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Perceptions and Expectations of Inflation by U.S. Households^{*}

Sandor Axelrod[†], David Lebow[‡], and Ekaterina Peneva[§]

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Abstract

To better understand inflation expectations, we examine newly available data on U.S. households' inflation perceptions—what people think inflation has been in the past. The overarching summary is that inflation perceptions look similar to inflation expectations. The central tendencies of the responses for perceived inflation over the past five to ten years are similar to those of expected inflation for the next five to ten years, and all are a little above official estimates of inflation. Thus, survey respondents overall do not expect long-term inflation to change in the future relative to the recent past. Moreover, individuals who perceive higher inflation in the past tend to expect higher inflation in the future; people whose perceptions change tend to revise their expectations in the same direction; and perceptions and expectations vary similarly by gender and income. These results suggest that if inflation perceptions were to change, they could lead inflation expectations to change as well.

Keywords: Inflation expectations; Inflation perceptions; Inflation dynamics; Consumer Surveys.

JEL classification: E31; D84.

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I. Introduction

Expectations of inflation play a central role in economists' analyses of inflation dynamics, as economic theory suggests that inflation expectations affect peoples' economic decisions and are a key determinant of actual inflation. For this reason, central bankers follow closely the different measures of inflation expectations and strive to keep them at a level consistent with their policy objectives. Yet survey measures of individuals' inflation expectations can be hard to interpret and raise many questions. For example, inflation expectations as recorded in household surveys in the U.S. tend to exceed those of professional forecasters and those inferred from financial-market prices.¹ Also, households tend to expect future inflation that is higher than official estimates of recent inflation. Thus, one natural question is whether people actually expect inflation to be higher in the future than it recently has been, or alternatively, do they think recent inflation has been higher than indicated by the official statistics? Another question is how to interpret the downward drift in households' long-term inflation expectations that began in mid-2014; was this decline driven by a reduction in their perceptions about past inflation?

If inflation expectations are influenced by past inflation behavior, that influence must work through the channel of how people perceive that inflation.

In this paper, we therefore attempt to shed light on the formation of inflation expectations by examining newly available data on individuals' *perceptions* of recent inflation—what people think inflation has been in the past. These data come from special questions included quarterly, since early 2016, in the University of Michigan Surveys of Consumers.

The overarching summary of these survey data is that household inflation perceptions look similar to inflation expectations. More specifically, this paper highlights several results.² First, as with inflation expectations, inflation perceptions differ across individuals, but even so, the bulk of responses are between zero and five percent and so appear broadly reasonable. Second,

¹ For example, over the 10 years ending in 2017, on average, median expected inflation over the next 5 to 10 years from the Michigan Surveys of Consumers was about 2¾ percent while actual CPI inflation was 1¾ percent, and the median expected inflation over the next 10 years in the Survey of Professional Forecasters was about 2¼ percent for the CPI measure. The 10-year breakeven inflation rate, an indicator of expected inflation derived from yields on Treasury Securities and Treasury Inflation-Indexed Securities, was about 1¾ percent.

² A preliminary version of some of the results in this paper was presented in Detmeister, Lebow, and Peneva (2016).

the distribution of responses to the questions on both perceived inflation over the past five to ten years and expected inflation for the next five to ten years have similar central tendencies which are a little above official estimates of inflation. Thus, survey respondents overall do not expect long-term inflation to change in the future relative to the recent past. Regarding expectations of inflation over shorter time horizons, the results are more nuanced as in 2016 and 2017 respondents perceived—correctly, in broad terms—that inflation had been unusually low, and they expected it to increase from those low levels. Third, inflation perceptions and expectations are correlated at the individual level: Individuals who perceive inflation to have been relatively high also expect inflation to be relatively high in the future. Furthermore, utilizing data on repeat participants in the Michigan survey, we find that people who revise their answer about long-term perceptions between surveys also tend to revise their long-term expectations in the same direction. Finally, inflation perceptions, as with inflation expectations, vary systematically by gender and income; a correlation between perceptions and age is less clear. But controlling for demographics does not alter the observed correlation between individuals’ inflation perceptions and expectations. That robust correlation suggests that changes in inflation perceptions could be an important determinant of changes in inflation expectations.

II. Description of the survey questions

In the Surveys of Consumers—henceforth, the “Michigan survey”—the University of Michigan Institute for Social Research queries about 500-600 households each month on their financial situations and other aspects of consumer sentiment. Since 1990, the survey has been including regularly, on a monthly basis, questions on price expectations. In 2016, the Board of Governors of the Federal Reserve System initiated and sponsored new questions on inflation perceptions. The questions on perceptions are worded consistently with the questions on inflation expectations and are currently posed four times a year—in February, May, August, and November. The questions are as follows:

Short-term perceptions: During the past 12 months, do you think that prices in general went up or went down, or stayed where they were a year ago? By about what percent do you think prices went (up/down), on the average, during the past 12 months?

Long-term perceptions: What about prices over the past 5 to 10 years? Do you think prices now are higher, about the same, or lower than they were 5 to 10 years ago? By about what percent per year do you think prices went (up/down), on the average, during the past 5 to 10 years?

Short-term expectations: During the next 12 months, do you think that prices in general will go up, or go down, or stay where they are now? By about what percent do you expect prices to go up/down on the average, during the next 12 months?

Long-term expectations: What about the outlook for prices over the next 5 to 10 years? Do you think that prices will be higher, about the same, or lower, 5 to 10 years from now? By about what percent per year do you expect prices to go up/down on the average, during the next 5 to 10 years?³

While surveys of households' inflation expectations have existed for some time and are generally of high quality, surveys of households' inflation perceptions have been more limited in scope, quality, and availability.⁴ As far as we know, this is the first survey of U.S. households that (a) asks about both short- and long-term perceptions, (b) has run for more than two years and is expected to continue to run, (c) has a substantial number of responses in each survey, and (d) has questions on inflation perceptions worded consistently with the long-running questions on inflation expectations.

