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Rethinking the Measurement of Household Inflation Expectations: Preliminary Findings

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Abstract

This paper reports preliminary findings from a Federal Reserve Bank of New York research program aimed at improving survey measures of inflation expectations. We find that seemingly small differences in how inflation is referred to in a survey can lead respondents to consider significantly different price concepts. For near-term inflation, the "prices in general" question in the monthly Reuters/University of Michigan Surveys of Consumers can elicit responses that focus on the most visible prices, such as gasoline or food. Questions on the "rate of inflation" can lead to responses on the prices that U.S. citizens pay in general—an interpretation, or concept, closer to the definition of inflation that economists have in mind; they also lead to both lower levels of reported inflation and to lower disagreement among respondents. In addition, we present results associated with new survey questions that assess the degree of individual uncertainty about future inflation outcomes as well as future expected wage changes. Finally, using the panel dimension of the surveys, we find that individual responses exhibit considerable persistence, both in the expected level of inflation and in forecast uncertainty. Respondents who are more uncertain make larger revisions to their expectations in the next survey.

Key words: Inflation expectations, survey measurement

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Introduction

(i) Background

Inflation expectations play a crucial role in modern monetary policy. In economic models with rational expectations, the long-run behavior of inflation expectations, and hence inflation itself, is an equilibrium outcome determined exclusively by the public's beliefs about the policy rule followed by the central bank. Following this fundamental insight from the rational expectations revolution, central banks increasingly communicate their policy reaction function in terms of possible paths for inflation expectations and by establishing inflation targets attempting to "anchor" the public's long-run inflation expectations. In addition, a wide range of household inter-temporal decisions can be affected by expectations and uncertainty about future inflation. Indeed, one definition of price stability ascribed to Alan Greenspan, is an environment where economic agents do not take into account uncertainty about future inflation in their decision-making. Accurate and consistent measurements of inflation expectations therefore represent an important source of information for appropriately calibrating monetary policy and deepening our understanding of economic behavior (Bernanke 2007).

As predicted by rational expectations models with learning over the central bank policy rule (see Kiley 2008 and references), many of the developments in inflation dynamics over the last forty years can be seen directly in various measures of inflation expectations. We focus on consumer inflation expectations but similar developments are present in surveys of professional forecasters and in inflation compensation required by fixed income investors. Figure 1 plots the median responses to questions about the change in prices in general over the next 12 months and between 5 and 10 years ahead from the Reuters/University of Michigan Survey of Consumers. Both the year-ahead and 5-10 years-ahead median responses were very high in the late 1970s and early 1980s relative to inflation rates of around 2% that we now associate with price stability and then came down slowly over the next 15 years, followed by almost 10 years of stability, with an uptick in the last few years. The correlation between the two median expectations over the 1978 to 1993 period fell from a peak of nearly 100% to zero.

The Reuters/ University of Michigan Survey of Consumers (henceforth the "Michigan Survey") is a nationally representative monthly random sample of around 500 households.[1] In addition to a range of questions about current economic conditions, the survey elicits year-ahead point forecasts for expected changes in "prices in general," asking '*By about what percent do you expect prices to go up/down on the average, during the next 12 months*?' followed by specific prompts (Figure 2). Similar wording is used to elicit 5-10 years-ahead point forecasts. In their basic form these questions on price changes have remained unchanged over the last 30 years and share a feature common with many other inflation expectation surveys: they use simplified wording asking about "prices in general" rather than directly asking about "the rate of inflation."

[1] The Michigan survey does have a panel aspect in that about 200 of the 500 respondents each month are from the survey sample 6 months before, while the other 300 are new respondents.

However, studies in survey design have long suggested that the use of simplified wording such as 'prices in general' provides no assurance that all respondents interpret it in the same way, or in the way that it may be interpreted by economists. Valid measurement requires respondents to agree with one another, and with the economic modelers, regarding what the survey question entails. As far as we know, the questions in the Michigan Survey measuring expectations for "prices in general" have not previously been systematically validated, in terms of how it is interpreted by respondents, how their interpretations of the question affect their responses, and how well their responses correlate to relevant behaviors.

If respondents have different interpretations of a question, their responses may show larger disagreements. Indeed, another feature Michigan's question about "prices in general" shares with other inflation expectation surveys is the high dispersion of responses around the median, which is partly related to observable characteristics of respondents such as age, sex, education and income. Further, a large number of respondents with certain observable characteristics consistently expect changes in "prices in general" to be significantly above current inflation rates. For example, from May 2008 to July 2008 one quarter of the respondents to the Michigan Survey expected price changes of greater than or equal to 10% over the next 12 months. Other surveys ask questions about the past change in prices and find that some of the dispersion about future price changes is related to dispersion of views about past price changes (see section 4).

The dispersion and perceptions of higher rates of inflation than reflected in published consumer price indices has also produced a large literature questioning the appropriateness of the rational expectations assumption (see, for example, Mankiw et al, 2003). Others have questioned whether inflation expectations are a leading indicator of future inflation pressures or are more of a backward looking indicator (see Cecchetti et. al 2007).

In our investigation of the nature and measurement of inflation expectations of households, we also wish to explore possible modifications to the current practice of asking consumers only for their point forecasts. It is now commonly understood that the Fisher equation of a century ago was incomplete. The costs of inflation run not just through inflation expectations, but also through the risk of inflation, which is a related, but distinct concept. Uncertainty about future inflation clouds the decision making of consumers and businesses and reduces economic well-being.[2] Without this uncertainty, consumers and businesses would be better able to plan for the future. Recent discussions (Mishkin, 2008) have suggested that a central bank might address these two costs differently.

Tracking inflation uncertainty is also important for assessing central bank credibility and effectiveness of communications. An increase in uncertainty about future inflation outcomes may be used as an early warning system of any erosion in central bank credibility. Central bank communications have stressed the importance of outlook risk, further highlighting the need for informative quantitative risk measures to be included as part of the policymaker's tool kit. Moreover, to the extent that uncertainty about future inflation affects consumers' inter-temporal decisions, such a measure is of direct

[2] For a discussion of alternative pathways through which inflation uncertainty affects economic decision making and welfare, see Golob (FRB Kansas City, Economic Review, third quarter 1994).

relevance for tracking and forecasting economic conditions, and may be itself an object of interest for monetary policymakers.

As part of our exploration of alternative measures of inflation expectations, we have also set out to collect information regarding wage expectations. Like inflation expectations, wage expectations affect consumer inter-temporal decisions, and are therefore of great value for understanding and forecasting economic behavior. Moreover, since price-setting behavior by firms is at least partly dependent on total labor cost, wage dynamics are an important determinant of actual and expected inflation. At the same time, because economic agents may set wages with reference to the expected rate of inflation, data on wage expectations provide an additional information source for analyzing inflation dynamics and the interaction between wage and price determination (the basis of the so-called "wage-price spiral"). Despite the obvious importance of wage expectations, as noted by Chairman Bernanke (2007), information on nominal wage expectations is particularly scarce.[3]

Finally, relatively little is known about the way in which individuals form and update expectations about future inflation. As argued by Chairman Bernanke (2007), "a fuller understanding of the public's learning rules would improve the central bank's capacity to assess its own credibility, to evaluate the implications of its policy decisions and communications strategy, and perhaps to forecast inflation". Tracking individual respondents over time would enable us to study how they revise expectations over time, and how such revisions vary across people who express different levels of uncertainty about future inflation outcomes.

For the last two years, the New York Fed, with support from the Cleveland Fed and other research institutions has been conducting a project to assess the possibility of improving the measurement and analysis of consumer inflation expectations.[4] The project has several broad long-term objectives: (i) to better align the measurement of household inflation expectations with the central role that inflation expectations play in current monetary policy formulation and communication; (ii) to improve our understanding of how consumers form and update their inflation expectations; (iii) to empirically assess the links between inflation expectations, assessed using different survey questions, and consumer choice behavior.

As a first step towards these broad goals, our project to date has primarily focused on (i) analyzing how respondents interpret the Michigan Survey questions and respond to their format; (ii) examining responses to a broader set of questions asking about inflation expectations using different question wordings (in addition to "prices in general") and time horizons, to complement the Michigan Survey; (iii) eliciting individual uncertainty about future inflation outcomes; (iv) asking for expectations about wages; (v) tracking the same set of households over time (i.e. introducing a panel dimension in our data collection effort) in order to study persistence and responsiveness of inflation expectations to inflation surprises.

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[3] Notable exceptions are survey questions on expected weekly earnings analyzed by Dominitz (1998) and on expected future income by Guiso et al (1992), Manski (1993) and Dominitz and Manski (1996).

[4] The past decade has witnessed a marked increase in the number and use of surveys of inflation expectations by Central Banks internationally. Several Central Banks have launched their own surveys of expectations or contracted with outside organizations to develop and conduct new surveys on their behalf with the same aim of improving the overall quality and usefulness of survey data on inflation expectations.

In what follows, we first present some background information about the pilot surveys we have undertaken as part of the project. We then provide a summary of the most significant findings from our pilot surveys, with regard to the various enhancements described above as well as a brief discussion of some important areas for further research.

This is followed by a detailed exposition of the findings from our pilot surveys. We split the discussion of the results into four main sections. Section 1 presents the findings that relate to year-ahead point forecasts from alternative measures of inflation expectations. Findings regarding the measurement of inflation uncertainty are described in section 2, while those relating to long term inflation expectations are discussed in section 3. Section 4 deals with wage growth expectations as well as additional inflation measures focusing on persistence in expectations and revisions to expectations following inflation "surprises". Finally, the paper ends with a brief literature review, a discussion of the original motivations for this research project and a more detailed description of the design of the various survey elements.

(ii) Overview of the project to date

After an initial set of exploratory meetings by a working group of Fed economists, academic economists, experts in survey design and psychologists, we carried out 30 in-depth open-ended cognitive interviews of consumers, jointly with a team of psychologists at Carnegie Mellon University.[5] Although the sample of interviewees was small and non-representative of the general population, such cognitive interviews typically provide qualitative insights that can not be obtained on a written survey.

The cognitive interviews were designed to examine respondent's familiarity with the concept of inflation, and how they interpret the Michigan question about expected changes in 'prices in general' and alternative questions asking for inflation expectations. The main findings of these interviews were that (a) all interviewees had heard of the term "inflation" and could give a reasonable definition; (b) interviewees had many interpretations of the Michigan question about "prices in general," with some interpreting it as asking about "inflation" while others interpreting it as asking about prices they paid, using salient examples such as gas prices; (c) interviewees had more focused interpretations when they were asked for their expectations about "the rate of inflation" with none mentioning salient example prices; and (d) interviewees wanted to express their forecast uncertainty, often using ranges instead of point forecasts.

The findings from these interviews helped guide us in developing alternative questions for measuring inflation expectations and led to a set of survey modules designed to analyze the properties of the Michigan question and of several alternative questions asking about the "rate of inflation" and "the prices you pay for the things you usually spend money on" using a larger sample. In addition, we designed a preliminary set of questions to allow respondents to systematically express their forecast uncertainty. [6]

[5] A description of the main findings from these interviews is available upon request.

[6] The survey modules were designed in collaboration with a team of behavioral psychologists from Carnegie Mellon University (CMU) led by Wandi Bruine de Bruin and Baruch Fischhoff. Olivier Armantier and Rob Rich (FRB-NY), academic consultants (Charles Manski, Kenneth Wolpin, Eric Johnson), a team from RAND's Roybal Center for Financial Decision Making led by Jeff Dominitz and

First, we constructed a short module on inflation expectations for inclusion in the American Life Panel, an internet survey conducted by RAND. The sample population for this survey is based on the Michigan Survey and includes respondents who agreed to participate in further interviews after completing their participation in the Michigan Survey. This short module has been repeated since November 2007 roughly every six weeks and allows us to contrast it to, as well as complement the information derived from, the Michigan Survey. In what follows we refer to the data generated by this series of short modules, administered at a regular frequency to the same sample of respondents, as the "Fed-ALP panel".

We also fielded two one-time longer modules as part of the ALP, which we refer to as "Fed-ALP special modules", to test in depth the information content of the Michigan question as well as of the alternative questions we have been developing. These modules also included a set of questions about wage expectations and perceptions about the persistence of inflation shocks. The Carnegie Mellon team is currently conducting a detailed psychometric survey to further examine the reliability and validity of the Michigan question about "prices in general" as well as questions using alternative wording. Additional details regarding the sampling design of the ALP survey and of the design of the various survey elements are provided in section 6.2 of this paper.

(iii) Summary of main findings

Survey results indicate that seemingly small differences in how inflation is referred to—for example as "prices in general" versus the "rate of inflation"—can lead respondents toward considering significantly different price concepts. Our results indicate that for near-term inflation, the "prices in general" question as used in the Reuters/ University of Michigan Survey of Consumers can elicit responses that focus on the most visible, and often increasing prices, such as gasoline or fuel oil. Questions about inflation tend to lead respondents to think about the prices of things that US citizens pay for in general, closer to the definition of inflation that economists have in mind. Questions that use the keyword "inflation" lead to both lower levels of reported inflation and to lower disagreement among respondents. These findings also apply to questions related to longer-term inflation expectations. A similar pattern is also found for questions about past inflation, with questions phrased in terms of the inflation rate yielding a lower median response.

Another finding from our research relates to the specific question formats used by the Michigan Survey to solicit inflation expectations. Results suggest that the selective use of follow-up questions which allow individuals with higher forecasts to revise their response may lead to biased estimates of overall expectations.

Results from a set of new questions designed to assess the degree of individual uncertainty about inflation outcomes indicate that while there is often a correlation between individual perceptions of uncertainty and the dispersion among individual responses, this is not always the case. Thus an important conclusion is that the use of

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Arie Kapteyn, all provided valuable input. Each module was pilot tested on small samples by the CMU team.

response dispersion as a proxy for individual forecast uncertainty will not always be reliable.

Survey respondents appear to be less uncertain about future wages than about prices and report that they find questions about wages changes to be clearer and easier to answer than similar questions about price changes. Overall, respondents expect wages to rise significantly less than prices, with the median discrepancy being about three percentage points.

Finally, utilizing the panel dimension of the surveys, we find that individual responses exhibit considerable persistence in both the expected level of inflation, and in the uncertainty attached to future inflation outcomes. Respondents who are more uncertain make larger revisions to their expectation in the following survey. The survey also asks questions to assess respondents' response to a temporary inflation surprise. The results suggest that on average revisions to expectations following such a surprise are not substantial, although the distribution of revisions has a large variance.

(iv) Future research

In addition to a several other specific topics discussed in the paper, we consider the main areas for future research to be, (1) learning more about how people form their expectations, and (2) studying the links between inflation expectations and behavior. Both goals will help to design better questions about inflation expectations, and to improve the modeling of expectations formation in economics.

First, gaining a deeper understanding of the processes by which expectations are formed and updated by households will help us to design survey questions that better allow respondents to express their expectations. It will also help us to predict how consumers respond to new information, surprises, anticipated or unanticipated shocks in the economic and financial environment. The speed and possible heterogeneity in the updating process can be of crucial importance for the central bank in order to forecast possible responses to policy actions or other changes.

Second, the connection between expectations and behavior is important, both to design and validate alternative questions using different wording and question formats to assess expectations, and to gain a better understanding of the ways in which expectations about prices and wages affect consumer behavior; the latter can be extremely useful to refine our working models of inter-temporal choices by consumers, which in turn can be used for economic modeling and forecasting by the central bank.

1. Year-ahead point forecasts

Currently the main source of information on consumer inflation expectations comes from the Reuters/ University of Michigan Survey of Consumers. The survey of a nationally representative sample of around 500 households is conducted monthly through phone interviews. Since 1978 the survey elicits point forecasts of year-ahead inflation and 5 to 10 years-ahead inflation. For each time horizon, the question asks respondents whether they believe "prices in general" will go up, go down, or stay where they are now. Those who respond "up" (or "down") are then asked by about what percent they expect prices in general to go up (or down.) While a large number of studies have used the survey data to measure and analyze inflation expectations, little is known about how the question wording and the question format used on these surveys may affect reported expectations. As far as we know, the questions in the Michigan Survey measuring expectations for "prices in general" have not been systematically validated, in terms of how it is interpreted by respondents, how their interpretations of the question affect their responses, and how well their responses correlate to relevant behaviors.

Here, we present a study that takes the first step towards systematically validating the Michigan questions. We fielded two special survey modules with a subsample of RAND's American Life Panel in December 2007 and May 2008 (referred to below as the Fed-ALP December and May special modules) in which we asked respondents to answer the year-ahead and long-term Michigan questions about "prices in general", to report how they interpreted the questions, and to evaluate them on other dimensions, such as question clarity. Doing so allowed us to systematically examine how respondents interpreted the questions, and how their interpretations affected responses to the Michigan questions. In order to follow responses to the Michigan question about year-ahead expectations for "prices in general" over time, we also included it as part of a short module administered to a different sub sample of RAND's ALP survey (referred to below as the Fed-ALP panel) approximately every six weeks starting in November 2007. Details about the construction of the Fed-ALP samples and of the ALP survey itself are provided in section 6.2 of this paper.

In section 1.1 we summarize reported forecasts in our Fed-ALP panel and compare our findings with those from the Michigan Survey itself. We analyze how the question's format (such as the clarifying follow-up questions that have been used) and the question's wording (i.e., "prices in general") affect responses, and assess the current imputation procedures used for incomplete or partial responses.

Our findings regarding the interpretation of the question asking about year-ahead changes in "prices in general", are discussed in section 1.2. In that section we also examine several alternative wordings of the12-months-ahead expectation question and compare reported forecasts to those for the standard Michigan version. Findings regarding the 5-10-years-ahead question will be presented later in section 3.

Section 1.3 summarizes our research findings, and suggests potential improvements in question format and question wording that could be made on the Michigan Survey of Consumers. Moreover, we discuss issues that require further research.

(1.1) The Michigan question about year-ahead changes in prices in general.

Figure 1.1 describes the structure of the question that is used on the Michigan Survey of Consumers to ask about expectations for prices in general. First, respondents receive the question "During the next 12 months, do you think that prices in general will go up, or go down, or stay where they are now?" followed by the response options "Go up," "Stay the same," and "Go down." Those who respond "stay the same" are asked whether they mean that prices would go up at the same rate, or stay the same. Those who indicate that they mean that prices would go up at the same rate are then given the same follow-up questions as those who originally answer that they believe prices will go up.

Subsequently, respondents who answer that they expect prices to go up or go down receive the question "By about what percent do you expect prices to go [up/down] on the average, during the next 12 months?" As reported in Curtin (2006) a substantial fraction of respondents provide a range as answer, after which they are prodded for a best guess. Accordingly, we instructed respondents as follows: "Below, please give your best guess OR your best guess for a range" followed by answer options "My best guess is that prices will go [up/down] by ____ percent" as well as "My best guess for a range is that prices will go up between ____ percent and ____ percent." Respondents who only fill out the lower bound or the higher bound of the range are prompted to fill out both. Those who only give a range are subsequently also asked for a best guess.

Following the same procedure as applied in the Michigan Survey of Consumers, respondents who give a best guess of over 5% are given the opportunity to revise their answer, using the following prompt: "Let me make sure I have that correct. You said that you expect prices to go up during the next 12 months by [x] percent. Is that correct?" Finally, respondents who had not given a best guess or a range are prompted one more time with the question "How many cents on the dollar do you expect prices to go up/down on the average, during the next 12 months?".

Before asking about expectations for "prices in general during the next 12 months", the Michigan Survey first asks respondents to report their perceptions of and expectations for their financial situation as well as for business conditions. To provide the same context, our Fed-ALP respondents also answered these questions before reporting their expectations for "prices in general."

(1.1.1) Recent time-series evidence

Since November 2007 we have administered the Michigan question about expectations for "prices in general during the next 12 months" to the Fed-ALP panel. Figures 1.2 and 1.3 report time trends for the median point forecast and for our measure of disagreement among respondents, namely the Inter-Quartile Range (IQR) of the distribution of point forecasts across respondents. The blue line refers to our replication of the Michigan question in the Fed-ALP panel, whereas the red line reports monthly results from the Michigan Survey micro-data.[7] Note that the calculations for the Fed-ALP

[7] The numbers we computed based on the Michigan micro-data are very close to the official numbers released by the Michigan Survey, but not always identical. One reason for this is that we do not use Michigan Survey sample weights for comparison reasons (we do not have comparable sample weights for the ALP sample). Second, the difference may be due to a possible difference in the computation of quantiles. Note that because all responses are integers, raw medians are relatively invariant over time (and

panel are based on a fixed set of respondents who provided forecasts at all survey dates (a so-called balanced panel), whereas the Michigan sample represents a repeated cross-section with only a limited panel dimension (see section 6.2).

Median expectations have risen in both surveys between November 2007 and May-June 2008 – although less so in the Fed-ALP panel – but have since significantly moderated. The Michigan Survey median forecast is also consistently lower than the Fed-ALP one. We discuss this gap in more detail later in section 1.1.3. Dispersion in responses across individuals, as reflected in the IQR, has also risen in both surveys over the time period under consideration, with a sharp increase in March-April 2008 especially in the Michigan Survey data, followed by a drop during the August-September period.

The initial sharp increase in disagreement is confirmed by an examination of the distributional changes in the two data series between November 2007 and July 2008 (Fig. 1.4). In creating these histograms responses under -10 were coded as -10 and responses exceeding 20 were top-coded at 20. In the Michigan micro-data, the frequency of responses in the 0-4 interval has dropped, with the frequencies of responses at 5, 10, 15 and 20+ all exhibiting sharp increases. A slightly different pattern occurs in the Fed-ALP panel, with a decline in responses in the 1-2 bins, more responses in the 6-8 interval, but no significant increases at 10, 15 or 20+. The distribution of responses in the Fed-ALP sample appears less dispersed than in the Michigan Survey, especially in July 2008; this is consistent with the lower disagreement in the Fed-ALP panel evidenced in Figure 1.3, during that period.

Before turning to an analysis of individual heterogeneity in inflation forecasts, it is worth noting that in both the Michigan and Fed-ALP samples the forecasts distribution reveals positive skewness, indicating a greater number of values that are smaller than the mean, as well as a strong positive kurtosis, pointing to a longer tail than would have been expected with normal distributions.

(1.1.2) Heterogeneity in year-ahead forecasts of changes in prices in general.

Table 1.1 focuses on heterogeneity of responses across broad demographic categories. We find very similar patterns in the Michigan Survey micro data and in the Fed-ALP data. Both forecast levels and disagreement are lower for men than for women, for the more educated than for the less educated, and for higher income than for lower income respondents. These patterns are consistent with previous evidence from other surveys, such as those conducted by the Cleveland Fed from 1998-2001 (see Bryan and Venkatu, 2001a, 2001b) as well as with the heterogeneity documented in monthly Michigan Survey reports.

This heterogeneity does not seem to significantly affect the time trends presented earlier: as figures 1.5 through 1.8 show, the increase in median forecasts between November 2007 and July 2008 consistently appears across all demographic groups under consideration.

We explore heterogeneity further in Table 1.2, based on results from the December special module. This table reports the Spearman rank correlation between

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change in one unit jumps) and insensitive to fairly substantial changes in the underlying forecast distribution. Medians are therefore computed using interpolation methods. Unfortunately we do not know the precise algorithm used by Michigan to compute its median as it has not been made public. We found that a simple linear interpolation procedure provided the closest fit to the Michigan numbers.

individual 12-month-ahead point forecasts from the Michigan question and various measures of cognitive ability and financial responsibility. The first, a measure of numeracy skills, corresponds to the number of correct answers (out of 11 questions) on a numeracy test adopted in Peters et al. (2006) to measure respondents' ability to use percentages.[8] The second, a measure of financial literacy, corresponds to the number of correct answers on three questions related to inflation taken from a measure developed by Lusardi (2007).[9] In addition, for each question respondents indicated how confident they were in their answer, on a scale from 50% (=just guessing) to 100% (=absolutely sure). The average across the three questions is our measure of expressed confidence in financial literacy.

We also asked individuals a set of questions about financial decision making in their households. First, we asked them to rate how knowledgeable they considered themselves to be about their household's financial situation, on a scale from 1 (=not knowledgeable at all) to 7 (very knowledgeable). Second, we asked respondents about the planning horizon they consider in their spending and saving decisions, varying between 1 (next day) to 9 (longer than 10 years).[10] Third, we asked respondents to assess their financial responsibility for different financial decisions in the household. Respondents were asked to rate how much responsibility they had for (a) budgeting and managing income, (b) paying bills, (c) shopping, and (d) investing and managing assets, on a scale from 1 to 5.

The main result in Table 1.2 is that respondents with low numeracy and low financial literacy report significantly higher inflation expectations. Similarly, respondents with shorter planning horizons – both for spending and saving decisions – tend to give higher point forecasts. Finally, household members who have greater responsibility for shopping tend to display higher inflation expectations when asked about "prices in general". While not reported here, similar patterns hold for disagreement as for forecast levels: e.g., respondents performing worse on the numeracy tests have both higher median forecasts and a higher IQR.

The heterogeneity in responses by demographic characteristics will to some extent reflect differences in cognitive ability and financial knowledge and responsibility.[11] In addition, they could reflect differences in expenditure patterns, question interpretation (alternative inflation concepts), differences in access to sources of information, or

[8] For example, the first item asked "Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up as an even number?" and was presented with a textbox in which respondents could type their answer.

[9] Respondents were presented with statements about inflation, such as "If your income doubles in the next ten years and prices of all goods also double, then you will be able to buy fewer goods in ten years than you can buy today." For each statement, they indicated whether they believed it was true or false.

[10] The exact questions we asked were: "In deciding how much of their [family] income to spend, people are likely to think about different financial planning periods. In planning your [family's] spending, which of the following time periods is most important to you [and your husband/wife/partner]?", with the other question asking about saving instead.

[11] Males, college educated individuals, and those with higher incomes scored significantly higher on the numeracy and financial literacy tests, and were more confident in their answers to the latter. They also reported to have greater responsibility in investing and managing assets. In addition, males and higher income individuals reported longer decision horizons and have less responsibility in household decisions related to shopping, budgeting and paying bills.

different attitudes towards uncertain outcomes. Several theories that have been proposed to explain inflation expectation heterogeneity will be discussed in sections 5 and 6.1. However, to date, conclusive evidence about these and other explanations is still lacking and further research is needed to understand how people form expectations of inflation – and specifically ones that seem unrealistically high.

(1.1.3) Analyzing differences in inflation expectations between surveys

As mentioned earlier, the median point forecast from the Michigan Survey is consistently lower than that from the Fed-ALP panel. We have explored several possible reasons for this disparity. Table 1.3 indicates that the sample composition regarding several demographic variables is roughly similar across the two sets of surveys, with the exception of the age distribution. As described in section 6.2, the sample used for the Fed-ALP panel only includes individuals aged 40 or more. However, Table 1.1 shows that differences in median point forecasts across different age groups are minimal. The small differences in other demographic characteristics should in fact have caused median forecasts in our sample to be lower than those in the Michigan Survey.

Possibly, differences in other, unmeasured, characteristics may account for the difference in responses. The Fed-ALP sample consists of Michigan Survey participants who agreed to join the ALP web-survey and who continuously participated during our period of observation. The composition may therefore be skewed towards more educated individuals, although monetary incentives for participation may have induced a greater participation among individuals with greater financial needs. While the latter group may report higher inflation expectations, the former is more likely to report lower expectations. However, as noted before, at least with respect to the demographic groupings discussed earlier, both samples appear to have similar compositions. Taking all these factors into account, we do not consider it very likely that the higher median forecasts in the Fed ALP sample are due to a difference in sample composition.

Yet another possible explanation concerns the treatment of range responses in the Michigan Survey. In the Fed-ALP survey all individuals, including those who initially only reported a range, ultimately were asked for and subsequently provided a point forecast. This was not apparently the case in the Michigan Survey, which has specific coding rules for converting range responses into point forecasts.[12] The rule is to compute the midpoint of the reported range and then round it to the nearest odd number. Thus a response of 5% to 10% would be coded as 7%. Curtin (2006, pg 10) argues that "the rule in combination of the prevalence of range responses produces the high prevalence of the coded values 3, 7, 13 and so forth".[13] Our findings from the Fed-ALP sample suggest that this procedure may produce systematic biases. For individuals who reported a range and also (possibly after an additional request for a best guess) a point forecast, we find that forecasts are on average significantly lower (at the 1% level) than the midpoint. This suggests that the current practice of converting range responses would cause Michigan responses to be slightly higher than ours, and thus could not have contributed to our finding of lower Michigan median forecasts.

[12] Unfortunately, it appears from private communication with Michigan Survey staff that original range responses were not recorded in the Michigan Survey.

[13] Somewhat strangely, the same paragraph contains the contradictory statement "Overall, range responses are quite rare" (Curtin 2006, pg 10).

One possible explanation for the difference in median responses to the year-ahead Michigan question concerns the differential item non-response rate in both surveys. While over 99% of respondents answered the question by providing a point forecasts in the Fed-ALP panel, during the period of our study only 87% of respondents in the Michigan Survey provided point forecasts.[14] [15] Out of the 13% who did not provide a point forecast in the Michigan Survey, some 11% to 12% of respondents did report whether they expected prices in general to go up or to go down over the next 12 months, but did not provide either a point forecast or a forecast range. As described in Curtin (2006) for those who expected an increase in prices but did not provide a point forecast, a forecast was *imputed,* treating those with missing forecasts as randomly drawn from the *entire* sample of respondents with non-missing forecasts. Given the patterns described in footnote 14, however, there is reason to believe that those with missing forecasts would have had *higher* forecasts than those reported by the entire sample. When we applied a similar imputation procedure that instead conditioned on the demographic variables in Table 1.1, the imputed forecasts were indeed higher, but the overall median increased only by a small amount. Although the treatment of non-responses may have contributed to the discrepancy in the median forecasts for the Michigan and Fed-ALP samples, we do not believe that it can account for the full discrepancy.

Finally, a particularly intriguing explanation for the differential in median forecasts relates to the follow-up question asked of Michigan respondents who report high responses (over 5%): "*Let me make sure I have that correct. You said that you expect prices to go up during the next 12 months by [x%]. Is that correct?*" Thus, respondents who gave high responses may have felt encouraged to change their answer. Although the Fed-ALP procedure used the same question, we suspect that the interview mode may have affected responses. While Michigan does not provide data on the percent of respondents who changed their answer as a result of this "5% challenge prompt," it is possible that a sizeable fraction lowered their reported expectations as a result of receiving it. In contrast, no one did so in our Fed-ALP web survey. The difference may be due to a mode effect, with respondents interpreting the 5% challenge as an encouragement to change (and possibly lower) responses when it comes from an interviewer -- as is the case on the Michigan Survey, which is conducted over the phone. Interviewers' tone of voice may have contributed to that interpretation. By contrast, when the 5% challenge appears on a web survey, as was the case for the Fed-ALP sample, it may be more likely to be interpreted as a verification check to make sure that the correct number was recorded by the computer.

Indeed, revisions due to the "5% challenge" prompt may explain the surprisingly small number of responses in the 6% - 9% inflation forecast range in the Michigan Survey micro-data, with a much higher proportion of responses falling in this range in our survey (Figure 1.9). If so, this raises concerns about whether respondents may have been encouraged to revise their responses to numbers that may not reflect their actual inflation expectations – a question we aim to explore in future research, described below.

[14] Item non-response rates varied across demographic groups with non-response being more common amongst women (17%) than men (7%), for those without a college degree (17%) than college graduates (8%), for those with incomes under 75 thousand dollars (17%) than those with higher incomes (5%).

[15] RAND procedures encourage high response rates. While respondents are allowed to skip questions, they receive a prompt reminding them that they did not answer the question, with a request to do so.

It is not possible to answer this question based on Michigan's data, because Michigan does not record (a) the original responses given before the 5% challenge; (b) whether or not a respondent changed his or her answer as a result of receiving the 5% challenge.

Moreover, the paucity of responses in this range, combined with the way in which the Michigan Survey computes its median expected inflation, implies that the Michigan median measure may become very unstable when it moves above 5%, with a non-trivial chance of large positive jumps. Thus, expectations for "prices in general" reported on the Michigan Survey of Consumers may become especially unreliable in times of high inflation, when, arguably, it may be most important to accurately track people's inflation expectations.

In Figure 1.10 we attempt to illustrate the extent to which respondents may have lowered their reported forecasts following the "5% challenge" prompt. Here, we first relate individual forecasts to observed respondent characteristics, by running a simple OLS regression of point forecasts on demographic attributes, using the data from the Fed ALP survey in November 2007. Then, using the estimated coefficients from this regression, we impute a predicted response for each respondent in the November 2007 wave of the Michigan Survey based on the respondent's characteristics. As less than 1% of respondents revised their answer in our survey, their predicted response can be interpreted to be an individual's initial response prior to receiving the "5% challenge" in the Michigan Survey. We then compute the difference between the predicted response and the actual response for each respondent in the Michigan Survey.

Figure 1.10 plots the revision (predicted-actual) response against the predicted Michigan response. If the "5% challenge" prompt induces downward revisions, and the demographic variables have sufficient explanatory power, then we should see significant positive differences between actual and predicted responses above 5%, whereas below 5% actual and predicted responses should roughly coincide (the difference should be closer to zero). This is indeed the pattern depicted in Figure 1.10, where the red curve represents a non-parametric spline fit of the median revisions as a function of the predicted forecasts. While we do not have direct evidence on the extent of any potential revisions following the "5% challenge" prompt, this Figure is suggestive of potentially large downward revisions. We hope to investigate this possibility and the existence of other mode effects more directly in the near future with a study that randomly assigns respondents to receiving the same questions over the telephone versus a web survey – thus allowing us to systematically examine (a) the percent of respondents who change their answer as a result of the prompt; (b) the direction in which people change their answer; (c) whether mode effects affect responses to Michigan's 5% challenge prompt.

(1.2) Alternative inflation measures

As mentioned in the introduction, at the beginning of this study, the CMU team conducted 30 in-depth open-ended interviews of consumers. In these interviews, respondents were asked to answer the Michigan question about their expectation for "prices in general", to define the concept of inflation, and to answer a question asking about their expectation for "the rate of inflation." Respondents gave a wide variety of interpretations for the Michigan question, when answering it: almost half (47%) of participants mentioned salient prices such as gasoline, whereas 38% mentioned the

general inflation rate.[16] Such differential interpretations could possibly lead to reporting different expectations. Indeed, if increasing prices are more salient than decreasing prices (as suggested in a review by Ranyard et al., 2008), respondents who come up with examples of salient prices may inadvertently be biased to give higher responses than those who just think of the inflation rate, when answering Michigan's question about "prices in general".

Thus, we examined whether it might be feasible to, instead, ask respondents directly about their expectations for the "rate of inflation." We found that all participants had heard of the term "inflation" and 97% gave a definition.[17] These findings are consistent with the evidence cited in the survey article by Ranyard et al. (2008) indicating that people have some elementary knowledge of inflation that should be sufficient to answer questions about the 'rate of inflation'.

Moreover, when answering an alternative question about the rate of inflation, "*What do you think the rate of inflation will be ..*" participants showed more agreement than when answering the Michigan question, with the majority talking about the inflation rate (67%) and no one discussing salient prices such as gasoline. Thus, expectations reported for the "rate of inflation" may be less likely to be artificially biased by thoughts of salient increasing prices (such as gasoline prices).

These findings point to the importance of question wording and its potential effect on reported expectations: alternative interpretations of the same question may directly affect responses. As a consequence, some of the cross-sectional variance in expressed expectations may reflect differences, not in what people expect about inflation, but in how they define it. Moreover, responses to the Michigan question may show a systematic bias, with respondents who think of salient increasing prices reporting artificially high expectations.

Below, we report on data from the Fed-ALP special survey modules, to test whether the interview results reported in this section hold with a larger sample. Specifically, we examine the effect of question wording (prices in general vs. rate of inflation) on expectations, and on disagreement between respondents.

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[16] A few examples of explanations to the question of whether prices in general will go up, down or stay the same are: (1) "*I think that prices will go up because fuel costs have gone up and everything needs to be transported which means everything has fuel costs built into it*" . (2) *I'd say they're going to go up, because they say that gas is going to go up near $4.00, and you know it's going to have a trickle effect on everything we see out there because you know it's going to cost more to deliver all those goods…and you go out to restaurants you know, some restaurants are charging surcharges because they can't afford the gas, you know, for delivery charges for their merchandise…so you know even if it's a pair of shorts, or a, in a store, you're still going to see it go up because of all the freight charges.".*
A few example for specific numeric responses are "Hmmm…well, just things that you read in the paper and you hear on the news and they…you know…you hear things have gone up X amount percent and it always seems like it's two three percent so that's what I'm thinking two", and "Ah… but, I think, you know, generally, just off the top of my head, I'm thinking of inflation is running two or three percent a year anyway and I, I, you know, I think it will stay within that range."

[17] Examples are *"How much your dollar can buy today versus what it's gonna buy tomorrow."* and *"Amount by which things increase by cost per year." Note that respondents felt comfortable admitting to not knowing other terms, such as "consumer price index"* (73% had heard of it) or "standard of living" (87% had heard of it.)

(1.2.1) Heterogeneity in interpretations of the Michigan question

The cognitive interviews indicate that in answering the Michigan question, respondents use different question interpretations. These interpretations may relate to different measures or concepts of inflation, possibly involving prices of different sets of goods and services and different weightings used to aggregate price changes of different goods into an overall forecast. For example, when thinking about *prices of the things they usually spend money on* individuals may place a greater emphasis on prices in shops, prices of things they buy more frequently and prices that have experienced larger increases. Answers in this case are more likely to depend on the composition of an individual's consumption basket, which would produce a higher level of disagreement or dispersion in forecasts across individuals. When thinking about the *rate of inflation* individuals may think more of an overall measure, such as headline numbers in the media for inflation, or think about cost-of-living adjustments to their wages or social security incomes that are adjusted based on changes in overall inflation as measured, for example, by the CPI.

The distinction between alternative inflation concepts is relevant for understanding the link between inflation expectations and economic behavior. There are likely to be differences across inflation concepts in the extent and manner in which changes in inflation expectations will affect respondents' behavior as consumers, workers and investors.[18] Therefore, in order to better understand how and to what extent individuals act on their inflation expectations, it is important to use questions that more clearly relate to a specific inflation concept, that is questions that have higher reliability. More reliable questions are ones on which respondents agree with one another (and with economic modelers) regarding what the inflation measure the question asks about means.

Furthermore, using questions that are interpreted in the same way by the majority of respondents will facilitate tests for the 'rationality' of reported expectations – in terms of how they compare on average to the inflation rates observed in the official data. One reason for the apparent lack of rationality found for some survey-based measures of expectations for "prices in general" (Gramlich, 1983; see section 5 for additional references) may be due to the inflation concept used by respondents being different from the measure of actual inflation it is compared to. Such discrepancy in concepts used by respondents may also explain some of the sometimes considerable heterogeneity of expectations across respondents, such as those discussed in section 1.1.2. Thus some of the heterogeneity in expressed expectations may reflect differences, not in what people believe about future inflation, but in how they define it. This heterogeneity in question interpretation in turn makes it difficult to understand the nature of any observed change in its overall median forecast in a given month.

Finally, and perhaps most importantly, the availability of reliable questions that relate to specific inflation concepts are of great importance to a central bank for monitoring consumer inflation expectations. Questions which elicit responses that are likely to reflect expectations about salient increasing prices may be less informative about overall inflation expectations than questions that are less sensitive to such salient prices.

[18] Note that the rate of inflation as measured by the CPI or PCE has a direct effect on nominal income for those with inflation-indexed income sources (social security income, investment returns) and those working under wage contracts in which salary changes depend on the realized rate of inflation.

