsen homescan panel to create measures of experienced inflation. We use the 12 months before the June of the survey wave to measure price changes and the 12 months before that period as the base period. Frequency CPI uses the frequency of purchases of a given good in Nielsen in the base period as weight. We detail the construction of the indices in section II.*C.* Standard errors are clustered at the household level. All regressions include survey-wave and inflation-question fixed effects. Demographic controls include age, square of age, sex, employment status, 16 income dummies, home ownership, marital status, household size, college dummy, four race dummies, and reported risk tolerance. Expectations controls include household income expectations, aggregate economic outlook, and personal financial outlook.

	Income		Age		Household Size	
	Low	High	Young	Old	Small	Big
	(1)	(2)	(3)	(4)	(5)	(6)
Frequency CPI	0.20***	0.19***	0.13**	0.22***	0.19***	0.21***
	(0.06)	(0.05)	(0.06)	(0.05)	(0.04)	(0.08)
Nobs	30,829	25,391	18,194	38,026	42,109	14,118
R^2	0.0970	0.1107	0.1009	0.1001	0.1008	0.1127
Demographics	X	X	X	X	X	X
Expectations	X	X	X	X	X	X
County FE	X	X	X	X	X	X

Standard errors in parentheses

$^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$

Table 4: **Salient Price Changes and Inflation Expectations**

Notes. This table reports the estimates of regressing individuals' inflation expectations on the inflation rates experienced in their household consumption bundle across three equal-sized groups based on the experienced inflation rates. We measure inflation expectations from the customized Chicago Booth Attitudes and Expectations survey, which we fielded in June of 2015 and 2016. We randomize the inflation question asking one half of the survey about changes in prices, following the wording in the Michigan Survey of Consumers, and one half directly about inflation, following the wording in the New York Fed Survey. We use the micro data from the Nielsen homescan panel to create measures of experienced inflation. We use the 12 months before the June of the survey wave to measure price changes and the 12 months before that period as the base period. Frequency CPI uses the frequency of purchases of a given good in Nielsen in the base period as weight. We detail the construction of the indices in section II.*C.* Standard errors are clustered at the household level. All regressions include survey-wave and inflation-question fixed effects. Demographic controls include age, square of age, sex, employment status, 16 income dummies, home ownership, marital status, household size, college dummy, four race dummies, and reported risk tolerance. Expectations controls include household income expectations, aggregate economic outlook, and personal financial outlook.

	Bottom Frequency CPI		Intermediate Frequency CPI		Top Frequency CPI	
	(1)	(2)	(3)	(4)	(5)	(6)
Frequency CPI	0.30**	0.32**	0.09	−0.01	0.16**	0.20**
	(0.15)	(0.15)	(0.28)	(0.33)	(0.08)	(0.08)
Range Frequency CPI	[-0.117, -0.009]		[-0.009, 0.028]		[0.028, 0.231]	
Nobs	19,706	18,568	19,707	18,903	19,713	18,749
R^2	0.0230	0.1002	0.0293	0.1038	0.0314	0.1122
Demographics		X		X		X
Expectations		X		X		X
County FE		X		X		X

Standard errors in parentheses
$^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$

Table 5: **Frequency of Exposure to Grocery Price Changes**

Notes. This table reports the estimates of regressing individuals' inflation expectations on the inflation rates experienced in their household consumption bundle. Columns (1) to (2) split the sample by main grocery short, columns (3) to (4) split the sample by shopping frequency, and columns (5) to (7) split the sample by distance to the primary grocercy store. We measure inflation expectations from the customized Chicago Booth Attitudes and Expectations survey, which we fielded in June of 2015 and 2016. We randomize the inflation question asking one half of the survey about changes in prices, following the wording in the Michigan Survey of Consumers, and one half directly about inflation, following the wording in the New York Fed Survey. We use the micro data from the Nielsen homescan panel to create different measures of experienced inflation. We use the 12 months before the June of the survey wave to measure price changes and the 12 months before that period as the base period. Frequency CPI uses the frequency of purchases of a given good in Nielsen in the base period as weight. We detail the construction of the indices in section II.*C.* Standard errors are clustered at the household level. All regressions include survey-wave and inflation-question fixed effects. Demographic controls include age, square of age, sex, employment status, 16 income dummies, home ownership, marital status, household size, college dummy, four race dummies, and reported risk tolerance. Expectations controls include household income expectations, aggregate economic outlook, and personal financial outlook.