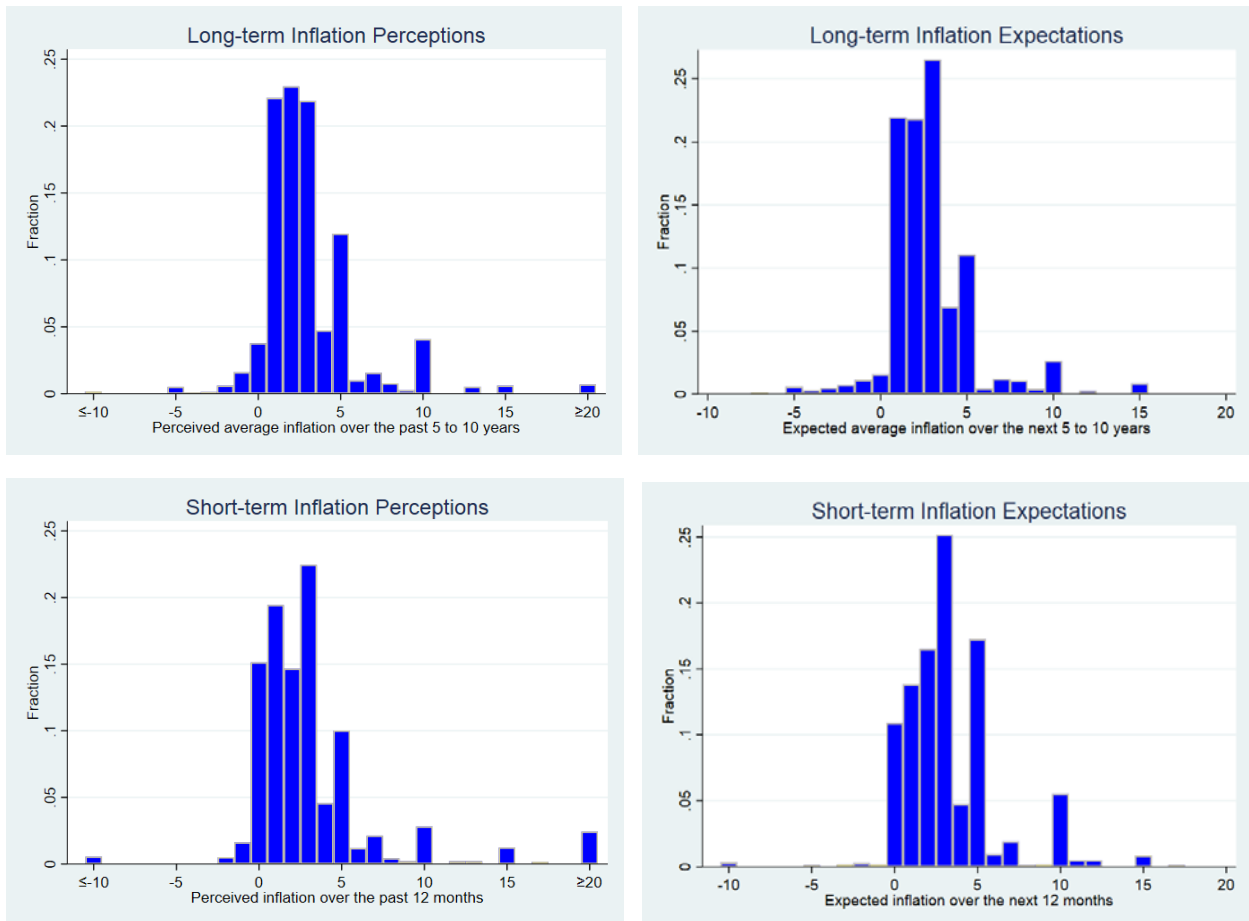
³ For each of these questions, if a respondent says they perceive/expect prices to be unchanged, the surveyor probes to see if the respondent truly means that *prices* will be unchanged (that is, that inflation will be zero) or that *inflation* will be unchanged. In addition, if a respondent's answer is greater than 5 percent, the surveyor probes with a follow up question. For example, the follow up question for the 12-month inflation perceptions is: "Let me make sure I have that correct. You said that you think that prices have gone (up/down) during the past 12 months by (X) percent. Is that correct?" See Curtin (1996) for the questionnaire, including the probing, regarding the expectation questions.

⁴ Duca, Kenny, and Reuter (2017) and Arioli et al. (2017) utilize the largest and longest-running survey on inflation perceptions that we have seen. The survey covers European Union member states, with numeric answers to the perception question that go back to 2003. That said, the survey asks only for short-term (12-month) perceptions and expectations of inflation.

III. Basic results and comparison with published inflation data

Figure 1 and Table 1 present the distributions of responses on inflation perceptions and expectations from the May 2018 survey, the latest survey we had at the time we constructed the dataset for this study (the distributions for earlier survey dates are comparable). As the histograms make clear, the responses for inflation perceptions are broadly similar to those for inflation expectations.

Figure 1. Inflation Perceptions and Expectations from the May, 2018 survey



As has been well known, households do not hold uniform expectations, and we find that they do not hold uniform perceptions either. That said, the bulk of the responses for long-term (or 5 to 10 year) inflation perceptions and expectations—between 80 and 90 percent—fall between 1 and

5 percent. For near-term (or 12 month) perceptions and expectations, the bulk of responses (more than 80 percent) lie in the 0 to 5 percent range, a touch wider than for long-term expectations. That is, in contrast to long-term responses, the share of respondents perceiving inflation to have been zero over the past year and expecting prices to remain unchanged over the next year is not trivial.⁵ The distributions of both short- and long-term inflation expectations and perceptions are slightly skewed to the right, producing means higher than the medians (Table 1).

Table 1. Perceptions of past inflation and expectations of future inflation from University of Michigan Survey of Consumers in May, 2018

	Perceived over past 5-to-10 years	Expected over next 5-to-10 years		Perceived over past 12 months	Expected over next 12 months
10 th Percentile	0.6	0.7		0.0	0.4
25 th Percentile	1.3	1.4		0.9	1.5
Median	2.4	2.5		2.4	2.8
75 th Percentile	3.8	3.5		3.7	4.7
90 th Percentile	5.5	5.2		6.4	6.2
Standard Deviation	3.2	2.5		4.5	2.9
Asymmetry (90,10)	1.3	0.9		1.6	1.0
Mean	3.0	2.8		3.2	3.3
4% Trimmed mean ⁱ	2.8	2.8		2.9	3.2
Observations ⁱⁱ	600	595		601	599

ⁱ The mean, 25th, and 75th percentile are as reported by the Michigan survey using the survey procedures for imputing missing data and adjusting for extreme responses (see Curtin, 1996). The trimmed mean, 10th, and 90th percentile are based on authors' calculations, in which we try to retain the survey procedures for imputing missing data and adjusting for extreme values. Asymmetry (90,10) is defined as (90th percentile – median) – (median-10th percentile). The trimmed mean is obtained by omitting the largest 2.5 percent and the smallest 2.5 percent of unweighted observations.

ⁱⁱ Number of people who gave a numeric answer or answered that prices went/will go up/down but did not give a numeric answer.

⁵ As with inflation expectations, inflation perceptions show a heaping of responses at multiples of 5 percent. This is true for both short- and long-term perceptions. See Binder (2015) for an interpretation of the round number responses.

Trimming just a few outliers tends to bring the means down toward the medians, as illustrated by the 4 percent trimmed mean. Finally, while the distributions for perceptions and expectations are overall quite similar, perceptions are somewhat more dispersed than expectations, as can be seen from the standard deviations of the distributions for both the short- and long-term measures.