(1.2.2) Comparing alternative inflation expectation questions

To investigate the extent and nature of the variation across individuals in the interpretation of the Michigan question for a larger sample, we fielded a special ALP module in December 2007 in which approximately 500 individuals were asked for their views on different aspects of the question asking for the expected change in 'prices in general during the next 12 months' (henceforth the "prices in general" question). In addition, based on the indications garnered from the open-ended interviews, the team designed two alternative questions regarding year-ahead inflation expectations. The first asks about the 'rate of inflation over the next 12 months' (henceforth the "rate of inflation" question), whereas the second asks about the 'prices you pay for things you usually spend money on during the next 12 months' ("prices you pay" question).[19] [20] In this module, the following randomization was implemented: one half of respondents were administered the "prices in general" and "rate of inflation" questions, whereas the other half was asked the "prices in general" and "prices you pay" questions.[21]

After answering these expectations questions, respondents rated the clarity and difficulty of each expectations question, and reported how they interpreted each question. In particular, based on our findings in the cognitive interviews we asked how much people thought of the prices of different expenditure categories (housing, food, clothing, transportation,…) and of different inflation concepts (prices of the things you spend money on, prices of the things Americans in general spend money on, the U.S. inflation rate, changes in cost of living, …) in trying to come up with an answer; and which inflation concept they thought the expectations question was asking for the most (listing same options as above).

Table 1.4 presents summary statistics for the expectations elicited using each question, where in this table and in subsequent tables and figures MI refers to the Michigan question, RI the "rate of inflation" question and PP the "prices you pay" question. In both the December and the May special modules, the median point forecast from the "rate of inflation" question is lower than that from the other two questions. In the December special module these differences are not statistically significant. The strong positive correlations between the different forecasts shown in Table 1.4 reflect the degree of consistency across the three expectation questions, which is corroborated by the

[19] The inflation rate question was asked using the same format and the same follow-up queries as that for the Michigan question described in Figure 1.1. The first question asked "*During the next 12 months, do you think that there will be inflation, deflation (the opposite of inflation) or neither?*" where those who said "neither" were asked "*Do you mean that, over the next 12 months, the rate of inflation will be zero, or that the rate of inflation will be the same as it is now?*". The question asking for a point forecast was phrased as "*What do you think the rate of [inflation/deflation] will be over the next 12 months?*" with the 5% follow-up question being "*Let me make sure I have that correct. You said that you expect the rate of inflation to be [x%] over the next 12 months. Is that correct?*". The 'prices you pay' question follows the exact same format and wording as the 'prices-in-general' question except with 'prices in general' replaced by 'the prices you normally pay for the things you usually spend money on".

[20] Questions about the 'rate of inflation' were previously included as one-off additions to consumer surveys by the Bank of Italy and the Dutch Central Bank. Since 1986, Barclays Capital's BASIX inflation expectations survey, a quarterly survey in the UK, has also asked consumers about the rate of inflation. Each quarter around 2,000 individuals are polled, face-to-face with an interview and asked "Can you tell me what you expect the rate of inflation to be over the next 12 months?".

[21] We also randomized the order of the two questions. While we found some evidence that the order in which questions were asked had some significant effects, it did not affect the overall results presented here.

percentages of “prices in general” respondents who used the exact same answer for the “prices in general” and “rate of inflation” questions (40%) and for the “prices in general” and “prices you pay” questions (55%). However, despite the observed consistency across questions, we found significant differences in how respondents answered these questions. While the differences between the medians were not statistically significant in the December module, in the May module (which produced much higher overall inflation forecasts), the median forecast from the “rate of inflation” question was significantly lower (at the 1% level) than those for the other two questions.[22] The median forecast from the “prices you pay” question was also significantly higher than that from the “prices in general” question. Further, the disagreement among respondents was lower for the “rate of inflation” question than for the other alternative wordings in both special modules. The IQR of responses was highest among respondents answering the “prices you pay” question (particularly so in May).

Respondents to the three inflation expectation questions were asked to rate how much they thought about a list of topics when coming up with an answer, from *not at all (1)* to *very much (7)*.[23] The topics on the list were derived from open-ended cognitive interviews. Table 1.5 shows that, compared to the “prices in general” question, the two alternative questions appeared to elicit more focused interpretations. Of the three questions, the “rate of inflation” question was the least likely to evoke thoughts about prices paid by oneself, or about specific prices. Rather, it was the most likely to evoke thoughts of the general rate of inflation and changes in cost of living, perhaps because the latter is often measured by the former. Conversely, and not surprisingly, the “prices you pay” question was the least likely to evoke thoughts of the prices Americans pay, of the rate of inflation and of changes in cost of living. Rather, it was the most likely to evoke thoughts of prices respondents pay as well as of specific prices – which were presumably prices they paid for the things they bought.

Interestingly, the original Michigan “prices in general” question evoked a mix of interpretations, in between those for the “rate of inflation” and the “prices you pay” questions. Consistently with the suggestive evidence from the open-ended interviews, the Michigan question was quite likely to evoke thoughts about prices paid by oneself, more so than thoughts about the general inflation rate. The incidence of thoughts about specific prices was also significantly higher than for the “rate of inflation” question but lower than for the “prices you pay” one.

Table 1.6 confirms this pattern. Here respondents were asked what they thought each question was *asking for the most*. Of those answering the “rate of inflation” question, 60% thought it was asking about the prices of things that Americans usually spend money on, or about the general inflation rate. Only 11% thought it was asking about the prices of things they themselves usually spent money on. The reverse pattern holds for the “prices you pay” question: 67% of respondents thought it was asking about the prices of things they usually spent money on, whereas only 15% thought it was asking about the prices of things that Americans usually spend money on, or about the general inflation rate. Again, the Michigan “prices in general” question evokes mixed

[22] The nonparametric Wilcoxon signed rank test was used to test for differences in the medians.

[23] The MI version of the question asked: “Below is a list of things you may or may not have thought of when trying to come up with an answer to the question about "prices in general during the next 12 months." Please rate how much you thought of each of these things, when trying to come up with an answer.”

interpretations: almost three out of every ten respondents (27%) thought it was asking the most about the prices of things they usually spent money on.

For each expectations question, we also asked how much respondents were thinking about the price of several broad CPI spending categories in answering the question, rating again from *not at all (1)* to *very much (7)*.[24] [25] Across all three questions transportation, food and housing were the categories most thought off. Expectations for the "prices in general" question and for the "prices you pay" question were equally likely to evoke thoughts of different CPI-composites: transportation and food were the most thought about categories. Expectations for the "rate of inflation" question generally also showed similar thoughts of CPI spending categories, but this question was significantly more likely to evoke thoughts of housing and health care. Comparing thoughts of CPI-composites when answering the questions about the rate of inflation versus the prices you pay, shows that the latter group thought significantly more about food and less about health care. Again, the associations evoked by the Michigan question were closer to those for the "prices you pay" question than for the "rate of inflation" one.

Different interpretations of questions matter: respondents who interpret a given question differently also tend to express different point forecasts in their 12-months-ahead expectations. We explore this aspect in Tables 1.8 – 1.10. Table 1.8 reports the rank correlations between point forecasts and thoughts evoked by each question regarding different concepts of prices and price changes. For both the "prices in general" and the "rate of inflation" questions, thinking more about prices of things respondents usually spend money on, about specific prices, or about changes in the cost of living is associated with significantly higher reported expectations on average. Thinking more about specific prices and changes in the cost of living also yielded higher responses for the "prices you pay" question. On the other hand, thinking more about the U.S. inflation rate was not associated with higher point forecasts for none of the three questions.

Table 1.9 confirms these patterns and adds some information on the extent of disagreement. Across all three questions, but especially for the "rate of inflation" question, median point forecasts are the lowest when respondents think the question was asking the most about the U.S. inflation rate, or the prices of things that Americans usually spend money on. Further, as we already mentioned, disagreement is lower for the "rate of inflation" question than for the two alternatives across the board, and is especially low when respondents think the question was referring to the U.S. inflation rate, or the prices of things that Americans usually spend money on.

Finally, Table 1.10 relates point forecasts about future inflation to thoughts about each of the CPI main spending categories defined earlier. For the Michigan question, point forecasts were significantly higher when respondents thought more about each of the CPI composites, except for recreation and entertainment. A similar positive association between point forecasts and thinking about a specific CPI category was present for the "rate of inflation" question only with regard to food and healthcare.

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[24] The categories used were: transportation, food, housing, healthcare, clothing, recreation and entertainment, education and childcare.

[25] Note that responses could be interpreted as indicating that consumers assigned more weights to prices in these expenditure items when expressing their short-term inflation expectations and/or that they expected price changes in these categories to be the largest or to contribute the most to their reported inflation expectation. We cannot distinguish between the two interpretations.

Moreover, these statistical associations were weaker than for the Michigan question. No significant association was found for the "prices you pay" question.

The December special module also addressed the issues of question clarity, difficulty and construct validity. Each of the three expectations questions were followed up by questions about how hard (clear) the question was for the respondent.[26] Table 1.11 shows that the "rate of inflation" question was viewed as slightly but significantly harder (at 1% level) than the "prices in general" question, which in turn was considered slightly harder to answer than the "prices you pay" question. All three questions were considered fairly clear, with the "prices you pay" question significantly clearer (at 5% level) than the "rate of inflation" one. Note that while the "rate of inflation" question may have been regarded as somewhat harder to answer than the other two questions, the response rates to all three questions were similar and all over 98 percent.

Two additional follow-up questions are reported in Table 1.11, to begin to examine the construct validity of each expectations question. The objective here is to see whether respondents seem to understand the concept described in each expectations question in a way that is consistent with what is implied by economic theory. One way to examine construct validity is to see whether reported beliefs about a given inflation concept are correlated to other beliefs to which they logically should be correlated – such as, for example, expectations reported on a different scale (ranging from very low to very high). The first follow-up question asks whether the expressed forecasts of price changes or of inflation for the next 12 months seem high or low compared to the past ten years. The second follow-up asks respondents to rank how much they think their financial situation will be affected by the expected level of inflation, if realized.[27]

Table 1.11 indicates that, across all three alternative expectations questions, respondents consider current expected inflation to be very high relative to the past ten years (the average score was 4.4 – 4.5, with 5 = very high), and they expect inflation to have a moderately large affect on their financial situation (the average score was 4.3 – 4.4, with 7 = very much).[28] Further, across all three expectations questions, the rank correlation between the expressed point forecasts and the respondents' qualitative answers to the two follow-ups was quite high, ranging between 0.33 and 0.47 (the lowest correlation occurred with the "prices you pay" question). The strongest association (0.47) occurred between the "rate of inflation" question point forecast and the qualitative assessment of how high this expectation was relative to the past ten years. These results constitute preliminary evidence of good construct validity for the alternative expectations

[26] Clarity and difficulty were measured on a qualitative scale of 1-7. For clarity, 1 = very unclear, 7 = very clear; for difficulty, 1 = very easy, 7 = very hard.

[27] More specifically, the "prices in general" versions of the two questions were: "You answered that, during the next 12 months, you expect prices in general to [stay the same/go up by X/go down by X]. Compared to the past 10 years, do you think that change is high or low?" [rating from 1(very low) to 5(very high) and "You answered that, during the next 12 months, you expect prices in general to [stay the same/go up by X/go down by X]. If in fact prices in general do [stay the same/go up by X/go down by X], how much do you think that will affect your financial situation? [rating from 1 (not at all) to 7 (very much).

[28] There was no statistically significant difference across the three questions in the qualitative rating of how high the expected change in prices is compared to the past ten years. This corresponds well to the lack of a significant difference in the median point forecasts reported in Table 1.4 for the December special module.

questions considered here: those giving higher forecast are more likely to consider it high relative to the past and to expect a bigger impact on their financial situation.[29]

Subsequent research is needed to examine how responses to the different expectations questions are correlated to the respondents' behaviors as consumers, workers and investors. To what extent do consumers act on their reported expectations about 'prices in general' and does it differ for expectations about the 'rate of inflation' or 'prices of the things you buy'?

(1.2.3) Asking directly about the rate of inflation

We have examined the behavior over time of one alternative to the Michigan "prices in general" question, namely the "rate of inflation" question, in our Fed-ALP panel. We asked the year-ahead "rate of inflation" question alongside the "prices in general" question, and are thus able to compare the time trends of forecasts elicited from these two questions. Figure 1.11 reports these time trends: the median point forecasts from the "rate if inflation" question are consistently lower than those from the "prices in general" one, for the entire period covered by the mini-modules (November 2007 to September 2008). The pattern over time is similar for the two sets of forecasts: the median forecast declines slightly from November 2007 to February 2008, increases until June 2008 after which it declined significantly. Overall, the "rate of inflation" question seems to exhibit less variability over time. Median forecasts are about the same at the end of the sample period as they were at the beginning. The initial increase in the medians is reflected in the distributions of responses for the "rate of inflation" question reported in Figure 1.13: between November 2007 and July 2008 the fraction of responses in the 2-5% range declines, whereas it increases in the 6-10% range.

The "rate of inflation" question also appears to elicit more focused forecasts across respondents; Figure 1.12 reports our measure of disagreement (IQR) for the two expectations questions: disagreement is consistently lower for the "rate of inflation" than for the "prices in general" question. The time pattern however is similar for the two questions, with disagreement rising from November 2007 to July 2008, after which both fell. Figure 1.14 gives visual confirmation that the distribution of responses for "rate of inflation" is less dispersed than for the "prices in general" question over the sample period: the bulk of responses for the former are concentrated in the range 3-5%, and there are fewer responses greater or equal than 10% than for the latter question.

We examine heterogeneity in responses, for the three alternative expectations questions, in Tables 1.12 and 1.13, based on data from the December and May special modules. We first look at heterogeneity with respect to demographic categories. Table 1.12 confirms the results reported in Table 1.1 from both the Michigan Survey and the Fed-ALP panel. Across the two special modules and all three expectations questions, both median forecast levels and disagreement are lower for men than for women, for the more educated than for the less educated, and for higher income than for lower income respondents. These patterns are especially significant for the "prices in general" and the "rate of inflation" questions. Further, it is interesting to note that across most demographic categories disagreement is highest for the "prices you pay" question and lowest for the "rate of inflation" one.

[29] We are currently conducting a more comprehensive examination of the construct validity of our alternative expectations questions in a special survey administered by the CMU team.

Table 1.13 repeats the analysis from Table 1.2, linking forecasts to measures of cognitive ability and financial knowledge, but extends it to the three alternative expectations questions and is based on the special December module (instead of the Fed-ALP panel). The results of Table 1.2 are broadly confirmed: for all three expectations questions, scores on our numeracy and financial literacy tests are negatively correlated with inflation expectations. Respondents with longer planning horizons also tend to express lower forecasts across all three expectations questions, although the association is stronger for the "prices in general" question than for the other two. Finally, primary shopping responsibility within the household is positively related to inflation expectations both in the "prices in general" and in the "rate of inflation" question. Primary responsibility for investing is instead negatively associated with reported forecasts, but not significantly so.

The December and May special modules also included 12-months-ahead expectations questions for the prices of specific goods: milk and gas in December, housing, food and transportation in May.[30] Table 1.14 reports the median point forecast and disagreement for these measures, as well as their correlations with the point forecasts from the three alternative general inflation expectations questions. Several interesting patterns emerge. First, while the median forecast for the change in the price of milk is significantly lower than the general inflation measures, the median forecast for the expected change in the price of gasoline is significantly higher: 9.7 vs. 4.5-4.8 for the three general inflation questions. Disagreement among respondents is also very high for the gasoline question, as is to be expected since the price of any specific item, and especially so for gas, tends to be more volatile than general price measures.[31]

Second, median point forecasts and disagreement for housing, food and transportation also seem sensible: the expected median change in housing costs is almost

[30] All questions asking about expected price changes of specific goods used the Michigan format described in Figure 1.1, asking first whether they think the price of the [MILK/GAS/FOOD/TRANSPORTATION] will go up, go down or to stay the same before asking by how much. The questions about housing asked about the "cost of housing" instead. Before asking the questions about the price/cost of food, housing and transportation, individuals were asked about the shares of their yearly spending budget used to buy food (which includes groceries, dining out and beverages), housing (which includes mortgage or rent, maintenance, and utilities) and transportation (which includes gas, public transportation fares, and car maintenance).

[31] There was little evidence of heterogeneity (disagreement) in responses across demographic groups and measures of cognitive ability and financial knowledge, perhaps due to respondents' direct and repeated experience with these prices. The questions asking for year-ahead forecasts of changes in the price of milk and gas were considered equally difficult as the "prices in general" and "prices you pay" questions (mean ratings 3.4 and 3.5), but easier at the 1% level than the "rate of inflation" question. In terms of clarity, both questions were considered clearer (ratings 6.1 and 6.2) than all three inflation questions with differences significant at the 1% level. Respondents expected a lower impact on their financial situation from expected changes in the price of milk (rating 3.1) but a greater impact of gas (rating 4.9), relative to all 3 expectations. In addition respondents considered their expected change in prices of milk and especially for gas to be reasonably high relative to past 10 years (2.6 for milk, 3.0 for gas) and more so than they did for expected changes in "prices in general", for the level of the "rate of inflation" and, for gas, also compared to the "prices you pay" question. Finally, questions about prices of milk and gas were significantly more likely to evoke thought of prices you pay for the things you usually spend money on, and less thoughts of everything else, especially thoughts about the prices Americans pay and about the rate of inflation.

zero, probably reflecting the current slump in the housing sector, and again forecast levels and disagreement are highest for the price of transportation goods and services.[32]

Third, the median point forecasts elicited by the "rate of inflation" question are the least correlated with median point forecasts for the price of milk, gas, food and transportation, which all showed salient increases during the survey period. For instance, the correlation between median forecasts from the "rate of inflation" question and those for changes in the price of gas is only 0.14 and not significantly different than zero. This finding suggest that increasing gas prices may be more salient when thinking about *prices in general* than when thinking of the *rate of inflation*, which is consistent with earlier results surveyed by (Ranyard et al., 2008) suggesting that people rely more on increasing prices than on decreasing prices when reporting their expectations for overall prices.

Similarly, the correlation between "rate of inflation" and food expectations is 0.4, whereas the correlation between "prices in general" forecasts and food price forecasts is 0.69. In contrast, the forecasts of the "rate of inflation" are similarly related to the expected change in the cost of housing as forecasts for changes in prices in general and in the prices you pay. This is consistent with our earlier remark about the potential role of salient prices as the cost of housing was relatively stable or declining and therefore should have been less salient.

Thus forecasts for the rate of inflation are generally less sensitive to expected changes in food prices and in transportation costs. This result suggests that of the three inflation expectations questions considered in the special modules, the "rate of inflation" one seems to come closer to the notion of a "core" inflation expectations measure, i.e. one that excludes food and energy price changes altogether.

The top panel of Table 1.15 reports correlations between inflation expectations and specific price change expectations separately for individuals for whom a given spending category represents a high vs. a low expenditure share of their total consumption expenditure. With the exception of food for the "prices you pay" question, a higher expenditure share of a given composite good implies a stronger correlation between inflation expectations and price change expectations for that composite. The pattern highlighted in Table 1.14 is also confirmed: forecasts generated by the "rate of inflation" question are the least correlated with expectations for food and transportation, for both high and low expenditure share individuals.

The bottom panel of Table 1.15 reports correlations between inflation expectations from all three inflation questions and the expenditure shares (in their annual spending budget) reported by respondents for housing, food and transportation, based on

[32] Like milk and gas, we found little heterogeneity in forecasts of food and transportation across demographic groups and cognitive ability and financial skills in the special May module. However, for housing we found the same patterns that we found for the three inflation measures: higher expectations for women, for those without a college degree, for singles and low income respondents. In terms of difficulty, respondents rated the question asking about the price of food and transportation similarly (3.8) to that of the "prices in general" and "prices you pay" questions, while the cost of housing was rated closer (4.2) to the "rate of inflation" question in terms of difficulty. All three questions about specific CPI-composites were considered clearer (ratings 5.6 to 6.0) than the inflation expectations questions. Respondent expected their financial situation to be more affected by changes in the price of food (4.8) and transportation (5.7) than by expected changes in the cost of housing (3.5). Finally, the expected change in the prices of food and transportation were considered higher than changes during the past 10 years (average ratings 3.0 and 3.4), while that for housing was considered relatively low (2.2).

the May special module. The "prices in general" and "prices you pay" point forecasts are significantly positively associated with the respondent's expenditure share of transportation, whereas "rate of inflation" forecasts are significantly positively associated with the expenditure share of housing. These latter findings corroborate some earlier evidence presented in (Ranyard et al., 2008) which indicates that people rely more on the prices of goods that they buy frequently when reporting their expectations for overall prices.

(1.3) Summary of main findings

1. Our Fed-ALP panel generates year-ahead expectations for "prices in general" that are comparable to the ones found on the Michigan Survey of Consumers. Response patterns are broadly consistent: trends over time, and of heterogeneity (with expectations being higher among women, the less educated, and lower-income respondents) are similar. However, some differences in forecast levels between the Michigan Survey and our Fed-ALP panel point to the possibility that certain features of the Michigan Survey, such as the 5% follow-up challenge, may affect the reliability of reported responses, especially during times of relatively high inflation. Follow-up research is needed to address the question of whether the clarifying follow-up question is necessary, how it affects responses, and whether its effect is larger in a telephone interview than in a web survey.
2. In addition to replicating previous research findings of heterogeneity, we find that lower scores in numeracy and financial literacy are also associated with higher inflation forecasts and higher disagreement. Follow-up research is needed to provide more insight into how people form inflation expectations – especially unrealistically high ones.
3. The Michigan question about "prices in general" elicits mixed interpretations, with a significant fraction of respondents thinking about examples of salient (increasing) prices, such as gasoline, which may have artificially increased expectations reported for that question. Different interpretations affect expectations: thinking about prices of the things that respondents themselves spend money on, or about specific prices, is associated with significantly higher inflation forecasts.
4. In contrast, when asked to report expectations for the "rate of inflation", respondents report fewer interpretations, and their expectations show less of a relationship with expectations for gas prices and food prices. Perhaps as a result, they report lower median forecasts and there exists much less disagreement among respondents than when asking about "prices in general" or about "prices of the things they spend money on". The latter suggests that the "rate of inflation" may be a more narrowly or precisely defined or understood concept than "prices in general", and thus lead to more reliable responses that can be more easily compared to actual inflation measures to assess rationality. However, follow-up research is needed to examine how responses to the different questions predict behaviors of respondents as consumers, workers and investors. For example, do they act on their expectations by changing their consumption and savings behavior or by demanding higher wages?

2. Inflation Uncertainty

(2.1) The purpose of measuring uncertainty about future inflation

In our investigation of the nature and measurement of inflation expectations of households, we wish to explore possible modifications to the current practice of asking consumers only for their point forecasts. It is now commonly understood that the Fisher equation of a century ago was incomplete. The costs of inflation run not just through inflation expectations, but also through the risk of inflation, which is a related, but distinct concept. Uncertainty about future inflation clouds the decision making of consumers and businesses and reduces economic well-being. [33] Without this uncertainty, consumers and businesses would be better able to plan for the future. Recent discussions (Mishkin, 2008) have suggested that a central bank might address these two costs differently.

Tracking inflation uncertainty is also important for assessing central bank credibility and effectiveness of communications. An increase in uncertainty about future inflation outcomes may be used as an early warning system of any erosion in Central Ban credibility. Central bank communications have stressed the importance of outlook risk, further highlighting the need for informative quantitative risk measures to be included as part of the policymaker's tool kit. Moreover, to the extent that uncertainty about future inflation affects consumers' inter-temporal decisions, such a measure is of direct relevance for tracking and forecasting economic conditions, and may be itself an object of interest for monetary policymakers.[34]

Current surveys ask for point forecasts and do not ask consumers about their degree of uncertainty about future inflation outcomes. It remains common in research of the risk of inflation to use respondent heterogeneity (often referred to as 'disagreement') as a proxy for risk (Bomberger 1996). [35] It is important to note, however, that individual uncertainty about future inflation is conceptually different from cross-sectional heterogeneity in point forecasts. Recent work based on the FRB-Philadelphia's Survey of Professional Forecasters (SPF) (see Rich and Tracy, 2008) as well as the Survey of External Forecasters (SEF) in the U.K. (Boero, Smith and Wallis, 2008) suggests that disagreement and uncertainty exhibit very different empirical properties. While they measure different things, however, both may well be related. For example, differences across individuals in uncertainty about future inflation outcomes may contribute to more cross-sectional dispersion in point forecasts, if it leads to differences in the way individuals learn and update their expectations over time. [36] As discussed below we will measure and analyze both disagreement and uncertainty, allowing us to test the adequacy

[33] For a discussion of alternative pathways through which inflation uncertainty affects economic decision making and welfare, see Golob (FRB Kansas City, Economic Review, third quarter 1994).

[34] For a discussion of central bank communications, risk, and decision making, see Mishkin (2008).

[35] Disagreement is usually measured by the variance or interquartile range of the distribution of point forecasts across respondents.

[36] In his recent NBER speech, Chairman Bernanke raised the possibility that an increase in disagreement during the Volcker disinflation of 1979-1982 may have reflected heterogeneity in individual respondents' willingness to accept the Fed's declared commitment to reducing inflation as being a true break from the past. Direct measurement of individual uncertainty would help shed additional light on the way and extent to which individuals respond to new information.

of disagreement as proxy for inflation uncertainty among households. We also exploit the panel nature of our mini-modules to examine (in Section 4.1) the possibility that differences in uncertainty may lead to differences in expectations updating over time.

(2.1.1) Measuring uncertainty

In the initial set of cognitive interviews we found many respondents to voluntarily express uncertainty: when we asked for a point estimate for prices in general, about half of those interviewed volunteered a range. Similarly, in our Fed-ALP web modules in which we gave respondents the explicit option to give a best guess or a range, about 30%-40% used a range for expectations over the next 12 months – and of those about a third used a range without a point estimate. Thus individuals showed a willingness to express uncertainty. However, such ranges do not allow us to systematically examine experienced uncertainty because it is unclear how respondents believe uncertainty is distributed within the range.

In our research we set out to systematically measure the public's uncertainty concerning future inflation outcomes using a more structured approach. More specifically, we elicit individual expectations about future inflation in the form of subjective probability distributions – so-called density forecasts. While the SPF and SEF have elicited such information regarding future inflation and GDP growth from professional forecasters since 1968 and 1981 respectively, during the past decade probabilistic questions have also become widely used in surveys of households. A rich and rapidly growing literature in economics on subjective expectations illustrates the feasibility and potential for probabilistic questions to provide meaningful quantitative information regarding an individual's uncertainty over a wide set of future outcomes and events.[37]

We collect information about consumers' density forecasts by asking a set of probabilistic versions of the "prices in general", "rate of inflation" and "prices you pay" questions. Essentially, this involves asking respondents to assign probabilities to the event that future inflation (or change in prices) falls in several pre-specified bins. In preparation of the question, survey participants are first given a set of simple instructions, which is followed by the question which is shown in Table 2.1. [38] [39] While the

[37] Several well known national longitudinal surveys of households, including the National Longitudinal Survey of Youth and the Health and Retirement Study, have begun to include probabilistic modules asking individuals to assign probabilities to a large set of future outcomes and behaviors. Noteworthy predecessors to these modules are the Bank of Italy's Survey on Household Income and Wealth, which in one of its waves elicited density forecasts of inflation and income (Guiso, Jappelli and Terlizzese, 1992), as well as the Survey of Economic Expectations, which included probabilistic questions about several outcomes including future income, employment, social security, investment returns, crime victimization (Dominitz an Manski, 1997a, 1997b). For an extensive survey of this and other academic research on subjective expectations, see Manski (2004).

[38] Respondents were provided the following statements: This question will ask what you think the percent chance is of different things happening. INSTRUCTIONS The percent chance can be thought of as the number of chances out of 100. You can use any number between 0 and 100. For example, numbers like: 2 and 5 percent may be "almost no chance", 20 percent or so may mean "not much chance", a 45 or 55 percent chance may be a "pretty even chance", 80 percent or so may mean a "very good chance", and a 95 or 98 percent chance may be "almost certain".

information contained in the reported interval-probabilities is generally not sufficient to calculate precise density summary statistics, such as its median and variance, it places bounds on such statistics. Rather than working with such bounds, in our analysis we follow Engelberg, Manski and Williams (forthcoming) in using the reported probabilities to fit a generalized Beta distribution over the range of inflation outcomes for each respondent. [40] The estimated parameters of individual density functions can then be used to compute, for each individual respondent, both measures of central tendency (such as the mean or the median) that can be compared to the point forecasts elicited earlier, and measures of individual uncertainty about future inflation (such as the variance or IQR).We can then aggregate across individuals to compute *aggregate* measures of central tendency (such as the median of the individual medians) and of uncertainty (such as the median of the individual IQRs).

Before presenting our findings, it is useful to present some information about the nature of individual responses to the probabilistic question. First, even though respondents rated the probabilistic version of the question asking about "prices in general" and "prices you pay" as slightly more difficult to answer (with the opposite being the case for the question asking about "rate of inflation") and slightly less clear (for all three question versions) than the questions asking for a point forecast (Table 2.2), response rates were always over 99 percent.[41] [42] They also reported little difficulty in coming up with answers that added up to 100%, which was consistent with finding numbers that added up to something different from 100% in fewer than 1% of cases. [43] On average, respondents assigned positive probability to between 4 and 5 intervals, with over 90% using more than 1 bin. The vast majority of intervals with positive probability were contiguous, but for about 1% to 3% of respondents in the various modules we fielded there was a gap between two of these intervals.

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[39] The selection of bins was based on the frequency of responses across intervals in the Michigan Survey. We plan to experiment with alternative bin selection and evaluate its effect on overall forecasts in a future stage of the project.

[40] The generalized Beta distribution, which uses two parameters to describe the shape of beliefs and two more to give their support, is a flexible form that permits a distribution to have different values for its mean, median and mode. Estimation of this distribution requires that the respondent assign positive probability to at least three intervals. In cases where a respondent places positive probability on only one or two intervals, we suppose that the distribution has the shape of an isosceles triangle whose parameters we estimate. See Engelberg et al (forthcoming) for additional details.

[41] Except for the "rate of inflation" question, for which the difference was statistically insignificant, the differences in clarity were statistically significant at the 1% level. The difference between average difficulty ratings was significant at the 1% level for the "prices in general" and "prices you pay" questions, and significant at the 5% level for the "rate of inflation" version. In additional analyses we found the difficulty rating to be uncorrelated with the density medians (discussed later) but to be positively and significantly related to the number of bins that were assigned a positive probability as well as the density IQR (discussed later), except for the "rate of inflation" question for which the latter positive correlation is not statistically significant.

[42] While they were allowed to skip any question, when respondents did not answer the probabilistic question, they received a prompt encouraging them to go back and answer the question. This prompt is likely to have contributed to the high item-response rates.

[43] Respondents who entered numbers that did not add up to 100% were given the total of probabilities entered and were reminded that this sum differed from 100 and encouraged to revise their entries. The number reported above counts cases that remain after potential revisions.

The left panel of Figure 2.1 shows the average probabilities assigned to different intervals across individual respondents in the April 2008 wave of our Fed-ALP panel, for the probabilistic version of the Michigan inflation question asking about 'prices in general'. Probabilities in the graph are represented by the size of the area. Thus the average probability assigned to the event that prices in general go up by between 2 and 4 percent across individuals is slightly over 28%. Also shown in the graph is a fitted generalized beta distribution, which provides a reasonable fit of the data. Note that the average probability distribution reflects both individual level uncertainty as well as differences across individuals in the level of inflation at which it is centered (disagreement). So changes over time in this average probability distribution would reflect a combination of changes in disagreement and uncertainty.

The right panel of Figure 2.1 shows the probabilities assigned to the different intervals, as well as the estimated generalized Beta distribution, for a person in the April 2008 survey whose individual uncertainty was close to the median across respondents. This "representative" respondent assigned positive probability to five intervals. The fitted density is only slightly right-skewed, as reflected by the small difference between the mean and median. Again, the graph indicates that the generalized Beta specification provides a reasonably close fit to the data.

While not explored here, it is important to note that the number and location of bins specified in the question may affect the observed responses, with people possibly using more bins when more are offered. In future research we hope to examine this issue and to assess the optimal number and width of bins, based in part on how people naturally express their uncertainty.

(2.1.2) Trends in uncertainty about year-ahead changes in prices in general

Data from the different waves of our Fed-ALP panel provide information about individual density forecasts in recent months. Before discussing the recent trend in average uncertainty, it is useful to first analyze changes in the values around which these distributions are centered (mean and median) and to compare these to the earlier trend in point forecasts. Using the wording of the Michigan inflation question asking about 'prices in general' we find the same trend in the medians of individual density means and medians as we found for the median point forecast [Figure 2.2]. Generally the median of the density means is a little higher than the median of density medians, reflecting the fact that most individual densities are slightly skewed to the right. While medians of both density-based measures of central tendency initially fell below that of point forecasts, more recently they have been slightly higher.

Figure 2.3 compares the measure of disagreement across respondents (IQR) based on individual point forecasts with that based on medians of individual densities. It shows that, except for a large difference in November 2007 when heterogeneity in point forecasts was significantly higher than that in individual density medians, both measures of disagreement show an initial sharp decline, followed by a considerable increase during January 2008 and April 2008 after which it has remained relatively steady at elevated levels until July 2008. Since then, there has been a significant decline in disagreement.

Turning now to individual uncertainty about year-ahead price changes, which we measure by the median of the individual density's interquartile ranges (IQRs), we find

that individual uncertainty dropped between November 2007 and February 2008, increased between February and June 2008, followed by a significant decline since then [Figure 2.4]. By September 2008, uncertainty was considerably lower than it was in November 2007 which corresponds to the beginning of the sample period for our Fed-ALP panel. While showing a similar overall trend as that for disagreement, the two measures sometimes go in opposite directions, such as between January and February of 2008 when uncertainty fell and disagreement increased. Further, between December 2007 and September 2008, disagreement (based on individual point forecasts) increased by about one full percentage point, while median uncertainty stayed about the same. Thus, conclusions based on disagreement used as a proxy for overall forecast uncertainty may be misleading.

(2.1.3) Heterogeneity

There are several reasons to expect forecast uncertainty to differ across individuals. As pointed out by Ericsson (2003), uncertainty about future inflation depends not only on the economic processes that actually determining inflation but also on the information available and the way this information is processed by the individual. If different individuals have different information sets, use different methods of forecasting, or differ in their ability (such as numeracy and financial literacy) to use the information they have to form forecasts, reported uncertainty about future inflation will differ across individuals.

Table 2.3 presents median values of individual levels of uncertainty (measured by the IQR of an individual's estimated density) across different demographic groups. Also shown in the first two columns of the table are, respectively, the median and dispersion (as measured by the IQR) of the individual density medians across respondents in each demographic category. The first two columns reveal a pattern similar to that found for point forecasts: inflation expectations and disagreement in these expectations across individuals are lower for male, college educated, married and higher income respondents. These results confirm our earlier findings that the probabilistic question provides information about an individual's central forecast that aligns closely to that provided by the question asking for a point forecast, showing comparable levels and heterogeneity across demographic groups.

Of course, the probabilistic question has the important advantage of also providing us with a measure of individual uncertainty about price changes during the next year. When comparing the level of uncertainty across different groups, we find a pattern similar to what we found for central forecasts and for disagreement, with uncertainty being lower for men than for women, for those without than with a college education, for married than for singles and for higher income than for lower income respondents. However, generally these differences in uncertainty are smaller than those in central forecasts, with only the differences by gender and income being statistically significant at the 5% level.

In Table 2.4 we relate individual uncertainty about year-ahead changes in prices in general to indicators of cognitive ability, financial knowledge and economic decision

making.[44] The Spearman rank correlations indicate that uncertainty is highly correlated with an individual's score on a numeracy skills test, with individuals with a higher ability to evaluate numerical data reporting significantly lower uncertainty about future inflation. Lower expressed uncertainty is also associated with greater self-assessed knowledge about the household's financial situation and an individual's score and confidence about correctness of answers on a financial literacy test. Individuals in households that use longer financial planning horizons in their spending and savings decisions also report lower uncertainty relative to those with shorter planning periods. Thus, the same groups that reported higher levels of inflation expectations (see Tables 1.2 and 1.13) also tend to express higher uncertainty around those expectations.

Finally, we find no statistically significant relationship between individual uncertainty about future price changes and financial responsibility within the household for budgeting and managing income, for paying bills and for shopping. However, individuals with primary financial responsibility for investing and managing assets report lower uncertainty about future inflation, likely reflecting the fact that individuals with such responsibility have more to gain or can benefit more from more detailed knowledge of inflation and inflation dynamics. [45] In future research we hope to investigate in more detail how people form their uncertainty, how they prefer to express it, and how it differs by cognitive ability and other variables.

(2.1.4) Comparing uncertainty across inflation measures

In our December special module, we included probabilistic versions of all three expectations questions: that asking about "prices in general", the "rate of inflation" and "prices of the things you usually spend money on. As shown in Table 2.5, mimicking the pattern for median point forecasts and disagreement, uncertainty about the "rate of inflation" was found to be significantly lower (at 1% level) than that for "prices in general" or "prices you pay". This may be because the rate of inflation is perceived to be less variable, more precisely defined, or simply because individuals have better knowledge about inflation dynamics. Interestingly there is also less heterogeneity across individuals in reported uncertainty. Differences between reported median uncertainty about changes in "prices in general" and in the "prices you pay" were not statistically significant at the 5% level, and in fact about a third of respondents who were asked both questions provided identical interval probabilities.

When comparing uncertainty about future overall inflation with uncertainty about future changes in the price of milk and gas (see the two rightmost columns of Table 2.5), we find uncertainty about changes in the price of milk to be significantly smaller than the

[44] When relating central forecasts (density median) to indicators of cognitive ability and financial knowledge and decision making, we found the same patterns as found for point forecasts in Table 1.2.

[45] Our findings of substantial heterogeneity in uncertainty about future inflation are consistent with the evidence of statistically significant forecaster fixed effects in density forecasts data from the Survey of Professional Forecasters reported by Rich and Tracy (2008). Our results that relate to financial knowledge and numeracy skills, even though obtained on a sample of consumers instead of professional forecasters, also support their interpretation that such heterogeneity captures the fact that some forecasters who have access to superior information or who possess a superior ability to process information are more confident in their point forecasts.

uncertainty about all three inflation measures, while that for the price of gas is significantly higher (at 5% level or lower) than uncertainty for all other measures. These patterns in the level of uncertainty across the various price measures are surprisingly similar to those reported earlier for point forecasts in Table 1.14. Thus higher median point forecasts appear to be accompanied by higher levels of uncertainty.

The rank correlations presented in Table 2.5 indicate that individuals who are uncertain about one inflation or price measure also tend to be uncertain about future changes in other price measures, with uncertainty about "prices in general" and that about the "prices you pay" being especially correlated. Similar to what we found when analyzing the correlations between point forecasts in Table 1.14, we find uncertainty about the future rate of inflation to be the least correlated with uncertainty about future changes in the price of milk and gas. This corresponds well to the weaker correlations we found between point forecasts of the rate of inflation and changes in the price of milk and gas.

To analyze whether the same heterogeneity patterns that were found for the "prices in general" version of the probabilistic question carry over to alternative wordings, Table 2.6 presents median levels of uncertainty by demographic characteristics based on data from the December special module. The first column shows that the differences across demographic groups for the "prices in general" wording are similar as those reported earlier in Table 2.2 that were based on data from the Fed-ALP panel. Moreover, the same differences appear when using the "rate of inflation" and "prices you pay" question wordings. While the differences in median uncertainty between demographic groups are not always statistically significant, they all indicate male, college educated and higher income individuals to report lower levels of uncertainty about future price changes. Similarly, the Spearman rank correlations presented in Table 2.7 shows uncertainty to be negatively correlated with various measures of cognitive ability and financial knowledge, but not significantly related to the level of responsibility within the household for various financial decisions.