	Primary Grocery Shopper		Shopping Frequency		Time to Primary Shopping Outlet		
	Yes	No	>1 per Week	<1 per Week	<20 Min	>20 Min & <60 Min	>60 Min
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Frequency CPI	0.17***	0.27***	0.17***	0.28**	0.14***	0.27***	0.80***
	(0.05)	(0.06)	(0.06)	(0.14)	(0.06)	(0.13)	(0.24)
Nobs	32,005	24,215	21,302	4,745	18,540	5,867	1,640
R^2	0.1036	0.0973	0.0895	0.1425	0.0954	0.1171	0.2322
Demographics	X	X	X	X	X	X	X
Expectations	X	X	X	X	X	X	X
County FE	X	X	X	X	X	X	X

Standard errors in parentheses

$^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$

Table 6: **Sources of Information About Prices**

Notes. This table reports the estimates of regressing individuals' inflation expectations on the inflation rates experienced in their household consumption bundle. Columns (1) to (2) split the sample by media information, columns (3) to (4) split the sample by other peoples' information and columns (5) to (6) split the sample by own experience. We measure inflation expectations from the customized Chicago Booth Attitudes and Expectations survey, which we fielded in June of 2015 and 2016. We randomize the inflation question asking one half of the survey about changes in prices, following the wording in the Michigan Survey of Consumers, and one half directly about inflation, following the wording in the New York Fed Survey. We use the micro data from the Nielsen homescan panel to create different measures of experienced inflation. We use the 12 months before the June of the survey wave to measure price changes and the 12 months before that period as the base period. Frequency CPI uses the frequency of purchases of a given good in Nielsen in the base period as weight. We detail the construction of the indices in Section II.*C.* Standard errors are clustered at the household level. All regressions include survey-wave and inflation-question fixed effects. Demographic controls include age, square of age, sex, employment status, 16 income dummies, home ownership, marital status, household size, college dummy, four race dummies, reported risk tolerance. Expectations controls include household income expectations, aggregate economic outlook, and personal financial outlook.

	Media		Other People		Own Experience		Frequency Gas Station	
	No	Yes	No	Yes	No	Yes	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Frequency CPI	0.30***	0.08	0.28***	0.12*	0.14***	0.28***	0.27***	0.16***
	(0.07)	(0.07)	(0.08)	(0.07)	(0.06)	(0.08)	(0.05)	(0.06)
Nobs	13,224	12,823	12,306	13,741	16,541	9,506	33,202	23,018
R^2	0.1131	0.0517	0.1167	0.0556	0.0717	0.1243	0.1050	0.0953
Demographics	X	X	X	X	X	X	X	X
Expectations	X	X	X	X	X	X	X	X
County FE	X	X	X	X	X	X	X	X

Standard errors in parentheses

$^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$

Table 7: **Sophistication in Economic Matters**

Notes. This table reports the estimates of regressing individuals' inflation expectations on the inflation rates experienced in their household consumption bundle. Columns (1)-(2) split the sample by quantitative major, columns (3)-(4) by mortgage ownership, and columns (5)-(6) by whether respondents reported rounded values for their inflation expectations. We measure inflation expectations from the customized Chicago Booth Attitudes and Expectations survey, which we fielded in June of 2015 and 2016. We randomize the inflation question asking one half of the survey about changes in prices, following the wording in the Michigan Survey of Consumers, and one half directly about inflation, following the wording in the New York Fed Survey. We use the micro data from the Nielsen homescan panel to create different measures of experienced inflation. We use the 12 months before the June of the survey wave to measure price changes and the 12 months before that period as the base period. Frequency CPI uses the frequency of purchases of a given good in Nielsen in the base period as weight. We detail the construction of the indices in section II.*C.* Standard errors are clustered at the household level. All regressions include survey-wave and inflation-question fixed effects. Demographic controls include age, square of age, sex, employment status, 16 income dummies, home ownership, marital status, household size, college dummy, 4 race dummies, reported risk tolerance. Expectations controls include household income expectations, aggregate economic outlook, and personal financial outlook.

	Quantitative Major		Mortgage Holder		Stock Market Participant		Rounder	
	No	Yes	No	Yes	No	Yes	No	Yes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Frequency CPI	0.23***	0.17**	0.28***	0.16***	0.26***	0.17***	0.10***	0.26***
	(0.04)	(0.07)	(0.06)	(0.06)	(0.05)	(0.05)	(0.03)	(0.05)
Nobs	46,466	9,754	19,131	20,942	37,112	19,108	19,340	36,880
R^2	0.0934	0.1351	0.1112	0.1190	0.1114	0.1182	0.0690	0.1007
Demographics	X	X	X	X	X	X	X	X
Expectations	X	X	X	X	X	X	X	X
County FE	X	X	X	X	X	X	X	X

Standard errors in parentheses

$^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$

Table 8: **Other Expectations and Real Outcomes**

Notes. This table reports the estimates of regressing individuals' national wage growth (column (1)), national house-price inflation expectations (column (2)), the logarithm of outstanding mortgage balances (column (3)), the logarithm of monthly mortgage payments (column (4)), the share of one's overall wealth in real estate (column (5)), and a dummy for whether the respondent holds a savings account (column (6)) on the individual numerical inflation expectations over the next 12 months. We measure inflation expectations from the customized Chicago Booth Expectations and Communication survey, which was fielded in March of 2019. Survey participants are directly asked about inflation, following the wording in the New York Fed Survey. Standard errors are clustered at the household level. Demographic controls include age, square of age, sex, employment status, 16 income dummies, home ownership, household size, and college dummy. Expectations controls include household income expectations and mortgage rate expectations.