When looking at the range of responses to questions about either perceptions or expectations, one must remember that individuals with different consumption profiles, or shopping in different locations, will likely have different experiences with inflation. Thus, differing inflation perceptions could reflect those different experiences, rather than different perceptions of similar experiences.⁶

Figure 2 plots the time series of median responses for both short- and long-term inflation perceptions and expectations from all the surveys available to date. Median long-term inflation expectations have been quite similar to median long-term perceptions, at about 2½ percent, over the period both measures are available. These readings therefore suggest that households do not expect inflation over the next 5 to 10 years to increase relative to the past 5 to 10 years.⁷

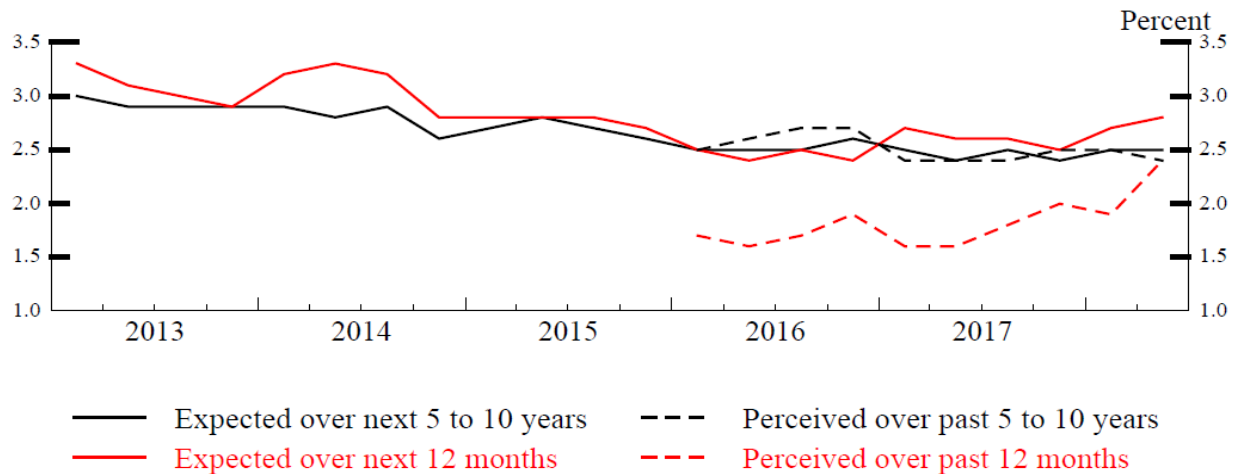
As for the short-term measures, median expectations of inflation over the next 12 months have been fairly close to the long-term measures, at 2½ percent or a bit higher. However, throughout 2016 and 2017 the median perception of inflation over the past 12 months was somewhat lower, at about 1¾ to 2 percent. Thus, households apparently perceived inflation as being relatively low in the past few years, compared with the past 5 to 10 years, and that they expected it to move up to the level of the past 5 to 10 years both over the near and longer term. Measured official inflation was indeed low in 2015 and 2016, as it reflected, among other factors, a sharp decline in global oil prices starting in mid-2014. However, inflation moved up noticeably in 2017 and the first half of 2018, and median short-term perceptions drifted upward as well, albeit with a lag:

⁶ For example, using scanner data, Kaplan and Schulhofer-Wohl (2016) find that households' inflation rates are quite heterogeneous (with an interquartile range for annualized inflation rates that varies between 6.2 and 9.0 percentage points). The study also finds that most of the heterogeneity is due to variation in prices paid rather than variation in the consumption baskets. Similarly, Johannsen (2014) finds a wide dispersion of inflation experiences across households.

⁷ Because the responses to these inflation questions are coded in integers, the median and other percentiles of the distribution shown in Table 1 are calculated by interpolation (see Curtin, 1996). For example, for the purpose of calculating the percentiles, responses of 2 percent are assumed to lie uniformly between 1.5 percent and 2.5 percent.

short-term perceptions reached 2.4 percent in May 2018, not far below short-term expectations and close to the median of the long-term measures.

Figure 2. Median Inflation Perceptions and Expectations



Comparison with published inflation data

Tables 2 and 3 compare the median responses to each of these questions with the published inflation data. Both long-term inflation perceptions and expectations (Table 2) are modestly higher than the published data. The median perception of average inflation over the past 5-to-10 years, stable at around 2½ percent, has been about ½ to 1 percentage point higher than the average officially published inflation over that time. For example, the median perceived pace of inflation over the past 5-10 years in May 2018 was 2.4 percent while the average annual increases in both the Consumer Price Index (CPI) and the Personal Consumption Expenditure (PCE) price index were about 1½ percent over the same time period. For the short-term measures, the message is again more nuanced (Table 3). The median of 12-month inflation expectations, at 2½ to 2¾ percent, was a little higher than the recent published inflation data. However, as noted above, the median of 12-month inflation perceptions remained somewhat lower than expectations through 2017, and these perceptions were roughly in line with published inflation during that time.

Table 2. Perceptions and expectations of long-term inflation from the University of Michigan Surveys of Consumers and officially published measures of inflation

		Perceived over past 5-to-10 years	Expected over next 5-to-10 years	Actual CPI Inflation		Actual PCE Price Inflation*	
				Last 5 years	Last 10 years	Last 5 years	Last 10 years
		median					
1	February, 2016	2.5	2.5	1.5	1.9	1.4	1.6
2	May, 2016	2.6	2.5	1.3	1.8	1.2	1.6
3	August, 2016	2.7	2.5	1.3	1.8	1.2	1.6
4	November,	2.7	2.6	1.3	1.9	1.2	1.6
5	February, 2017	2.4	2.5	1.3	1.9	1.2	1.6
6	May, 2017	2.4	2.4	1.3	1.8	1.2	1.6
7	August, 2017	2.4	2.5	1.4	1.7	1.2	1.5
8	November,	2.5	2.4	1.3	1.7	1.2	1.5
9	February, 2018	2.5	2.5	1.5	1.7	1.3	1.5
10	May, 2018	2.4	2.5	1.6	1.6	1.3	1.4

* Using current vintage data.

The fact that inflation perceptions have run modestly above published inflation, at least for the long-run measures, has implications for interpreting the data on inflation expectations: To put households' long-term expectations on a consistent basis with published PCE inflation requires adjusting them downward. Perceptions of inflation over the past 5 to 10 years exceed published PCE inflation by 1 percentage point. Applying that same adjustment forward implies that households' expectations for average long-term inflation around 2½ percent over the next 5 to 10 years are most consistent with published PCE inflation of 1½ percent—below the Federal Reserve's objective of 2 percent.

Table 3. Perceptions and expectations of short-term inflation from University of Michigan Surveys of Consumers and officially published measures of inflation

		Perceived over past 12 months	Expected over next 12 months	Actual CPI Inflation	Actual PCE Price *
		median		Last 12 months	
1	February, 2016	1.7	2.5	1.4	1.0
2	May, 2016	1.6	2.4	1.1	1.0
3	August, 2016	1.7	2.5	0.9	0.9
4	November, 2016	1.9	2.4	1.6	1.5
5	February, 2017	1.6	2.7	2.5	2.1
6	May, 2017	1.6	2.6	2.2	1.8
7	August, 2017	1.8	2.6	1.7	1.5
8	November, 2017	2.0	2.5	2.0	1.7
9	February, 2018	1.9	2.7	2.1	1.8
e	May, 2018	2.4	2.8	2.4	2.0

* Using current vintage data.

We interpret the differences between the central tendencies of perceived inflation and the published inflation data as being modest and not particularly surprising. We surmise that most survey respondents answer questions about perceived inflation primarily with reference to their own experiences, rather than through familiarity with recent published inflation data. When Michigan survey respondents are asked whether they recently heard of any “favorable or unfavorable changes in business conditions,” only about 4 percent, on average, report having heard news about prices (see Sahm and Sockin, 2016). Inattention to recent inflation news is not surprising for low-inflation countries as the financial cost of inattention is relatively small. For example, Cavallo et al. (2017) find that individuals in low-inflation contexts have significantly

weaker priors about the inflation rate and their inflation perceptions are relatively less accurate.⁸ Furthermore, according to Bruine de Bruin et al. (2012), the fact that the expectations and perceptions questions in the Michigan survey are phrased in terms of changes in “prices in general” (as opposed to “inflation”) makes respondents more likely to base their responses on their own personal experiences, and this may result in more dispersed responses to these questions.