We also analyzed the relationship between question interpretation (ratings of factors individuals thought of in coming up with an answer) and individual uncertainty about future inflation, but found no statistically significant differences for either of the three expectations questions. Comparing median levels of uncertainty by what the respondent thought the question asked about the most also did not reveal significant differences for either expectation question.

(2.1.5) The relationship between uncertainty and point forecasts

The previous findings showed the level of uncertainty to be higher among demographic and financial and cognitive skills groups with higher median expectations of inflation. To analyze the relationship between point forecasts and uncertainty more generally, Table 2.8 presents rank correlations between a set of alternative point forecasts (of the rate of inflation, and the change in prices in general, prices you pay, and the price of milk and gas) and two density-based measures: the individual's central forecast (measured by the median of the individual's forecast density) and uncertainty (measured by the interquartile range of the density).

Not surprisingly, given the findings described above, we find point forecasts and density medians to be strongly correlated for all five price expectations (and especially for the rate of inflation question), indicating again that the probabilistic questions imply individual central forecasts that align closely to their point forecasts. More importantly, the reported correlations in the second row of the table imply a strong positive relationship between reported point forecasts and uncertainty for all 5 price measures. Individuals providing high point forecasts generally express higher levels of uncertainty about future changes in prices.

We find this relationship to be consistent within demographic groups, with correlations varying between 0.47 and 0.59, and also to be fairly consistent over time, varying between 0.48 and 0.56 during our period of observation. The scatter plot presented in Figure 2.5 provides a visual depiction of the relationship between point forecasts and uncertainty for the "prices in general" question. As captured by the estimated median spline (a smooth nonparametric fit to the medians of uncertainty across intervals of point forecasts), there is a clear positive relationship especially at values above the median of point forecasts.

A starker characterization of the relationship is obtained when we compare the cross-sectional distribution of point forecasts among individuals with below and above median levels of uncertainty. The corresponding histograms in Figure 2.6 reveal a striking result: forecasts among low-uncertainty respondents are tightly distributed in the 0-10 range, with essentially no forecasts outside that range. Instead, almost all those with a point forecast outside the range, had a level of uncertainty higher than the sample median.

The positive correlation between point forecasts of inflation and uncertainty in inflation is consistent with the well known empirical finding that periods with high (low) mean inflation have a correspondingly high (low) variance of inflation.[46] The correlation may also reflect heterogeneity across individuals in information sets, beliefs or in the way information is used to forecast future price changes. For example, extreme responses combined with high uncertainty may be due to a lack of knowledge of inflation (as suggested by our findings of higher median point forecasts as well as uncertainty among those who rate themselves as less knowledgeable about their households financial situation). Alternatively, such responses may result from a lack of understanding of the question. We hope to investigate this in more detail in future research.

Finally, we investigated whether the use of range responses was correlated with features of the density forecasts. For the Michigan "prices in general" question we find positive correlations (at the 1% level) between the reporting of a range and, respectively, the density median, density IQR and the number of bins that were assigned nonzero probability. Thus individuals who reported a range generally had higher central forecasts

[46] The long-run average level of inflation is strongly correlated with the inter-year variance of inflation. As noted by Ball and Cecchetti (1990) an increase in the level of inflation is often associated with a corresponding increase in the variance and/or uncertainty of future inflation. Some of the evidence is based on surveys that document the positive correlation between inflation and inflation uncertainty where the latter is measured by the disagreement amongst respondents in their point forecasts of inflation. More recently Lahiri and Liu (2006) using density forecasts from the Survey of Professional Forecasters found the level of inflation to be positively correlated over time with median forecast uncertainty. A number of explanations have been proposed to explain these empirical regularities, one of which relates to uncertainty about the response of monetary policy to inflation or about its impact.

and were more uncertain about future inflation. If we only consider range responses where initially no point forecast was provided, all correlations become insignificant except for that with the central forecast.

For the two alternative inflation measures, none of the correlations were statistically significant except for a positive significant correlation between the use of a range response and central forecast for the "rate of inflation" question.[47] For observations with range responses, we related the width of the range reported by an individual to the individual's density median and density IQR and found statistically significant (at the 1% level) positive correlations varying between 0.40 to 0.68, indicating that range widths (for those who reported a range) capture an individual's uncertainty about future inflation reasonably well.

(2.2) Summary of main findings related to consumer uncertainty about future inflation

1. When asked for a point estimate or a range, 38% of respondents volunteered to give a range, suggesting their willingness to express uncertainty. We designed probabilistic questions that allowed more systematic expressions of uncertainty, in which individuals assign probabilities to different inflation outcome ranges. Individuals were willing and able to respond to these probabilistic questions, Response rates were close to 100%, with respondents on average assigning positive probabilities to between 4 and 5 outcome intervals. Uncertainty is correlated across questions, suggesting relatively stable individual differences and reliability of measurement. In future research, we aim to examine how people interpret our probabilistic questions, experiment with different question formats, measure test-retest reliability of specific responses, and examine validity in terms of correlations with other expressions of uncertainty about inflation outcomes.
2. Following an initial decline between November 2007 and February 2008 there was a significant increase in uncertainty about future inflation until June. Since then, there has been a considerably decline in inflation uncertainty. Uncertainty about future inflation varies considerably across individuals, with females, individuals without a college education and lower-income individuals generally being more uncertain. Uncertainty is also strongly related to several measures of cognitive ability, where those who scored higher on measures of numeracy (ability to use percentages), financial literacy and self-perceived financial knowledge expressed less uncertainty. Similarly, those with greater responsibility in the household for investment decisions, and those in households that use a longer planning horizon in their spending and savings decisions report a lower interquartile range for future inflation.
3. Uncertainty about future inflation is positively correlated with point forecasts (correlation coefficient about 0.55). Whether this simply reflects the positive correlation between inflation realizations and inflation volatility, or instead reflects heterogeneity across individuals in information sets, beliefs or in the way information is used to forecast future price changes, is an important question for future research.

[47] For the MI question the Spearman rank correlations between reporting a range and, respectively, the density median, density IQR and number of nonzero bins were 0.11, 0.12 and 0.10. When only considering reports of a range without a best guess the correlations instead were 0.10, 0.02 and -0.00.

4. Uncertainty about the future rate of inflation is less strongly correlated with uncertainty about future price changes for milk and gas than is uncertainty about future changes in “prices in general” and in the “prices you pay”. This is consistent with our finding for point forecasts of the rate of inflation, which were similarly less strongly correlated with forecasts of price changes for milk and gas.

3. Measuring longer-term expectations

A central question in Central Bank policy-making concerns the extent to which long-term inflation expectations are "well-anchored"; that is, the extent to which the public's long-run expectation of inflation respond to incoming information, including supply shocks, such as changes in the price of oil and real activity shocks, and changes in aggregate demand. A related issue is whether and to what extent the public changes their long-run expectation in response to recent higher-than-expected inflation realizations. The answer to the latter question may also tell us something about central bank credibility. To answer such questions and to be able to distinguish between temporary and more persistent movements in inflation expectations, expectations should be measured both at short and long-run time horizons. Moreover, measures of long-run inflation expectations are themselves of key importance for assessing whether inflation expectations are anchored somewhere close to a Central Bank's target.

(3.1) The Michigan Survey question on long-term inflation

Introduced in 1979, the Michigan Survey asks respondents for their expectations of long-term inflation using a similar format as the question asking about expected changes in prices in general during the next 12 months. The structure of the question is presented in Figure 3.1. First, respondents receive the question "What about the outlook for prices over the next 5 to 10 years? Do you think prices in general will be higher, about the same, or lower, 5 to 10 years from now?". Those who respond "stay the same" are then asked whether they mean that prices will go up at the same rate as now, or that prices in general will not go up during the next 5 to 10 years. Those who indicate that they mean prices will go up at the same rate are then given the same follow-up questions as those who answer that they believe prices will be higher 5 to 10 years from now, as described below.

Respondents who answer that they expect prices to be higher [lower] 5 to 10 years from now receive the question "By about what percent per year do you expect prices to go up [down] on the average, during the next 5 to 10 years?". In the Michigan Survey only respondents who give a response over 5% are then asked a clarification follow-up question asking "Would that be [x] percent per year, or is that the total for prices over the next 5 to 10 years?". Respondent who answer 'total', are then asked for a 'per year' amount. In order to examine whether confusion about the question asking for the percent per year or for the entire time period might also affect respondents who give a response below or at 5%, we gave the clarification follow-up question to all respondents.

Figure 3.2 presents monthly median responses from the Michigan Survey during the period of our study.[48] After remaining fairly constant at around 2.9-3.0 until February 2008, within the next two months it increased to 3.4. Since May 2008 the median long-term forecast declined to 3.2 in July, followed by a further decline back to 3.0 in September.

[48] The medians were computed using the raw Michigan micro data. We used the same procedures as those used by Michigan to impute missing percent responses for individuals who only answered the question asking for the direction of change. Medians were then calculated using a linear interpolation procedure.

(3.1.1) Comparison of alternative inflation expectations questions

Using the Michigan question format, we asked respondents in our May special module either about their long-term expectation about "prices in general", "the rate of inflation" or "prices you pay for things you usually spend money on" (henceforth "prices you pay"). Respondents were randomly assigned to receiving one of the three question wordings. For each question wording, we kept Michigan's elaborate question structure described in Figure 3.1 to make sure that any effect on responses would be due to question wording only.[49] Median responses are presented in Table 3.1.[50] As was the case for the year-ahead version of the three expectations questions, the median response to the "rate of inflation" question was lower than that to the "prices in general" question which in turn was lower than for the "prices you pay" question. While showing the same pattern, the differences were smaller than for the year-ahead question and only the difference between the "prices you pay" and the "prices in general" version was statistically significant at the 5% level. A similar pattern is found for forecaster disagreement, with disagreement about long-term forecasts of the rate of inflation being smaller than that for the other two questions.

When comparing average ratings of the difficulty and clarity of the different question versions we find the same pattern we found before with the year-ahead question, with the question asking about the rate of inflation being considered a little more difficult to answer and somewhat less clear than the questions asking about prices in general or prices you pay. However, response rates to all three long-term questions were all greater than 99 percent.[51]

We also asked respondents who answered the long-term question to rate how much they thought of different specific topics in coming up with an answer. The results, not shown, reconfirmed our finding for the year-ahead forecasts: while those answering the long-term question about "prices in general" think both about prices of the things they spend money on as well as prices Americans in general pay or the U.S. rate of inflation, those answering the "rate of inflation" question think more about the prices Americans in general pay and of the rate of inflation. Those answering the "prices you pay" question instead think much more about the prices they themselves pay. Across the three questions, we find, as for the year-ahead questions, that those who think a question was asking the most about the U.S. inflation rate or about prices that Americans pay usually report lower expectations (median 3.3) than those thinking more about the prices they pay for the things they themselves buy (median 3.9).

[49] While using the same question structure, there are slight differences in the wording. For example, the question about long-term inflation began by asking "What about the outlook for inflation over the next 5 to 10 years? Do you think there will be inflation, deflation (the opposite of inflation), or neither over the next 5 to 10 years?".

[50] Note that the median response in May to the long-term question about prices-in-general (3.7) was higher than that in the Michigan survey (3.4). This may be due to interview mode effects or due to differences in sample composition (unlike the mini-modules, respondents to the special modules also included non-Michigan Survey respondents, see the appendix describing sampling and survey details).

[51] As noted earlier, RAND procedures encourage high response rates. While respondents are allowed to skip questions, they receive a prompt reminding them that they did not answer the question, with a request to do so.

We also explored whether there were differences between the three inflation expectations questions in how individuals interpreted the somewhat ambiguous wording 'five to ten years from now'. More specifically, we asked each respondent which of the following three options best described what they thought of in coming up with an answer to the question: (1) I thought mainly of changes in prices between now and 10 years from now, (2) I thought mainly of changes in prices between now and 5 years from now, (3) something else[52]. Table 3.2 shows the proportion of respondents who chose either option for each of the three inflation expectation questions. The answers clearly reflect the ambiguity of the wording of the question.

Interestingly, when respondents were asked about the rate of inflation over the next 5 to 10 years, they were significantly more likely to have used a longer time horizon of ten years than those answering the two alternative questions about prices in general and prices they paid. Whereas 61 (33) percent of those answering the "rate of inflation" question used a 10 year (5 year) horizon, among those answering the "prices in general" and "prices you pay" questions these rates were 36 (57) and 32 (64), respectively. However, the time horizon people thought of when considering expectations for the next 5 to 10 years did not affect their reported expectations.[53] Therefore, even though the questions elicit different interpretations regarding the time horizon to use, this does not appear to contribute to increased heterogeneity in forecasts across individuals, nor does it appear to be responsible for the lower median long term expectations when asking about the future rate of inflation.

One possible reason for why the ambiguity about the long-term time horizon did not appear to matter may be that people do not plan very far ahead financially, making the difference between 5 years or 10 years ahead not very meaningful to them. When considering our measures of 'planning horizons', we find that only 6% of the respondents say they plan for the next 5 to 10 years, and 4% for longer than 10 years when planning their family spending. The numbers are 15% and 18% for savings, which still leaves the majority planning for the (much) nearer future. In subsequent research, we aim to find out how planning horizons affect people's inflation expectations and related financial decisions, and the validity of short-term versus long-term expectations, in terms of relationships to individuals' financial decisions and behaviors.

(3.1.2) Revisions to the Michigan Survey follow-up question

At the bottom of Table 3.1 we report the rates at which respondents revise their initial answers in response to the follow-up question. They indicate that a large proportion of respondents changed their answers. Differently from the follow-up question for the year-ahead question, which is likely to have been interpreted by respondents as a verification of correct entry of their numeric response, the follow-up to the long-term question asked whether respondents meant their response to reflect price changes per year or over the entire time period. The follow-up therefore served a different purpose, namely

[52] For those answering the question about the rate of inflation, the answer options were (1) I thought mainly of the rate of inflation over the next 5 years, (2) I thought mainly of the rate of inflation over the next 10 years (for individuals who expected deflation, the word 'inflation' was replaced by 'deflation').
[53] Spearman correlations between horizon (0=5 years, 1=10 years) and long-term inflation expectations were 0.06 (p=0.38) for the 'prices in general' question, 0.01 (p=0.92) for the 'rate of inflation' question, 0.01 (p=0.90) for the 'prices you pay' question and 0.01 (p=0.82) overall.

to clarify what the question meant. Even though the question asked for a percent change or rate per year, respondents may not have noticed these words and nevertheless may have inadvertently given a total instead. The clarification question led a large proportion of respondents who gave responses over 5% to admit that their answer reflected the total, and to lower their answer to reflect their estimated price change per year.

In the Michigan Survey, only respondents who give responses over 5% receive the follow-up question to make sure that responses reflect estimated price changes "per year." In our May special module, we examined whether individuals giving responses below 5% also may have misinterpreted the question and reported a total instead of annual rate. We find that 20 to 30 percent of respondents who initially gave responses under 5% admitted that they had given estimated price changes for the total period, leading them to lower their answers to a per year estimate.

Figure 3.3 shows a scatter diagram of all respondents' initial responses against their revisions, that is, the difference between their revised and initial answers. Cases where respondents did not revise their answers correspond to points whose revision (y-axis) is zero. Also shown in the figure is a nonparametric median spline which represents a smooth fit through the median revision at each initial response. The spline function reveals the strong negative correlation between the median revision and initial response, which in turn reflects a strong positive correlation between the rate at which respondents revise their answer after the follow-up (the revision rate) and their initial answers (see the last row of Table 3.1). Also note that the median revisions are generally nonzero in the -5% to 5% range. Hence, administering the follow-up question only to respondents who give expectations over 5% will fail to correct misinterpretations among those who gave lower responses. In our sample, if the follow-up had only been administered to those giving responses over 5%, then the median long-term expectation would have been 4.3 instead of 3.7. Thus we have reasons to believe that the 5% follow-up question in the Michigan Survey leads to a systematic overestimation of actual average responses.

We also examined the effect of asking the clarifying follow-up in questions asking about "rate of inflation" and "prices you pay." As was shown in Table 3.1, the revision rate for the "rate of inflation" question was significantly lower (at the 1% level) than those for the two alternative questions. In part this may be due to the strong positive correlation between initial response and rate of revision (respectively 0.35, 0.37 and 0.48 for the "prices in general", "rate of inflation" and "prices you pay" versions) combined with a lower median response for the "rate of inflation" question. It is also possible that it simply is more natural for people to think of the rate of inflation as an annual rate, rather than a cumulative rate. [54,55]

There are reasons to believe that in our online survey the rate at which individuals revised their answer in response to the clarification question may actually underestimate the percent of respondents who may have been confused with regard to whether the long-

[54] The question wording for the rate of inflation version was "About what rate of inflation per year do you expect on the average over the next 5 to 10 years". In a regression of whether the respondent revised their answer on the respondent's initial response as well as dummy indicators for answering the prices-you-pay and rate-of-inflation question versions, the estimated coefficient (t-stat) on the latter was -0.08 (1.80).

[55] The heterogeneity in the rate at which respondents revise their answer after the follow-up across demographic groups shows similar patterns as that for year-ahead point forecasts and uncertainty. The rates are lower for males, for college educated and higher income respondents. Those with greater numeracy and financial literacy skills also were also less likely to revise their initial answer.

term question asked for the percent per year or for the percent for the full time period. In a phone interview, it may be much harder to notice that the question asked "per year" than in an online survey in which respondents read (and, when needed, reread) the questions themselves. This is worrisome because the percent of respondents who were confused in the online survey is already quite large. In follow-up research, we aim to examine whether such mode effects exist, and what can be done to reduce the reported confusion.

Another concern about the observed pattern of revisions is that the average (final) responses of those who revised based on the follow-up question are significantly lower than the responses given by those who did not revise. If the mistake of overseeing a request for a 'per-year' rate is distributed randomly across respondents, then after correcting their earlier answer by reporting a 'per-year' rate after the follow-up question, average responses should have been the same between the two groups. A possible explanation for finding higher responses among who did not revise could be that those who did and did not revise had a different way at arriving at their response. For example, those who revised may have overcorrected downward due to problems with the mental arithmetic of computing the per year response from the response for the entire time period – a mental procedure that the ones who gave the 'per year' response right away may not have followed. Alternatively, it may also be the case that some of those who did not revise did actually give a response for the entire time period but when they received the follow-up did not admit to that. In follow-up research, we aim to disentangle these explanations.

(3.1.3) Heterogeneity in long-term forecasts and relation to year-ahead forecasts

As shown in Table 3.3, when comparing median long-term forecasts across demographic groups, we find similar patterns as those found for year-ahead forecasts, although the differences across groups are generally smaller and often no longer statistically significant. Males, married individuals, those with a college education and with incomes over $75,000 on average have lower median long-term inflation expectations and are much less heterogeneous in their forecasts compared to women, single individuals, those without a college degree and individuals with lower incomes. In contrast there no longer exist clear correlations between long-term forecasts and measures of cognitive ability and financial knowledge and responsibility (see Table 3.4). As with the year-ahead expectations, the rate of inflation question consistently yields lower median levels and less disagreement in point forecasts across all demographic categories.

Short and long-term inflation expectations are strongly positively correlated, with a correlation coefficient varying between 0.40 for the "rate of inflation" question and 0.53 for the "prices in general" question, with that for the "prices you pay" question being 0.49 (see Table 3.5). The strong positive correlation does not only exists across demographic groups (as previously discussed), but also within each demographic groups.

When comparing overall median year-ahead forecasts of 3.7, 3.2 and 4.2 for the three wordings of the expectations question, with the median long-term forecasts of 6.5, 5.1 and 8.2 for the same sample of respondents, it appears that forecasts about the future rate of inflation are less sensitive to the change in forecast horizon than is true for forecasts of changes in prices in general and of prices you pay. However, when analyzing

individual-level differences between long-term and year-ahead forecasts, we find a median difference across individuals that varies between -1.8 (for the "rate of inflation" question) and -2.5 (for the "prices you pay" question) and these median differences are not significantly different from each other at the 5% level.

While there appears to be no systematic variation across demographic groups in the median difference between respondents' long-term and year-ahead forecasts for the "prices in general" and "prices you pay" versions, Table 3.5 reveals a different pattern for the "rate of inflation" question. There are significant differences across demographic groups with the median difference between long-run and year-ahead forecasts being greater for women than for men, for respondents without a college degree compared to those with a degree, and for respondents with income below $75,000 compared to those with higher incomes. This result is consistent with the earlier finding in Table 3.3, that exhibited more muted differences across demographic groups in long-term than short-term expectations, especially for the "rate of inflation" question.

Finally, Table 3.6 reports the rank correlations between expectations for the three alternative versions of long-term inflation expectations, on the one hand, and the year-ahead expectations for changes in the price of three composite goods (food, housing, and transportation) on the other. All three long-term expectations measures are positively correlated with the year-ahead forecasts for the composite goods. As is the case for the year-ahead inflation expectations, the "rate of inflation" wording elicits the lowest correlation with the expected short-term price change in specific composite goods, and especially so for food.

When comparing the correlations in Table 3.6 with those presented for year-ahead expectations in Table 1.14 an interesting pattern emerges. We find that correlations of expectations for prices in general over the next 12 months are significantly (at 1% level) more strongly related to expectations for transportation prices over the next 12 months than are expectations for prices in general over the next 5 to 10 years (r_s=.39, vs. r_s=.55). A similar (statistically significant) pattern is found for the "prices you pay" version (r_s=.35, vs. r_s=.50), but not for the "rate of inflation" one (r_s=.32 vs. r_s=.37). The pattern for the questions about "prices in general" and "prices you pay" was not replicated for housing prices (r_s=.26 vs. r_s=.19, for prices in general; r_s=.20 vs. r_s=.24 for the rate of inflation; r_s=.25 vs. r_s=.27 for the prices you pay).

These results are consistent with the hypothesis that at least part of the difference between long- and short-term forecasts can be attributed to the fact that short-term expectations are more strongly affected by expectations for salient short-term price increases (such as those for transportation) than are long-term expectations. This would imply a greater decline in the correlations for transportation compared to those for the cost of housing, which should be less salient as it was relatively stable or decreasing during the period of observation.

(3.1.4) Tracking long-term inflation expectations and inflation uncertainty

Since we began our project in November 2007, we experimented with an alternative wording and time horizon for the longer-term inflation question. More specifically, we included as part of our Fed-ALP panel a probabilistic question asking respondents for their three-years ahead forecasts of the rate of inflation. We chose this time horizon in order to let respondents focus on a time frame that is salient to them,

while at the same time not being sensitive to cyclical fluctuations and allowing monetary policy to work its effects. The question asked respondents for the percent chance that three years from now the rate of inflation will be between 0 and 2, 2 to 4, 4 to 8, 8 to12, higher than 12 percent, as well as the percent chance that there will be deflation between 0 and 2, 2 and 4 and more than 4%.[56] By being more specific about the time horizon and about the measure of inflation, the question aims to avoid ambiguities about interpretation.

Figure 3.4 presents the median 3-years-ahead central forecast (measured by the density median) as well as the median uncertainty level among our (balanced) panel of respondents.[57] Except for a temporary drop in February the median 3-years-ahead forecast has been relatively stable during the sample period, although in recent months it has begun to fall. During the same period uncertainty about future inflation, which also saw a temporary drop in February, experienced an overall small decline.

In June we introduced a randomization where half of the respondents were asked an additional question just before the 3-years-ahead probabilistic question discussed above. The question was identical to the 3-years-ahead probabilistic question except that it asked instead about the rate of inflation *over the next 12 months*. The question was introduced to permit a comparison between one-year-ahead and three-years-ahead median forecasts and levels of uncertainty. As shown in Figure 3.4, among respondents for whom we have density forecasts for both the one-year-ahead and three-years-ahead rate of inflation we find that the median year-ahead forecast declined by 0.6 percentage points, while the median three-year-ahead forecast fell by 0.9 percentage points between June and September 2008.

Interestingly, the placement of the question just before the three-year ahead question turned out to affect responses to the latter. For example, while the median 3-years-ahead forecast for the group who first answered the 1-year-ahead version of the question in June was 4.5 and for those who did not receive the 1-year ahead question was 5.0, the median forecasts for these groups in mid-July (September) were, respectively, 4.2 and 4.8 (3.6 and 4.4) .[58] The experiment illustrates the importance of questionnaire content and question order. When eliciting expectations about inflation at multiple horizons, special attention should be given to the order in which the questions are asked. While perhaps not easily implementable in a telephone survey, a format that asks about inflation at different horizons simultaneously by presenting a table (such as the table format used in the Survey of Professional Forecasters) could mitigate any potential question order effects and may therefore be worth considering.

(3.2) Summary of main findings

1. As with the year-ahead questions, we find significant effects of question wording. That is, the median forecast as well as disagreement were lower when asking

[56] The actual question asked in June was the following: Now we would like you to think of inflation **3 years from now**. In your view, what would you say is the percent chance that the following things may happen to the rate of inflation/deflation over the one-year period between **June 2010 and June 2011**? Please note: The numbers need to add up to 100%.

[57] As with the year-ahead probabilistic question, the density median and IQR are based on a parametric fit of the generalized Beta distribution to each individual's reported interval probabilities.

[58] The figures in Figure 3.4 on the red line apply only to individuals who did not receive the additional question about the year-ahead rate of inflation.

about the “rate of inflation” question than when asking about “prices in general” or “prices you pay”. In follow-up research we plan to examine whether questions asking about expectations for inflation better predict household financial decisions than do questions asking about price changes.

2. The follow-up question that is asked in the Michigan Survey to make sure that individuals who express a long-term forecast greater than 5% (in absolute value) give responses reflecting estimates of price changes per year rather than for the entire time period leads almost half of the respondents to realize that they gave responses for the entire time period. As a result of the follow-up question, they significantly lower their initial response to reflect a per year estimate. In addition, 20 to 30 percent of respondents who gave answers under 5% also lowered their answer in response to the follow-up question. Therefore, only asking the follow-up question to respondents who give expectations over 5%, as is done on the Michigan Survey of Consumers, will fail to correct misinterpretations among those who gave lower responses, and, hence, lead to systematic overestimation of actual expectations. In follow-up research, we aim to examine whether this problem is exacerbated in a phone interview compared to an online survey, and what can be done to reduce the reported confusion.
3. While many respondents reported to have thought mainly of changes in prices between now and 10 years from now, when answering the question about changes in prices ‘five to ten years from now’, another large group of respondents instead reported to have thought mainly of changes in prices between now and 5 years from now. The former group is much larger among those who are asked about the rate of inflation than those asked about changes in prices in general or in the prices they pay. However, what time horizon a respondent thought of did not appear to significantly affect their response to the long-horizon questions. In subsequent research, we aim to find out how planning horizons affect people’s inflation expectations and related financial decisions, and the validity of short-term versus long-term expectations, in terms of relationships to individuals’ financial decisions and behaviors.
4. Experimentation with an alternative question asking about the rate of inflation three years from now indicates that during the period of our study the central forecast among respondents as well as uncertainty about three-year ahead inflation both slightly fell. Our exploratory analysis points to both the feasibility of eliciting detailed information about individual density forecasts and also illustrates the importance of question sequencing. The latter represents an important topic for further research.

4. Measuring other aspects of inflation expectations

(4.1) Measuring expectations of wage inflation

In addition to enhancing our measures of inflation expectations, we have also set out to collect information regarding wage expectations. Like inflation expectations, wage expectations affect consumer inter-temporal decisions, and are therefore of great value for understanding and forecasting economic behavior. Moreover, since price-setting behavior by firms is at least partly dependent on total labor cost, wage dynamics are an important determinant of actual and expected inflation. At the same time, because economic agents may set wages with reference to the expected rate of inflation, data on wage expectations provide an additional information source for analyzing inflation dynamics and the interaction between wage and price determination (the basis of a so-called "wage-price spiral"). Despite the obvious importance of wage expectations, as noted by Chairman Bernanke (2007), information on nominal wage expectations is particularly scarce.[59]

(4.1.1) Expectations about future changes in wages

In the May special module we elicited point forecasts of wage growth over the next 12 months for currently employed workers, conditional on staying in the same job, in the same conditions and working the same number of hours.[60] We also randomly assigned all respondents to one of two questions: one that asked for their expectations about wage changes for Americans in general, and one that asked currently employed respondents for expected changes in their wages over the next 12 months, unconditional on staying at the current job.

Table 4.1 presents median point forecasts for changes over the next year in (1) own wages on the current main job, (2) own wages in any job and (3) wages of Americans in general. Median expectations about changes in wages of Americans in general (an increase of 0.4 percent) are significantly lower (at the 1% level) than expectations about the respondent's own wage, both when conditioning (2.8) and not conditioning on remaining in the current job (3.0). The median unconditional expectation about the change in the respondent's own wages over the next year is slightly higher than when the respondent is asked to condition on remaining in the current job, with the difference being statistically significant at the 5% level. The level of disagreement

[59] Notable exceptions are survey questions on expected weekly earnings analyzed by Dominitz (1998) and on expected future income by Guiso et al (1992), Manski (1993) and Dominitz and Manski (1996).

[60] We first asked individuals who reported to be working for pay how many jobs they had. We then informed them that in some subsequent questions we ask about their MAIN job, which we defined to be the job at which they usually work the most hours. The structure of the wage expectation question then followed that of the Michigan inflation question. Specifically we first asked: "Suppose that, 12 months from now, you actually are working in the exact same [MAIN] job at the same place you currently work, and working the exact same number of hours. Twelve months from now, do you expect your earnings on this job, before taxes and deductions, to have gone up, or gone down, or stayed where they are now?". For those who said gone up or gone down we then asked "By about what percent do you expect that your hourly earnings on this job, before taxes and other deductions, will have gone [UP/DOWN], 12 months from now, if you actually are working in the exact same job at the same place you currently work, and working the exact same number of hours?".

follows a similar pattern, with disagreement in expectations being much lower when asking about wage changes for Americans in general than when asking about the respondent's own wage.

As could be expected, expectations about own wages conditional and unconditional on staying in the same job are highly correlated and in fact 84% of respondents provide the exact same response to both questions. This is consistent with a median subjective probability of 0.90 of working in the exact same job next year. Among the 16% of individuals who report a different estimate for both questions, 11% report a higher unconditional expectation, reflecting either an expectation of a job switch or an increase in hours of work. Expectations about wages of Americans in general instead have a much weaker positive correlation with expectations about own wages on the current job, and 71% of respondents report a different expectation for both. Of these only 19% expect the wages of Americans to grow faster than their own wage, with the remaining 52% expecting the opposite.

Finding much lower expectations for wage growth for Americans in general than for own wages could be rationalized if respondents in our survey did not constitute a representative random sample of Americans. As discussed in section 6.2, we cannot exclude this possibility. For one thing, our sample is based on internet users. However, the pattern observed here is consistent with a similar finding in the psychology literature of individuals believing that bad things are more likely to happen to others, which is generally referred to as optimism bias (Weinstein, 1980).

In Table 4.2 we analyze the extent to which wage expectations differ between different demographic groups. While males, those with incomes over $75,000 and respondents with ages between 40 and 49 forecasted slightly higher growth in their own wages, none of the differences in medians found in Table 4.2, with the exception of those between the two age groups were statistically significant at the 5% level. Similarly, we found no statistically significant correlations between wage expectations and our measures of cognitive ability and financial knowledge and responsibility.

We also asked respondents to rate the difficulty and clarity of the alternative questions asking for their forecast of future wage changes. As shown in Table 4.3 respondents rated the two questions about their own future wage growth as relatively clear (average ratings 2.4, 2.6) and easy to answer (average ratings 6.3, 6.4), especially when compared to the questions about year-ahead inflation, which had difficulty ratings varying between 3.4 and 4.3 and clarity ratings between 5.4 and 5.7 (see Table 1.11). The question about wages of Americans in general was considered somewhat harder to answer and somewhat less clear than the questions about the respondent's own wage, with ratings that are closer to those given by respondents to the year-ahead inflation questions. The question asking about the respondent's wage on the current job was rated as slightly more unclear but slightly easier, with the differences being statistically significant at the 5% level.

Individual expectations about the growth in prices over the next year generally exceed expectations about growth in wages, irrespective of the measure of prices and wages used. As shown in Table 4.4 the median difference between the expected change in "prices in general" and the expected change in the wage on the current job is 2.1 percentage points, while in the case of the "rate of inflation" or "prices you pay" questions the median difference is respectively 2.3 and 1.7 percentage points. When not

conditioning on staying in the current job, the median differences are a little smaller, but remain statistically significant at the 1% level. When comparing expected inflation to expected changes in the wages of Americans in general, inflation expectations exceed wage growth expectations by more than 3 percentage points.

(4.1.2) Heterogeneity in expectations of wage changes

We have seen that individuals generally expect wages to grow at a significantly lower rate than inflation. As shown in Table 4.4 there are some noticeable differences across demographic groups with women, individuals without a college degree and those earning less than $75,000 expecting wages to grow at a much slower rate than prices in general. The same is found when using expectations about the "rate of inflation" or "prices you pay" instead of "prices in general". When relating individual differences between expected wage and inflation growth to our indicators of cognitive ability and financial knowledge and responsibility, we find the differences to be negatively correlated with scores on our numeracy and financial literacy tests (i.e., those with higher numeracy and financial literacy scores expected wages to grow at a rate that, while still lower, is closer to that of prices in general). In fact, our heterogeneity analysis yields results that are consistent with our earlier findings indicating that while expectations of future wage growth are very similar across demographic groups and unrelated to measures of cognitive ability and knowledge, these same characteristics were significantly related to their inflation expectations.

In addition to comparing the respondent's year-ahead forecast of inflation with the year-ahead forecast of wage growth, we also directly asked the randomly chosen group of respondents who answered questions about wages of Americans in general [of themselves] to assess the probability that wages [their wage] will grow faster than the rate of inflation [prices they pay] over the next 12 months. The median probabilities reported at the bottom of Table 4.4 are consistent with our earlier findings that most individuals expect wages to grow at a slower rate. Moreover, while the associations are somewhat weaker than for the difference between an individual's wage and inflation expectation, we find reported probabilities to vary in very similar ways with demographic characteristics and with our measures of cognitive ability and financial knowledge, indicating that our measures have good construct validity. Finally, while the median probabilities that wages grow faster than inflation over the next five years are slightly larger than probabilities comparing growth in wages and prices over the next 12 months, (0.30 and 0.25 instead of 0.23 and 0.20), they remain relatively low suggesting that most respondents expect to see a deterioration in their real wage over the next five years.[61]

(4.1.3) Relationship between price and wage expectations

[61] The reported probabilities of own wages increasing faster than prices you pay over the next year (5 years) were strongly correlated with the difference between the own wage forecast and the forecast for prices you pay, with a correlation coefficient of 0.56 (0.53). The correlation coefficient between the reported probabilities that wages of Americans in general would increase faster than the rate of inflation over the next year (5 years) and the difference between the forecast for wages of Americans in general and the expected rate of inflation was 0.27 (0.32).

To analyze how individual forecasts of wage changes and price changes are related, Table 4.5 presents rank correlations between our three wage measures and expected changes in "prices in general", the "rate of inflation", changes in "prices you pay", and changes in the price of milk and gas. Interestingly, all correlations point to a weak *negative* relationship between wage and price inflation, suggesting that at least in the near future, consumers do not appear to foresee the beginning of a wage-price spiral. Those individuals with higher inflation expectations in fact expect smaller wage increases over the next year than individuals with lower inflation expectations; this is consistent with specific demographic groups (e.g., the less educated and lower income respondents) expecting lower wage growth – based on recent historical experience – while at the same time expressing higher than average inflation expectations, as we have seen in Section 1. Comparing across price measures, we find the correlation between expectations of wage changes and the "rate of inflation" to be closer to zero, while those for "prices in general" and "prices you pay" are both around -0.10 (though statistically insignificant). The strongest negative and statistically significant correlations were found between expectations of future changes in prices in general and of wages of Americans in general (-0.12), and between expectations of future changes in wages of Americans in general and of the price of gas (-0.16). Thus the cross-sectional evidence suggests that individuals do not currently consider the reasons for expected price increases (such as increases in the price of gas) to generate pressure on future wages. [62]

(4.1.4) Measuring uncertainty about future wage changes

In our special December module, we also included a probabilistic version of the questions asking for the expected wage change in the current job (for those working). As was done for the probabilistic version of the inflation questions, the interval probabilities were used to fit a generalized beta distribution for each individual respondent. We then computed the density's median (which we refer to as the individual's central forecast) and the density's IQR (which represents our measure of individual uncertainty). As shown in Table 4.6 the median across individual central forecasts (3.0) was similar to the median point forecast (2.8). However, disagreement as measured by the dispersion across individuals in the central forecast (3.8) was smaller than disagreement in point forecasts (4.6).

The median level of individual uncertainty about changes in wage earnings on the current job (2.0) is considerably lower than that found earlier for year-ahead changes in prices in general (2.8). In addition, while wage uncertainty was somewhat higher for males, the college educated, individuals with higher incomes and for individuals not between 40 and 59 years of age, none of the differences were statistically significant at the 5% level.

Point forecasts and central forecasts of wages are similarly correlated (correlation coefficient 0.77) as point forecasts and central forecasts of prices in general (0.73). The correlation between individual point forecasts of wage changes and uncertainty about

[62] It is worth pointing out that the different pattern found for wage forecasts suggests that the consistency between short- and long-term inflation expectations is not due to mechanistic scale use (ie. some people systematically using lower or higher numbers), because then the correlation with wage expectations should also have been positive.

future wage changes (correlation coefficient of 0.36) on the other hand was much smaller than that between point forecasts and uncertainty about future inflation (correlation coefficient of 0.55).

We also investigate whether central forecasts of and uncertainty about future wage changes are related to uncertainty about future changes in prices. As shown at the bottom of Table 4.6, while there is no significant relationship between central forecasts of wage changes and uncertainty about a variety of future price changes, there is a significant positive correlation between an individual's uncertainty about future wage changes and uncertainty about future price changes. This may reflect heterogeneity across individuals in information sets or in the way in which individuals process information. It could also reflect a perceived link between price and wage changes in the future.

(4.1.5) Measuring expectations about future wage changes over time

Much of what we learned about expectations regarding future wage changes was based on cross-sectional evidence. Unfortunately we currently do not have a long enough time series to thoroughly analyze the dynamic interrelationship between changes in wage forecasts and wage uncertainty over time. Since June our Fed-ALP panel includes a set of wage growth expectations questions, so in time we will be able to study their time trends as well. Table 4.7 shows some preliminary results indicating that while between June and September of 2008 the median central forecasts for changes in prices in general and in wages on the current job over the next year both declined, there was no change in the central forecast of changes in wages on the current job. However, during the same period there was a decline in disagreement across individuals in both their wage and inflation forecasts. While uncertainty about future price changes fell by 0.6 percentage points between June and September, there was a much smaller decrease of 0.2 percentage points in average individual uncertainty about future wage changes.

(4.1.6) Summary of main findings on wage expectations

(a) Respondents are willing and capable of expressing their expectations about future wage changes, both for themselves and about wages of Americans in general.

(b) Individuals expect prices to grow much faster than wages, with the median forecast of nominal wage growth in December 2007 as well as in June and July 2008 being around 3 percentage points. Nominal wage expectations vary little across most demographic groups. Female respondents, those with no college education and with lower incomes generally expect larger declines in their real wage rate.

(c) Expectations about wage growth for Americans are much lower than those for own wage growth.

(d) There is a negative cross-sectional relationship between individual wage and price expectations, particularly between expected changes in prices in general as well as the price of gas, with expectations of changes in wages of Americans in general.

(e) Individual uncertainty about future wage growth and price changes are positively correlated.