	Wage Inflation	House Price Inflation	Mortgage Balance	Mortgage Payment	Share Housing	Savings Account
	(1)	(2)	(3)	(4)	(5)	(6)
Inflation Expectations	1.63^{***} (0.28)	2.48^{***} (0.30)	6.19^{**} (2.96)	3.62^{**} (1.78)	1.43^{*} (0.77)	-0.87^{***} (0.21)
Nobs	3,374	8.862	43,487	43,487	42,227	62,304
R^2	0.0978	0.1367	0.0788	0.0808	0.037	0.0745
Demographics	X	X	X	X	X	X
Expectations	X	X	X	X	X	X

Standard errors in parentheses
$^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$

Online Appendix:
Grocery Shopping Drives Inflation Expectations

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Not for Publication

Table A.1: **Alternative Definitions of Inflation Expectations**

Notes. This table reports the estimates of regressing individuals' inflation expectations on the inflation rates experienced in their household consumption bundle. Columns (1) to (3) exclude inflation expectations of 0, columns (4) to (6) use the mean of the inflation expectations distribution, and columns (7) to (9) exclude individuals who report the same values for inflation perceptions and expectations. We measure inflation expectations from the customized Chicago Booth Attitudes and Expectations survey, which we fielded in June of 2015 and 2016. We randomize the inflation question asking one half of the survey about changes in prices, following the wording in the Michigan Survey of Consumers, and one half directly about inflation, following the wording in the New York Fed Survey. We use the micro data from the Nielsen homescan panel to create different measures of experienced inflation. We use the 12 months before the June of the survey wave to measure price changes and the 12 months before that period as the base period. Frequency CPI uses the frequency of purchases of a given good in Nielsen in the base period as weight. We detail the construction of the indices in section II.*C*. Standard errors are clustered at the household level. All regressions include survey-wave and inflation-question fixed effects. Demographic controls include age, square of age, sex, employment status, 16 income dummies, home ownership, marital status, household size, college dummy, four race dummies, and reported risk tolerance. Expectations controls include household income expectations, aggregate economic outlook, and personal financial outlook.

	No 0 Inflation Expectations			Mean of Distribution			Perceptions $\neq$ Expectations		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Frequency CPI	0.19***	0.20***	0.23*	0.06***	0.08***	0.16***	0.13**	0.16***	0.24
	(0.05)	(0.05)	(0.12)	(0.02)	(0.02)	(0.04)	(0.06)	(0.06)	(0.19)
Nobs	42,263	40,158	40,158	59,125	56,219	56,219	29,019	27,558	27,558
R^2	0.0205	0.1250	0.8570	0.0184	0.1324	0.8022	0.0158	0.1144	0.8828
Demographics		X	X		X	X		X	X
Expectations		X	X		X	X		X	X
County FE		X	X		X	X		X	X
Individual FE			X			X			X

Standard errors in parentheses
$^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$

Table A.2: **Grocery Shopping and Inflation Perceptions**

Notes. This table reports the estimates of regressing individuals' inflation perceptions on the inflation rates experienced in their household consumption bundle. We measure inflation expectations from the customized Chicago Booth Attitudes and Expectations survey, which we fielded in June of 2015 and 2016. We randomize the inflation question asking one half of the survey about changes in prices, following the wording in the Michigan Survey of Consumers, and one half directly about inflation, following the wording in the New York Fed Survey. We use the micro data from the Nielsen homescan panel to create different measures of experienced inflation. We use the 12 months before the June of the survey wave to measure price changes and the 12 months before that period as the base period. Household CPI uses the Nielsen expenditure shares in the base periods as weight, and Frequency CPI uses the frequency of purchases of a given good in Nielsen in the base period as weight. We detail the construction of the indices in section II.*C.* Standard errors are clustered at the household level. All regressions include survey-wave and inflation-question fixed effects. Demographic controls include age, square of age, sex, employment status, 16 income dummies, home ownership, marital status, household size, college dummy, four race dummies, and reported risk tolerance. Expectations controls include household income expectations, aggregate economic outlook, and personal financial outlook.

	(1)	(2)	(3)
Household CPI	0.20^{***}		-0.02
	(0.03)		(0.05)
Frequency CPI		0.28^{***}	0.29^{***}
		(0.03)	(0.05)
Nobs	57,730	57,730	57,730
R2	0.0878	0.0883	0.0883
Demographics	X	X	X
Expectations	X	X	X
County FE	X	X	X

Standard errors in parentheses
$^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$