Given the supposition that survey respondents are thinking about their own experiences, consider next the difficulty of the question they are trying to answer. In order to answer survey questions about “prices in general,” respondents must consider the wide range of prices they encounter, which can and do move quite differently from one another over time. Some items are purchased infrequently; some items will have changed over time so that a direct price comparison is complicated or not meaningful; and pricing of some items (like cell phone service plans) may be quite complex. Even for individuals who pay close attention to the prices they face, performing a rough mental aggregation of all those different price movements is quite challenging.

Beyond the general difficulty of the problem, there are several reasons to expect inflation perceptions to be above inflation as measured by the official price indexes. First, when people base their responses on their personal experiences, they both are more likely to focus on extreme price changes and tend to recall price increases more readily than price decreases.⁹ Second, perceptions of inflation tend to be more heavily weighted toward more frequently purchased items, and over the past 10 or so years, inflation for these items has averaged a little higher than for the overall CPI.¹⁰ Finally, some items change over time, with quality that typically improves relative to the old items. The official price indexes attempt to adjust for such quality changes, tending to hold down measured inflation relative to a simple price comparison across items, but individuals’ perceptions of inflation may not fully (or at all) adjust for quality changes in this

⁸ In an online survey, Cavallo et al. (2017) find that in the United States the mean inflation perception for the preceding 12 months was 5.1 percent, while average inflation over the previous 5 years was 1.8 percent. The mean inflation perception in Argentina was 27.8 percent compared to an average inflation rate of 22.5 percent. While the absolute difference was therefore larger in Argentina, in percent terms the difference in Argentina was much smaller.

⁹ Bruine de Bruin et al. (2011, 2012).

¹⁰ Vlasenko and Cunningham (2015). For the frequency bias also see Georganas, Healy, and Li (2014).

manner.¹¹ Individuals' perceptions also may not adjust for item substitutions reflecting shifts in consumer preferences in the way that official price indexes do.

To summarize, we agree with the insight that Ranyard et al. (2008) draw from the existing literature on perceptions and expectations: "...while consumers may have a limited ability to store and recall specific prices, and even succumb to a number of biases in the way in which they form perceptions and expectations of global price changes, they do seem to have some feel for, and ability to judge and forecast, inflation."

As noted earlier, previous measures of inflation perceptions have been collected, in the U.S. and abroad, though these earlier measures have been limited in scope, quality, and availability. For this reason, comparisons to previous surveys and research are not straightforward. That said, some of these attempts to measure inflation perceptions have yielded perceptions that exceed the official inflation statistics by much more than the responses shown here. For recent U.S. experience, estimates from a Zogby poll (2016), conducted in early June of that year, showed median inflation perceptions of 10 percent for the preceding year. As Table 2 illustrates, the 12-month change in inflation was running around 1 percent around that time. Estimates for European countries also point to reported short-term perceptions that exceed official statistics by much more than we find in the Michigan survey (for a recent analysis, see Arioli et al., 2017).¹² However, based on a 2008 U.S. survey, Bruine de Bruin et al. (2012) report a median perceived change in prices over the preceding year of 5 percent, not far from the 12-month change in CPI, which was running between 4 and 5 percent for most of that year. We are intrigued by the differences with these previous surveys. While we do not have a convincing explanation for them, one possible explanation might be the way the surveyors conducting the Michigan survey

¹¹ For example, the Detroit Free Press (January 7, 2016) reported that average new car transaction prices increased 20 percent from 2005 to 2015 according to IHS Automotive. In comparison, the CPI index for new cars, which attempts to adjust for changes like shifts in the types of cars purchased and the addition of improved safety features, rose only 7 percent over the same period. More generally, Moulton and Moses (1997) calculated that the BLS's quality adjustment procedures held down CPI inflation in 1995 between 0.28 and 1.76 percentage points, depending on the calculation used.

¹² The survey results for Europe also have a larger positive skew than our data from the Michigan survey, with means that are further above the medians (see Duca, Kenny, and Reuter, 2017). Ashton (2012) suggests some possible corrections to align perceptions with actual inflation measures.

probe answers that are greater than 5 percent (see footnote 3). Since we do not have data on how many (if any) respondents revise their answer after the probing, this is just a conjecture.

IV. Differences across demographic groups

Previous researchers have noted that inflation expectations tend to differ systematically for different groups of respondents, varying by gender, age, race, and income. To study how responses differ across these demographic groups, we combine the data for long-term inflation expectations and perceptions from ten available surveys, that is, from February 2016 through May 2018, thereby providing more observations for each group. Table 4 presents the median and trimmed mean of long-term inflation perceptions and expectations for the different groups (we do not report means, as they are particularly sensitive to outliers). Results for the short-term measures are similar, and are reported in Table A1 in Appendix A. Again, it is important to remember that different individuals have different experiences with inflation, and that insight holds when comparing averages across demographic groups as well.

Consistent with Jonung (1981) and Bryan and Venkatu (2001a), we find that women tend to both perceive and expect higher inflation than men. The differences are more notable for the trimmed means than for the medians, indicating that the differences are more pronounced toward the top of the distributions (see also Meyer and Venkatu, 2011). The difference in the trimmed means for both perceived and expected inflation are statistically significant at the 1% level.¹³

Researchers have debated the explanations for this difference across genders, without clear consensus.¹⁴

¹³ The significance tests for trimmed means are t-tests from Yuen (1974).

¹⁴ Bryan and Venkatu (2001b) view this difference as a puzzle, noting that women's higher inflation perceptions do not seem to be because of the basket of goods they buy, the frequency of their shopping, or their knowledge of the officially reported CPI. Pfajfar and Santoro (2009) posit that an explanation could involve differences in news consumption, as a much smaller share of female respondents report that they have heard news about prices in the previous month. In an experimental setting, Armantier et al. (2012) show that women are more likely than men to update their inflation expectations based on new information, suggesting that women use different information-processing rules or that they have higher uncertainty about inflation expectations. Supporting this last possibility, Bruine de Bruin et al. (2010) find evidence showing more uncertainty about future inflation among women.

Table 4. Perceptions and expectations of long-run inflation by selected demographic group from University of Michigan Surveys of Consumers (combined February, 2016- May, 2018)^a

	Perceived		Expected		Number of observations (weighted) ^b
	Median	4% Trimmed mean	Median	4% Trimmed mean	
Full sample	2.5	3.0	2.5	2.7	5,844
Gender					
Male	2.4	2.6	2.4	2.5	3,252
Female	2.7	3.5	2.6	3.0	2,593
Race					
White	2.4	2.8	2.5	2.6	4,321
Nonwhite	2.6	3.3	2.5	2.9	1,321
Income percentiles					
Bottom 25	3.0	4.4	2.8	3.2	1,393
25-50	2.6	2.8	2.5	2.7	1,439
50-75	2.3	2.7	2.4	2.5	1,385
Top 25	2.1	2.3	2.3	2.4	1,388
Age					
Age 18 to 44	2.4	2.8	2.4	2.6	2,290
Age 45 to 64	2.5	3.0	2.6	2.8	2,169
Age 65+	2.6	3.1	2.5	2.7	1,335

^aThe trimmed mean and median for the demographic groups are authors' calculations, in which we try to replicate the survey procedures for imputing missing data, adjusting for extreme values, and interpolating between integers. The trimmed mean is obtained by omitting the largest 2 percent and the smallest 2 percent of unweighted observations. The naming of this measure as the 4 percent trimmed mean is consistent with the Cleveland Fed's 16 percent trimmed mean CPI which trims 8 percent off each tail of the CPI monthly price-change distribution.