(f) In recent months, during which the median forecast of year-ahead inflation declined, there was no change in the median wage forecasts, but there was a significant drop in disagreement between forecasters and in uncertainty about future price and wage increases.

(g) An interesting topic for future research is to analyze how our findings might have been affected by the bins we chose to offer to our respondents.

(4.2) Expectations formation, persistence and dynamics

Relatively little is known about the way individuals form and update expectations about future inflation. As argued by Chairman Bernanke (2007), "a fuller understanding of the public's learning rules would improve the central bank's capacity to assess its own credibility, to evaluate the implications of its policy decisions and communications strategy, and perhaps to forecast inflation". The information collected from both the Fed-ALP panel (in which we track the same individuals over time) and the special May module enables us to examine several important questions regarding the updating and persistence of inflation expectations on the part of consumers.

As indicated earlier, the relationship between changes in short- and longer-run inflation expectations over time provides valuable information regarding whether inflation expectations are well-anchored. Are large changes in short-term point forecasts (and uncertainty) from one month to the next associated with large changes in the corresponding long-term measures, both in the same period and in subsequent months? In other words, what is the transmission (or propagation) mechanism between short and long term expectations? Analyzing the extent to which the public considers short-term changes in expected inflation as permanent or temporary is of direct importance.

The availability of panel data, consisting of a time series of responses from the same set of individual about their short- and long-term inflation expectations permits an analysis of persistence in inflation expectations (point forecasts as well as uncertainty) over time. At the individual level how much and how frequently do inflation expectations change over time? To what extent is the persistence due to individual time-invariant heterogeneity in beliefs? To what extent do overall changes in inflation expectations as measured by a change in the median reflect changes in expectations at the individual level? Do moves in inflation expectations at the aggregate level reflect changes in expectations of only a subset of individuals, or do they reflect changes in expectations that are more widespread?

In addition to exploiting the panel dimension of the data from the Fed-ALP panel, we set out to further our understanding of consumer perceptions of inflation persistence by included additional questions about past realized inflation and perceived inflation persistence. We also look at how individual respondents revise their expectations about future inflation following a hypothetical inflation surprise.

Finally, as a first step to improve our understanding of individual's information sets, we asked individuals to rank their main sources of information regarding inflation, such as television and radio, newspapers, internet, friends and family, financial advisors.

(4.2.1) A panel data analysis of inflation dynamics

The longitudinal feature of our Fed-ALP panel, where the same set of individuals are interviewed each survey wave, provides a rich source of information for analyzing dynamics in inflation expectations. Unlike repeated cross-sectional data, such as those provided by the Michigan Survey, panel data are less affected by changes in the composition of the sample across waves. Given the substantial heterogeneity we found in

inflation forecasts across demographic groups and other individual characteristics, even relatively small changes in the composition of a sample (which in the Michigan Survey includes 500 respondents) could in principle generate variation in the overall median and mean forecast over time. By tracking the same individuals over time, panel data can provide more accurate measures of changes in inflation expectations. Moreover, these data allow further analysis of how a given individual updates his or her expectation over time and provide further insight into the persistence in inflation expectations.

To analyze persistence in inflation expectations we estimated several simple AR(1) models. As indicated by the estimates for models 1 and 4 presented in Table 5.1, using data from our Fed-ALP panel, we find significant persistence in both individual point forecasts and uncertainty over time. As in each month we measure expectations of changes in prices over the next 12 months, much of the persistence is likely to capture the 11-month overlap in the 12-months forecasts reported in consecutive months. High persistence in inflation expectations may also indicate that when an individual changes his/her forecast, the change is relatively small and/or persistent over time. This may reflect a belief about the process determining actual inflation, and it could also capture aspects of the expectations formation process where new information becomes part of the individual's information set used to forecast inflation now and in the future. High persistence in inflation expectations could also reflect time-invariant individual heterogeneity, where some individuals consistently have lower or higher expectations than others, or are more or less uncertain than others about future inflation. Some individuals may be more pessimistic than others or may continuously rely on a different source of information about inflation than others.

When controlling for demographic variables (gender, education, income, marital status and age) in models 2 and 5, the estimated persistence drops somewhat but remains large. However, when we also control for unobserved time-invariant heterogeneity, the estimates for models 3 and 6 presented in Table 5.1 suggest that the main source of persistence in inflation expectations is individual time-invariant heterogeneity. In fact, after allowing for random effects in these models, the relationship between current and past inflation expectations becomes slightly negative, pointing to mean reversion, while there is no persistence in uncertainty.[63]

We also investigated the dynamic relationship between uncertainty about future inflation and updating behavior. More specifically, we analyzed whether expressed uncertainty in one wave was related to the absolute size of the revision to the forecast made in the subsequent wave. The corresponding specification in Table 5.1 is model 7. Interestingly, respondents who exhibit higher uncertainty in a given month also tend to have larger revisions in their point forecasts in the following month. This pattern is consistent with Bayesian learning where individuals with noisy priors, place more weight on new information. This finding, together with our previous results regarding the relationship between the levels of individual point forecasts and individual uncertainty, suggests that for forecasting inflation there may be gains to forecast accuracy by re-weighting the predictions of individuals, with the weight inversely related to the degree of uncertainty. However, for analyzing economic behavior and forecasting future economic outcomes such weighting would be less desirable as one would generally want

[63] As the panel currently remains somewhat short (covering slightly less than a year), it is possible that the unobserved time-invariant heterogeneity component picks up the overlap in 12-month forecast horizon.

to track both point forecasts and uncertainty. In future work we hope to explore gains to forecast accuracy further, by for example comparing the root mean square error of "certainty" weighted inflation forecasts with that of the unweighted forecasts. We also plan to analyze the extent to which individuals act on their reported inflation expectations, including their forecast uncertainty.

(4.2.2) Exploratory questions about perceived inflation dynamics

In our May special module, we included a set of questions to assess individual perceptions of variability and persistence in future changes in inflation. First, we added a follow-up question to the questions asking about changes in prices or the rate of inflation five to ten years from now, asking "When coming up with an answer to the question about "prices in general per year during the next 5 to 10 years" how consistent did you expect the change in prices to be?"[64]. Individuals were asked to rate the consistency on a scale that varied from 'About the same every year' (1) to 'Vary a lot from year to year' (7). As shown in Table 5.2 individuals considered future prices and inflation to be quite variable, with no statistically significant difference in perceived variability across the three measures of inflation.

We also fielded a set of questions aimed at measuring individual perceptions of the persistence in future changes in inflation by asking about the expected effect of an inflation surprise in a given year on their inflation expectations for the subsequent year. More specifically, after recording their year-ahead point forecast we first asked each respondent for their expectations about inflation two years from now, assuming that inflation next year turns out to be equal to the rate they had predicted for that year. The second question then asks for their expectations about inflation two years from now assuming that inflation next year ends up being 3% higher than they predicted.[65]

The difference between both answers reflects both the extent to which the individual perceives an increase in inflation to be persistent as well as the extent to which individuals update their expectations in response to new information. For example, in case the respondent is a Bayesian learner, the extent to which the individual would update their expectation depends on how much weight they place on their prior beliefs and on the new information. The latter could depend on how uncertain they are and on how variable they perceive yearly inflation to be.

The median difference in the responses to the pair of questions described above, which we will refer to as forecast revision, represents a slight decline of (-0.2) - (-0.3)

[64] We used similar wording for 'prices of the things you spend money on' while for the rate of inflation we asked how consistent they expected the rate of inflation to be.

[65] For both questions we used the same question format as Michigan's year-ahead inflation expectation question. More specifically, for the 'prices-in-general' version we first asked "Suppose that, like you predicted earlier, prices in general do indeed end up [*earlier response to year-ahead question*] during the next 12 months. Do you think that, during the 12 months after that, prices in general will go up, stay the same, or go down?". We then asked for a point forecast by asking "If prices in general do indeed end up [*earlier response to year-ahead question*] during the next 12 months, by about what percent do you expect prices to go up/down on the average, during the 12 months after that?". We then asked "Next suppose instead that prices in general actually do end up [*going up/going down*] by say 3% [*more/less*] than what you predicted, that is end up [*going up/down by X%*] during the next 12 months. Do you think that, during the 12 months after that, prices in general will go up, stay the same, or go down?" followed by "If prices in general actually do end up [*going up/down by X%*] during the next 12 months, by about what percent do you expect prices to go [*up/down*] on the average, during the 12 months after that?".

percentage points, depending on the specific wording of the expectation question (Table 5.2). Thus on average it appears that the overall effect of higher-than-expected inflation over the next 12 months on expectations about inflation in the subsequent year is very small. If anything, rather than increasing their two-years-ahead forecast they slightly reduce it.[66] This response pattern may suggest, among other possibilities, that respondents expect mean-reverting behavior in inflation.

As shown by the levels of disagreement and by the 25th and 75th percentiles of the revision distribution, however, there is considerable variation across respondents, with 25 percent of respondents revising their expectation down by at least 2.3% and with 25 percent revising their expectation up by 0.4 percent or more. Interestingly, as indicated by the figures in Table 5.2, revisions are positively related to perceived variability in the rate of inflation and in changes in the prices you pay, with those considering price changes and inflation to be reasonably constant across years making negative revisions to their 2-years-ahead forecast while those who consider inflation to be more variable over time more likely to revise upwards.[67]

Not only is there no statistically significant difference in the median size of the revision across the three inflation expectation questions, there also is no significant variation in the median revision across most demographic groups, except for a difference between men and women, with men reporting a larger decline in expectations following the increase (see Table 5.3). Similarly we found no significant correlation with most of our measures of cognitive ability and financial knowledge and responsibility, with the exception of the numeracy test score, with those scoring higher on the test also making a larger downward revision.

Respondents rated the questions about two-years-ahead inflation a little harder to answer than the single question asking about inflation 5 to 10 years from now, with the "rate of inflation" version again being considered to be somewhat more difficult than the "prices in general" question, which in turn was rated as more difficult than the "prices you pay" version. There was no statistically significant difference in clarity ratings across the three questions, with average rating being comparable to that for the long-term Michigan question. [68]

In addition to the quantitative questions regarding revisions to two-years-ahead expectations in response to higher than expected inflation over the next twelve months, we also asked respondents a more qualitative question regarding persistence of inflation shocks. More specifically, we asked the question: "If, in a given year, prices in general were to go up much more than you expected, would that change what you expect to happen in the year after that?" with corresponding questions for the two alternative inflation expectation questions. As shown in Table 5.4, the responses to the qualitative

[66] It is important to keep in mind that the responses found here may be specific to the size of the inflation surprise. Given the relatively high average level of uncertainty expressed about future inflation, respondents may have considered a surprise of 3 percentage points to be relatively small, and may have been more likely to revise after a larger surprise.

[67] Results not shown here also indicate revisions to be uncorrelated with year-ahead forecasts.

[68] The answers to the questions asking for expectations about the year after the next 12 months revealed some patterns that differed from those for year-ahead forecasts: they were not correlated with the demographic variables, they were no longer positively correlated with the expected impact on financial situation and with perceptions of how the forecasts compares to past realizations, and they were less clear and harder to answer. Therefore it appears the questions may have less construct validity.

questions reflect the heterogeneity across respondents found earlier for our quantitative questions, with 41% of respondents expecting that an increase one year will lead to increases in subsequent years, 32% expecting a lower rate of inflation the following year, and 27% reporting that they don't think that bigger increases in prices in one year would have any effect on what they expect to happen in the following year.

Thus respondents disagree about the likely persistence of an inflation shock, which is not inconsistent with our earlier finding of a small average revision close to zero. When relating individual's responses to the quantitative and qualitative questions, we find a median increase of 0.2 percentage points for those expecting a higher inflation rate in the year following an unexpected increase in inflation, a median downward revision of 1 percentage point for those who expect lower inflation following an positive inflation shock, and a median downward revision of 0.2 percentage points for those who do not think a higher rate of inflation in one year has any effect on what they expect to happen in the following year.

(4.2.3) Perceptions of past inflation

An analysis of past inflation perceptions and their relationship to current inflation expectations can help shed additional light on the formation and updating of inflation expectations on the part of consumers. In the special May module, we asked survey participants for their perceptions of inflation during the past year. Using the same format as that for the year-ahead inflation forecast described in Figure 1.1 (which corresponds to that used in the Michigan Survey), respondents were asked by what percent they thought prices in general went up or down, during the past 12 months.[69]

As reported in Table 5.5 for each of the three inflation measures the median reported for past-year inflation is considerably lower than the median year-ahead forecast, pointing to an overall expectation of higher inflation over the next year. Perceptions about the "rate of inflation" during the past 12 months are again significantly (at the 1% level) lower than those for changes in "prices in general" and in "prices you pay". In addition, even though disagreement about past inflation realizations, while less than that for year-ahead expectations, remains considerable for all three measures, there is less disagreement among respondents about past realizations in the "rate of inflation" question than in the two other measures.

Perceptions about past-year inflation also show the same differences across demographic groups as those found for year-ahead forecasts (see Table 5.6). While the differences are on average a little smaller and not always statistically significant, we find that median assessments of past inflation were lower for men, college educated individuals, and those with incomes over $75,000. Generally the variability of perceptions of past-year inflation across demographic groups is comparable to that for year-ahead inflation. In contrast, when relating perceptions of past-year inflation to our measures of cognitive ability and financial knowledge and responsibility in Table 5.7 we find none of the relationships that were statistically significant for year-ahead forecasts to be so for perceived past-year inflation.

[69] Those answering the 'prices-you-pay' and 'rate-of-inflation' versions asked corresponding questions. For example, the latter were asked what they thought the rate of inflation/deflation was over the past 12 months.

With regard to the clarity and difficulty of the questions asking about past-year inflation, because in the May special survey we did not ask individuals to rate the questions asking about price changes or inflation during the next 12 months, we were unable to compare the difficulty and clarity of the past-year and year-ahead inflation questions.

However, we are able to compare the past-year and long-term inflation questions. Relative to the long-term question, respondents rated the question about past-year inflation to be slightly less difficult and somewhat clearer. Individuals also rated past-year inflation as less high compared to the past 10 years than they rated their long-term forecasts. Respondents again rated the "rate of inflation" version of the question about past-year inflation to be somewhat harder than the "prices in general" wording which in turn was rated as a little harder that the "prices you pay" version. There was no statistically significant difference in the clarity of the three question versions.

When asking respondents what they thought the question was asking for the most, the answers were comparable to those for the long-term inflation question. Compared to those who answered the "prices in general" version, those who answered the question about the "rate of inflation" more frequently said that they thought the question asked about prices of things Americans in general usually spend money on or about the U.S. inflation rate. Those who answered the "prices you pay" version instead more often said that the question was asking about the prices of the things they themselves usually spend money on. Therefore, the "prices in general" wording again tended to elicit more mixed interpretations than the "rate of inflation" one.

A similar pattern appeared in the ratings of how much they thought of various topics, with those answering the "rate of inflation" ("prices you pay") question thinking more (less) of prices paid by Americans in general or the inflation rate and less (more) about the prices of the things they buy themselves compared to those answering the "prices in general" version. As before, we found these ratings and interpretations to be correlated with their reported past-year inflation figures in the same way as was found for year-ahead and long-term inflation forecasts. Those who think the question is asking mostly about the rate of inflation or about prices that Americans in general pay, generally report a lower median of past-year inflation, irrespective of which question version they answered.

(4.2.4) Relationship between perceptions of past inflation and inflation expectations

In Table 5.8 we relate individual year-ahead inflation forecasts to individual perceptions of past-year inflation. For all three inflation measures, there is a strong positive correlation between past-year realizations and year-ahead expectations, with rank correlation coefficients varying between 0.57 and 0.64. Note that these are stronger than the rank correlation between year-ahead and long-term forecasts presented in sections 3, which varied between 0.40 and 0.53. Correlations between past-year realizations and long-term expectations (also reported in Table 5.8) are weaker still, varying between 0.38 and 0.46. [70]

While individuals on average appear to expect an increase in inflation over the next 12 month compared to the past 12 months, it is unclear whether and to what extent

[70] This finding is consistent with a stronger correlation between consecutive actual inflation realizations than between inflation realizations multiple years apart.

this may be related to a higher than expected inflation realization during the past year. To explore this issue we asked individuals whether the past-year inflation they reported was higher/the same/or lower than what they had expected for this period 12 months ago.[71] As shown in Table 5.8 a majority of respondents of each question reported inflation to be higher than they had previously expected, with those answering the "prices in general" and especially the "prices you pay" questions significantly more likely to have underestimated inflation during the past year than individuals who answered the "rate of inflation" version.

As shown in Table 5.8 how people rated inflation during the past year relative to what they had expected is strongly related to their reported expectation, with those reporting higher (lower) inflation during the past year being more likely to report that inflation was higher than they had expected. A higher than expected inflation realization during the past year is also positively related to year-ahead forecasts (though not significantly so for the "prices you pay" version). Furthermore, the individual's rating of past inflation relative to what had been expected is positively related to the amount by which the year-ahead forecasts differs from perceived inflation during the past year.

(4.2.5) Sources of information about inflation

Finally, as a first step to improve our understanding of individual's information sets, we asked individuals to identify their sources of information regarding inflation. More specifically we asked them to indicate where they had heard about the U.S. inflation rate: eliciting yes/no answers for each option including television and radio, newspapers, internet, friends and family, financial advisors. As shown in Table 5.9, almost all individuals (92%) reported that they had heard about the rate of inflation through television and radio broadcasts. A majority of respondents also listed newspapers and magazines (78%) and the internet (57%) as information source. Among inter-personal relations, about 58% of respondents indicated that they had heard about the rate of inflation from family and friends, 35% from co-workers and 23% from financial advisors. In future research we plan to investigate the channels of information, and the nature of individuals' information related to inflation in more detail.

(4.2.6) Summary of main findings

1. Longitudinal data analysis points to considerable persistence in inflation expectations, much of which appears to be due to time-invariant heterogeneity across individuals. Respondents who express higher uncertainty about year-ahead changes in 'prices in general' or about year-ahead inflation make larger absolute revisions in their forecasts between survey rounds.
2. Responses to a set of questions about the expected effect of an inflation surprise in a given year on their inflation expectations for the subsequent year indicate that on average individuals do not substantially revise their inflation forecast. There is however considerable heterogeneity in responses to inflation surprises across respondents with 41% of respondents expecting higher inflation in the following year, 32% expecting lower inflation and 27% reporting that they did not think that

[71] More specifically, individuals were asked the question "Was past inflation higher/same/lower than what you had expected for this period 12 months ago?".

higher inflation or bigger increases in prices in one year had any effect on what they expected to happen in the following year. Thus respondents disagree about the likely persistence of an inflation shock. Those who expect some persistence in the shock, only make modest upward revisions for the year following the shock (a median increase of 0.2 percentage points), while those who expect a subsequent decline in inflation relative to what they would have expected without the surprise, make a larger downward revision of subsequent inflation (median decline of 1 percentage point). While intriguing, it is possible that the questions may have been difficult to understand. In addition, the results found here may be dependent on the size of the surprise, which in our case may have been seen as relatively small (even if it is large to economists). In follow-up research, we aim to examine how people shape perceptions and expectations of persistence and shocks.

3. Perceptions of past inflation show similar heterogeneity patterns as well as differences across inflation measures as we found for year-ahead and long-term inflation expectations. Males, college educated responses and those with higher incomes report lower perceptions of past-year inflation. Median reported past-year inflation rates were lower when asking about the “rate of inflation” than when asking about “prices in general” or about the “prices you pay”. As is the case for year-ahead and longer-term expectations, those answering the “rate of inflation” (“prices you pay”) question think more (less) of prices paid by Americans in general or the inflation rate and less (more) about the prices of the things they buy themselves compared to those answering the “prices in general” version.
4. A majority of respondents report past-year inflation to be higher than what they had previously expected for that period. Their median year-ahead inflation expectation in turn exceeds their perceptions of past inflation. A longer panel of observations on the same set of individuals in which we record past inflation experiences and expectations will provide further insight into these findings and into the formation and updating of expectations more generally. This is a key objective for follow-up research.

5. Brief review of literature on survey-based measures of inflation expectations.

The idea that expectations of inflation are crucial in linking the nominal values to real decisions can be traced to the seminar work of Fisher (1896), though he references an even earlier discussion of the topic that pre-dates his work by nearly a century. Indeed, the importance of price expectations in decision-making is among the oldest propositions in economics.[72] Inflation expectations were a cornerstone of early theories of macroeconomic dynamics, notably the work of Keynes (1936), and they have been an active part of the monetary policy debate at least since Friedman's presidential address to the American Economic Association (1968). In this work, Friedman makes obvious the crucial role inflation expectations play in the monetary authority's ability to influence real economic activity. Today, economists assume almost without debate that the public's expectation of inflation is a key variable in the propagation of the business cycle, and indeed, the inflation process itself, and for these reasons it has become an essential object of control by central banks.

Unfortunately, expectations of inflation are not directly observed, and empirical work has fallen well behind the theoretical interest in the subject. In many, if not most cases, research infers the public's inflation expectation as statistical artifacts of observed price data, commonly distributed lags of some price aggregate. This work imposes on inflation expectations a process that may not accurately reflect the true nature of inflation expectations formation.[73]

Alternative measures of inflation expectation include the forecasts of professional economists, although the correspondence between these predictions and those of the decision-making public more generally, is unknown.[74] The measurement of inflation expectations has recently benefited from new financial instruments from which investor expectations can be estimated, most commonly the spread between TIPS and ordinary treasury yields. These measures are handicapped by their relatively recent introduction—TIPS markets have only been active since 1997—and complications in separating the inflation expectations component of the data from the securities related inflation risk premium and liquidity differential.[75]

Relatively more direct measures of the public's inflation expectations are those derived from household survey data, such as the monthly Reuters/University of Michigan Survey of Consumers produced by the Survey Research Center at the University of

[72] For a discussion of this very early research, see Dimand (1999).

[73] Under some extreme conditions, such as inflation as a random walk, adaptively formed expectations can be consistent with rational decision-making (see Muth, 1960). More generally, however, adaptively formed expectations would seem to violate rational behavior. Evidence against the reasonableness of adaptively formed expectations, however, has recently been challenged in both theory and evidence. See, for example, Evans and Ramey (1998).

[74] There is a large literature that compares the accuracy of household inflation predictions with those derived from financial markets and economic forecasts. While this work appears inconclusive, a reasonable interpretation of the available evidence is that there exist significant, and as yet unexplained differences between households' and economists' expectations of future price change. An early reference in this line is Carlson (1977). More recent investigations include Thomas and Grant (2008) and Mehra (2002).

[75] A recent contribution to this literature is Wei et al (2005).

Michigan.[76] These measures have the advantage of a relatively long history—the survey of household inflation expectations has been available monthly since 1978 and quarterly since 1948. Many studies have investigated the accuracy of these survey data relative to some aggregate inflation measure, usually the Consumer Price Index. While the errors of these measures have tended to be large, on average, the evidence that they are larger than other predictions of inflation has been mixed. Mehra (2002), among others shows that the data from the Survey of Consumers has been a more accurate predictor of inflation than a "naïve" forecast that assumes inflation is a random walk. However, tests of unbiasedness were mixed, with the survey's median measure yielding an unbiased estimate of 12-month CPI changes, but biased for the survey's mean value.[77] Others have tested the unbiasedness of these survey data (also called "weak form tests of rationality") with varying degrees of success. Extending earlier work by Gramlich (1983) who found the survey data failed to pass weak-form rationality tests, Bryan and Gavin (1986) and Batchelor and Dua (1989), use a different estimation procedure and find these measures to be unbiased predictors of inflation.

Studies that have subjected household survey data to "strong-form" tests of rationality—that is, prediction errors in the survey data are uncorrelated with information available at the time of the forecast—have tended to be more widely rejected. Batchelor and Dua (1989) find that the survey data fail to exploit information useful to the prediction of inflation, as does Thomas (1999), though Mehra (2002) cautions that similar tests using real-time data tend to support the rationality of household forecasts.

A parallel line of research exists that investigate the empirical properties of foreign household inflation expectations, with generally similar (in)conclusion. A good example is Bakshi and Yates (1998) who consider two quantitative surveys of UK households and find the responses are biased. Berk (2002), examining qualitative consumer inflation surveys from a set of European Union nations, concludes that the majority are unbiased, though they may fail the strong-form test of rationality.

All of the work thus far cited considers the public's inflation expectations as a common aggregate. However, the assumption of a "representative agent" does not fit the data. A wide disagreement in inflation expectations across households is well documented.[78] The heterogeneity of expectations across agents is both intriguing and potentially important for the establishment of optimal monetary policy rules. Akerlof, Dickens, and Perry (2000) show that in an environment where a subset of economic agents form inflation expectations that ignore inflation, the long-run Phillips curve may not be perfectly vertical as rational expectations would suggest. Mankiw and Reis (2002) have introduced a "sticky-information" model where agents face costs of acquiring information and re-optimize at different points in time. In this model, the central bank faces potentially large costs to disinflate, even when agents form their expectations in otherwise rational ways. There are also a host of related "learning models" where agents face different costs and benefits from updating their expectations and the distribution of

[76] A description of these measures can be found in Curtin (1996).
[77] Preference for the median of the survey responses is suggested by Curtin (1996) who suggests the median measure is a more reliable indicator as a result of its smaller monthly variance. Others, like Thomas (1999), have shown that the median measure fares better than the mean survey measure in tests of unbiasedness. However, as evidence by Bryan and Venkatu (2001a), the median survey response represents a systematic exclusion from the data of a nonrandom subset of the U.S. population.
[78] For example, see Mankiw et al (2003).

these agents across the economy can have important implications for the efficient conduct of economic policy.

Despite the great need to understand the nature of the disagreement in inflation predictions, and household predictions in particular, little is actually known about how the public forms their inflation forecasts.[79] Indeed, there is some suggestion that there is rather wide disagreement across the general public regarding exactly what, inflation is.[80]

In our ongoing project, we hope to help fill that void. We wish to re-examine the measurement of household expectations of inflation in surveys and, in the process, learn more not only about what, exactly, the public perceives inflation to be, but perhaps even more importantly, how they form that perception and how they make predictions about the future.

[79] One noteworthy exception is Jonung (1984) who using survey data on Swedish households to document different underlying "models" of inflation expectation formation across different demographic groups.

[80] Using survey data of his own construction, Shiller (1996) shows that while people have strong opinions about "inflation", their opinions vary by generation and nationality, and, perhaps most interesting from the perspective of measurement, there is a general disconnect between consumers and economists on precisely what, inflation is.

6. Project background

(6.1) Background to Household Inflation Expectations Project (HIEP)

(6.1.1) Importance and use of inflation expectations

Inflation expectations play an important role in economic decision making. Investors use information on market inflation expectations to make informed investment decisions, while business firms incorporate this information in making capital investment, purchase and pricing decisions and in determining how much to borrow to meet liquidity needs. To consumers expectations of high inflation imply that goods will cost more tomorrow, which may lead them to buy and hoard them today. This consumer response in turn can cause prices to rise even faster. Inflation expectations are important to workers and firms in setting current wages and prices. Wage contracts typically are not continuously renegotiated, and workers and firms may therefore want to factor in expectations about future inflation. Finally, borrowing and lending behavior may be affected by inflation expectations, since inflation impacts creditors and debtors differently.

Given its importance for forecasting future economic activity, considerable attention has been devoted to the measurement of inflation expectations among consumers and entrepreneurs. These expectations in turn are influenced by media reports on current inflation and inflation predictions provided by professional forecasters. Data on inflation expectations are also of prime importance to policymakers in conducting monetary and fiscal policy and in assessing their effectiveness in controlling for long-term inflation. For example, these data are of key importance for evaluating the impact of a perceived change in the Federal Reserve's commitment to price stability on long-term market inflation expectations. Finally, data on the inflation expectations of economic agents are of great importance in economic research.

Despite the importance of expectations in economic models with forward looking behavior, little is known about how individuals form expectations, on how they acquire and process information. The standard practice, often referred to as 'revealed preference analysis', has been to infer expectations from data on observed choices. Such analyses usually combine modeling assumptions about the stochastic processes of uncertain future events and about the content of each individual's information set with the assumption that the individual's expectations are rational (efficient use of all information, and the individual knows the objective probability distribution of future events). Since the early 1990s there has been an increase in the direct use of data on future expectations in order to relax or validate commonly imposed modeling assumptions. Our research is motivated by a belief that a better understanding of how persons revise their expectations with receipt of new information is a prerequisite for credible use of econometric decision models to predict behavior.

(6.1.2) Measuring inflation expectations

In order to measure inflation expectations, economists have resorted to several different data sources. A common approach has been to forecast future inflation based on time series models estimated with data on past inflation realizations as well as regression models motivated by the Philips curve and estimated using real activity measures.

Another approach has been to infer expectations about future inflation from data on the term structure of interest rates. This approach has been criticized for providing a wide range of estimates and relying heavily on many explicit and implicit assumptions, making the results difficult to interpret. Another approach has been to measure inflation expectations by the difference in yields between conventional Treasuries and Treasury Inflation Protected Securities (TIPS). The idea behind the approach is that to a risk neutral investor only the expected real yield matters, so the yield spread reflecting investment decisions of a large number of investment would provide an accurate measure of the average expected inflation. There are two major criticisms of this approach. First, if investors are risk averse, the yield difference will include an inflation risk premium to compensate investors for taking on the risk of uncertain inflation. Second, the yield spread will include a liquidity premium, which compensates investors for the fact that TIPS are less liquid implying a risk of incurring large costs buying or selling the asset in a secondary market. Recent evidence points to the importance of both risk premiums, where the magnitude of the latter is expected to fall as the market for TIPS is becoming more liquid [Shen and Corning, 2001].

A fourth major source of data on inflation expectations are surveys in which individuals are directly asked about their subjective expectations of inflation. These include the Livingston Survey and the Survey of Professional Forecasters (SPF), both managed by the FRB-Philadelphia, and the Michigan Survey of Consumers. The Livingston Survey semi-annually elicits forecasts about a set of macroeconomic variables including inflation from 30 to 40 economists in industry, government, banking and academia The SPF conducts quarterly interviews with 30 to 50 private forecasters in the business sector to obtain their short and longer-run forecasts of inflation and other macro-economic variables. The Michigan Survey of Consumers is a monthly survey of approximately 500 households representing a cross-section of the population on their expectations over the next year. Compared to data used in deriving the other measures discussed above, survey information is less frequently updated and covers a relatively small portion of the population. Nevertheless, a recent study by Ang, Bekaert and Wei (NBER 11538, 2005) found survey forecasts to outperform methods of forecasting inflation based on macro variables and asset prices. This result is consistent with that of an earlier comparison study by Hafer and Hein (1985). Whether one considers these findings credible or not, the value of survey expectations on inflation is predicting future economic activity is well recognized and demonstrated by the importance and attention devoted to new data releases.

Similar surveys of consumers, businesses and professional forecasters have been conducted in many other countries including most members of the European Union, Australia and South Africa. Compared to the US surveys, the majority of these surveys have traditionally focused on the collection of qualitative (up/down/no change) rather than quantitative data on expectations, where respondents are asked only about the direction of an expected price change and not its magnitude as done in many US surveys. Analysis of such information usually requires a translation of the qualitative responses into quantitative measures using one of a number of possible quantification methods (Nardo, 2003). The resulting measurement errors, and the sensitivity of quantitative inflation measures to the particular quantification method chosen limit their usefulness and help explain the finding that direct quantitative inflation expectation surveys

typically perform better than qualitative surveys (Shields and Lee, 2004; Laubscher and Schombee 1999)

In recent years there has been a sharp increase in the collection and analysis of inflation expectations survey data, and in efforts to improve their informational content, including a shift from more qualitative to quantitative survey measures of inflation expectations. This includes the Inflation Psychology Survey conducted by FRB Cleveland in association with Ohio State University, the 2002 revisions to the Consumer Survey of the European Union, and the introduction in 2001 of a new survey conducted by the Bank of England. Between 1998 and 2001, the FRBC/OSU Inflation Psychology Survey collected information on household inflation perceptions and expectations using a monthly survey of approximately 500 Ohioans. Respondents were asked for their perceptions of price changes over the past 12 months as well as their expectations for price changes over the next 12 months, and were also queried about their perceptions of past price changes of different commodity groups and the respondents' familiarity with the CPI.

The European Commission's Consumer Survey (started in 1985) currently asks approximately 50,000 people in the Eurozone about their expectations regarding developments in the consumer price level over the following year. It is a monthly survey with at least 1,500 individuals queried in each of the member states. The revisions to the EC Consumer Survey included the addition of questions in 2003 aimed at obtaining point estimates of the perception of past and expectation of future inflation. Since 2001, the quarterly Inflation Attitudes Survey conducted by the Bank of England includes nine questions seeking information on public knowledge, understanding and attitudes towards the Monetary Policy Committee (MPC) process as well as expectations of interest rates and inflation and also look to measure satisfaction/dissatisfaction with the way the Bank of England is 'doing its job'.

(6.1.3) What have we learned from survey data on inflation expectations?

In addition to proving its value in forecasting future economic activity, a large and growing literature analyzing self-reported inflation expectations of consumers, businesses and professional forecasters has produced several important empirical findings. These relate to (a) the existence of substantial **heterogeneity** in forecasts across respondents and variation in the dispersion over time with the level of actual inflation and with the business cycle, and (b) the considerable **uncertainty** expressed by respondents in forecasting inflation and the heterogeneity therein across forecasters.

Based on the idea that economic agents possess the same information regarding the stochastic processes determining inflation, conventional rational expectations models typically assume that agents share a common information set and form expectations conditional on that information producing identical inflation forecasts. Survey evidence instead has shown that there is considerable **heterogeneity** in self-reported forecasts across respondents, which has helped spur an active area of research. Rich and Tracy (2008) using data from the SPF document a strong positive association between disagreement and the average (aggregate) expected inflation level, suggesting that heterogeneity may be a key to macroeconomic dynamics.

One branch of this literature attributes the heterogeneity in forecasts to differences across individuals in the information they possess in forming forecasts. This includes the

demand shock model of Cukierman and Wachter (1979) and the 'sticky-infomation' models of Carroll (2003), Mankiw and Reis (2002, 2006) and Mankiw, Reis and Wolfers (2003). In the model proposed by Cukierman and Wachter people operate in different markets and the flow of information among markets is not instantaneous. Although agents have full information about the current price in their own market, their information about prices in other markets and therefore about the general price level is incomplete (for example due to delays between data collection and reporting in media). The resulting inability to distinguish immediately between aggregate and specific causes for movements in the price in their own market produces heterogeneity across markets in their views about the general level of prices. This model suggest that both differences in expectations about the future rate of inflation and most of the changes over time in the variance of inflation are driven by the variance of aggregate demand shocks.

In sticky-information models economic agents update their expectations only periodically because of costs of collecting and processing information. With only a fraction of individuals upgrading their information in each period, these models are able to account for heterogeneity in forecasts and also imply time series patterns that are consistent with those in the data including auto-correlated forecast errors and insufficient sensitivity to recent macroeconomic news. Extensions of the sticky-information model let the distribution of information across agents vary over time by allowing agents to endogenously determine the frequency at which they update their information using a homogenous forecasting model (usually assumed to be a VAR specification with time-varying coefficients) (Branch 2004).

An alternative approach proposed by Branch (2005) assumes that instead of differences in information sets, heterogeneity in individual expectations reflects uncertainty about the underlying Macroeconomic model for inflation. In this Model Uncertainty Approach, people switch between forecasting models (VAR, Adaptive Expectations predictor equal to weighted average of lagged realizations, Naive predictor equal to lagged inflation rate), with the proportions across these different predictors changing over time. A time-varying distribution of survey responses will arise as the forecast models change and the distribution of agents across these models varies over time. Branch finds this model provides a better fit to the survey expectations data than the sticky information models and implies greater persistence in the response to monetary shocks.

Yet another strand in this literature has focused on the correct interpretation of the reported forecast and the particular wording of the survey question. As pointed out by Engelberg, Manski and Williams (2006), forecasters in the Survey of Professional forecasters appear to summarize the underlying subjective probability distributions of future inflation in different ways. Comparing point forecasts with self-reported distributions of future inflation, many point predictions are found to be consistent with the mean, median or mode, while others are not. For those whose point forecasts do not appear consistent, they find them on average to be favorable relative to the central tendency of the underlying distributions. They also find considerable persistence over time in individual reporting practices.

Another interesting perspective on the correct interpretation of the individual's forecast was provided by Capistran and Timmermann (2005). They suggest that instead of reporting the mean of their subjective distribution of future inflation realizations,

individuals provide optimal forecasts which they use in their own decision making, obtained by minimizing an expected loss function. Only under a mean squared error loss function, would forecasters then report the mean of their subjective distribution and this estimate will be unbiased and forecast errors serially uncorrelated. However, under a more general loss function this need not be the case. In case of an asymmetric loss function and heterogeneity across agents in their degree of loss asymmetry, the model generates cross-sectional variation as well other time-patterns observed in the survey data on inflation expectations. Thus even with identical information and identical beliefs about the distribution of future inflation, optimal forecasts will differ as long as they have different degrees of loss asymmetry. Capistran and Timmermann suggest that respondents should be seen as end users of the information on future inflation, where for example borrowers and lenders (and more generally those with different exposures to inflation risk) will be asymmetrically affected by the over- and under-prediction of inflation. An important implication of these studies is that cross-sectional dispersion cannot directly be interpreted as reflecting disagreement in beliefs.

While the evidence on this remains limited, some findings point to the importance of the specific wording of the questions used for soliciting inflation expectations. When consumers are asked about expected changes in 'prices in general' they may draw more from their own experience in purchasing or selling goods, in which case the expected price change reported will reflect particular consumption bundles, shopping behavior or product market in which consumers or firms operate. Various studies have found evidence that expectations of future inflation and perceptions of current inflation vary considerably by demographic groups, with those of women and low-income households generally exceeding those of men and those of higher income households and with similar differences existing by age, education, race and marital status (Bryan and Venkatu 2001a,2001b; Souleles 2004). At least some of these differences in price perceptions and expectations may be related to differential shopping behavior (frequency and type of goods bought) and differences in the consumption basket across groups.

Evidence from the FRBC/OSU Inflation Psychology Survey revealed considerable differences in perceptions of past price changes across different commodity groups. Survey participants were also asked about their familiarity with the CPI and for those who said they were, were asked about their perception of the recent change in the consumer price index which were found to line up well with the actually realized rate of change in the CPI. They were also asked to report their perceptions of 'prices in general', and their responses were found to be very different suggesting that the way individuals aggregate prices differs from that measured by the CPI (Bryan and Venkatu (2001b). Differences across individuals in perceptions and expectations may in part reflect heterogeneity in the respondent's familiarity with the CPI, or consumers may apply different weights to different goods and may not apply the same quality adjustment as done in the CPI.

Linden (2005) argues that given that acquiring accurate information is costly, it becomes likely that most respondents would not have up to date information on the CPI, explaining why inflation perceptions of consumers are not directly related to the CPI. To investigate this further he considers a subsample of consumers in the EC Survey of Consumers who have a greater incentive to learn about the CPI, those who expect it likely to purchase a car or home in the near future, which may involve taking out loans

and a rebalancing of portfolio. He finds that perceived and expected inflation rates correspond more closely to the official rate of inflation for this group, while for the remainder of the total sample they generally exceed actual inflation rates.

Surveys asking individuals for point predictions can at most convey some notion of the central tendency of their beliefs, and nothing about the **uncertainty** they feel when predicting outcomes. An important recent development in the empirical research on expectations has been the increase in efforts by economists to measure this uncertainty through the elicitation of probabilistic expectations of events and outcomes (see Manski 2004). More specifically, while probabilistic questions have been part of the Survey of Profession Forecasters since 1968, since the early 1990s a number of large-scale surveys have begun to use probabilistic formats to elicit expectations, in order to capture each individual's subjective probability distribution. These include the Health and Retirement Survey (Juster and Suzman 1995, Hurd and McGarry 1995), the Bank of Italy's Survey of Household Income and Wealth (Guiso, Jappelli and Terlizzese 1992, Guiso, Jappelli and Pistaferri 2002), the Survey of Economic Expectations (Dominitz and Manski 1997a, 1997b), the Dutch VSB Panel Survey (Das and Donkers, 1999), and the 1997 cohort of the NLSY (Fischhoff et al 2000, Dominitz, Manski and Fischhoff 2001, Walker 2001).