^bThis column gives the total number of weighted observations for each demographic group in the survey. The actual number of (weighted) observations used to calculate the median and trimmed mean for each question can be smaller than the number reported in this column if some respondents did not answer the question.

We also find that inflation perceptions and expectations tend to systematically decline as income increases. Almost all of the differences in the trimmed means between income percentiles are

statistically significant at the 1% level.¹⁵ And, we see a statistically significant difference across racial groups, with nonwhite respondents exhibiting higher inflation perceptions and expectations than whites.

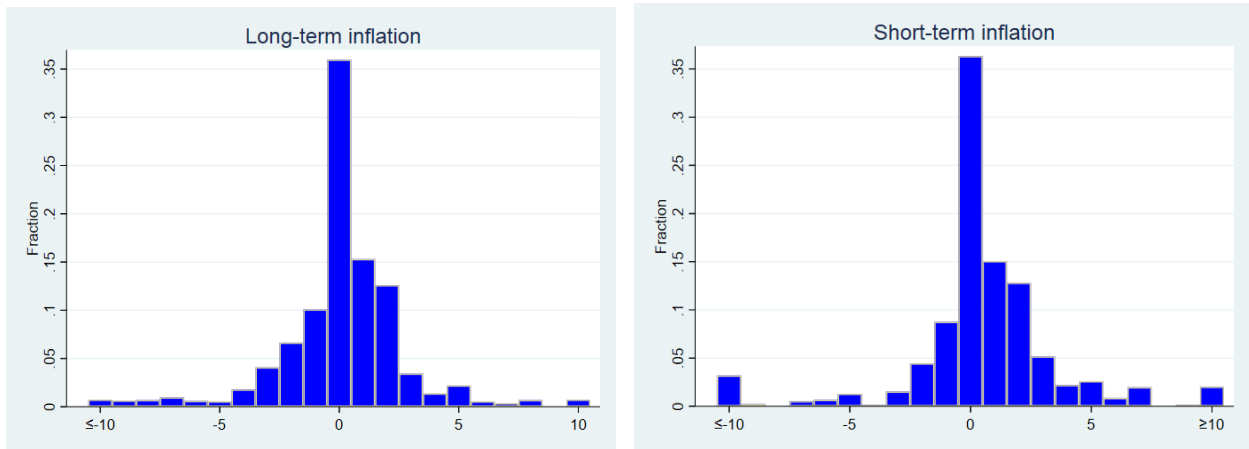
However, we find that perceived and expected inflation are quite similar across the three age groups we consider. None of the differences in trimmed means between age groups are statistically significant at the 1% level. While the results for age are consistent with some of the prior studies on expectations, including Johannsen (2014), we find the result a bit surprising in light of evidence that people's experiences influence their inflation perceptions and expectations, and the fact that people in the younger age cohort can have only limited personal memory of the relatively high inflation from the 1970s (see Malmendier and Nagel, 2016).

V. The cross-sectional relationship between expectations and perceptions

We have seen that the distributions of responses to questions about inflation perceptions and inflation expectations look similar. That similarity holds for the individual responses as well: People with high inflation expectations also tend to have high inflation perceptions—or in other words, most people do not expect inflation to change much relative to their perceptions of recent history. Figure 3 presents distributions of the difference between individuals' expectations and perceptions for the May 2018 survey (again, results are quite similar for other dates). For both short- and long-term inflation, the difference between individuals' expected and perceived inflation rates are distributed fairly tightly, and roughly symmetrically, around zero, with more than one-third of respondents expecting zero change and about 60 percent expecting change of no more than 1 percentage point relative to their perceived past inflation.

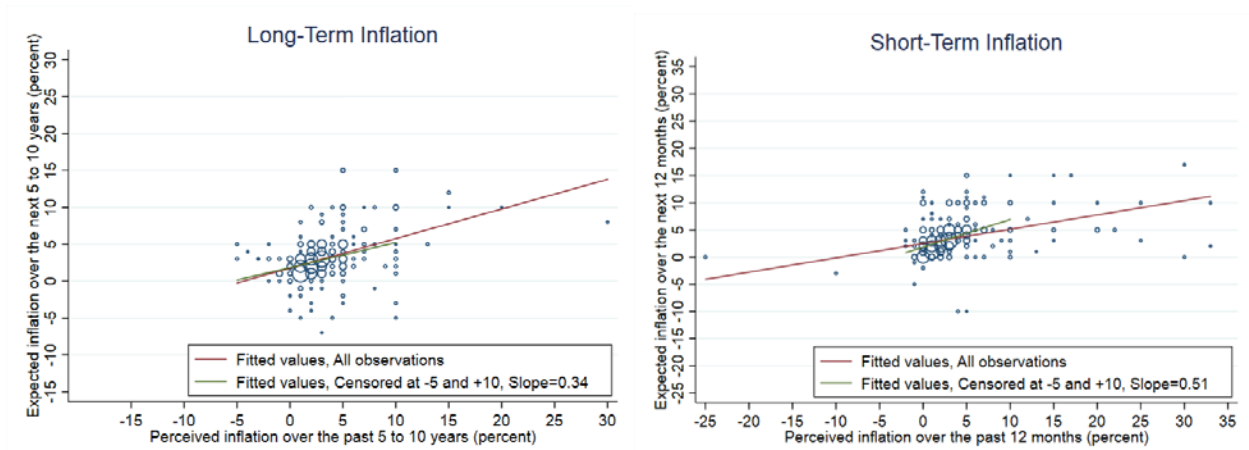
¹⁵ Among the hypotheses for this result is that low-income populations tend to have lower levels of financial literacy and that they tend to be more myopic when making financial decisions, which can imply shorter planning horizons and less attention to long-term inflation trends. See Bruine de Bruin et al. (2010) or Johannsen (2014).

Figure 3. Difference between individual expectations and perceptions, May 2018 survey



To further examine this relationship, Figure 4 shows scatterplots of reported inflation perceptions versus inflation expectations, along with simple regression lines. The size of the dots reflects the number of observations (adjusted for their weight) at each point.¹⁶

Figure 4. Relationship between individual expectations and perceptions, May 2018 survey