During the June 2002-May 2003 period the Michigan Survey of Consumers included a series of 'percent chance' questions to elicit subjective probabilities of micro and macro events (Dominitz and Manski, 2004, 2005). The empirical evidence shows that survey respondents from a variety of populations are willing and able to report expectations in probabilistic form for a diverse set of future events and over different time horizons. This coincides, and may reflect a greater exposure to probabilistic formats in the media. Most studies find that individuals are as willing to respond to probabilistic questions as they are to traditional attitudinal questions on same subject. Moreover, respondents are generally found to give internally consistent, sensible responses which possess face validity when the questions concern well-defined events that are relevant to respondents' lives. As probability provides a well-defined absolute numerical scale for responses, there is also good reason to expect responses to be interpersonally comparable.

There are two important advantages over point forecasts from eliciting information characterizing an individuals' subjective probability distribution. First, it removes a potential source of ambiguity over which (if any) measure of central tendency an individual's point forecast corresponds to (see Engelberg et al 2006). The extent of disagreement among forecasters could then be measured using a common measure, such as the mean (or median) of the subjective probability distribution. Second, and perhaps most importantly, it provides a measure of uncertainty each forecaster has about future outcomes. To date the experience with probabilistic questions about future inflation has been limited to the SPF, the Bank of Italy Survey and a recently added module to the Empire State Survey at the Federal Reserve Bank of New York. These surveys reveal that not only do forecasters have different average expectations, they differ considerably in their extent of forecast uncertainty.

(6.2) Survey Design

The survey modules were designed in collaboration with Olivier Armantier and Rob Rich (NYFed), academic consultants (Charles Manski, Kenneth Wolpin, Eric Johnson), a team from RAND's Roybal Center for Financial Decision Making led by Jeff Dominitz and Arie Kapteyn, and a team of behavioral psychologists from Carnegie Mellon including Baruch Fischhoff and Julie Downs. We also benefited from valuable discussions with Arthur Kennickell, Andrew Levin and Athanasios Orphanides from the Board of Governors. Each module was pilot tested on small samples by the CMU team.

(6.2.1) Construction of the Fed-ALP panel

The American Life Panel (ALP) is an internet panel conducted by the RAND Corporation. Respondents in the panel either use their own computer to log on to the Internet or use a Web TV which allows them to access the Internet, using their television and a telephone line. The technology allows respondents who did not have previous Internet access to participate in the panel and furthermore use the Web TVs for browsing the Internet or use email. About once a month, respondents receive an email with a request to visit the ALP URL and fill out questionnaires on the Internet. Typically an interview will not take more than 30 minutes. Respondents are paid an incentive of about $20 per thirty minutes of interviewing (and proportionately less if an interview is shorter).

The respondents in the ALP are recruited each month from among individuals who are respondents to the Michigan Survey of Consumers of the University of Michigan's Survey Research Center (SRC). Each month, the Michigan Survey interviews approximately 500 households by telephone, of which 300 households are a random-digit-dial sample and 200 are re-interviewed from the random-digit-dial sample surveyed six months previously. During the first interview respondents are asked by the SRC if they have internet access and, if yes, whether they would be willing to participate in internet surveys. Those who agree and give consent to the transfer of their information and contract details with RAND are then later contacted by RAND to ask if they would be willing to actually participate in an Internet survey.

When the ALP was initially set up in 2002, the sample only included Michigan Survey respondents aged 40 and over. We call this sample the 'old' sample. In 2007 the sample was expanded to include respondents under age 40. The sample of respondents who entered after the elimination of the age restriction is called the 'new sample'. While at first respondents were only interviewed every six months or so, in more recent years they are interviewed on an almost monthly basis.

Our survey plans called for the fielding of a short module of questions to a subsample of respondents approximately every six weeks or so. This sample, which we call the Fed-ALP panel only included respondents from the ALP 'old sample' (and thus were all 40 years of age or older). The sample consists of approximately 400 respondents, of which slightly more than 200 have participated in each of our six-weekly surveys. One of the purposes of this smaller module was to track inflation expectations over time. In addition to the Fed-ALP panel we fielded two large modules containing numerous psychometric questions, the first in December 2007, the second in May 2007. We administered both modules to a sample of respondents from the ALP 'new sample', who

were aged 18 or older. In this paper we refer to both surveys as the December and May special modules.

(6.2.2) The December special module

The purpose of this module is to examine the psychometric properties of questions asking about expectations for general prices (a) prices in general, (b) the rate of inflation, (c) the prices of things you usually spend money on, (d) gas prices, and (e) milk prices. We examine respondents' (a) voluntary use of ranges and their effect on reported expectations; (b) interpretation of the response that prices will stay the same, if they gave that response, and the effect of asking what they meant; (c) tendency to change expectations over 5% when given the opportunity to do so; (d) ratings of each question's clarity, (e) interpretations of each question following from those given by interviewees in an earlier phase of this project, and the relationship of these interpretations to reported expectations, (f) economic perceptions and their relationship to reported expectations, and (g) measures of cognitive ability and demographic variables that have traditionally been related to expectations, and their relationship to reported expectations.

To date, a total of 609 respondents have completed this module between December 22nd, 2007 and May 22nd, 2008. Of those, 98.0% were US citizens, 54.8% were female, and 65.7% married or living with a partner. Their highest level of education completed was no high school diploma (1.5%), high school or GED equivalent (37.9%), associates degree (11.8%), Bachelors degree (28.2%), and advanced degree (20.5%). Respondents self-identified as white (87.7%), African-American (6.2%), American Indian or Alaskan native (.7%), Asian or Pacific Islander (3.3%) or other (2.1%). Median reported income was in the category of $60-$75k (with categories ranging from "less than $5k" to "$75k or more").

The module included the Michigan question about the 'change in prices in general over the next 12 months' using the format that was characterized in Figure 1.1. and described in section 1. The module also included two alternative version of the question: One asking about the 'rate of inflation', the other asking about 'Prices of the things you usually spend money on'. The latter used the exact same format as that for 'prices in general', but with 'prices in general" replaced with "the prices of things you usually spend money on." The question asking about the rate of inflation first asked "What do you think the rate of inflation will be over the next 12 months? Below, please give your best guess OR your best guess for a range," while using the same presentation format as the question about prices in general. Respondents who only filled out the lower bound or the higher bound of the range were prompted to fill out both. Those who gave a range were also asked to give a best guess. Responses over 5% were followed with "Let me make sure I have that correct. You said that you expect the rate of inflation to be [x]% over the next 12 months. Is that correct?" A "yes" response was followed by a request for a new best guess.

Questions about expectations for specific prices focused on gas and milk followed the structure of the question about prices in general, except that respondents who expected prices to stay the same were not asked to explain whether they meant that the price would go up at the same rate or stay the same.

For each expectations question, respondents rated how clear the question was, in terms of what it was asking about, on a scale from 1 (very unclear) to 7 (=very clear).

Respondents also rated how hard it was to come up with an answer to the question, on a scale from 1 (=very easy) to 7 (=very hard). These ratings were reverse- coded such that higher ratings reflected perceptions of the question being easier to answer.

In addition, for each expectations question, respondents rated how much they thought of the following topics when answering the specific inflation expectation question (1=not at all, 7=very much): (a) the prices of things you usually spend money on, (b) the prices of things that Americans usually spend money on, (c) annual raise in salary, (c) the price of one or more specific things, (d) the U.S. inflation rate, (e) seasonal changes in prices, (f) changes in the cost of living for next year, (g) how your life will be different next year, (g) how to pay for loans or other debts next year, (h) how to cover expenses next year or (i) other, please specify, followed by a textbox. For each expectations question, respondents also rated how much their answer relied on what they knew about the past versus what they knew about the future, on a scale from 1 (=mostly relied on the past) to 7 (=mostly relied on the future). These interpretations were originally given by interviewees discussing their responses to expectations questions in an earlier phase of this project.

For the questions about expectations for prices in general, the rate of inflation, and the prices you pay for the things you usually spend money on, respondents also rated how much they thought of the following specific prices, using the same 7-point scale: (a) housing, which includes mortgage or rent, maintenance and utilities, (b) food, which includes groceries, dining out, and beverages, (c) stocks and bonds, (d) clothing, (e) transportation, which includes gas, public transportation fares, and car maintenance, (f) health care, (g) income taxes, (h) recreation and entertainment, (i) education and child care. These prices were in part chosen to reflect the basic categories that consumers' cost of living. To avoid contaminating responses to subsequent questions about expectations, in the sense of suggesting specific prices respondents may not otherwise have thought of, questions about specific prices were asked only with the second (and last) question about general expectations, before respondents moved on to ponder expectations about specific prices (i.e., gas or milk).

Measures of construct validity

Qualitative perceptions. For each specific question about inflation expectations, respondents indicated whether they believed their response was high or low compared to the past 10 years, on a scale from 1 (=very high) to 7 (=very low). Responses were reverse-coded such that higher numbers reflected relatively higher expectations. They also indicated how much they thought the specific inflation expectation would affect their financial situation, on a scale from 1 (=not at all) to 7 (=very much).

Measures of cognitive ability

Education. Respondents reported their highest level of education completed, which we used as a proxy for cognitive ability. Response options included (a) less than 1st grade, (b) 1st, 2nd, 3rd, or 4th grade, (c) 5th or 6th grade, 4 7th or 8th grade, (d) 9th grade, (e) 10th grade, (f) 11th grade, (g) 12th grade NO DIPLOMA, (h) HIGH SCHOOL GRADUATE high school DIPLOMA or the equivalent (For example: GED), (i) Some college but no degree, (j) Associate degree in college Occupational/vocational program, (k) Associate degree in college Academic program, (l) Bachelor's degree (For example:

BA,AB,BS), (m) Master's degree (For example: MA,MS,MEng,MEd,MSW,MBA), (n) Professional School Degree (For example: MD,DDS,DVM,LLB,JD), and (o) Doctorate degree (For example: PhD,EdD). Because the higher and lower categories were checked by few respondents, the reported analyses use the condensed categories (a) no high school diploma, (b) high school or GED equivalent, (c) associates degree, (d) bachelors degree, and (e) advanced degree.

Numeracy. The numeracy measure measured respondents' ability to use percentages and was taken from Peters et al. (2006). For example, the first item asked "Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up as an even number?" and was presented with a textbox in which respondents could type their answer.

Financial literacy. Questions about financial literacy were taken from a measure developed by Lusardi (2007). Respondents were presented with statements about inflation, such as "If your income doubles in the next ten years and prices of all goods also double, then you will be able to buy fewer goods in ten years than you can buy today." For each statement, they indicated whether they believed it was true or false.

Confidence in financial literacy. For each item on the financial literacy scale, respondents indicated how confident they were in their answer, on a scale from 50% (=just guessing) to 100% (=absolutely sure).

Perceived financial knowledge. Respondents rated how knowledgeable they are about their household's financial situation, on a scale from 1(=not knowledgeable at all) to 7 (very knowledgeable.)

Perceived financial responsibility. Respondents were asked to rate how much responsibility they had for (a) budgeting and managing income, (b) paying bills, (c) shopping, and (d) investing and managing assets, on a scale from 1 to 5.

Demographic measures

Respondents were asked to report their gender as well as the total combined income of all members of their family (living there) during the past 12 months. They were told that this includes money from jobs, net income from business, farm, or rent, pensions, dividends, interest, social security payments, and any other money income received by members of their family who are 15 years of age or older. Response options were (a) Less than $5,000, (b) $5,000 to $7,499, (c) 3 $7,500 to $9,999, (d) $10,000 to $12,499, (e) $12,500 to $14,999, (f) $15,000 to $19,999, (g) $20,000 to $24,999, (h) $25,000 to $29,999, (i) $30,000 to $34,999, (j) $35,000 to $39,999, (k) $40,000 to $49,999, (l) $50,000 to $59,999, (m) $60,000 to $74,999, and (n) $75,000 or more.

Procedure

Respondents first answered the warm-up questions asking about their perceptions of and expectations for their financial situation and business conditions, taken from the Michigan Survey of Consumers. The subsequent question order was randomized. A total of 267 first received the question about expectations for prices in general, followed by either the question about the rate of inflation (n=116) or the question about your prices (n=151). The other 291 first received one of those alternatives (inflation n=171; your prices n=120) and then the question about prices in general. Finally, respondents were

randomly assigned to the expectations question about milk prices (n=245) or gas prices (n=306).

After answering each specific question about expectations, respondents answered how difficult they thought it was to answer, how clear the question was, how much their response would affect their financial situation, how high or low their response is compared to the past 10 years, and how much they relied on the past versus the future.

Finally, respondents completed measures of numeracy, financial responsibility, and financial literacy.

(6.2.3) The May special module

The purpose of the May special module was to examine the psychometric properties of questions asking about expectations for general prices (a) prices in general, (b) the rate of inflation, (c) the prices you pay for the things you usually spend money on. These questions were repeated for different time horizons, including the past 12 months, the next 12 months, the 12 months after next (assuming that over the next 13 months prices will behave as expected, and assuming that they will be 3% higher than expected), as well as the next 5 to 10 years. We examine respondents' (a) perceptions and expectations, and how they vary across the different types of wording as well as the different time horizons, (b) voluntary use of ranges and their effect on reported expectations; (c) interpretation of the response that prices will stay the same, if they gave that response, and the effect of asking what they meant; (d) tendency to change responses over 5% when given the opportunity to do so; (e) ratings of each question's clarity, (f) interpretations of each question following from those given by interviewees in an earlier phase of this project, and the relationship of these interpretations to reported expectations, (g) economic perceptions and their relationship to reported expectations, as an indication of questions' construct validity; and (h) measures of cognitive ability and demographic variables that have traditionally been related to expectations, and their relationship to reported expectations.

To date, a total of 759 respondents participated in the May special module between May 29, 2008 and June 4th, 2009. Of those, 98.2% reported being US citizens, 54.2% were female, and 65.5% married or living with a partner. Their highest level of education completed was no high school diploma (2.2%), high school or GED equivalent (36.4%), associates degree (11.5%), bachelors degree (28.3%), and advanced degree (21.6%). Respondents self-identified as white (87.9%), African-American (6.9%), American Indian or Alaskan native (.5%), Asian or Pacific Islander (3.2%) or other (1.6%). Median reported income was in the category of $60-$75k (with categories ranging from "less than $5k" to "$75k or more").

The module included the same Michigan questions about the 'change in prices in general over the next 12 months' as in the December special module. It also included the 'rate of inflation' and 'prices of the things you usually spend money on' versions.

Respondents were also asked equivalent questions about expectations for prices in general over the next 5 to 10 years, expectations for prices in general for the 12 months after next, if expectations for the next 12 months end up being correct, expectations for prices in general for the 12 months after next, if prices are 3% higher than expected in the next 12 months, and perceptions of prices over the past 12 months, with two notable exceptions. First, the follow-up question giving respondents the opportunity to revise

responses was phrased differently for expectations over the next 5 to 10 years. That is, respondents were asked "Would that be [x%] over the [x%] per year, or the total for prices over the next 5 to 10 years?" Although, in the Michigan Survey of Consumers, this question is only asked of respondents who gave expectations over 5%, we presented it to every respondent, independent of whether their answer was above, at, or below 5%. Second, the questions about the 12 months after next did not include follow-up questions giving the opportunity to revise answers.

For each time horizon, the questions about expectations for the "rate of inflation" used the same structure as the corresponding time horizon for expectations for "prices in general" (Figure 1). The main difference pertained to the wording. For example, the question about expectations for the next 12 months began by asking "Over the next 12 months, do you think that there will be inflation, deflation (the opposite of inflation), or neither?"

For each time horizon, the questions about expectations for the "prices you pay" also used the same structure as the corresponding time horizon for expectations for "prices in general" (Figure 1). However, "prices in general" was replaced with "the prices of things you usually spend money on."

Question clarity

For each type of expectations question (prices in general, rate of inflation, prices you pay) and three time horizons (the past 12 months, the 12 months after next, and the next 5 to 10 years), respondents rated how clear the question was, in terms of what it was asking about, on a scale from 1 (very unclear) to 7 (=very clear). Respondents also rated how hard it was to come up with an answer to the question, on a scale from 1 (=very easy) to 7 (=very hard). These ratings were reverse- coded such that higher ratings reflected perceptions of the question being easier to answer.

Question interpretation

For two time horizons (past 12 months and next 5 to 10 years), respondents rated how much they thought of the following topics after answering each type of expectation question (1=not at all, 7=very much): (a) the prices of things you usually spend money on, (b) the prices of things that Americans usually spend money on, (c) annual raises in salary, (c) the price of one or more specific things, (d) the U.S. inflation rate, (e) seasonal changes in prices, (f) changes in the cost of living during the next 5 to 10 years, (g) how your life will be different during the next 5 to 10 years, (g) how to pay for loans or other debts during the next 5 to 10 years, (h) how to cover expenses during the next 5 to 10 years, and (i) other, please specify, followed by a textbox. Respondents also rated how much their answer relied on what they knew about the past versus what they knew about the future, on a scale from 1 (=mostly relied on the past) to 7 (=mostly relied on the future).

Respondents further rated how much they thought of the following specific prices, using the same 7-point scale: (a) housing, which includes mortgage or rent, maintenance and utilities, (b) food, which includes groceries, dining out, and beverages, (c) stocks and bonds, (d) clothing, (e) transportation, which includes gas, public transportation fares, and car maintenance, (f) health care, (g) income taxes, (h) recreation and entertainment,

(i) education and child care. These prices were in part chosen to reflect the basic categories that consumers' cost of living.

For expectations about the next 5 to 10 years, respondents also indicated whether they thought of the time period between now and 10 years from now, the time period between now and 5 years from now, or another time period to be reported in a text box, and how consistent they expected the change in prices to be, on a scale from 1 (=about the same every year) to 7 (vary a lot from year to year).

Measures of construct validity

Qualitative expectations and effect on financial situation. For each type of expectations question and each time horizon, respondents indicated whether they believed their response was high or low compared to the past 10 years, on a scale from 1 (=very high) to 7 (=very low). Responses were reverse-coded such that higher numbers reflected relatively higher expectations. They also indicated how much they thought the specific inflation expectation would affect their financial situation, on a scale from 1 (=not at all) to 7 (=very much).

Procedure

Respondents were randomly assigned to receiving questions about (a) prices in general (n=262), (b) the rate of inflation (n=235), or (c) the prices you pay for the things you spend money on (n=262). All respondents first answered the warm-up questions asking about their perceptions of and expectations for their financial situation and business conditions, taken from the Michigan Survey of Consumers. They then received the question about expectations for the next 12 months, immediately followed by the question about expectations for the next 5 to 10 years. For the latter, they were then asked to rate its clarity, to report their interpretation of the question, and answer measures of construct validity.

Subsequently, respondents were asked to suppose that prices over the next 12 months behaved as they had expected, and to report their expectations for the 12 months after that. Next, they were asked to suppose that the actual rate was 3% higher, and to report their expectations for the 12 months after that. For these questions, respondents only rated question clarity, items related to construct validity, and their interpretation of the time period.

Subsequently, respondents were asked about perceptions of the past 12 months, as well as their interpretation of that question, and measures of construct validity.

For three of the time horizons (the past 12 months, the 12 months after next, and the next 5 to 10 years), respondents answered how difficult they thought each type of expectations question was to answer, how clear the question was, how much their response would affect their financial situation, how high or low their response is compared to the past 10 years, and how much they relied on the past versus the future.

Finally, respondents completed measures of numeracy, financial responsibility, and financial literacy.

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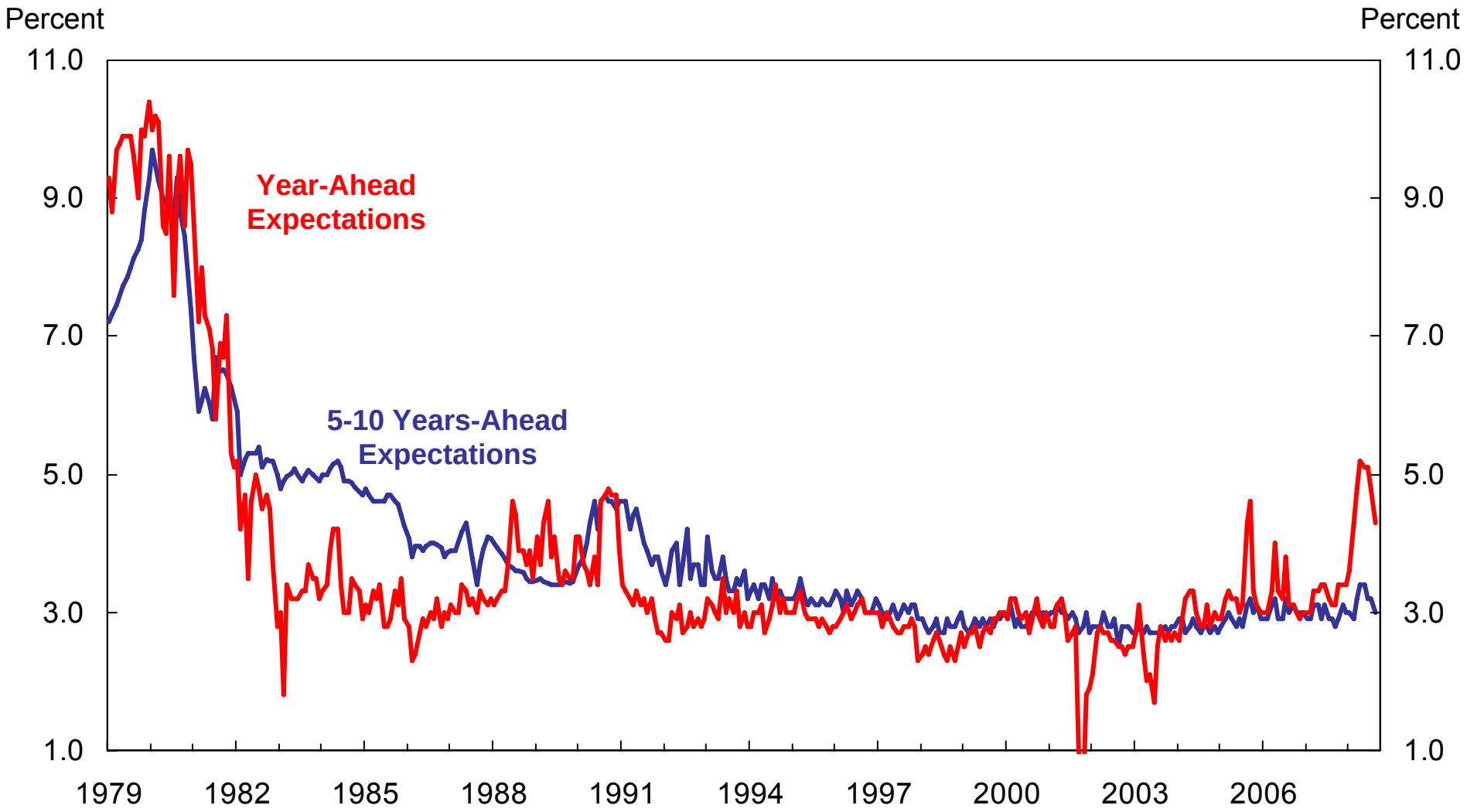
Fig 1 Michigan Survey Median Forecasts



Michigan Survey micro data.

Fig 1.1 Structure of Michigan's Year-Ahead Inflation Expectations Question

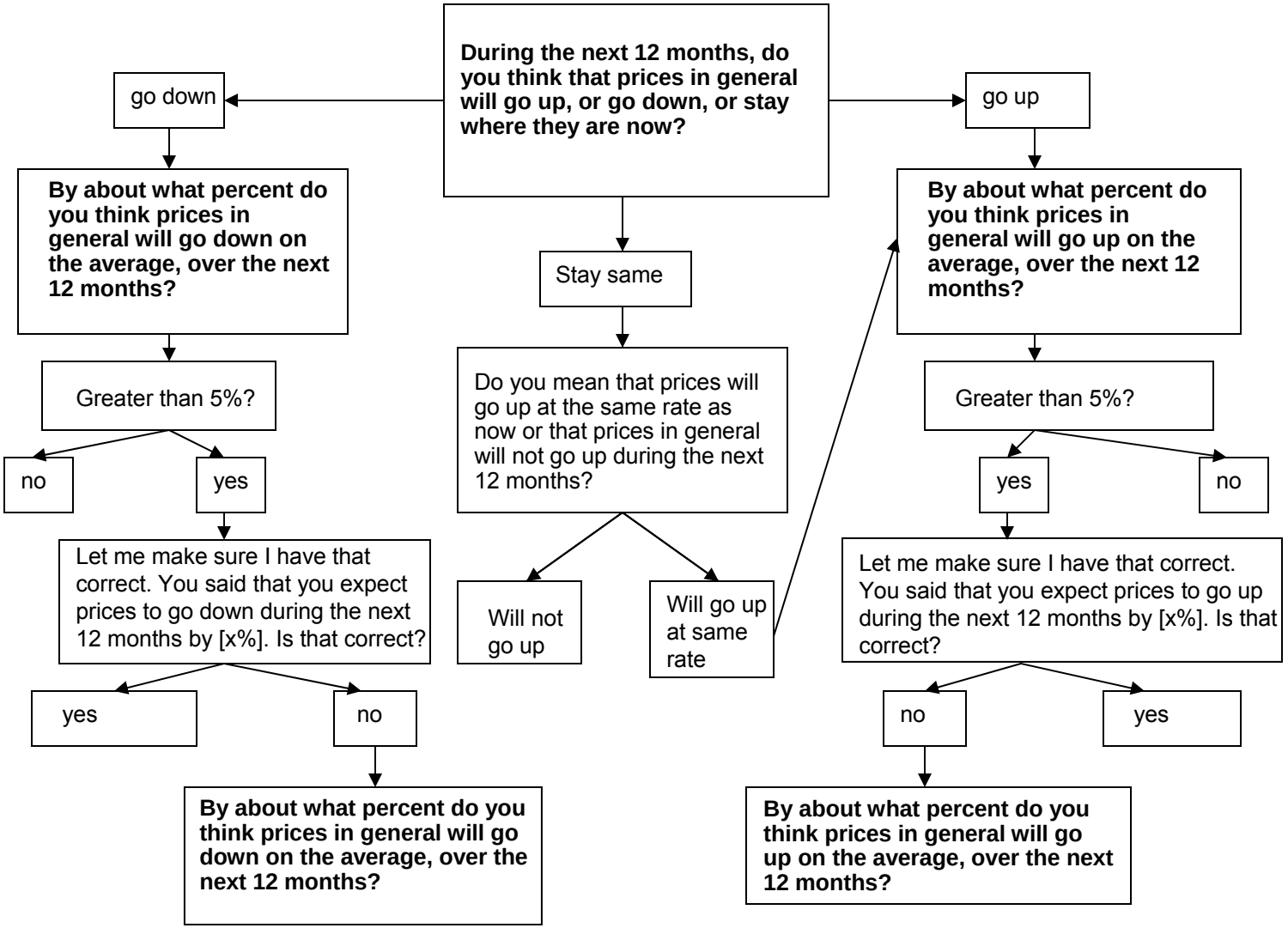
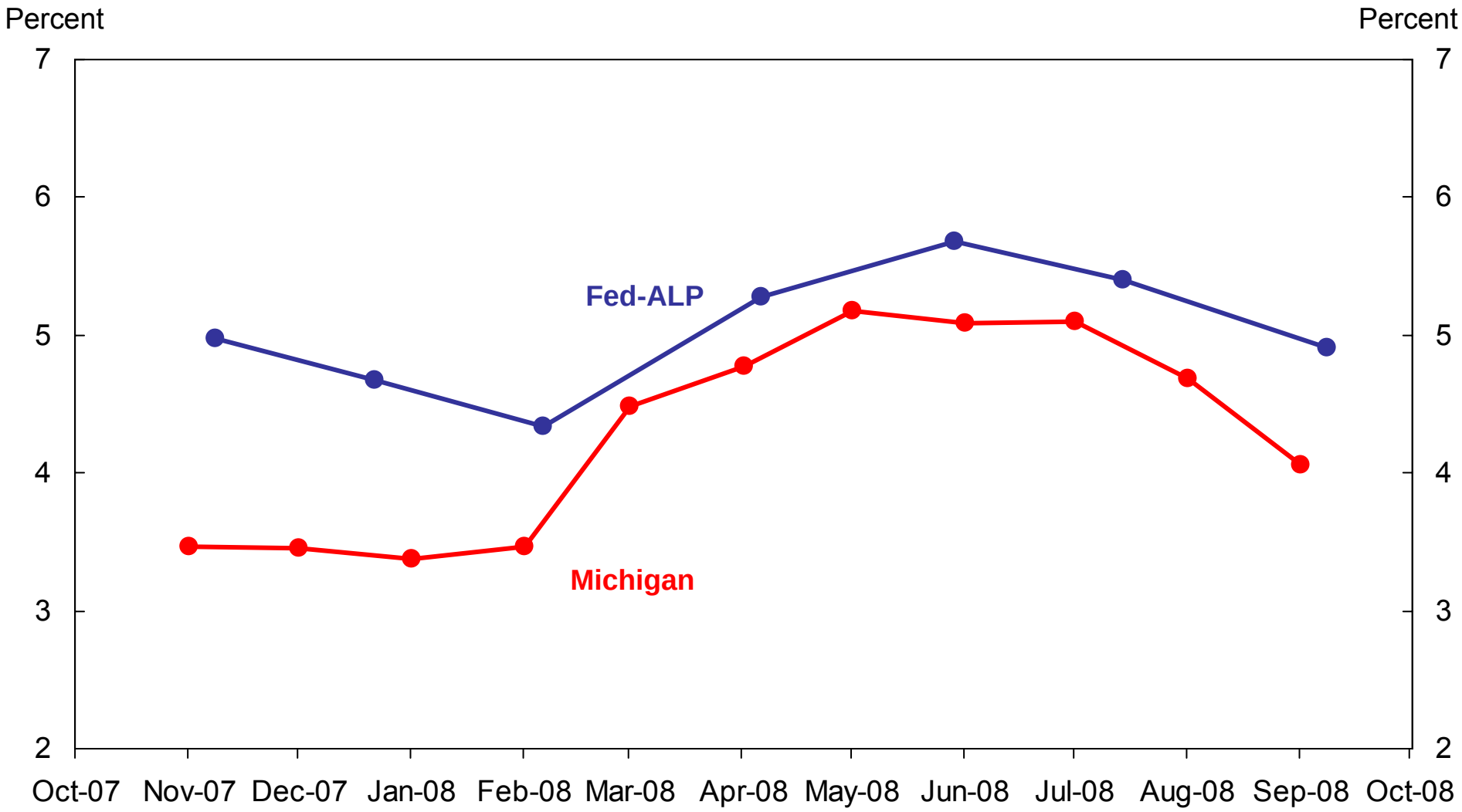
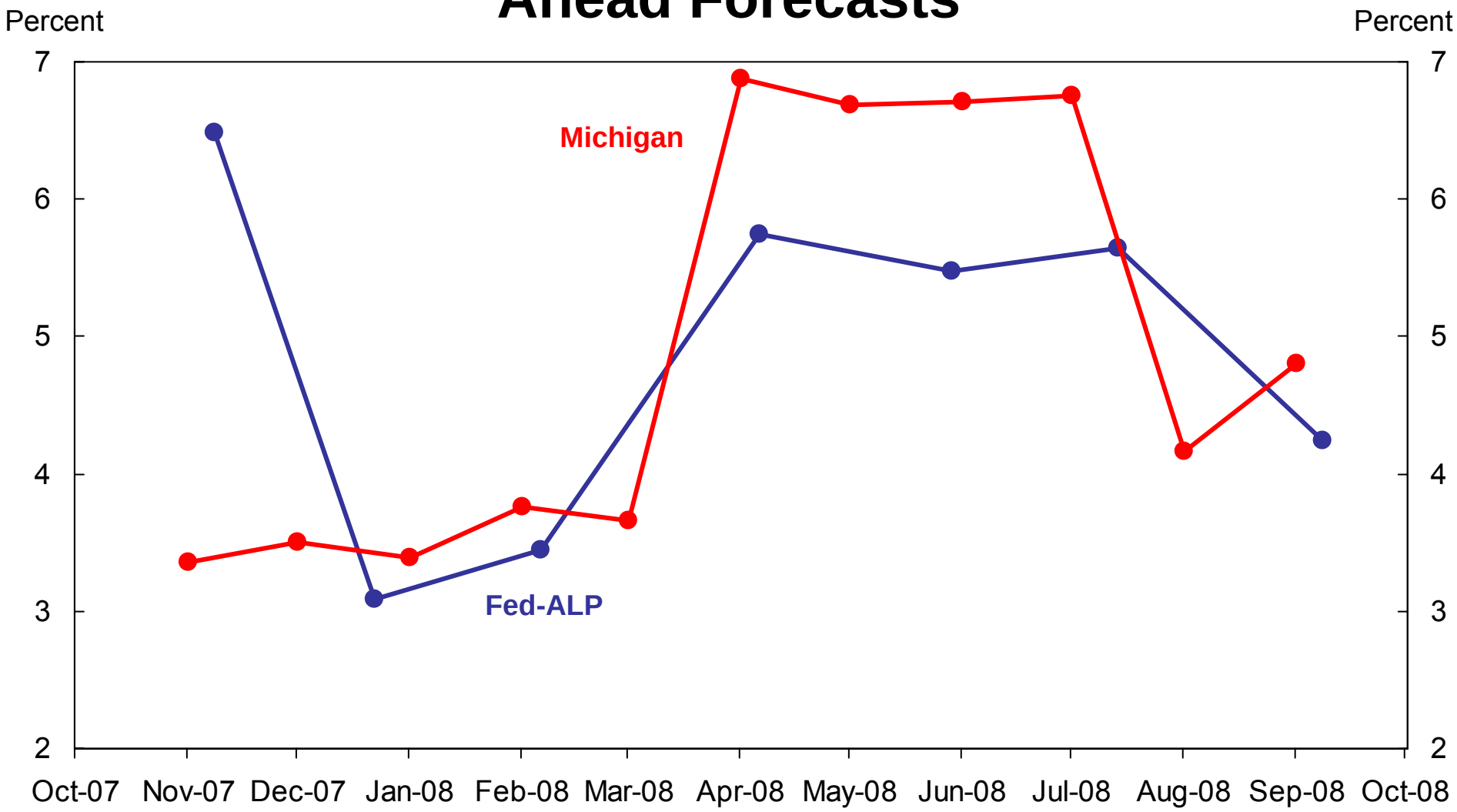


Fig 1.2 Trends in Median Year-Ahead Forecast



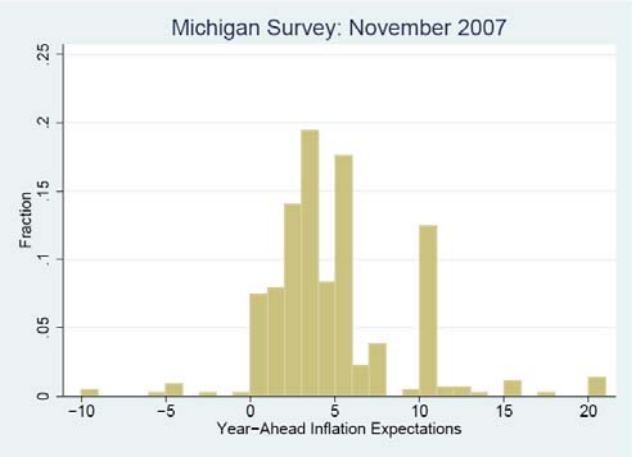
Michigan Survey and Fed-ALP Panel. Point forecasts from ‘prices in general’ question. Own median computations (see text).

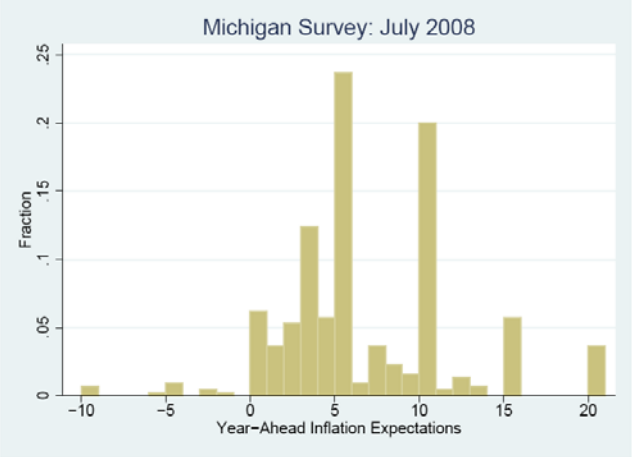
Fig 1.3 Trends in Disagreement (IQR) Across Year-Ahead Forecasts

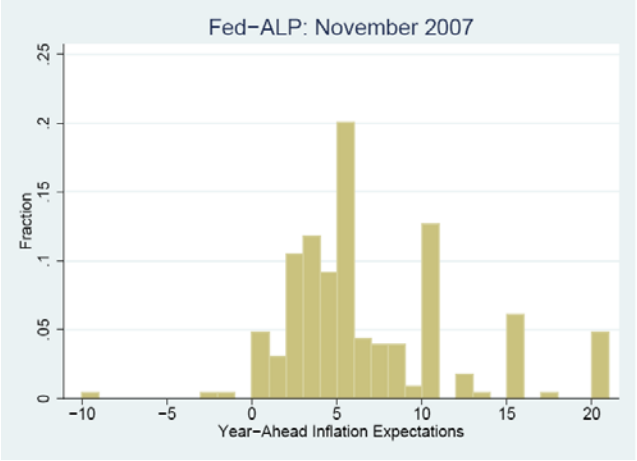


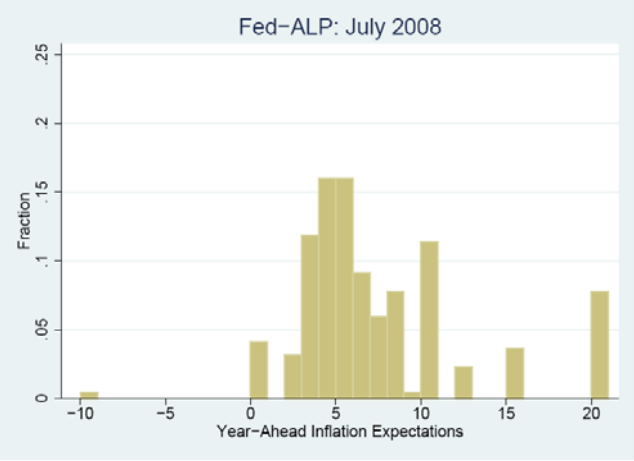
Michigan Survey and Fed-ALP Panel. Point forecasts from `prices in general' question. Own quantile computations (see text).

Fig 1.4 Distribution Changes from Nov 2007 to Jul 2008









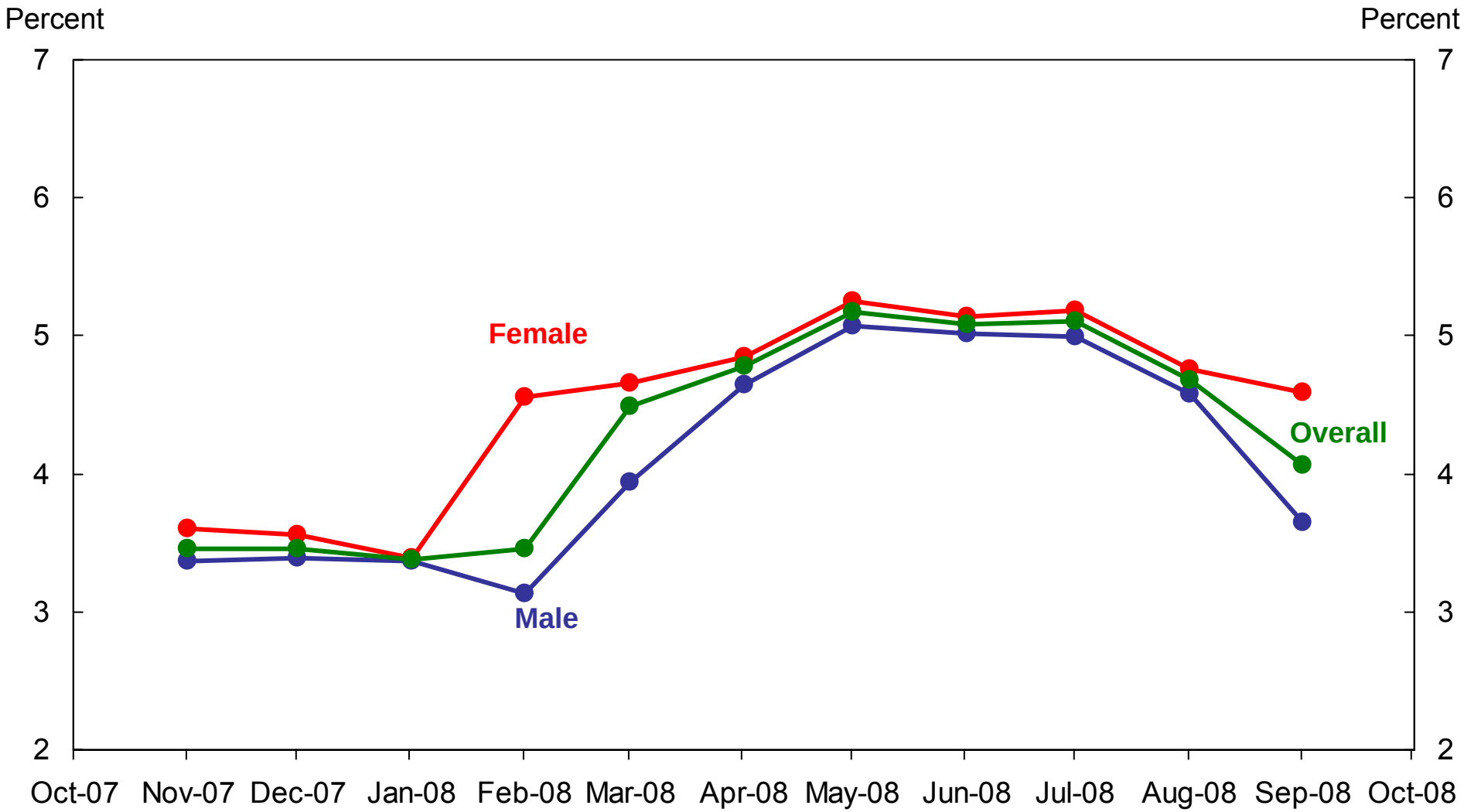
Michigan Survey and Fed-ALP Panel. Point forecasts from ‘prices in general’ question. Forecasts above 20 have been coded to 20 while forecasts below -10 have been coded to -10 for display purposes.

Table 1.1 Heterogeneity in Year-Ahead Forecasts by Demographics

	Median		IQR		Obs	
	Michigan Survey	Fed-ALP Modules	Michigan Survey	Fed-ALP Modules	Michigan Survey	Fed-ALP Modules
Female	4.7**	5.5**	7.0	6.5	2588	1070
Male	4.3	4.9	4.1	3.2	1934	946
No B.A	4.7**	5.3**	7.0	6.4	2413	970
B.A. or More	4.4	5.0	3.8	4.3	2094	1046
Single	4.8	5.3	7.0	6.3	1747	736
Married	4.5	5.1	4.4	5.0	2774	1283
Income<=75K	4.8**	5.5**	7.0	6.3	2526	1175
Income>75K	4.2	4.8	3.1	3.8	1622	839
Age in [40,59]	4.6	5.1	4.5	6.1	1851	1342
Age not in [40,59]	4.6	5.2	5.9	5.9	2680	677

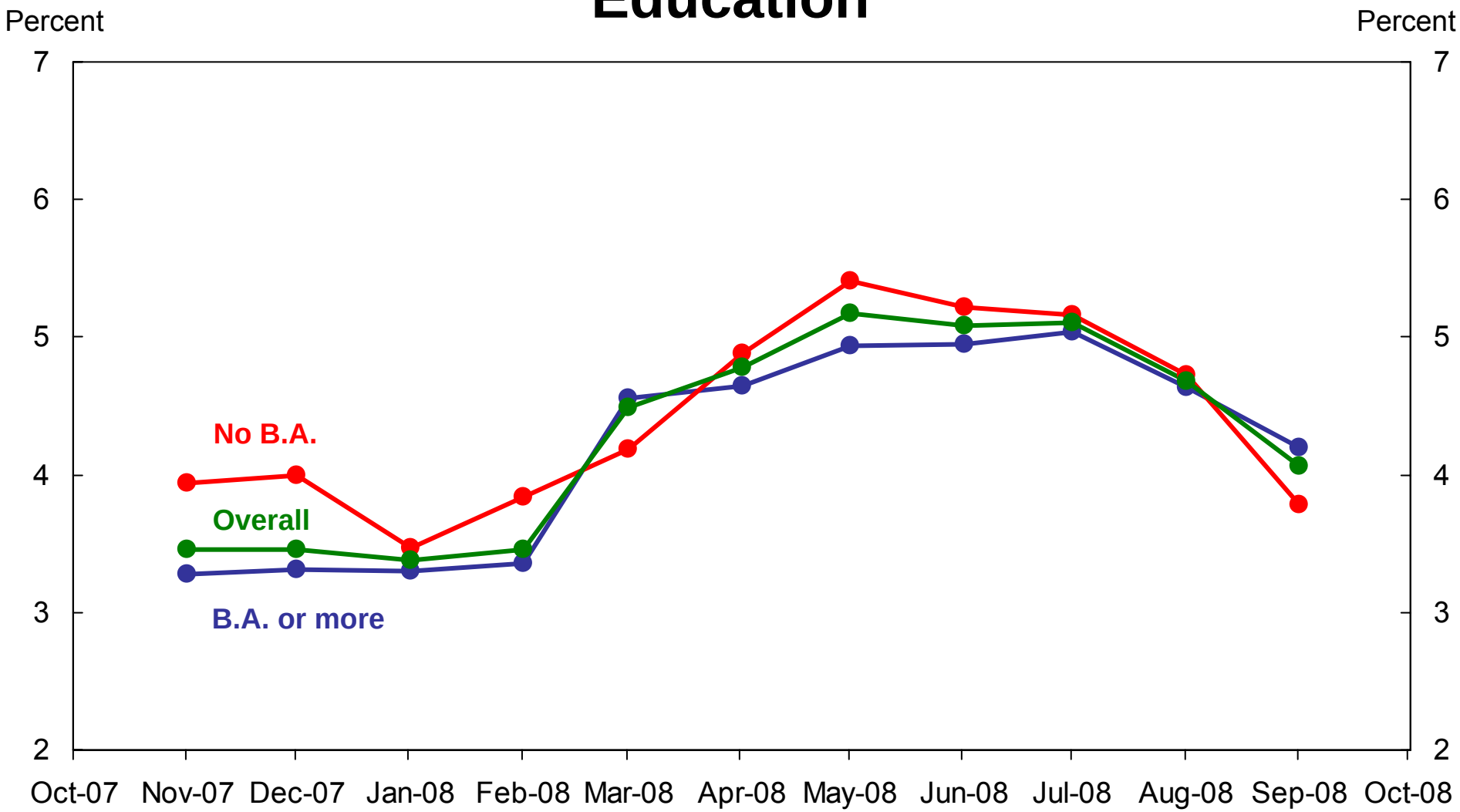
Michigan Survey and Fed-ALP Panel from November 2007 to July 2008. Point forecasts from 'prices in general' question. ****** Indicates response differences between demographic pairs are statistically significant at the 1% level.

Fig 1.5 Trends in Median Point Forecast by Gender



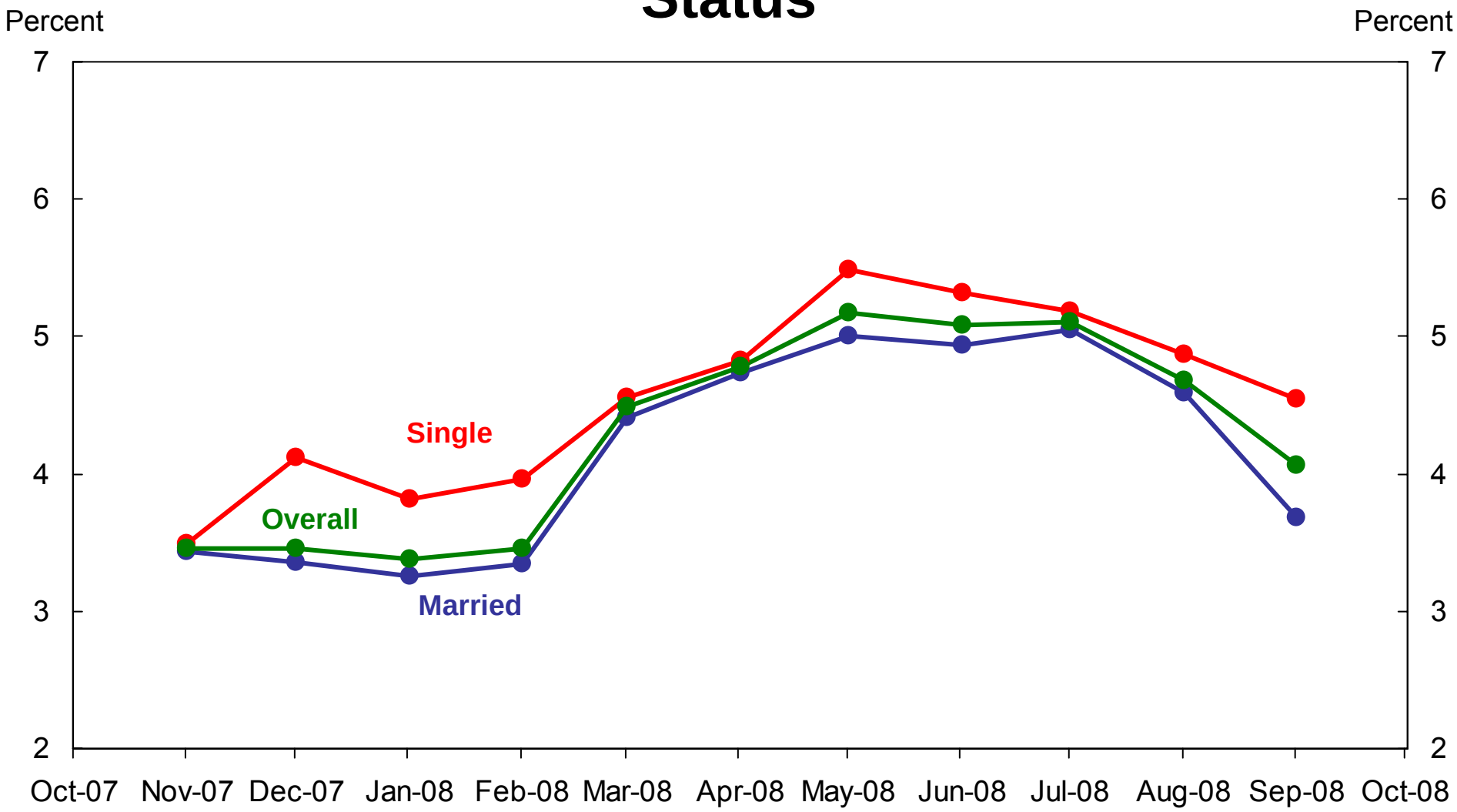
Michigan Survey micro data. Point forecasts from ‘prices in general’ question.

Fig 1.6 Trends in Median Point Forecast by Education



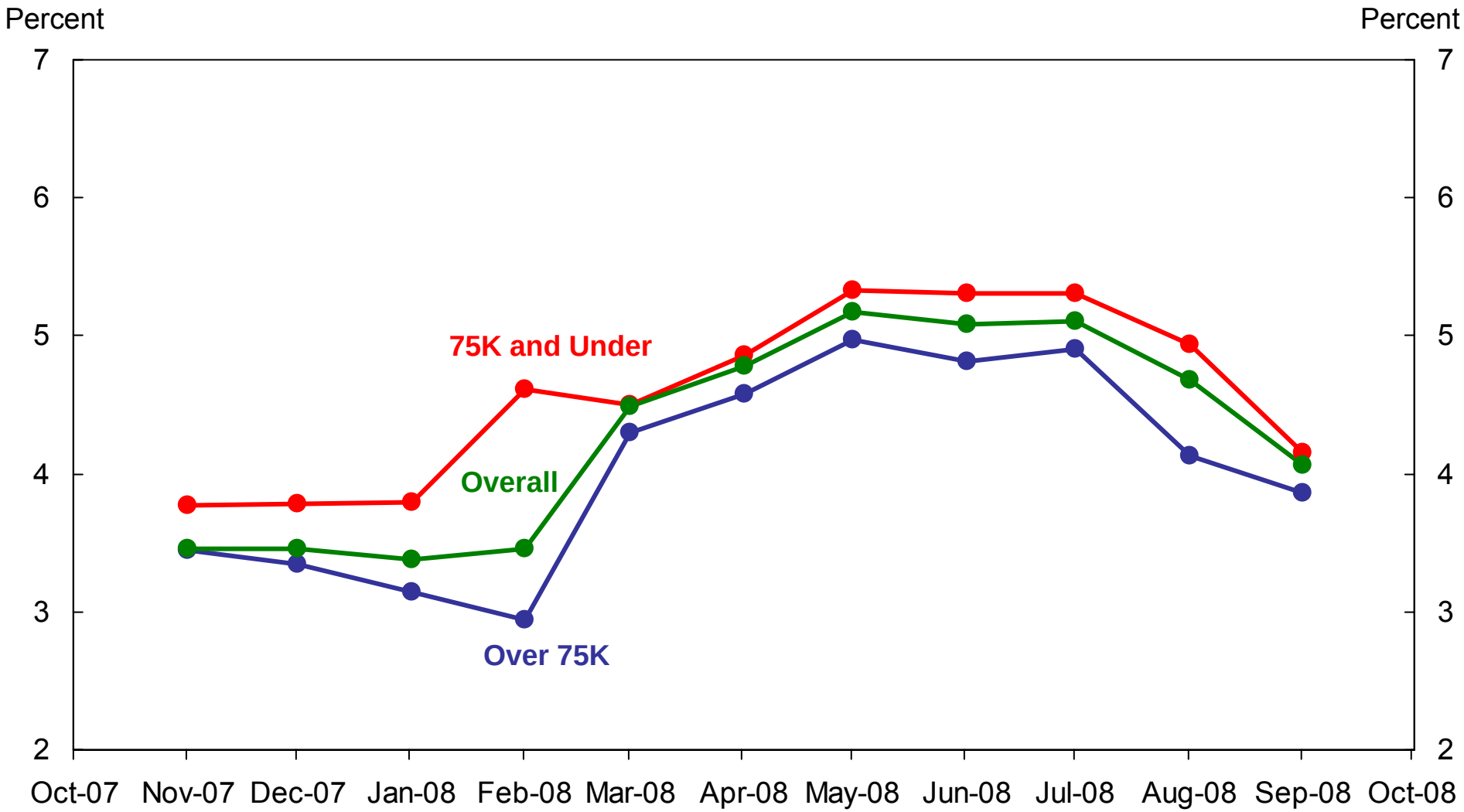
Michigan Survey micro data. Point forecasts from ‘prices in general’ question.

Fig 1.7 Trends in Median Point Forecast by Marital Status



Michigan Survey micro data. Point forecasts from ‘prices in general’ question.

Fig 1.8 Trends in Median Point Forecast by Income



Michigan Survey micro data. Point forecasts from ‘prices in general’ question.

Table 1.2 Heterogeneity in Year-Ahead Forecasts by Knowledge/Financial Behavior

Rank correlations between ratings and point forecasts

Numeracy	-0.26**
Financial Knowledge	-0.00
Financial Literacy	-0.18**
Financial Literacy confidence	-0.12**
Planning Horizon – Spending	-0.12**
Planning Horizon – Saving	-0.12**
Responsibility Budgeting	0.03
Responsibility Paying Bills	0.05
Responsibility Shopping	0.10*
Responsibility Investing	-0.06

Fed-ALP December Special module. Point forecasts from 'prices in general' question. Spearman rank correlations. ** p<0.01 ; * p<0.05. Numeracy measured as number of correct answers out of 11 questions. Self-assessed financial knowledge varies from 1(not knowledgeable) to 7 (very knowledgeable). Financial literacy is measured as number of correct answers out of 3 and confidence as average self assessed confidence in provided answers which varies from 0 (just guessing) to 1 (absolutely sure). The planning horizon was measured by responses to the question 'In deciding how much of their [family] income to spend, people are likely to think about different financial planning periods. In planning your [family's] spending, which of the following time periods is most important to you [and your husband/wife/partner]', with answers varying from 'Next day' (1) to 'Longer than 10 years' (9). Responsibility for various household tasks was measured by responses to the question 'In your household, how much responsibility do you have for the following tasks', with choices varying from none (1) to all (5).

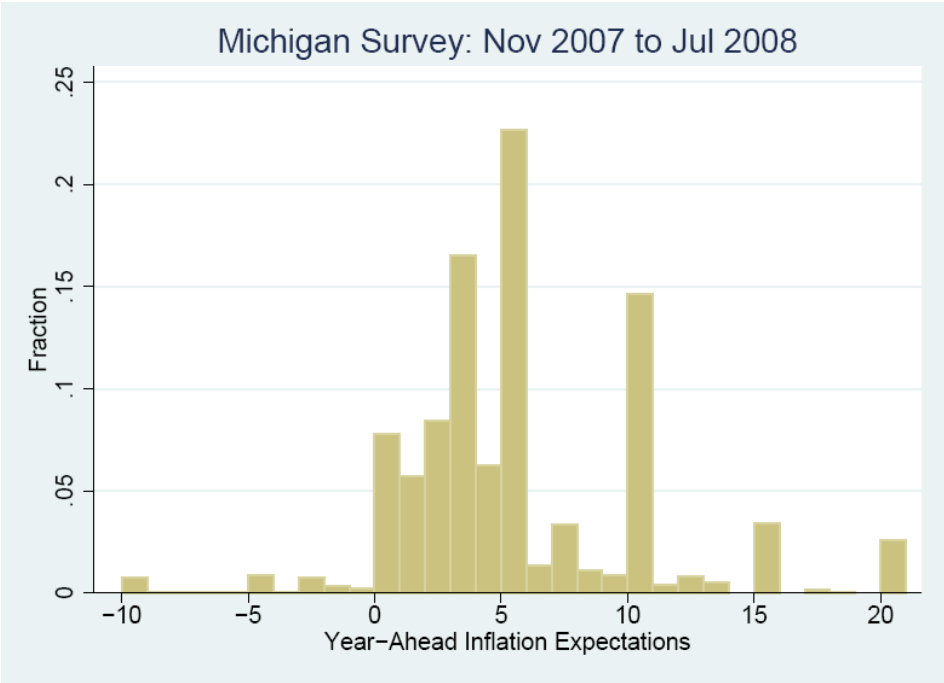
Table 1.3 Sample Composition

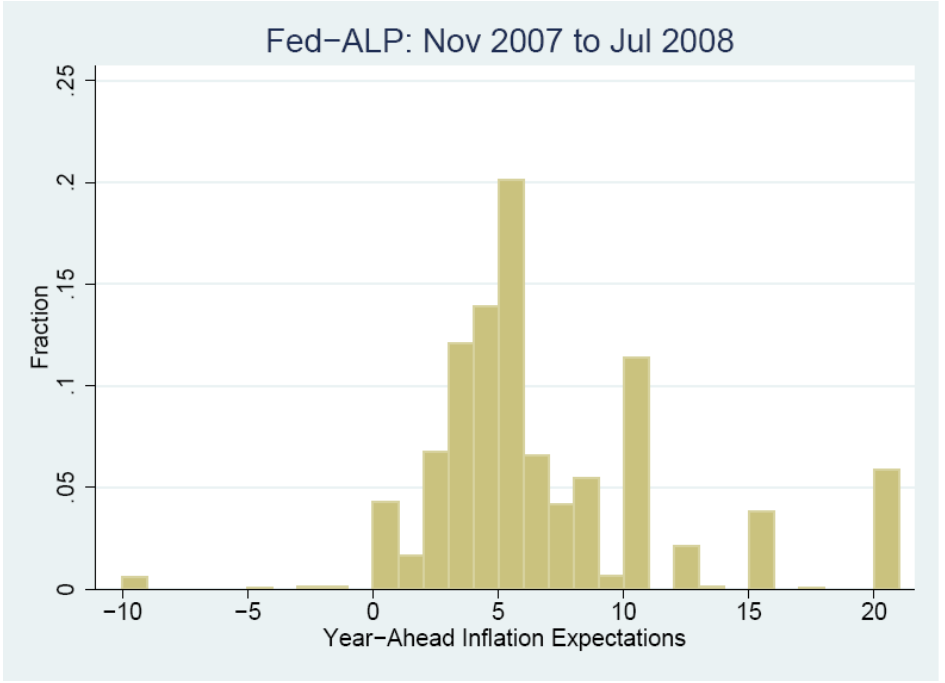
	Fed-ALP Panel	Michigan Survey
Female	53%	57%
Married	64%	61%
B.A. or More	52%	46%
Income>75K	41%	39%
Age 40-59	66%	41%

Michigan Survey and Fed-ALP Panel.

Fig 1.9 Comparison of Year-Ahead Forecast Distributions

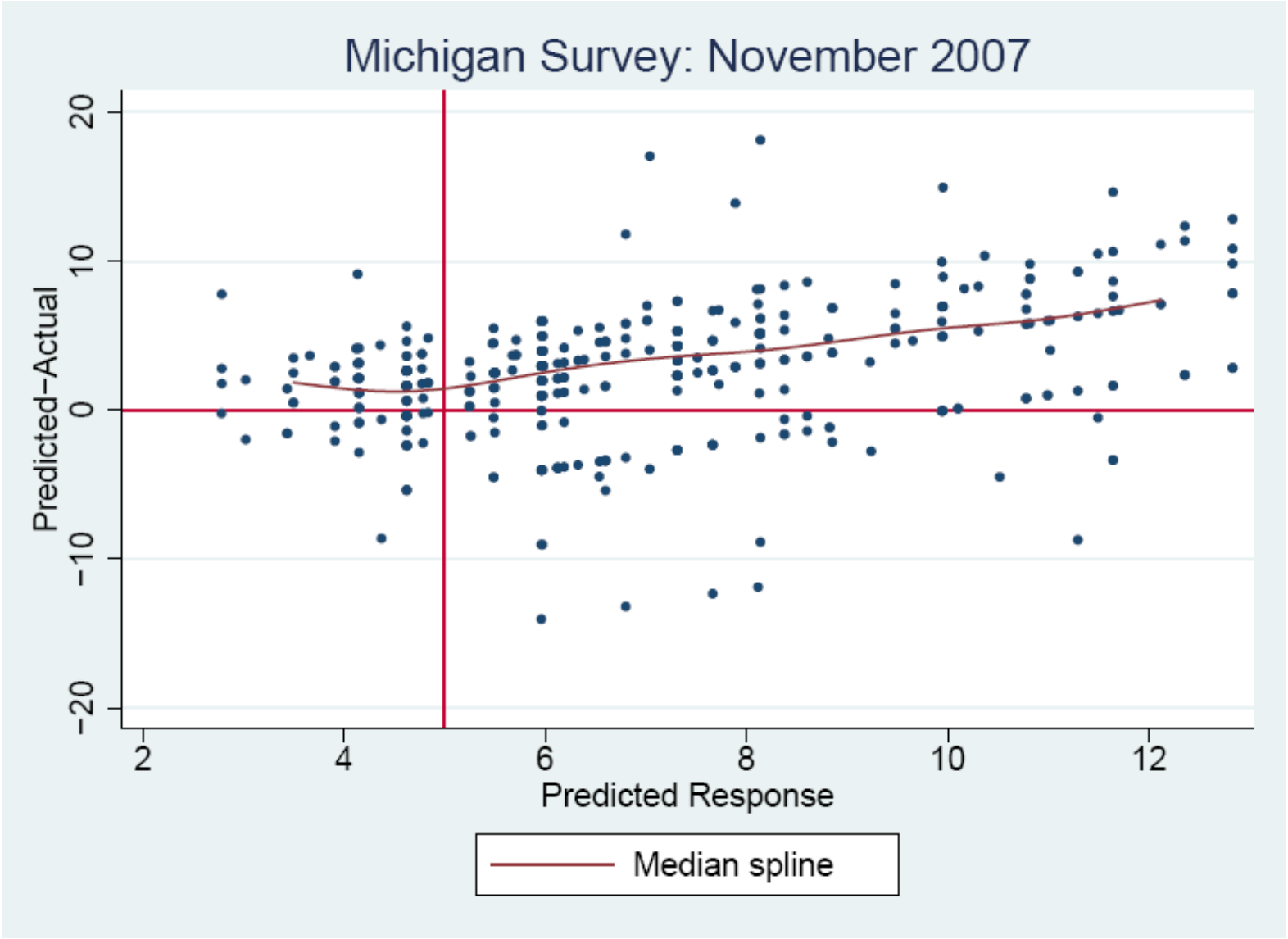
Michigan Survey vs. Fed-ALP Panel





Michigan Survey and Fed-ALP Panel. Data pooled across months. Point forecasts from ‘prices in general’ question. Forecasts above 20 have been coded to 20 while forecasts below -10 have been coded to -10 for display purposes.

Fig 1.10 The 5% Challenge Prompt



Michigan Survey and Fed-ALP Panel. Data from the November 2007 ‘prices in general’ question.

Table 1.4 Comparing Alternative Wordings of Year-Ahead Inflation Question

	MI Prices in General	**RI** Rate of Inflation	**PP** Prices You Pay
December Special Module			
Median	4.7	4.5	4.8
IQR	5.0	3.4	6.8
Obs	608	310	296
Correlation with MI response		0.65	0.75
Proportion same response as MI		39%	55%
May Special Module			
Median	6.5	5.1**	8.2++
IQR	7.1	6.4	10.2
Obs	261	233	261

Fed-ALP Panel December and May Special modules. Independent sample t-tests comparing MI and RI expectations: ** p<.01;* p<0.5. Comparing MI and PP expectations : none significant. Comparing RI and PP expectations: ++ p<0.01; + p<0.05.

Table 1.5 How much did you think of…?

	MI Prices in General	**RI** Rate of Inflation	**PP** Prices You Pay
Prices of the things you usually spend money on	5.7	5.0**	6.4**
Prices of things that Americans usually spend money on	5.2	5.0*	4.0**
Specific prices	3.8	3.5**	4.1**
U.S. inflation rate	4.4	5.3**	3.9**
Changes in cost of living for next year	4.5	4.8	4.1**

Fed-ALP December Special module. Paired t-tests comparing ratings of MI question to those of RI and PP:
** $p<0.01$;* $p<0.05$. All differences between the ratings for the RI and PP questions were statistically significant at the 1% level. Ratings score: (1=not at all, 7=very much).

Table 1.6 What did you think the question was asking for the most?

	MI Prices in General	**RI** Rate of Inflation	**PP** Prices You Pay
Prices of the things you usually spend money on	27%	11%	67%
Prices of things that Americans usually spend money on/U.S. inflation rate	52%	60%	15%
Changes in cost of living for next year	14%	18%	9%
Other	7%	11%	9%

Fed-ALP December Special module. ‘Other’ includes 'The price of one or more specific things', 'Annual raise in salary', 'Seasonal changes in prices', 'How your life will be different next year', 'How to pay for loans or other debts next year‘, and 'How to cover expenses next year'.

Table 1.7 How much did you think about the price of each? (average ratings)

	MI Prices in General	**RI** Rate of Inflation	**PP** Prices You Pay
Transportation	6.1	6.1	6.2
Food	6.0	5.7	6.1^{+}
Housing	5.0	5.4**	5.2
Healthcare	4.8	5.4*	4.8^{++}
Clothing	4.1	4.0	4.1
Rec/Entertainment	3.8	3.6	3.8
Education/Childcare	3.2	3.4	3.2

Fed-ALP December Special module. Independent sample t-tests comparing MI and RI expectations: ** p<.01; * p<0.5. Comparing MI and PP expectation: none significant. Comparing RI and PP expectations : ++ p<0.01; + p<0.05.

Table 1.8 Relating Interpretations to Reported Expectations

Rank correlations between ratings and point forecasts

	MI	RI	PP
Prices of the things you usually spend money on	0.15**	0.19**	-0.05
Prices of things that Americans usually spend money on	0.03	0.19**	0.01
Specific prices	0.16**	0.17**	0.12*
U.S. inflation rate	0.01	0.07	0.03
Changes in cost of living	0.13**	0.21**	0.13*

Fed-ALP December Special module. Spearman rank correlations between ratings of question to corresponding point forecasts : ** $p<0.01$;* $p<0.05$.

Table 1.9 Relating Interpretations to Reported Expectations (cont.)

Medians (IQRs) by what respondents thought question asked for the most

	MI	**RI**	**PP**
Prices of the things you usually spend money on	4.9(6.6)	4.8(4.3)	4.8(6.6)
Prices of things that Americans usually spend money on/U.S. inflation rate	4.4(5.1)	4.2(2.5)	4.4(7.2)
Changes in cost of living	4.7(3.2)	4.7(4.4)	5.1(6.5)
Others	5.0(6.4)	5.2(6.2)	4.8(10.8)

Source: Fed-ALP December Special module. ‘Other’ includes 'The price of one or more specific things', 'Annual raise in salary', 'Seasonal changes in prices', 'How your life will be different next year', 'How to pay for loans or other debts next year' and 'How to cover expenses next year'.

Table 1.10 Relating interpretations to reported expectations (cont.)

Rank correlations between ratings and point forecasts

	MI	RI	PP
Transportation	0.27**	0.07	0.09
Food	0.23**	0.17*	-0.02
Housing	0.22**	0.15	0.06
Healthcare	0.22**	0.21*	0.14
Clothing	0.16**	0.01	-0.14
Rec/Entertainment	0.05	-0.02	0.08
Education/Childcare	0.12*	-0.03	-0.03

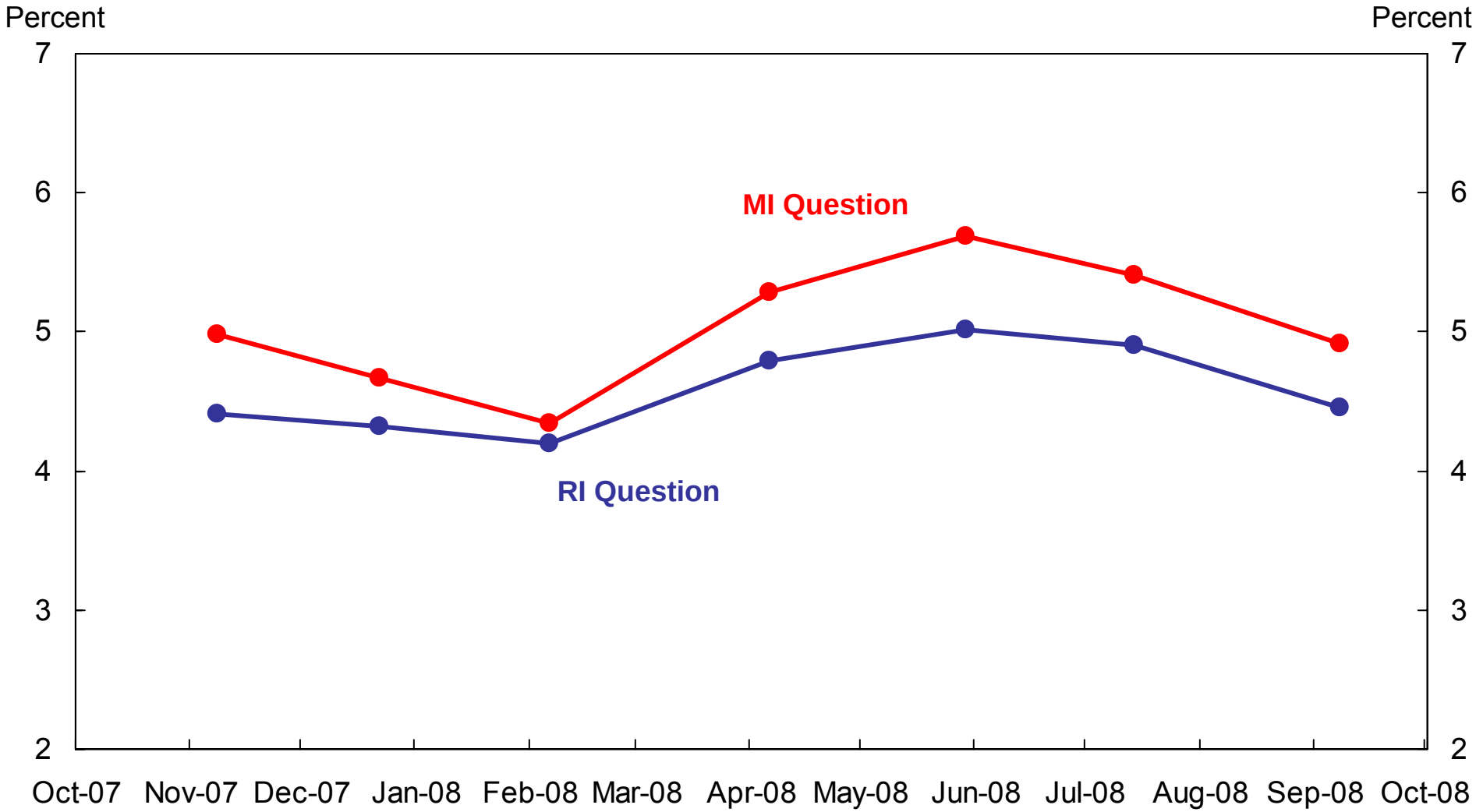
Fed-ALP December Special module. Spearman rank correlations between rating of how much respondent thought of different prices of different CPI categories and reported expectations. ** $p<0.01$;* $p<0.05$.