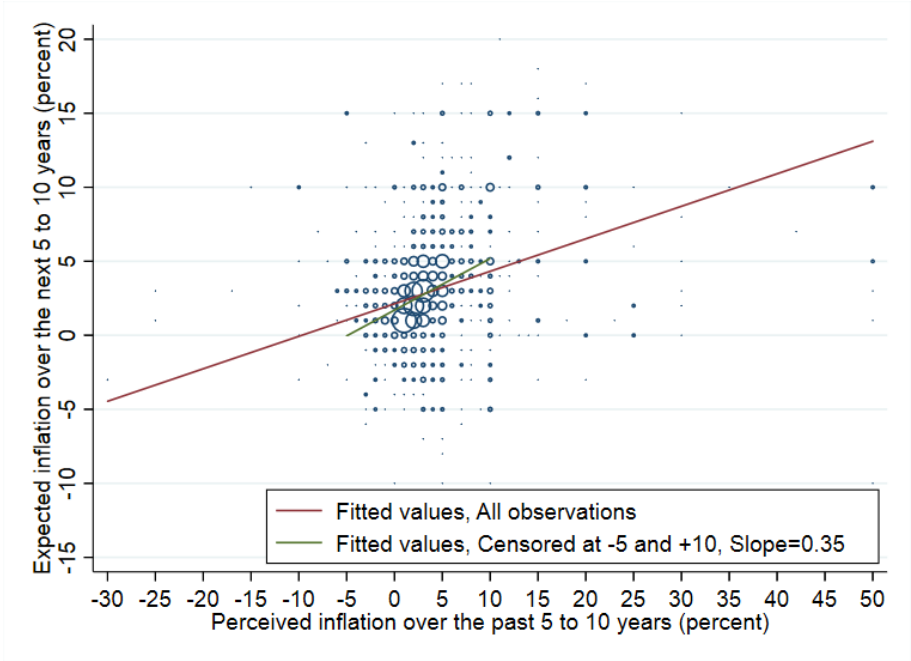


Note: The size of each dot reflects the number of observations, adjusted for their weight, on each point.

¹⁶ In the Michigan survey, each household is assigned a weight designed to yield a representative sample of all U.S. households.

For the 5-to-10 year measures, there is a clear positive correlation. For the 12-month measures the correlation is weaker given the wider range of responses; but when we limit ourselves to individuals with both perceived and expected inflation that is between negative 5 percent and positive 10 percent (about 95 percent of the respondents who answered the questions on both perceptions and expectations numerically), a strong positive correlation becomes evident. Similar results are shown in Figure 5, which combines the long-term responses from each of the 10 surveys from February 2016 through May 2018: Especially when perceptions and expectations outliers are removed, there is a strong positive correlation between individuals' inflation perceptions and their inflation expectations.

Figure 5. Relationship between long-run expectations and perceptions (10 surveys combined February, 2016 - May, 2018)



Note: The size of each dot reflects the number of observations, adjusted for their weight, on each point.

Furthermore, as can be seen from the regression results in Table 5, the correlation between long-term inflation perception and expectations holds even when controlling for gender, age, and short-term perceptions. This finding is in agreement with the limited existing literature on this

topic. Based on survey data for Sweden, Jonung (1981) finds that perceived rates of inflation are strongly positively correlated with expected inflation. More recently, Coibion et al. (2018) find that managers in New Zealand who believe inflation has recently been high are much more likely to expect higher inflation in the future.

Table 5. Regression results for long-term inflation expectations (10 surveys combined February, 2016 - May, 2018)

Dependent variable: 5-to-10 year ahead inflation expectations.

All inflation variables limited to the range [-5, 10]

Variable	Model 1	Model 2	Model 3
5-to-10 year inflation perceptions	0.35***	0.35***	0.28***
Gender		0.08	0.03
Income		-0.07***	-0.04*
12-months inflation perceptions			0.21***
Constant	1.70***	1.78***	1.50***
Adjusted R ²	0.13	0.14	0.20
No. of observations	5,153	4,983	4,805
No. of obs. out of the [-5, 10] range	152	144	260

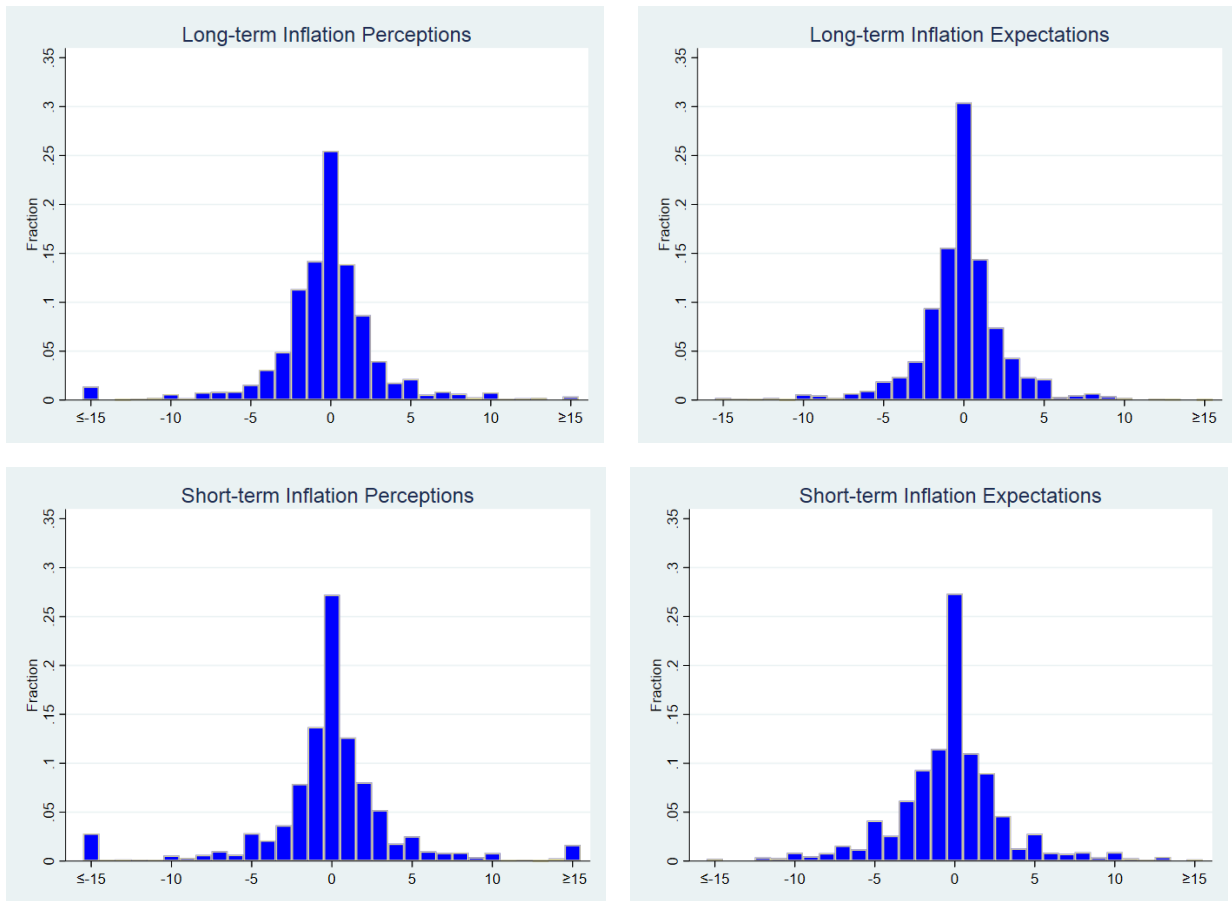
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

An even stronger result relating perceptions and expectations is evident from the change in individuals' responses over time. In the Michigan survey, about 40 percent of respondents are re-interviewed six months later.¹⁷ This panel aspect of the survey allows us to examine, for those individuals, the changes to their responses over time. We combine the 10 surveys (conducted every three months) and this gives us eight sets of revisions to households'

¹⁷ Interestingly, the distribution of responses for people being interviewed for a second time (for both inflation perceptions and expectations) is somewhat tighter than for the first time these people were interviewed. The histograms are included in Appendix B. A larger share of respondents perceive/expect inflation in the range of 1-3 percent, with fewer responses higher or lower than that range. This suggests to us some evidence of learning. For example, perhaps seeing the inflation-related questions in the initial interview prompts respondents to pay more attention to the price changes they observe, or to media reports of inflation data, than they did previously.

perceptions and expectations for inflation. We match the respective inflation responses for each household and, for each question, we retain only the households that gave a numeric answer in both the first and the second interview. As a result, this dataset contains fewer observations. Figure 6 plots the histograms of the revisions to both long- and short-term perceptions and expectations. As the histograms make clear, in the combined dataset, at least one-quarter of the households do not revise their perceptions and/or expectations.