Table 1.11 Question clarity, difficulty and construct validity

		MI	RI	PP
How hard was question?				
(1=very easy, 7=very hard)	Mean	3.6	4.3**	3.4*++
How clear was question?				
(1=very unclear, 7=very clear)	Mean	5.5	5.4	5.7+
How high compared to past 10 years?				
(1=very low, 5=very high)	Mean	2.5	2.4	2.5
Rank correlation with point forecast		*0.43*	*0.47*	*0.33*
How much financial situation affected?				
(1=very little, 7=very much)	Mean	4.3	4.3	4.4
Rank correlation with point forecast		*0.46*	*0.43*	*0.42*

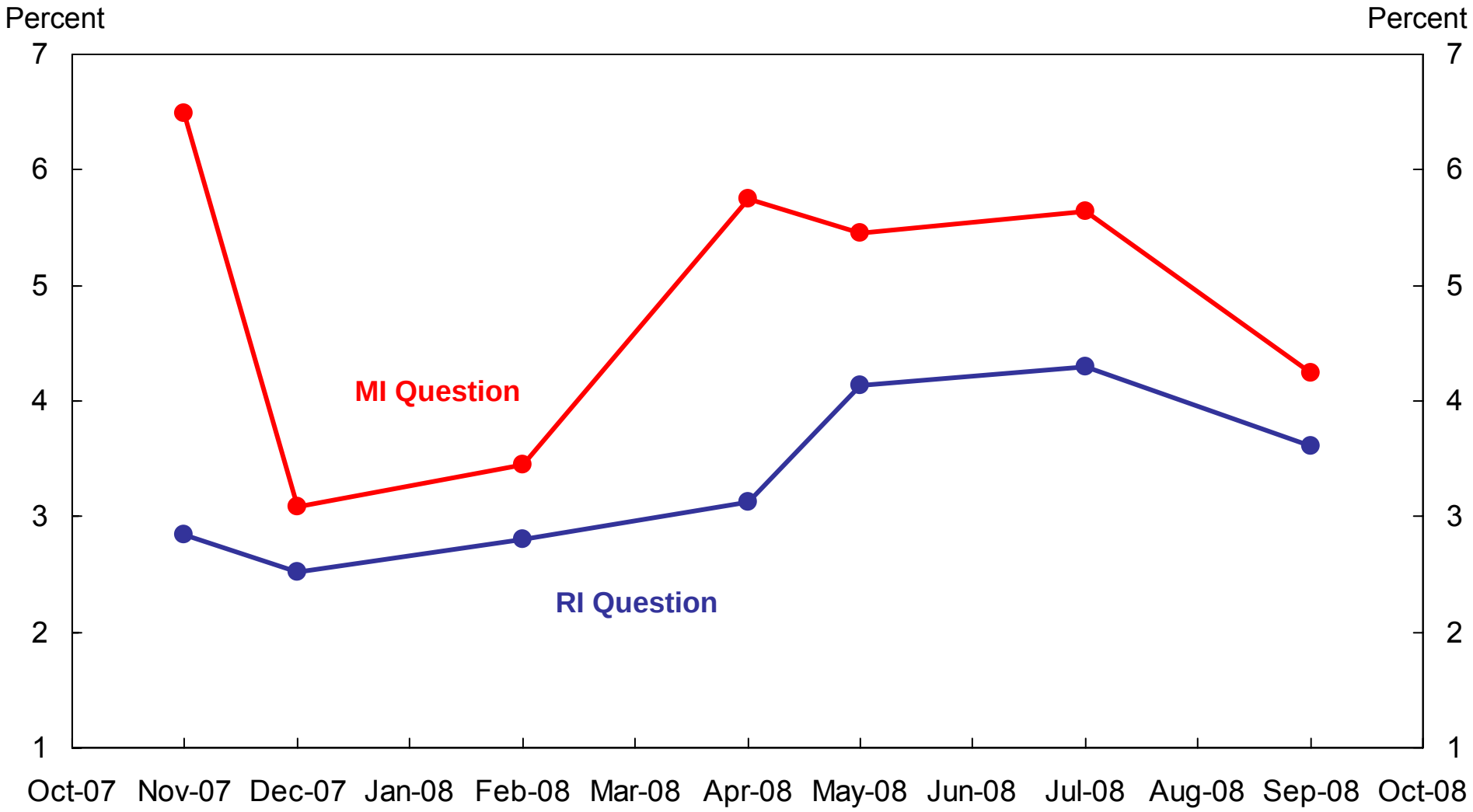
Fed-ALP December special module. t-tests for equality of means comparing MI and RI measures ** p<0.01; * p<0.05. When comparing RI and PP measures: ++ p<0.01; + p<0.05

Fig 1.11 Prices in General and Rate of Inflation: Median Year-Ahead Forecasts



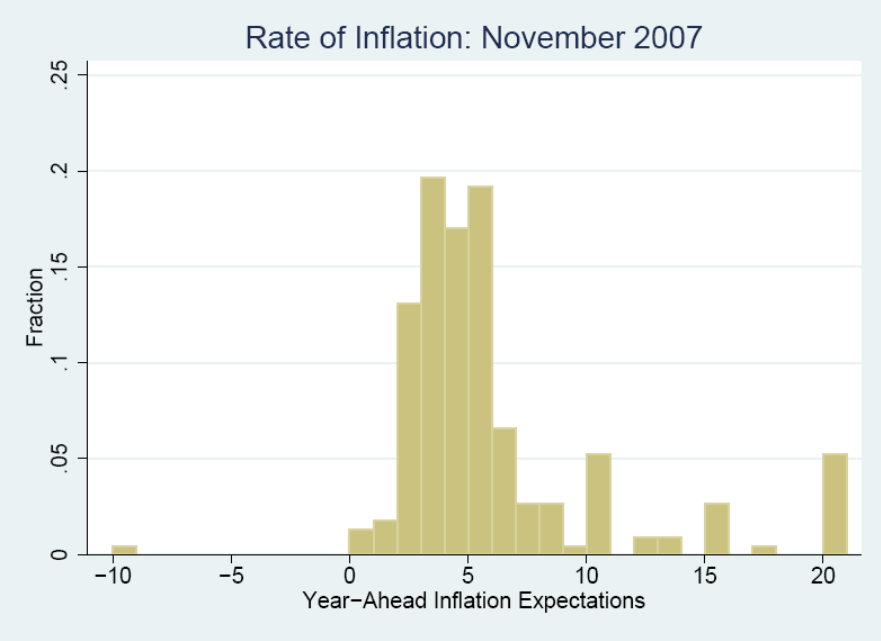
Fed-ALP Panel

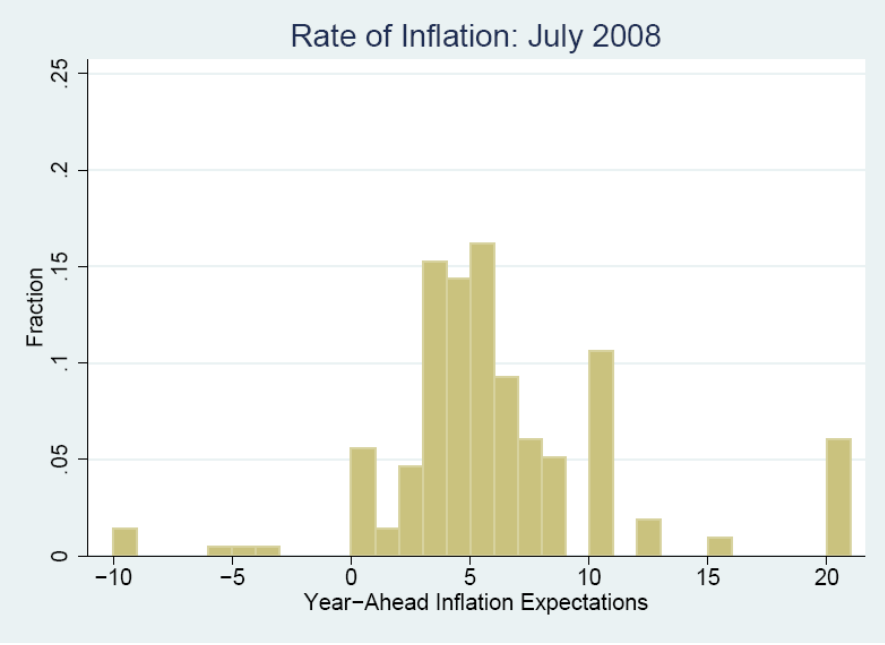
Fig 1.12 Prices in General and Rate of Inflation: Disagreement (IQR) Across Year-Ahead Forecasts



Fed-ALP Panel

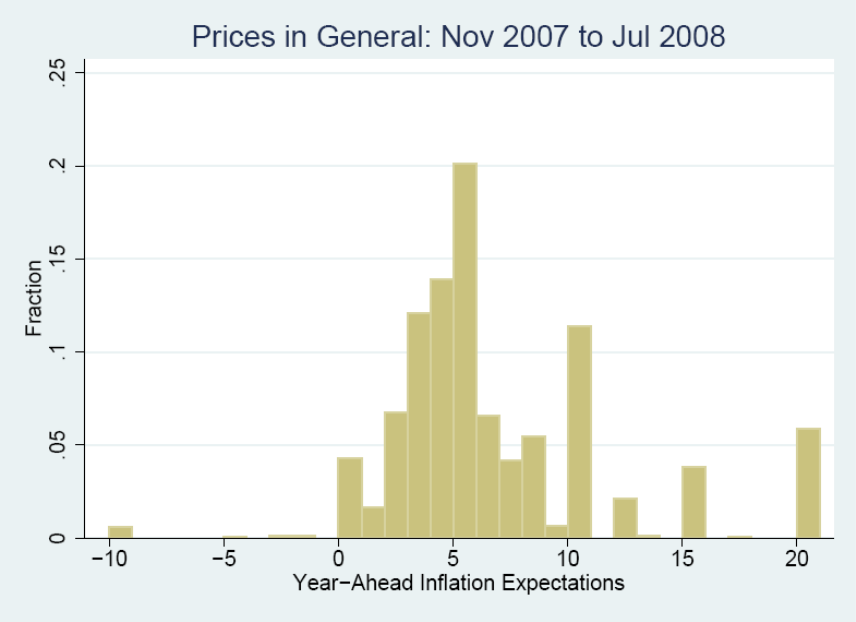
Fig 1.13 Distribution Changes from Nov 2007 vs. Jul 2008: Rate of Inflation

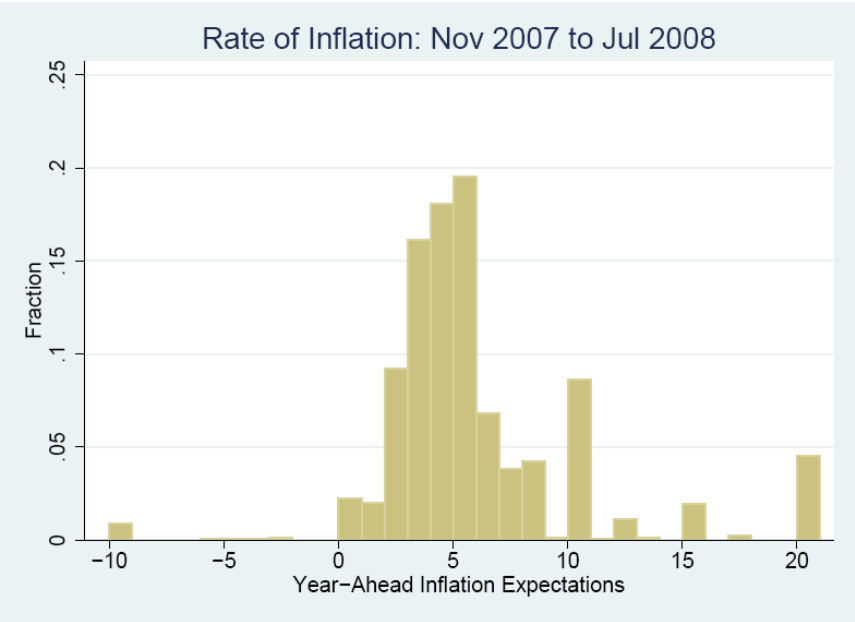




Fed-ALP Panel micro data. Point forecasts from ‘Rate of Inflation’ question. Forecasts above 20 have been coded to 20 while forecasts below -10 have been coded to -10 for display purposes.

Fig 1.14 Comparison of Forecast Distributions: Prices in General vs. Rate of Inflation





Fed-ALP Panel micro data, pooled across months. Forecasts above 20 have been coded to 20 while forecasts below -10 have been coded to -10 for display purposes.

Table 1.12 Heterogeneity in Year-Ahead Forecasts by Demographics

	December			May		
Median (IQR)	**MI**	**RI**	**PP**	**MI**	**RI**	**PP**
Female	5.0** (6.7)	4.9** (5.1)	5.0 (7.1)	7.3 (10.7)	5.5** (8.3)	9.8* (10.4)
Male	4.2 (2.7)	4.0 (2.5)	4.5 (3.5)	6.1 (5.5)	4.6 (3.8)	5.8 (6.1)
No B.A	5.1** (7.0)	5.1** (6.4)	5.0* (7.2)	9.0** (10.4)	5.7** (10.9)	9.7 (10.6)
B.A. or More	4.2 (2.6)	3.9 (2.2)	4.6 (3.2)	5.5 (5.5)	4.9 (3.5)	7.3 (7.8)
Single	4.9 (6.4)	4.6 (3.8)	4.6 (7.2)	7.0 (10.5)	5.2 (8.4)	9.7 (11.0)
Married	4.6 (4.6)	4.5 (3.3)	4.8 (5.0)	6.3 (5.8)	5.1 (6.1)	7.8 (10.1)
Income<=75K	5.0** (6.8)	4.9** (5.0)	5.0* (7.0)	7.6** (10.1)	6.4** (11.4)	9.6 (10.7)
Income>75K	4.4 (2.7)	3.9 (2.4)	4.6 (3.6)	5.4 (5.9)	4.7 (3.0)	7.7 (5.8)
Age in [40,59]	4.4* (3.9)	4.2 (3.1)	4.6* (4.1)	5.9 (5.5)	4.8 (6.7)	6.9* (10.2)
Age not in [40,59]	4.9 (6.5)	4.7 (3.8)	5.0 (6.7)	7.1 (10.5)	5.5 (6.0)	9.8 (10.3)
Obs	608	310	296	261	233	261

Fed-ALP December and May Special modules. Difference in median test between demographic pairs: ** p<.01; * p<.05

Table 1.13 Heterogeneity in Year-Ahead Forecasts by Knowledge/Financial Behavior

Rank correlations between ratings and point forecasts

	MI	RI	PP
Numeracy	-0.26**	-0.28**	-0.25**
Financial Knowledge	-0.00	-0.03	-0.01
Financial Literacy	-0.18**	-0.17**	-0.16**
Financial Literacy confidence	-0.12**	-0.11	-0.13*
Planning Horizon – Spending	-0.12**	-0.09	-0.09
Planning Horizon – Saving	-0.12**	-0.12*	-0.10
Responsibility Budgeting	0.03	0.01	-0.06
Responsibility Paying Bills	0.05	0.03	-0.03
Responsibility Shopping	0.10*	0.13*	0.04
Responsibility Investing	-0.06	-0.04	-0.08

Fed-ALP December Special module. Point forecasts from 'prices in general' question. Spearman rank correlations. ** p<0.01 ; * p<0.05. Numeracy measured as number of correct answers out of 11 questions. Self-assessed financial knowledge varies from 1(not knowledgeable) to 7 (very knowledgeable). Financial literacy is measured as number of correct answers out of 3 and confidence as average self assessed confidence in provided answers which varies from 0 (just guessing) to 1 (absolutely sure). The planning horizon was measured by responses to the question 'In deciding how much of their [family] income to spend, people are likely to think about different financial planning periods. In planning your [family's] spending, which of the following time periods is most important to you [and your husband/wife/partner]', with answers varying from 'Next day' (1) to 'Longer than 10 years' (9). Responsibility for various household tasks was measured by responses to the question 'In your household, how much responsibility do you have for the following tasks', with choices varying from none (1) to all (5).

Table 1.14 Relationship to Price Change Expectations of Specific Goods

December Special Module

	MI	**RI**	**PP**	**Milk**	**Gas**
Median	4.7	4.5	4.8	3.9	9.7
IQR	5.0	3.4	6.8	7.6	15.3
Obs	608	310	296	269	338

Rank correlations	**MI**	**RI**	**PP**
Milk	0.45	0.33	0.39
Gas	0.38	0.14	0.49

May Special Module

	MI	**RI**	**PP**	**Housing**	**Food**	**Transp**
Median	6.5	5.1	8.2	0.9	5.4	10.2
IQR	7.1	6.4	10.2	5.3	6.6	14.9
Obs	261	233	261	741	748	557

Rank Correlations	**MI**	**RI**	**PP**	**Housing**	**Food**	**Transp**
Housing	0.19	0.24	0.27	1	0.17	0.14
Food	0.69	0.40	0.53	0.17	1	0.56
Transportation	0.55	0.37	0.50	0.14	0.56	1

Fed-ALP December and May Special modules. Differences between Milk and both MI and PP forecasts are statistically significant at 5% level. Difference between Gas and MI, RI and PP forecasts are all statistically significant at 1% level. All rank correlations are statistically significant at the 1% level except the correlation between RI and Gas, which is statistically significant at the 5% level.

Table 1.15 Relationship to Price Change Expectations of Specific Goods (2)

Rank Correlations between MI, RI, PP forecasts and expectations for specific goods

		MI	RI	PP
Price expectation				
Housing	low share	0.17**	0.20**	0.20**
	high share	0.21**	0.30**	0.34**
Food	low share	0.65**	0.28**	0.52**
	high share	0.74**	0.44**	0.50**
Transportation	low share	0.46**	0.33**	0.39**
	high share	0.62**	0.41**	0.61**

Rank correlations between MI, RI, PP forecasts and expenditure shares

	MI	RI	PP	Mean expend share
Expenditure shares				
% housing	0.06	0.18**	0.08	34%
% food	0.09	0.07	-0.00	20%
% transportation	0.27**	0.12	0.16*	18%

Fed-ALP May Special module. Expenditure shares were only available for respondents who listed housing [or food or transportation] as one of their top three expenditure categories, which was the case for respectively 87%, 87% and 82% of the sample.

Table 2.1 Measuring uncertainty

[After instructions]:

What do you think is the percent chance that, during **the next 12 months**, the following things will happen?

Prices in general will:

go up by 12% or more	_____ percent chance
go up by 8% to 12%	_____ percent chance
go up by 4% to 8%	_____ percent chance
go up by 2% to 4%	_____ percent chance
go up by 0% to 2%	_____ percent chance
go down by 0% to 2%	_____ percent chance
go down by 2% to 4%	_____ percent chance
go down by 4% or more	_____ percent chance
	100 % Total

Table 2.2 Question Clarity and Difficulty

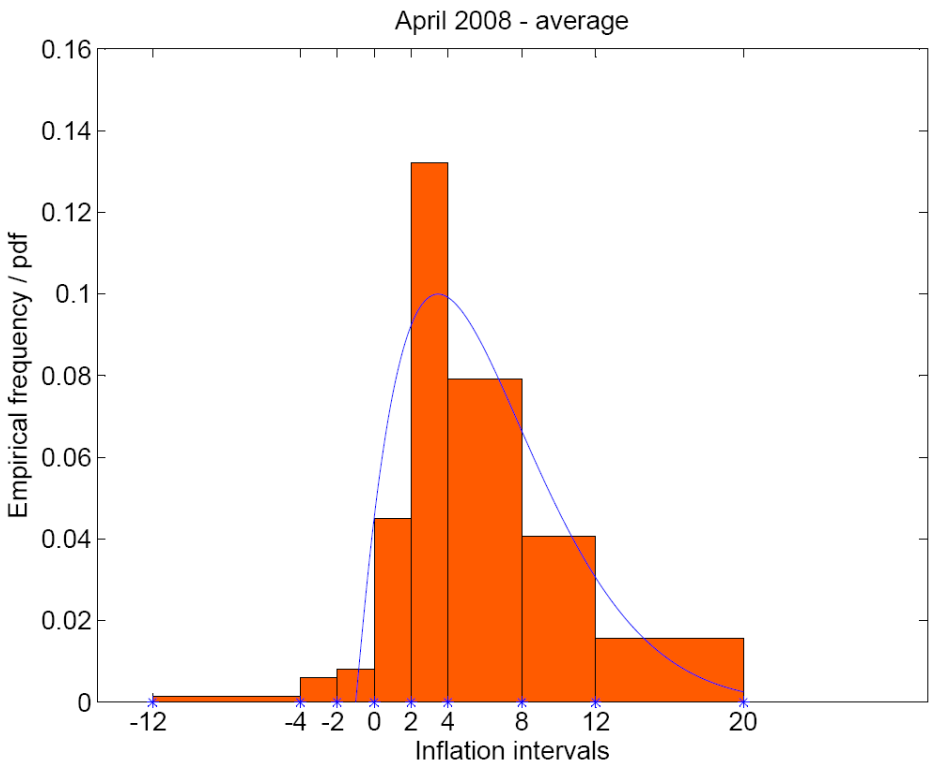
Average Ratings

	MI	RI	PP
How hard was question?			
(1=very easy, 7=very hard)			
Point forecast	3.6**	4.3*	3.4**
Density forecast	3.9	4.1	3.9
How hard to come up with answers that added up to 100%?			
(1=very easy, 7=very hard)			
Density forecast	3.7	3.7	3.7
How clear was question?			
(1=very unclear, 7=very clear)			
Point forecast	5.5**	5.4	5.7**
Density forecast	5.3	5.2	5.3

Fed-ALP December Special module. Paired t-tests for equality of ratings point and density forecast rating: ** p<0.01; * p<0.05.

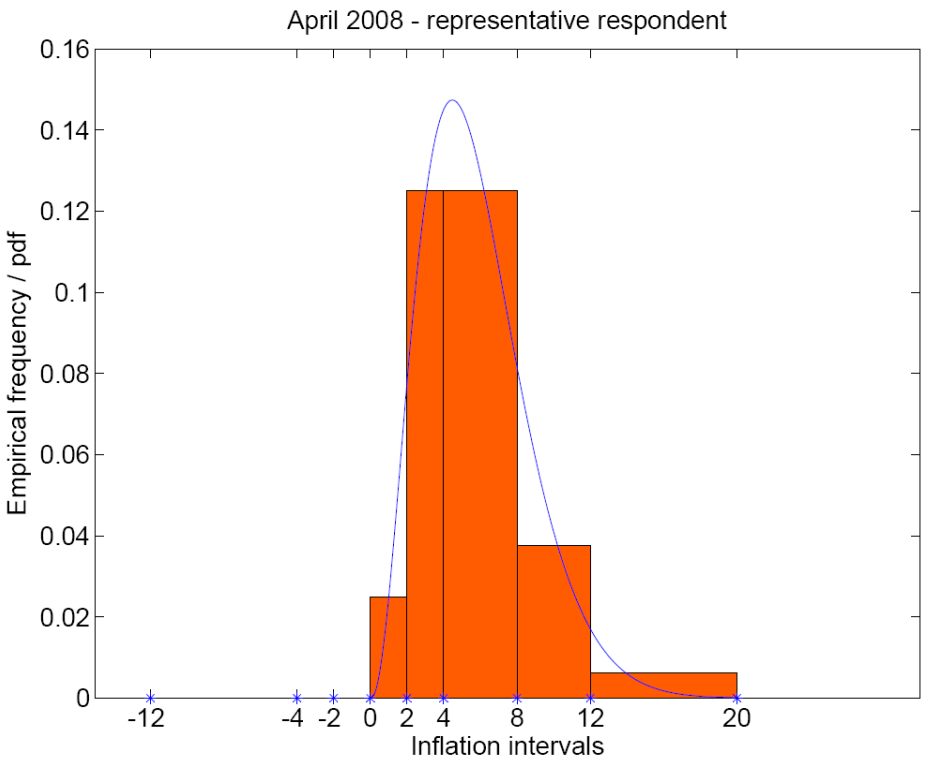
Fig 2.1 Probabilistic Responses and Fitted Densities

Average Across Individuals



Mean	Median	IQR
6.2	5.4	5.9

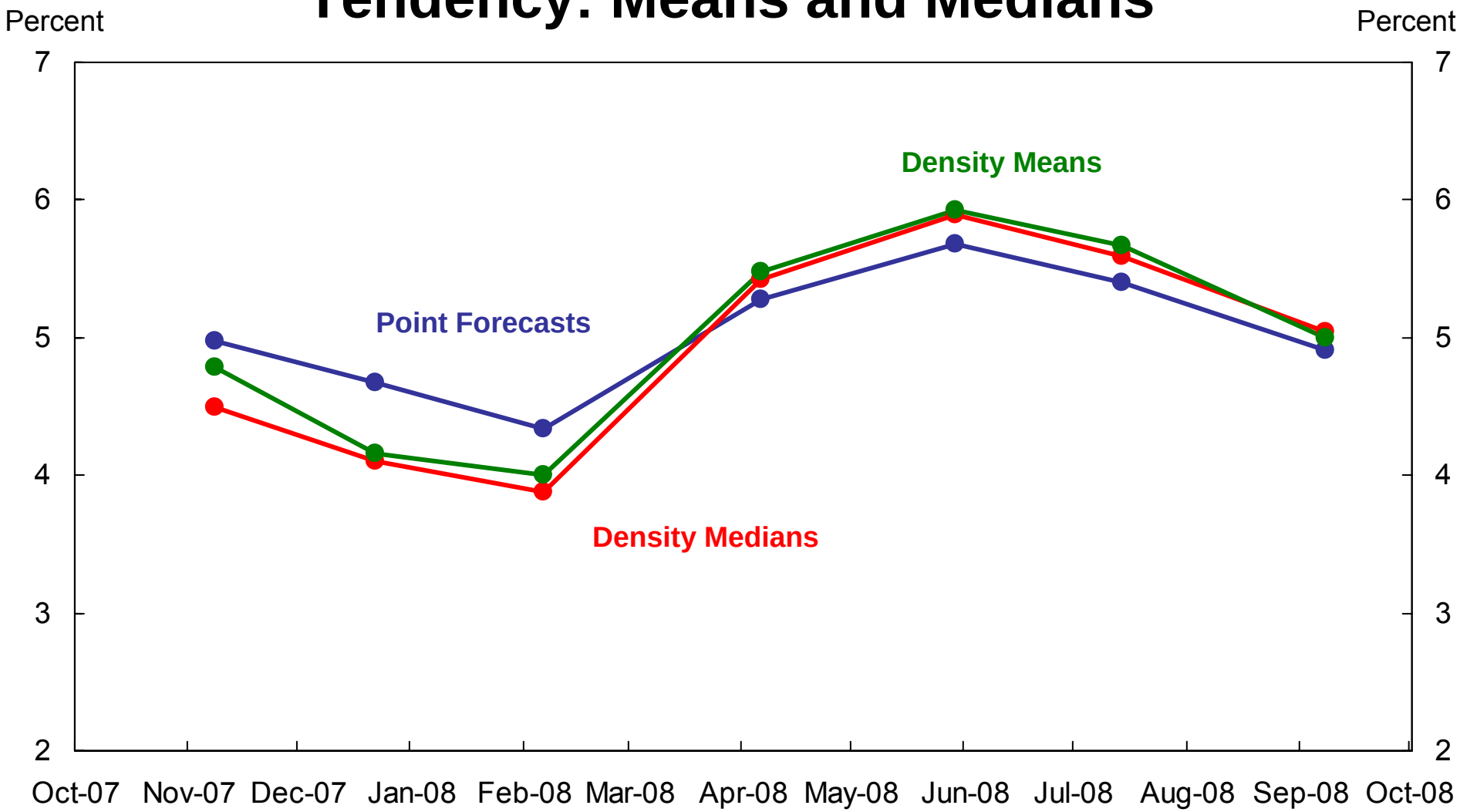
Respondent with Median Uncertainty



Mean	Median	IQR
5.8	5.4	3.8

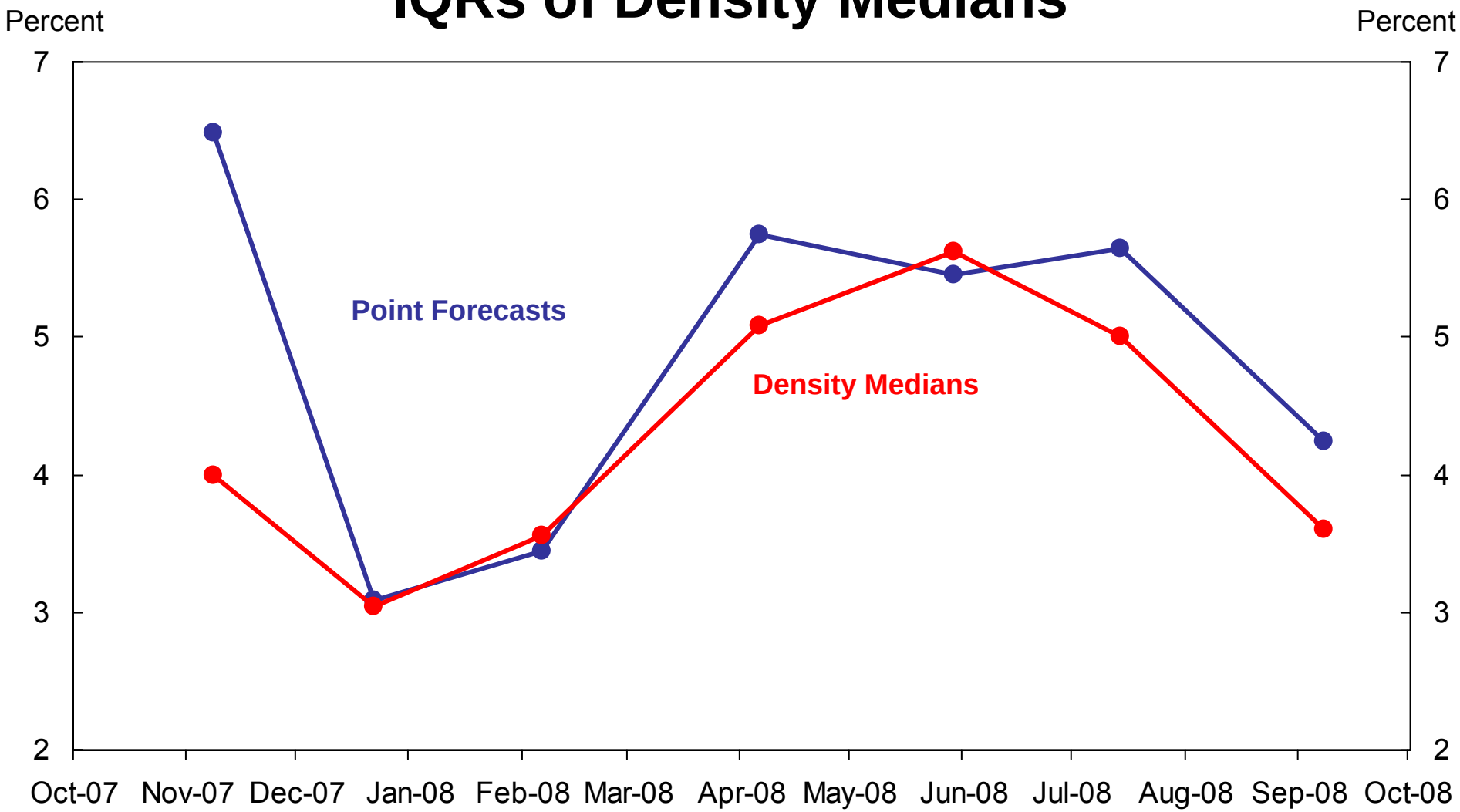
Fed-ALP Panel

Fig 2.2 Density-Based Measures of Central Tendency: Means and Medians



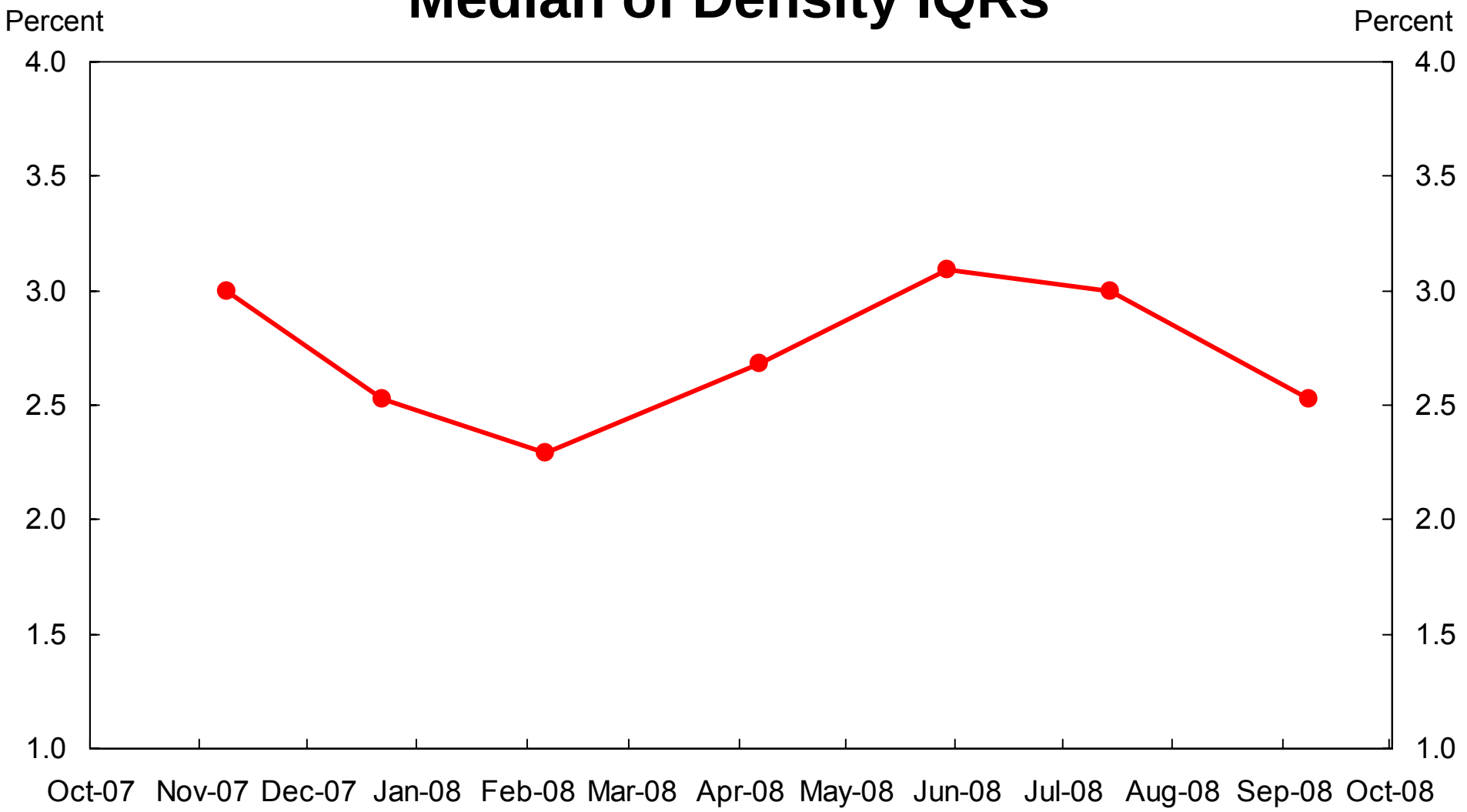
Fed-ALP Panel. Data are from ‘prices in general’ question. All reported numbers are sample medians.

Fig 2.3 Density-Based Measure of Disagreement: IQRs of Density Medians



Fed-ALP Panel. Data are from ‘prices in general’ question. All reported numbers represent sample IQRs.

Fig 2.4 Density-Based Measure of Uncertainty: Median of Density IQRs



Fed-ALP Panel. Data are from ‘prices in general’ question. Sample medians of individual density IQRs.

Table 2.3 Heterogeneity in Density Forecasts by Demographics

	Density Median	Disagreement	Uncertainty	Obs
Female	5.5**	6.0	3.1**	1046
Male	4.9	3.6	2.7	930
No B.A	5.7**	6.3	3.0	945
B.A. or More	4.8	3.8	2.8	1031
Single	5.4**	5.7	2.9	721
Married	5.0	4.2	2.8	1258
Income<=75K	5.8**	6.2	3.0**	1144
Income>75K	4.6	3.7	2.6	830
Age 40-59	5.0	4.8	3.0	1317
Age Not 40-59	5.6	5.1	2.7	662

Fed-ALP Panel from November 2007 to July 2008. Difference between demographics statistically significant at the 5% (*) or the 1% (**) level. Disagreement is measured by the sample IQR of the density medians, and uncertainty is measured by the sample median of the individual density IQRs.

Table 2.4 Heterogeneity in Uncertainty by Knowledge/Financial Behavior

Rank correlations between ratings and uncertainty

Numeracy	-0.26**
Financial Knowledge	-0.09*
Financial Literacy	-0.14**
Financial Literacy confidence	-0.16**
Planning Horizon – Spending	-0.16**
Planning Horizon – Saving	-0.16**
Responsibility Budgeting	-0.02
Responsibility Paying Bills	-0.00
Responsibility Shopping	0.05
Responsibility Investing	-0.10**

Fed-ALP December Special module. Point forecasts from 'prices in general' question. Spearman rank correlations. ** p<0.01 ;* p<0.05. Numeracy measured as number of correct answers out of 11 questions. Self-assessed financial knowledge varies from 1(not knowledgeable) to 7 (very knowledgeable). Financial literacy is measured as number of correct answers out of 3 and confidence as average self assessed confidence in provided answers which varies from 0 (just guessing) to 1 (absolutely sure). The planning horizon was measured by responses to the question 'In deciding how much of their [family] income to spend, people are likely to think about different financial planning periods. In planning your [family's] spending, which of the following time periods is most important to you [and your husband/wife/partner]', with answers varying from 'Next day' (1) to 'Longer than 10 years' (9). Responsibility for various household tasks was measured by responses to the question 'In your household, how much responsibility do you have for the following tasks', with choices varying from none (1) to all (5).

Table 2.5 Comparing Uncertainty across Alternative Expectation Questions

	MI Prices in General	**RI** Rate of Inflation	**PP** Prices You Pay	**Milk**	**Gas**
Median Uncertainty	2.8	2.7**	3.0	2.6*	4.9**
Dispersion in Uncertainty (IQR)	3.1	2.7	3.4	3.2	5.3
Obs	592	307	286	266	332
% identical density as MI		16%	33%	8%	11%
Rank correlations					
MI	1	0.68	0.86	0.54	0.38
RI		1	NA	0.42	0.22
PP			1	0.55	0.44

Fed-ALP December Special module. * Differences with MI question significant at 5% level. ** Differences with MI question significant at 1% level. All rank correlations are statistically different from zero at the 1% level.

Table 2.6 Heterogeneity in Uncertainty Across Alternative Expectation Questions by Demographics

Median Uncertainty (Density IQR)	MI	RI	PP
Female	3.2**	2.8	3.1
Male	2.6	2.6	2.8
No B.A	3.6**	3.2**	3.7**
B.A. or More	2.4	2.2	2.6
Single	3.1	3.0	3.5
Married	2.8	2.5	2.8
Income<=75K	3.1	3.2**	3.2
Income>75K	2.7	2.4	2.7
Age in [40,59]	3.1	2.6	3.0
Age Not in [40,59]	2.7	2.9	3.0

Fed-ALP December Special module. Differences between demographics are statistically significant at the 1% (**) level.

Table 2.7 Heterogeneity in Uncertainty Across Different Expectation Questions by Knowledge/Financial Behavior

Rank correlations between ratings and uncertainty

	MI	RI	PP
Numeracy	-0.26**	-0.23**	-0.26**
Financial Knowledge	-0.09*	-0.11*	-0.15**
Financial Literacy	-0.14**	-0.21**	-0.14*
Financial Literacy confidence	-0.16**	-0.11	-0.25**
Planning Horizon – Spending	-0.16**	-0.12*	-0.24**
Planning Horizon – Saving	-0.16**	-0.08	-0.28**
Responsibility Budgeting	-0.02	-0.03	0.03
Responsibility Paying Bills	-0.00	0.00	0.06
Responsibility Shopping	0.05	0.09	0.07
Responsibility Investing	-0.10**	-0.09	-0.11

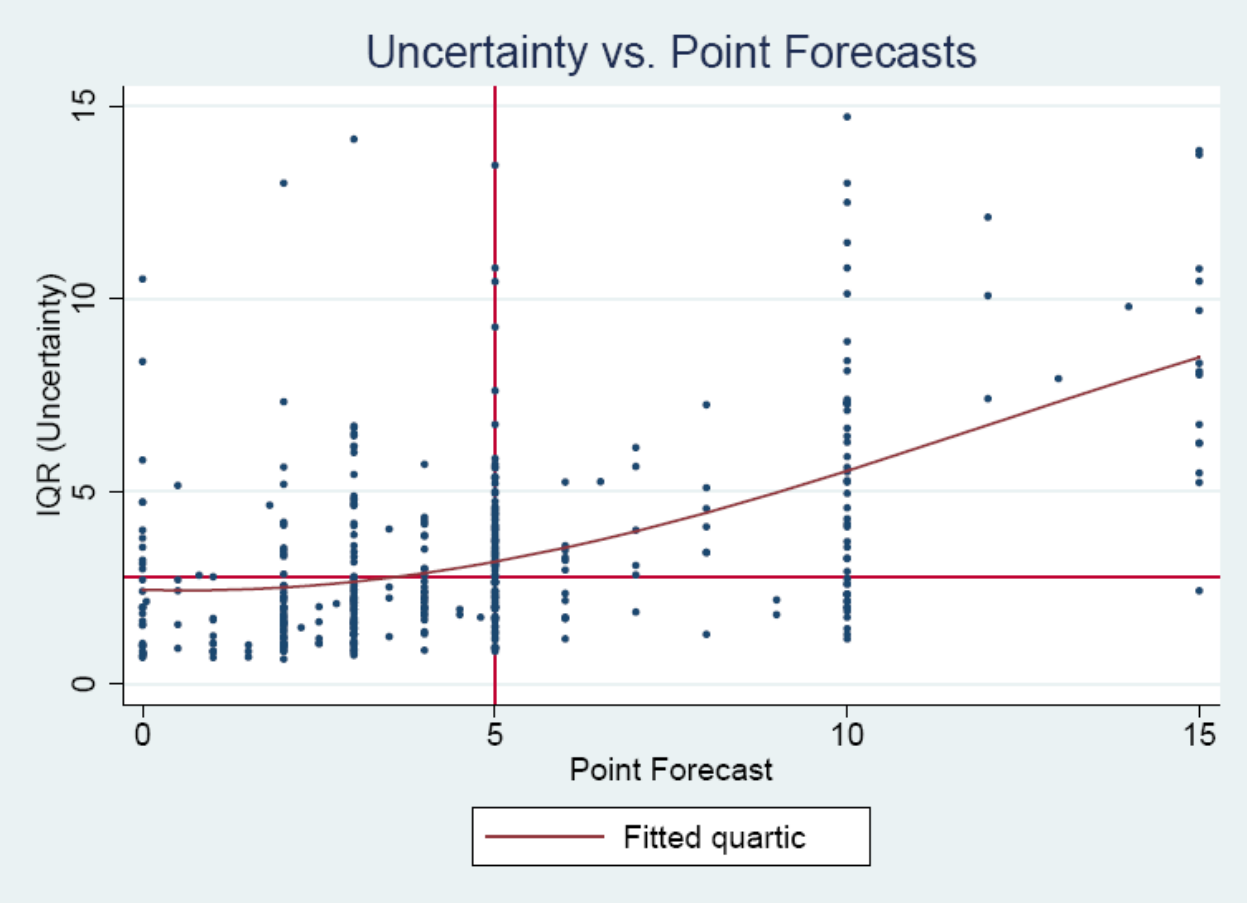
Fed-ALP December Special module. Point forecasts from 'prices in general' question. Spearman rank correlations. ** p<0.01 ;* p<0.05. Numeracy measured as number of correct answers out of 11 questions. Self-assessed financial knowledge varies from 1(not knowledgeable) to 7 (very knowledgeable). Financial literacy is measured as number of correct answers out of 3 and confidence as average self assessed confidence in provided answers which varies from 0 (just guessing) to 1 (absolutely sure). The planning horizon was measured by responses to the question 'In deciding how much of their [family] income to spend, people are likely to think about different financial planning periods. In planning your [family's] spending, which of the following time periods is most important to you [and your husband/wife/partner]', with answers varying from 'Next day' (1) to 'Longer than 10 years' (9). Responsibility for various household tasks was measured by responses to the question 'In your household, how much responsibility do you have for the following tasks', with choices varying from none (1) to all (5).