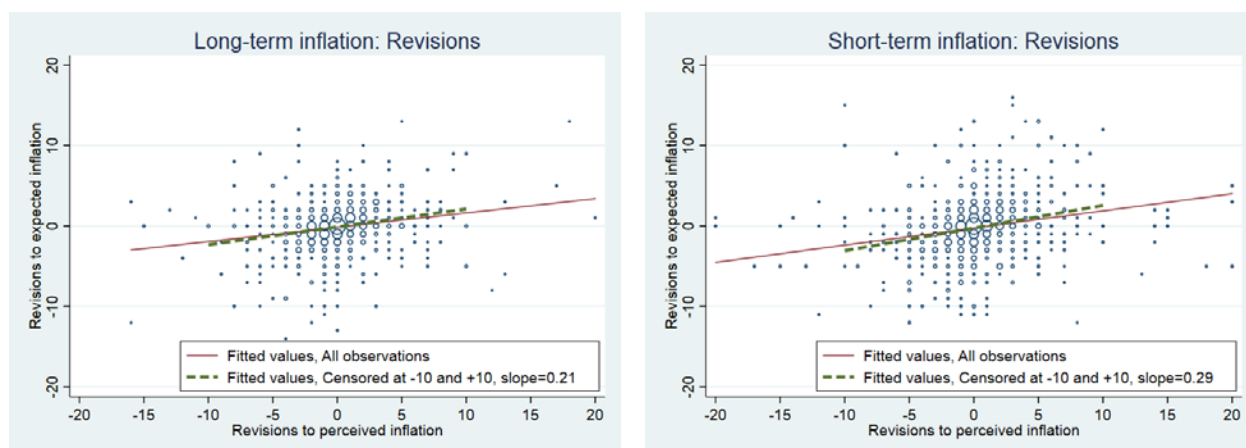
Figure 6. Revisions to individual expectations and perceptions from combined surveys (February, 2016 - May, 2018)



But the scatterplots and regression lines in Figure 7 demonstrate that people who revise their long-term inflation perceptions tend to revise their inflation expectations in the same direction.

The relationship between revisions to long-term perceptions and revisions to long-term expectations (the regression results are in Table 6) is not as tight as the levels relationship shown

Figure 7. Relationship between revisions to individual expectations and perceptions from combined surveys (February, 2016 - May, 2018). Revisions are truncated at -20 and 20.



Note: The size of each dot reflects the number of observations, adjusted for their weight, on each point.

Table 6. Regression results for revisions to long-term inflation expectations (10 surveys combined February, 2016 - May, 2018)

Dependent variable: Revisions to 5-to-10 year ahead inflation expectations.

Revisions limited to the range [-10, 10]

Variable	Model 1	Model 2	Model 3
Revisions to 5-to-10 year inflation perceptions	0.21***	0.20***	0.18***
Gender		0.22	
Income		0.04	
Revisions to 12-months inflation perceptions			0.19***
Constant	-0.08	-0.48*	-0.13**
Adjusted R ²	0.04	0.05	0.09
No. of observations	1,354	1,329	1,294
No. of obs. out of the [-10, 10] range	26	25	62

** $p < 0.01$, * $p < 0.05$, * $p < 0.1$

in Figure 5 but is statistically significant and holds when controlling for demographic variables. In addition, as shown by Model 3, revisions to individuals' *short-term* inflation perceptions also help explain the observed revisions to their longer-term expectations. Interestingly, however, this cross-section result is not evident in the central tendencies of the two series. Figure 2 showed that the median values of longer-term expectations (and perceptions) held about stable in 2018 even as the median of shorter-term perceptions moved up.

VI. Implications for understanding movements in long-term expectations

From the late 1990s through mid-2014, long-term inflation expectations from the Michigan survey were remarkably stable, with a median near 2.9 percent, despite significant swings in prices of oil and other commodities, two recessions (one of them Great), and unprecedented monetary policy actions. Households' long-term inflation expectations were also unaffected by the Federal Reserve's announcement of a 2 percent longer-run objective for PCE price inflation in January 2012.¹⁸ However, these expectations drifted modestly lower starting in mid-2014. This decline occurred after several years of persistently low inflation following the Great Recession and around the time when oil prices declined sharply and measured headline inflation moved even lower. That said, the decline also corresponds to a time when the U.S. was well into an economic recovery and the unemployment rate had returned close to most estimates of its natural rate. The median reading of households' long-term inflation expectations reached 2.5 percent in mid-2016, and has remained near that lower level since then.

This behavior of long-term expectations has been a focus of Federal Reserve policymakers. The general stability of these expectations over the past two decades is widely viewed as being of central importance for explaining recent inflation dynamics. The question of whether the post-2014 decline is of material importance also has attracted significant attention, with some policymakers concerned it could be an indication that inflation may remain below the Federal

¹⁸ Detmeister et al. (2015) find that the Federal Open Market Committee's announcement of an explicit inflation objective had some effect on professional forecasters' long-run inflation expectations but not on households' expectations.

Reserve's objective.¹⁹ Here we ask whether the data on inflation perceptions can help elucidate the recent downward drift in expectations and, more generally, speak to the conditions under which long-term expectations might adjust in the future.

Because the data on inflation perceptions are available only since early 2016, when the post-2014 downward drift in expectations was largely complete, they cannot provide direct evidence on that decline—let alone on the broader period of stability since the late 1990s. However, several aspects of our analysis are suggestive that inflation perceptions are important for understanding changes in inflation expectations.

First, and somewhat obviously, we note that if inflation expectations respond to observed inflation, this response must work through the channel of perceptions. People's expectations cannot be influenced by things they are unaware of. Second, the survey respondents show an awareness of inflation behavior: We interpret the data on perceptions as broadly consistent with actual inflation as reflected in the published data, even if a little higher on average. For example, the median of 12-month inflation perceptions was lower than long-term inflation perceptions *and* expectations in 2016 and 2017, following a period when published inflation was also temporarily low. Third, we find a close relationship between inflation perceptions and inflation expectations in the cross section: We note both the strong positive correlation between perceptions and expectations across survey respondents and the fact that respondents who revise their inflation perceptions also tend to revise their expectations in the same direction. The last regression in Table 5 provides additional evidence, showing that respondents' expectations of inflation over the next 5-to-10 years are positively related not only to their perceptions of inflation over the past 5-to-10 years, but also to their perceptions of inflation over the past 12 months.