Table 2.8 Relating Density Forecasts to Point Forecasts

	Point Forecasts				
Rank Correlations	**MI**	**RI**	**PP**	**Milk**	**Gas**
	Prices in General	Rate of Inflation	Prices You Pay		
Density Median	0.73	0.82	0.62	0.80	0.78
Density IQR (Uncertainty)	0.55	0.52	0.56	0.54	0.50

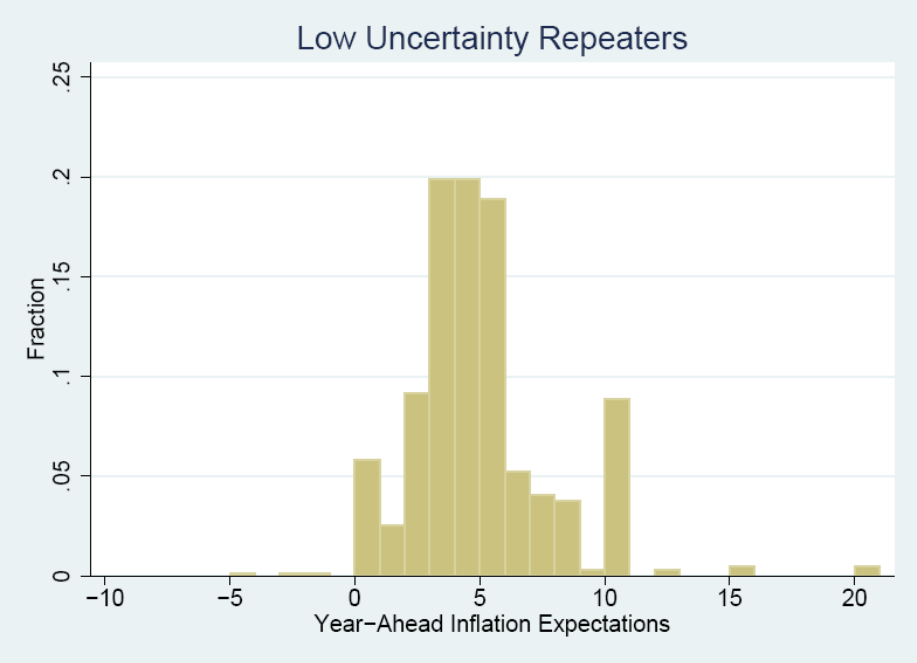
Fed-ALP December Special module. All rank correlations are statistically different from zero at the 1% level.

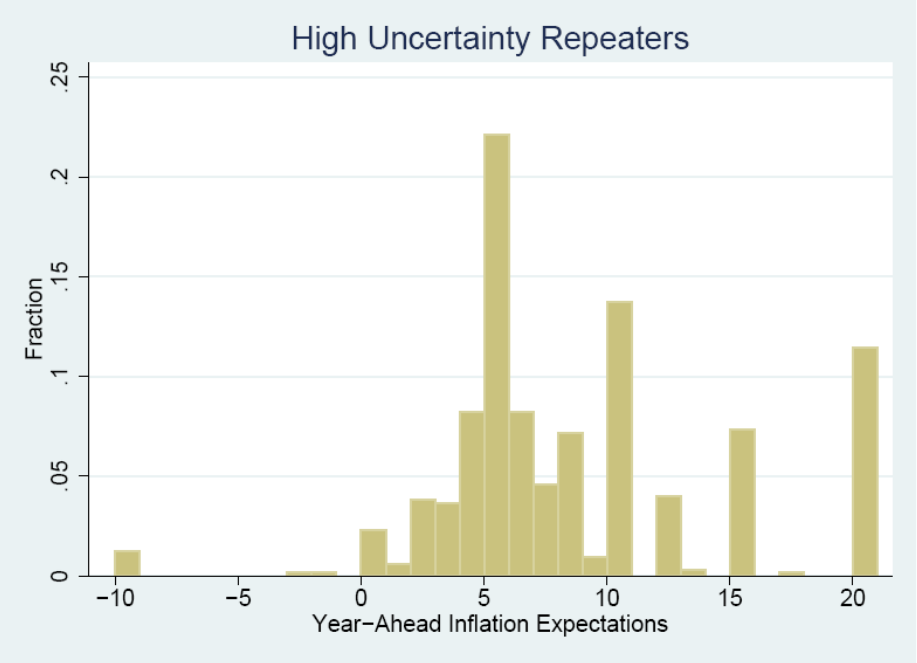
Fig 2.5 Year-Ahead Point Forecasts vs. Uncertainty



Fed-ALP December Special module. Data are from the 'prices in general' question.

Fig 2.6 Point Forecast Distributions for Low and High Uncertainty Respondents





Fed-ALP Panel pooled data from the 'prices in general' questions. Values greater than 20 are coded to 20 and values less than -10 are coded to -10.

Fig. 3.1 Structure of Michigan's Long-Term Inflation Expectations Question

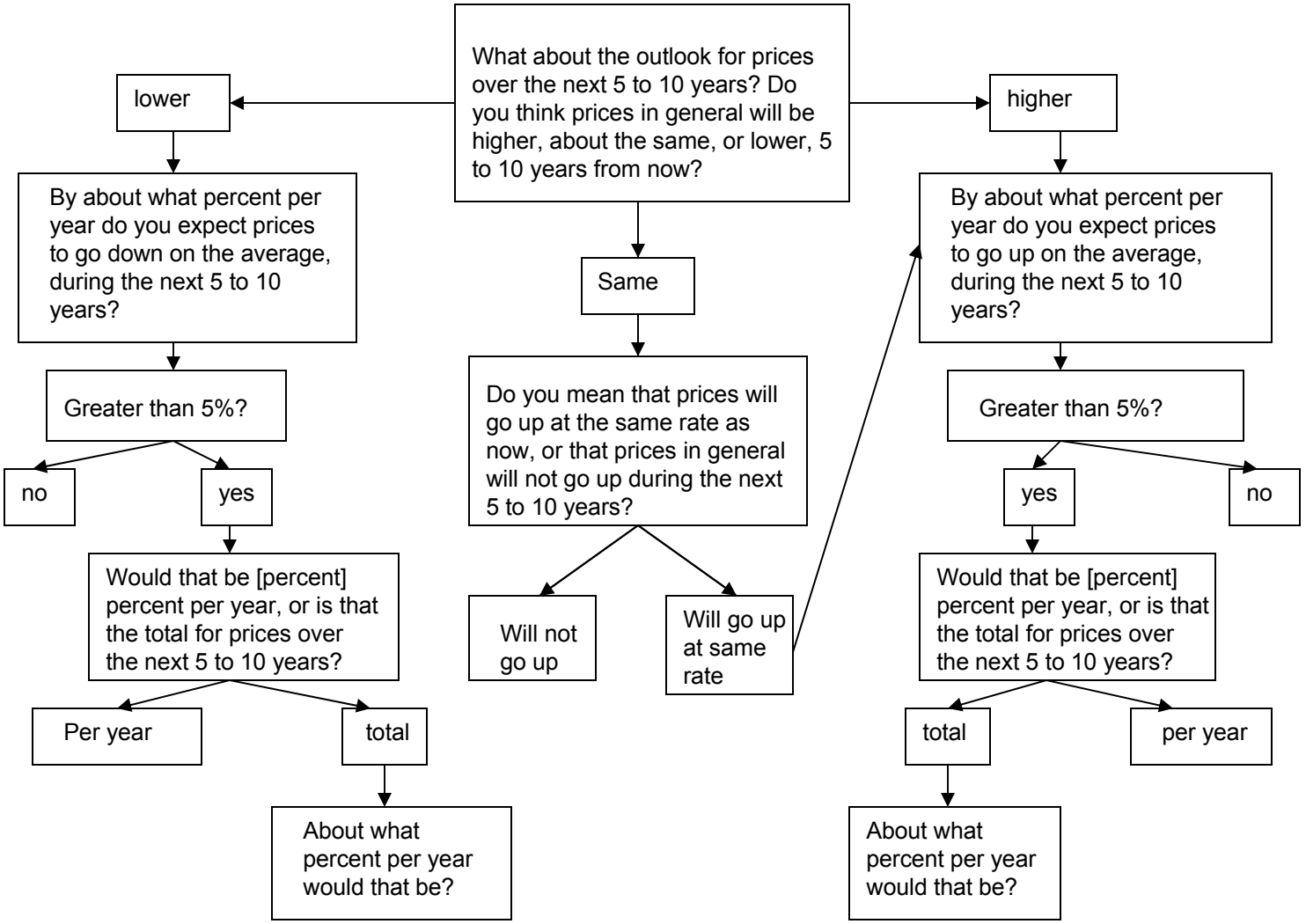
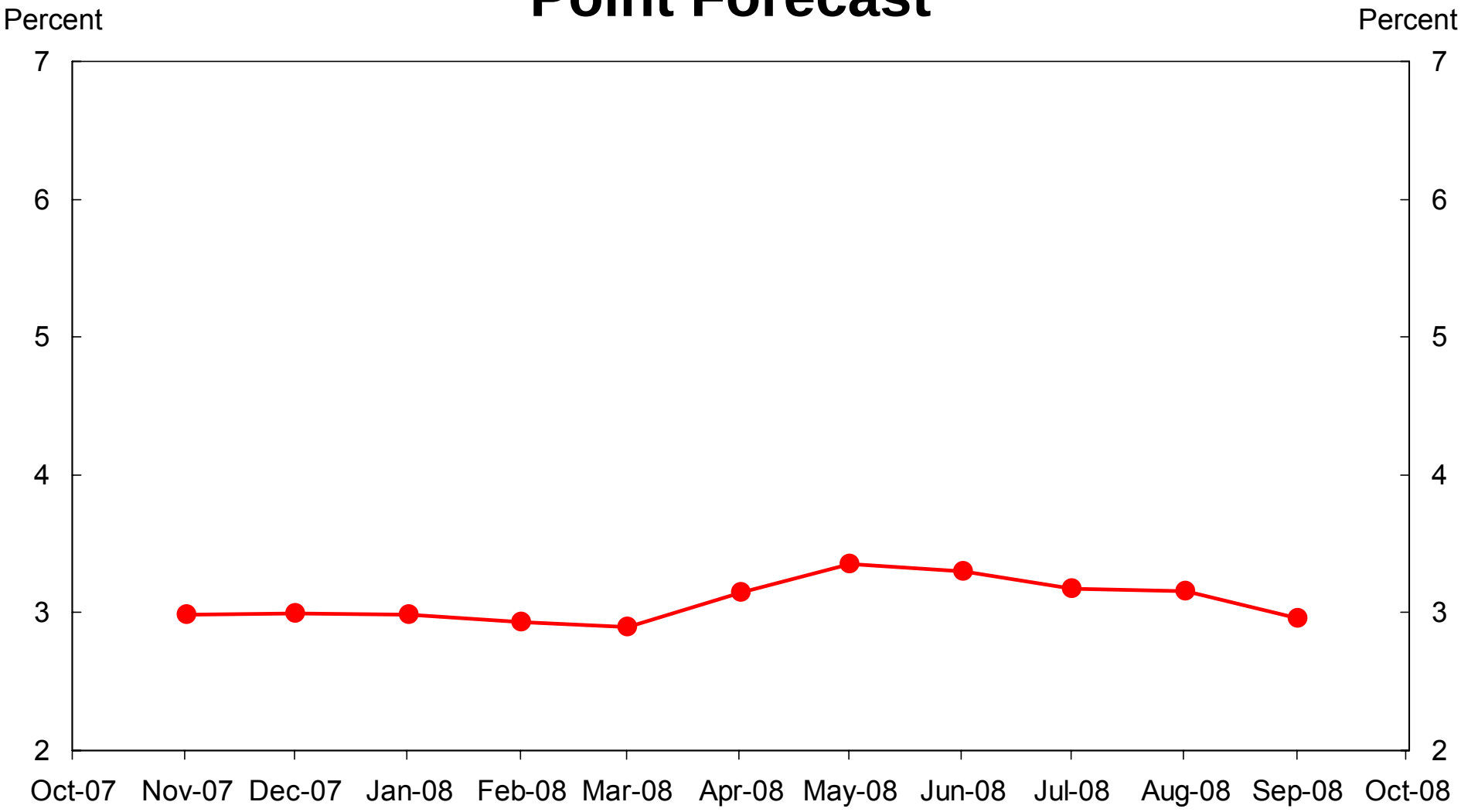


Fig 3.2 Michigan 5-10 Years Ahead Question: Median Point Forecast



Michigan Survey micro data

Table 3.1 Long-Term Forecasts

Five-to-Ten Year Ahead Forecasts

	MI Prices in General	**RI** Rate of Inflation	**PP** Prices You Pay
Median	3.7	3.2	4.2+
IQR	4.7	3.5	3.6
Obs	260	234	261
How hard was question? (1=very easy, 7=very hard)	4.4	4.6	4.2+
How clear was question? (1=very unclear, 7=very clear)	5.5	5.0**	5.4++
Revision rate after follow-up(%)	49	37**	50++
Correlation between revision rate and initial answer	0.38	0.37	0.48

Fed-ALP May Special module. ** Forecast statistically different from MI forecast at 1% level. + Forecast statistically different from RI forecast at 5% level. ++ Forecast statistically different from RI forecast at 1% level.

Table 3.2 What Time Horizon?

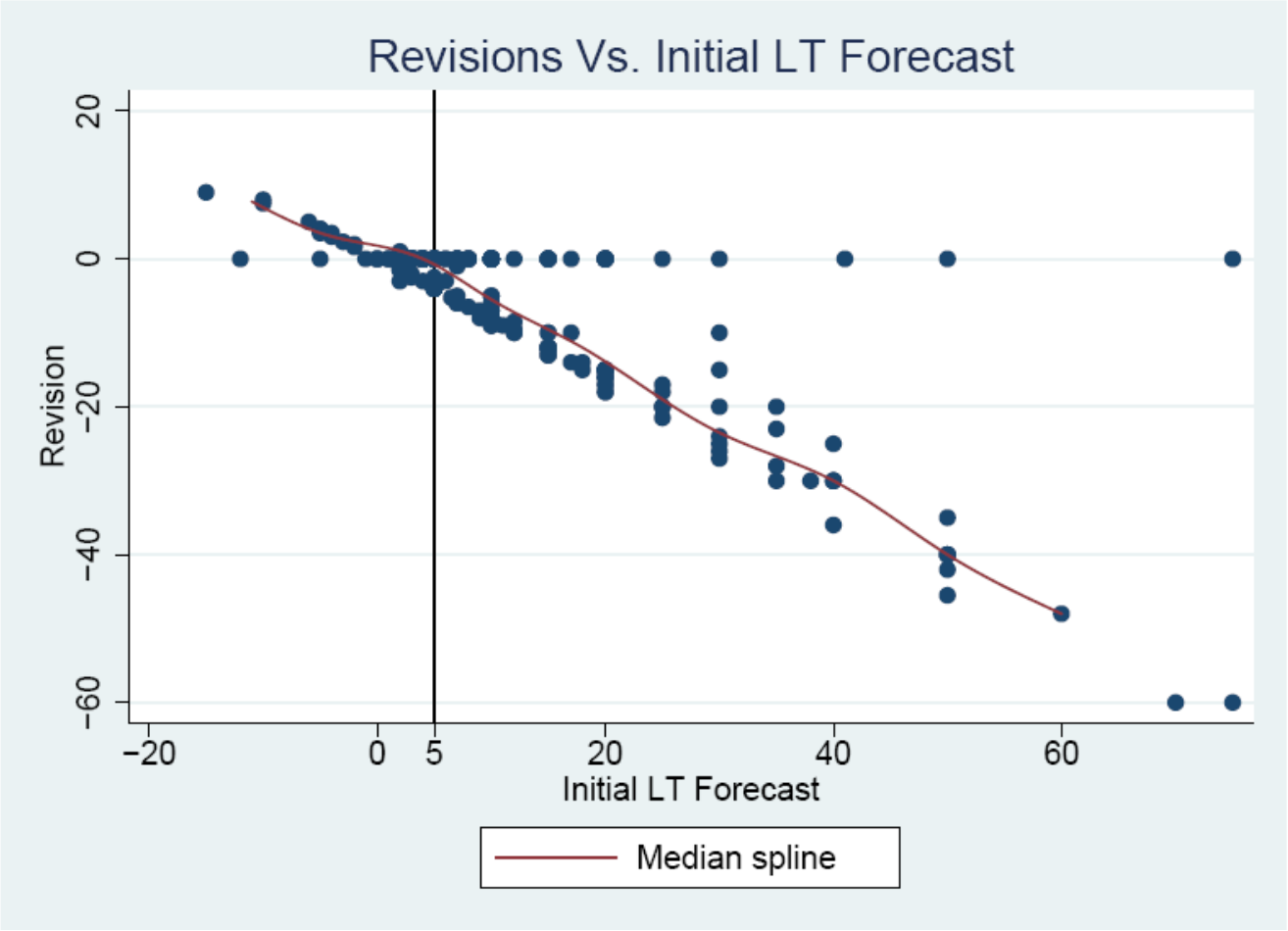
What option best describes what you thought of in coming up with an answer to the question?

- Thought mainly of changes in prices between now and 10 years from now
- Thought mainly of changes in prices between now and 5 years from now

Percentages	**MI**	**RI**	**PP**
Now - 10yrs	36	61**	32++
Now - 5yrs	57	33	64
Other	7	6	5

Fed-ALP May Special module. ** Statistically different from MI response at 1% level. ++ Statistically different from RI response at 1% level.

Fig 3.3 Revisions After Follow-Up



Fed-ALP May Special module.

Table 3.3 Heterogeneity in Long-Term Forecasts by Demographics

Median 5-10 Year Ahead Forecasts (IQR)	MI	RI	PP
Female	3.8 (7.7)	3.2 (4.2)	4.6* (4.7)
Male	3.7 (3.1)	3.2 (2.6)	3.8 (3.0)
No B.A	4.2 (7.5)	3.1 (3.9)	4.6 (5.5)
B.A. or More	3.3 (3.2)	3.3 (3.0)	3.9 (3.0)
Single	4.6* (7.2)	3.1 (4.7)	4.5 (4.2)
Married	3.4 (3.4)	3.2 (3.3)	4.1 (3.1)
Income<=75K	4.6** (7.7)	3.3 (4.6)	4.3 (4.7)
Income>75K	3.1 (2.9)	3.1 (2.9)	4.1 (3.0)
Age in [40,59]	3.5 (3.6)	3.1 (3.4)	4.0 (3.8)
Age Not in [40,59]	4.1 (5.5)	3.3 (3.5)	4.3 (3.3)

Fed-ALP December Special module. Differences between demographics are statistically significant at the 5% (*) or the 1% (**) level.

Table 3.4 Heterogeneity in Long-Term Forecasts by Knowledge/Financial Behavior

Rank correlations between ratings and long-term forecasts

	MI	RI	PP
Numeracy	0.00	0.07	0.07
Financial Knowledge	0.03	-0.03	0.10
Financial Literacy	0.04	-0.06	-0.03
Financial Literacy confidence	0.04	0.02	0.04
Planning Horizon – Spending	-0.06	0.05	-0.09
Planning Horizon – Saving	-0.11	0.01	0.04
Responsibility Budgeting	0.10	0.08	0.11
Responsibility Paying Bills	0.08	0.09	0.06
Responsibility Shopping	0.12	0.07	0.10
Responsibility Investing	0.12	0.08	-0.02

Fed-ALP December Special module. Point forecasts from ‘prices in general’ question. Spearman rank correlations. ** p<0.01 ;* p<0.05. Numeracy measured as number of correct answers out of 11 questions. Self-assessed financial knowledge varies from 1(not knowledgeable) to 7 (very knowledgeable). Financial literacy is measured as number of correct answers out of 3 and confidence as average self assessed confidence in provided answers which varies from 0 (just guessing) to 1 (absolutely sure). The planning horizon was measured by responses to the question 'In deciding how much of their [family] income to spend, people are likely to think about different financial planning periods. In planning your [family's] spending, which of the following time periods is most important to you [and your husband/wife/partner]', with answers varying from 'Next day' (1) to 'Longer than 10 years' (9). Responsibility for various household tasks was measured by responses to the question 'In your household, how much responsibility do you have for the following tasks', with choices varying from none (1) to all (5).

Table 3.5 Relating Long-Term and Short-Term Forecasts

Rank correlations	MI	RI	PP
One-Year Ahead Forecasts	0.53**	0.40**	0.49**
Median Difference LT-ST	-2.4	-1.8	-2.5
Female	-2.3	-2.5**	-3.0
Male	-2.5	-1.1	-1.8
No B.A.	-2.1	-2.8**	-2.3
B.A. or More	-2.6	-1.3	-2.6
Income<75K	-2.5	-2.5**	-2.3
Income>75K	-2.2	-1.2	-2.8

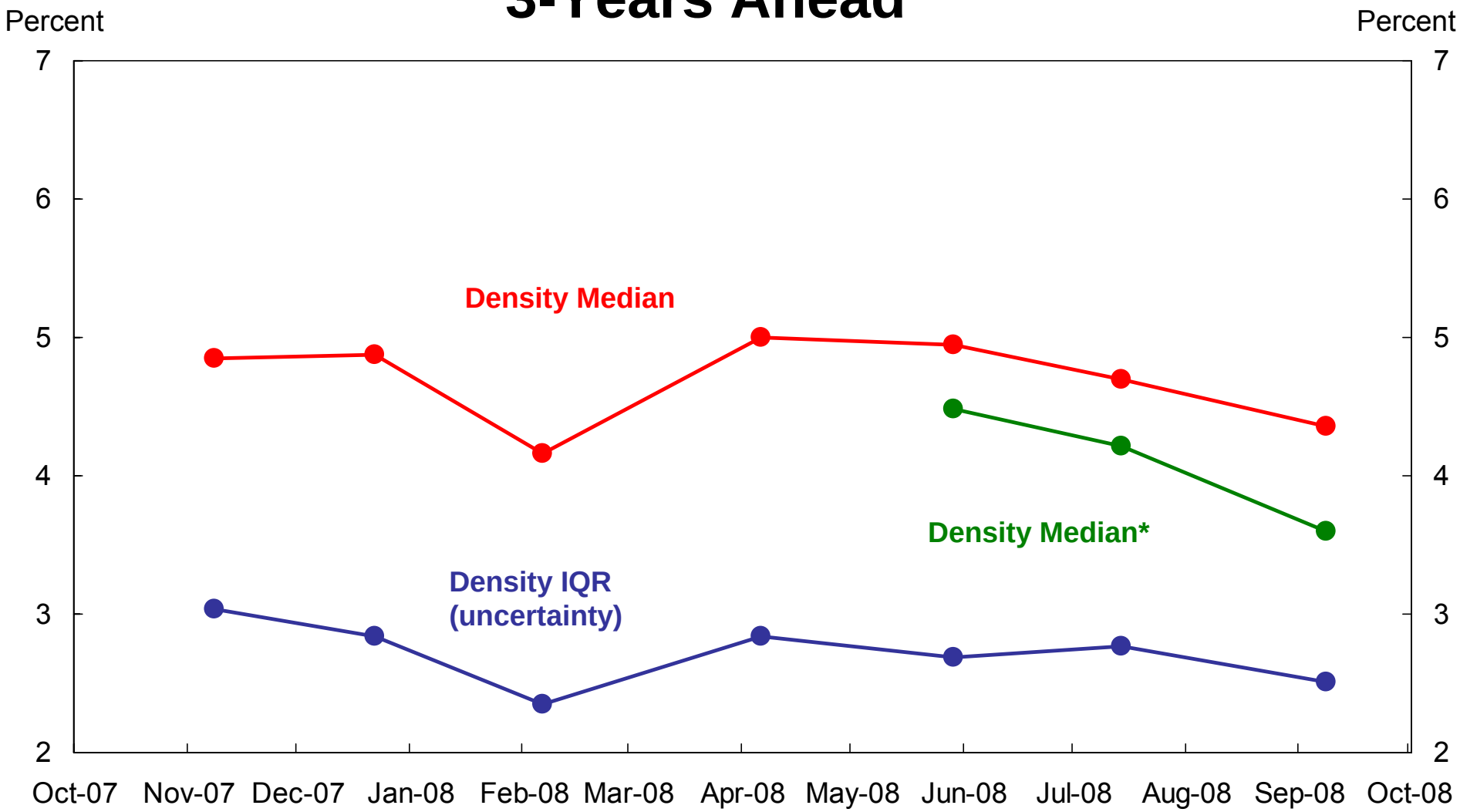
Fed-ALP December Special module. Spearman rank correlations. ** p<0.01.

Table 3.6 Relationship Between Long-Term Expectations and Year-Ahead Price Change Expectations for Composite Goods

	Long-Term Forecast		
Rank Correlations	**MI**	**RI**	**PP**
Year-Ahead Forecast of			
Food	0.52	0.33	0.46
Housing	0.26	0.21	0.25
Transportation	0.39	0.32	0.35

Fed-ALP May Special module. Spearman rank correlations. All differences are significant at the 1% level.

Fig 3.4 Trends in Expectations for Rate of Inflation 3-Years Ahead



Fed-ALP Panel. * Sample of respondents who first answered year-ahead question.

Table 4.1 Year-Ahead Forecasts of Wage Changes

	Own Wage Current Job	Own Wage Any Job	Wages in General
Median	2.8	3.0*	0.4**
Disagreement (IQR)	4.6	5.1	4.1
Obs	407	198	208
% same as own wage current job		84%	29%
% higher than own wage current job		11%	19%
Rank Correlations			
Own wage current job		0.89++	0.28++
Median probability of:			
Working in same job next year (workers)=			0.90
Working next year (non-workers)=			0.05

Fed-ALP December Special module. Median test statistically different from zero at the 5% (*) and 1%(**) levels. Spearman rank correlations. ++ p<.01.

Table 4.2 Heterogeneity in Wage Expectations

Median (IQR)	Own Wage Current Job	Own Wage Any Job	Wages in General
Female	2.7 (4.4)	2.6 (4.9)	0.4 (3.3)
Male	2.9 (4.7)	3.3 (5.7)	0.4 (2.9)
No B.A	2.8 (4.7)	2.9 (5.2)	0.3 (3.0)
B.A. or More	2.8 (4.4)	3.0 (4.9)	0.4 (3.2)
Single	2.9 (4.5)	3.3 (6.2)	0.4 (3.2)
Married	2.7 (4.5)	2.8 (5.0)	0.4 (3.1)
Income<=75K	2.5 (4.7)	2.6 (5.2)	0.4 (3.5)
Income>75K	3.0 (4.4)	3.3 (4.7)	0.3 (2.9)
Age in [40,59]	3.0* (4.9)	3.3 (6.0)	0.4 (3.3)
Age Not in [40,59]	2.7 (4.2)	2.8 (4.8)	0.4 (3.0)

Fed-ALP December Special module. Sample consists of individuals currently working. * $p<0.05$.

Table 4.3 Question Clarity and Difficulty

Average Ratings

	Own Wage Current Job	Own Wage Any Job	Wages in General
How hard was question?			
(1=very easy, 7=very hard)	2.4	2.6**	3.6**
How clear was question?			
(1=very unclear, 7=very clear)	6.4	6.3*	5.9**

Fed-ALP December Special module. Paired t-tests for equality of ratings of wage forecast, relative to MI question: ** p<0.01; * p<0.05.

Table 4.4 Wage Growth Relative to Inflation

Median difference between expected changes in prices and wages:

	Own Wage Current Job	Own Wage Any Job	Wages in General
MI	2.1**	1.4**	3.2**
RI	2.3**	NA	3.3**
PP	1.7**	1.3**	NA

Median difference between change in 'prices in general' (MI) and wages:

Female	2.9++	2.3+	3.5
Male	1.3	0.5	2.9
No BA	2.6	1.9	3.8+
BA	1.6	1.1	3.0
Income<75K	2.8+	2.4	3.3
Income>75K	1.4	0.8	3.1

	Probability wages will grow faster than prices you pay/ inflation next year		Probability wages will grow faster than prices you pay/ inflation over next 5 years	
	Own	**General**	**Own**	**General**
Median Probability	0.23	0.20	0.30	0.25

Fed-ALP December Special module. ** Statistically different from zero using the median test at the 1% level. Difference between demographics statistically significant at the 5% (+) or the 1% (++) level.

Table 4.5 Relating Wage Expectations to Inflation Expectations

Rank Correlations	Inflation Expectations				
	MI	**RI**	**PP**	**Milk**	**Gas**
Wage Change Forecast					
Own Wage: current job	-0.09	-0.02	-0.11	-0.01	-0.11
Own Wage: any job	-0.09	NA	-0.10	-0.12	-0.03
Wages in General	-0.12*	0.01	NA	0.02	-0.16*

Fed-ALP December Special module. Spearman rank correlations. * Statistically different from zero at the 5% level.

Table 4.6 Wage Change Density Forecast

Year-Ahead Wage Change (current job)

	Point Forecast	Density median	Density IQR (Uncertainty)
Median	2.8	3.0	2.0
IQR	4.6	3.8	2.3

Rank Correlation	Wage change uncertainty
Wage change point forecast	0.36**

	Future Price Change Uncertainty				
Rank Correlations	**MI**	**RI**	**PP**	**Milk**	**Gas**
Wage change point forecast	-0.02	0.01	-0.04	0.04	-0.03
Wage change uncertainty	0.17**	0.23**	0.17*	0.24**	0.11

Fed-ALP December Special module. Spearman rank correlations. Statistically different from zero at the 5% (*) or 1% (**) level.

Table 4.7 Recent Trends in Price and Wage Inflation Expectations

	June	July	Sept
Expected change in prices in general			
Median central forecast (density median)	5.9	5.6	5.0
Disagreement in central forecast (IQR)	5.6	5.0	3.6
Median uncertainty (density IQR)	3.1	3.0	2.5
Expected change in wage on current job			
Median central forecast (density median)	3.0	3.0	3.0
Disagreement in central forecast (IQR)	3.0	2.4	2.5
Median uncertainty (density IQR)	1.6	1.2	1.4

Fed-ALP Panel. Data from June and July 2008 surveys.

Table 5.1 Panel Data Regressions

	Estimate (std error) of a_1
Model 1: $\pi_{it} = a_0+a_1 \pi_{it-1}+\varepsilon_{it}$	0.39 (0.03)
Model 2: $\pi_{it} = a_0+a_1 \pi_{it-1}+X_i'b+\varepsilon_{it}$	0.35 (0.03)
Model 3: $\pi_{it} = a_0+a_1 \pi_{it-1}+X_i'b+\theta_i+\varepsilon_{it}$	-0.13 (0.08)
Model 4: $iqr(\pi)_{it} = a_0+a_1 iqr(\pi)_{it-1}+\varepsilon_{it}$	0.41(0.03)
Model 5: $iqr(\pi)_{it} = a_0+a_1 iqr(\pi)_{it-1}+X_i'b+\varepsilon_{it}$	0.38 (0.03)
Model 6: $iqr(\pi)_{it} = a_0+a_1 iqr(\pi)_{it-1}+X_i'b+\theta_i+\varepsilon_{it}$	0.04 (0.05)
Model 7: $\lvert\pi_{it}-\pi_{it-1}\rvert = a_0+a_1 iqr(\pi)_{it-1}+\varepsilon_{it}$	0.57(0.09)

Fed-ALP Panel micro data. π_{it} denotes individual *i*-th point forecast of year-ahead inflation in survey wave t, and $iqr(\pi)_{it}$ denotes individual *i*-th uncertainty (as measured by the density IQR) of year-ahead inflation in survey wave t. X_i represents a vector of demographic characteristics of individual I, θ_i is an individual random effect and ε_{it} are i.i.d residuals. Models 3 and 6 were estimated using the Arellano-Bound estimation procedure in Stata.

Table 5.2 Perceived Variability and Persistence of Inflation Shocks

	MI	RI	PP	Overall
Perceived variability (1=about same each year, 7=vary a lot year to year)	4.2	3.9	3.9	**4.0**
Revision of expectation due to inflation surprise				
Median	-0.3	-0.2	-0.2	**-0.2**
25th Percentile	-2.5	-2.1	-2.2	**-2.3**
75th Percentile	0.3	0.9	0.4	**0.4**
IQR	2.9	3.1	2.6	**2.7**
Observations	255	232	260	**747**
Rank correlations between revision and				
Perceived Variability	0.02	0.13*	0.13*	**0.09****

Fed-ALP December Special module. Spearman rank correlations. Statistically significant from zero at the 5% (*) or 1% (**) level.

Table 5.3 Perceived Persistence of Inflation Shocks by Demographics

Revision of expectation to increase in inflation next year by demographics

	MI	RI	PP
Female	-0.1	-0.1	-0.2
Male	-0.6	-0.3	-0.2
No B.A.	-0.2	-0.1	-0.2
BA or More	-0.3	-0.3	-0.2
Income≤75K	-0.2	-0.1	-0.2
Income>75K	-0.4	-0.2	-0.1

Fed-ALP December Special module. Variability(1=same each year, 7=varies a lot from year to year).

Table 5.4 Perceived Persistence of Inflation Shocks (Cont.)

If, in a given year, prices in general [inflation, prices you pay] were to go up much more than you expected, would that change what you expect to happen in the year after that?

	MI	RI	PP	Overall
I would expect bigger increases in prices	35	45	41	41
I would expect smaller increases in prices	38	23	34	32
No change in expectation	27	32	25	27

Median expected change in prices by qualitative response

	MI	**RI**	**PP**	**Overall**
Overall median	**-0.3**	**-0.2**	**-0.2**	**-0.2**
I would expect bigger increases in prices	0.1	0.3	0.1	0.2
I would expect smaller increases in prices	-0.9	-1.7	-0.5	-1.0
No change in expectation	-0.3	-0.2	-0.2	-0.2

Fed-ALP May Special module. Actual wording of answer options: I would expect bigger increases (or smaller decreases) in prices than I originally expected. I would expect smaller increases (or bigger decreases) in prices than I originally expected. I don't think that bigger increases in prices in one year have any effect on what I expect to happen in the following year.

Table 5.5 Perceived Inflation Over the Past Year

	MI Prices in General	RI Rate of Inflation	PP Prices You Pay
Perceived Inflation Past 12 Months			
Median	5.5	4.4**	7.3++
IQR	6.5	4.9	6.0
Obs	257	230	261
Forecast Next 12 Months			
Median	6.5	5.1**	8.2++
IQR	7.1	6.4	10.2
Obs	261	233	261

Fed-ALP May Special module. ** Difference from MI question is statistically significant at the 1% level. ++ Difference from RI question is statistically significant at the 1% level.

Table 5.6 Heterogeneity in Perceived Inflation by Demographics

	Past 12 months			Next 12 months		
Median (IQR)	**MI**	**RI**	**PP**	**MI**	**RI**	**PP**
Female	6.7 (11.0)	5.0* (6.9)	7.6 (10.0)	7.3 (10.7)	5.5** (8.3)	9.8* (10.4)
Male	5.3 (6.0)	4.0 (2.5)	6.3 (6.0)	6.1 (5.5)	4.6 (3.8)	5.8 (6.1)
No B.A	7.2* (11.1)	4.9 (7.0)	7.6 (5.9)	9.0** (10.4)	5.7** (10.9)	9.7 (10.6)
B.A. or More	5.2 (5.9)	4.1 (2.9)	6.1 (6.1)	5.5 (5.5)	4.9 (3.5)	7.3 (7.8)
Single	6.8 (11.0)	4.1 (6.6)	8.0 (8.0)	7.0 (10.5)	5.2 (8.4)	9.7 (11.0)
Married	5.3 (6.3)	4.5 (4.3)	6.6 (5.9)	6.3 (5.8)	5.1 (6.1)	7.8 (10.1)
Income<=75K	7.6** (10.8)	4.8 (7.3)	7.5 (6.1)	7.6** (10.1)	6.4** (11.4)	9.6 (10.7)
Income>75K	4.7 (4.5)	4.1 (2.6)	6.7 (5.9)	5.4 (5.9)	4.7 (3.0)	7.7 (5.8)
Age in [40,59]	5.1 (6.3)	4.0* (4.2)	6.4 (5.8)	5.9 (5.5)	4.8 (6.7)	6.9* (10.2)
Age not in [40,59]	6.7 (10.8)	4.8 (5.1)	7.9 (7.8)	7.1 (10.5)	5.5 (6.0)	9.8 (10.3)
Obs	261	233	261	261	233	261

Fed-ALP December and May Special modules. Difference between demographics statistically significant at the 5% (*) or the 1% (**) level.

Table 5.7 Heterogeneity in Perceived Inflation by Knowledge/Financial Behavior

Rank correlations between ratings and inflation perceptions and expectations

	Past 12 months			Next 12 months		
	MI	**RI**	**PP**	**MI**	**RI**	**PP**
Numeracy	-0.05	-0.14	0.02	-0.26**	-0.28**	-0.25**
Financial Knowledge	0.07	-0.12	0.29**	-0.00	-0.03	-0.01
Financial Literacy	0.03	-0.12	-0.10	-0.18**	-0.17**	-0.16**
Financial Literacy confidence	0.01	-0.10	-0.03	-0.12**	-0.11	-0.13*
Planning Horizon – Spending	-0.09	-0.04	-0.08	-0.12**	-0.09	-0.09
Planning Horizon – Saving	-0.09	0.05	-0.04	-0.12**	-0.12*	-0.10
Responsibility Budgeting	0.05	-0.09	0.11	0.03	0.01	-0.06
Responsibility Paying Bills	0.03	-0.08	0.10	0.05	0.03	-0.03
Responsibility Shopping	0.06	-0.04	0.16*	0.10*	0.13*	0.04
Responsibility Investing	0.04	-0.07	0.07	-0.06	-0.04	-0.08

Fed-ALP December Special module. Point forecasts from ‘prices in general’ question. Spearman rank correlations. ** p<0.01 ;* p<0.05. Numeracy measured as number of correct answers out of 11 questions. Self-assessed financial knowledge varies from 1(not knowledgeable) to 7 (very knowledgeable). Financial literacy is measured as number of correct answers out of 3 and confidence as average self assessed confidence in provided answers which varies from 0 (just guessing) to 1 (absolutely sure). The planning horizon was measured by responses to the question 'In deciding how much of their [family] income to spend, people are likely to think about different financial planning periods. In planning your [family's] spending, which of the following time periods is most important to you [and your husband/wife/partner]', with answers varying from 'Next day' (1) to 'Longer than 10 years' (9). Responsibility for various household tasks was measured by responses to the question 'In your household, how much responsibility do you have for the following tasks', with choices varying from none (1) to all (5).

Table 5.8 Relationship between Perceived Inflation and Expectations

	MI Prices in General	RI Rate of Inflation	PP Prices You Pay
Correlation of past inflation with forecast next 12 months, 5-10 years			
Next 12 months	0.65**	0.62**	0.57**
Next 5-10 years	0.38**	0.39**	0.46**
Obs	261	233	261
Past inflation relative to what expected year ago (1-3):			
Lower (1)	1%	5%	0%
About what I expected (2)	31%	44%	20%
Higher (3)	68%	51%	80%
Rank correlation with			
Past Inflation	0.33**	0.34**	0.24**
Year-ahead expectation	0.21**	0.16**	0.06
Year-ahead expectation minus past inflation	0.09	0.15*	0.19**

Fed-ALP May Special module. Spearman rank correlations. Statistically different from zero at the 5% (*) or 1% (**) level. Question wording: 'Was past inflation higher/same/lower than what you had expected for this period 12 months ago?'

Table 5.9 “Where have you heard about the U.S. inflation rate?”

• TV, radio	92%
• Newspapers, magazines	78%
• Internet	57%
• Financial advisor(s)	23%
• Co-workers	35%
• Family, friends	58%

Fed-ALP May Special module. Sample of 753 respondents.