All told, these results suggest to us that perceptions of inflation likely play an important role in explaining inflation expectations.²⁰ Changing perceptions of both short- and long-term inflation could have contributed to the modest decline in long-term inflation expectations between 2014

¹⁹ For an example of policymakers' emphasis on stable long-term inflation expectations, see Yellen (2017). For concern regarding the decline in the Michigan survey measure, see Brainard (2017).

²⁰ Whether reductions in expectations contribute to holding down actual inflation is another matter. For a skeptical view, see Nalewaik (2016).

and 2016, and changing perceptions would likely be an important signal for any changes in inflation expectations that may occur in the future.

VII. Concluding discussion

In an attempt to better understand households' inflation expectations, we examine newly available data from the Michigan survey on inflation perceptions. As far as we know, this is the first survey for the U.S. that asks about both short- and long-term inflation perceptions, has run for more than two years and is expected to continue to run, has a substantial number of responses in each survey, and has questions on perceptions that are worded consistently with the long-running question on inflation expectations. We view the survey responses as generally reasonable: The bulk of responses for perceived inflation over the past 5 to 10 years are in the range of 1 to 5 percent and, in contrast to many other surveys, the median is only a little higher than the published inflation data.

We find that people's inflation expectations look quite similar to their inflation perceptions. Of particular interest, the central tendency of the responses for expected inflation for the next five to ten years is very close to that of perceived inflation over the past five to ten years. This suggests that respondents overall do not expect long-term inflation to change in the future relative to the recent past even though the median of long-term expectations is a little above official estimates of recent inflation. We find some evidence that people's inflation perceptions respond to observed changes in inflation and substantial evidence that changes in inflation perceptions tend to be accompanied by changes in inflation expectations. These findings suggest that changes in households' inflation expectations could well be foreshadowed by a change in inflation perceptions. We view these data on inflation perceptions as a valuable tool for understanding inflation expectations and inflation outcomes.

Appendix A

Table A1. Perceptions and expectations of long-run inflation by selected demographic group from University of Michigan Surveys of Consumers (12-month; combined February, 2016- May, 2018)^a

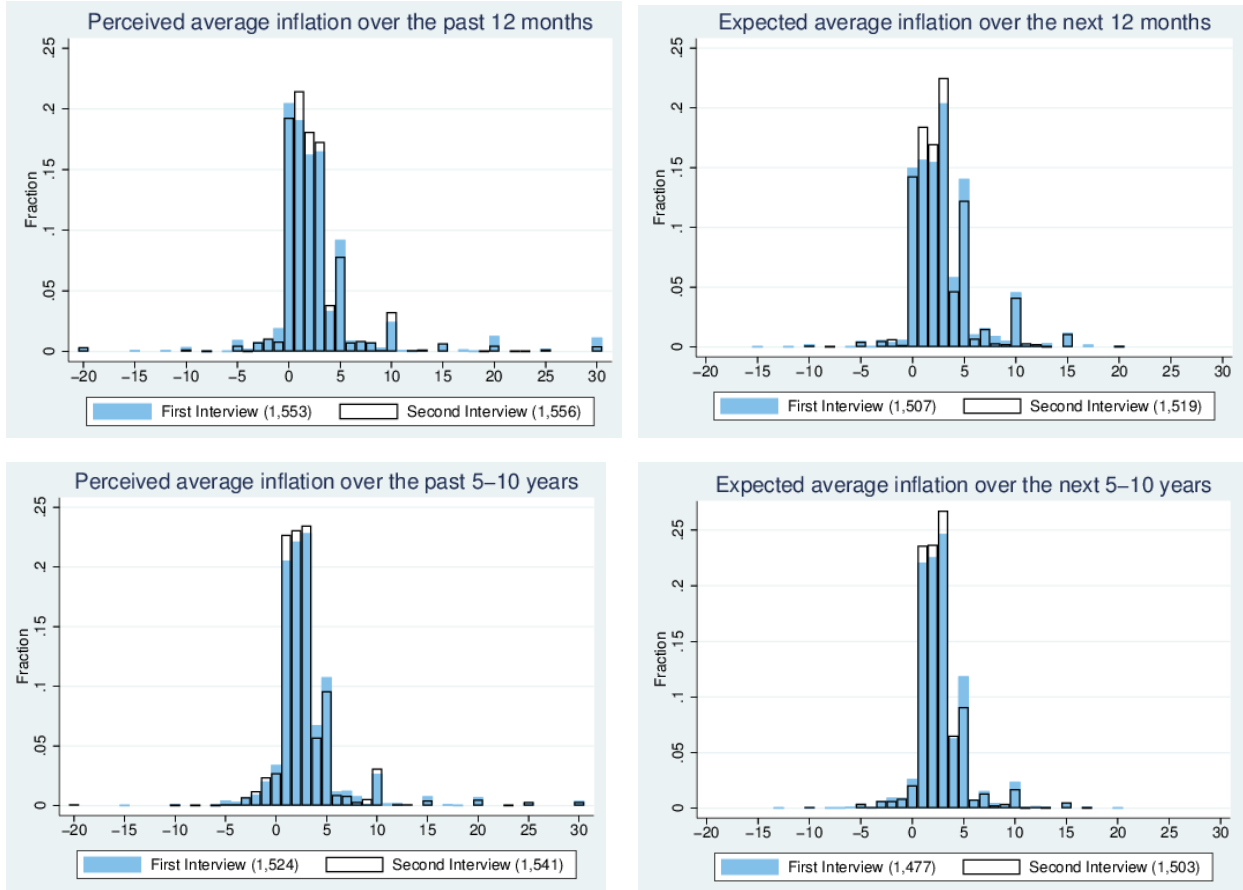
	Perceived		Expected		Number of observations (weighted) ^b
	Median	4% Trimmed mean	Median	4% Trimmed mean	
Full sample	1.8	2.5	2.6	3.0	5,844
Gender					
Male	1.6	2.1	2.5	2.7	3,252
Female	2.1	3.1	2.8	3.3	2,593
Race					
White	1.8	2.4	2.5	2.9	4,321
Nonwhite	1.9	3.0	2.8	3.4	1,321
Income percentiles					
Bottom 25	2.5	4.0	3.0	3.8	1,393
25-50	1.9	2.4	2.7	3.1	1,439
50-75	1.6	2.2	2.5	2.8	1,385
Top 25	1.4	1.7	2.2	2.4	1,388
Age					
Age 18 to 44	1.5	2.0	2.4	2.8	2,290
Age 45 to 64	1.9	2.7	2.6	3.0	2,169
Age 65+	2.3	3.0	2.8	3.2	1,335

^aThe trimmed mean and median for the demographic groups are authors' calculations, in which we try to replicate the survey procedures for imputing missing data, adjusting for extreme values, and interpolating between integers. The trimmed mean is obtained by omitting the largest 2 percent and the smallest 2 percent of unweighted observations. The naming of this measure as the 4 percent trimmed mean is consistent with the Cleveland Fed's 16 percent trimmed mean CPI which trims 8 percent off each tail of the CPI monthly price-change distribution.

^bThis column gives the total number of weighted observations for each demographic group in the survey. The actual number of (weighted) observations used to calculate the median and trimmed mean for each question can be smaller than the number reported in this column if some respondents did not answer the question.

Appendix B

Figure B1. Inflation Perceptions and Expectations from the first and second interviews (matched responses from 10 surveys, February, 2016 - May, 2018)



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