Inflation Targeting Does Not Anchor Inflation Expectations: Evidence from Firms in New Zealand

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Abstract: We study the (lack of) anchoring of inflation expectations in New Zealand using a new survey of firms. Managers of these firms display little anchoring of inflation expectations, despite twenty-five years of inflation targeting by the Reserve Bank of New Zealand, a fact which we document along a number of dimensions. Managers are unaware of the identities of central bankers as well as central banks' objectives, and are generally poorly informed about recent inflation dynamics. Their forecasts of future inflation reflect high levels of uncertainty and are extremely dispersed as well as volatile at both short and long-run horizons. Similar results can be found in the U.S. using currently available surveys as shown in Binder (2015).

JEL: E3, E4, E5
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"*Indeed, expectations matter so much that a central bank may be able to help make policy more effective by working to shape those expectations. … the effects of monetary policy on the economy today depend importantly not only on current policy actions, but also on the public's expectations of how policy will evolve*." Ben Bernanke (2007)

1 Introduction

Central bankers increasingly emphasize the importance of the public's expectations. One reason is that unanchored inflation expectations are commonly viewed (e.g. Solow 1979) as having played an important role behind the Great Inflation of the 1970s and the subsequent large costs of bringing down inflation over the course of the 1980s. Maintaining low and stable "well-anchored" inflation expectations has become a mantra of modern central banking. But with the onset of the zero bound on interest rates, expectations have also taken a new role as a potential instrument of monetary policy. By trying to raise inflation expectations when they are very low, central bankers can immediately lower real interest rates and thereby stimulate economic activity even when nominal rates are constrained, a strategy actively pursued by the Central Bank of Japan, for example.

In this paper, we investigate both the question of whether inflation expectations are indeed well-"anchored" and whether monetary policies designed to influence inflation expectations are likely to be successful. To do so, we rely primarily on a recent survey of managers of firms in New Zealand, the country that pioneered inflation targeting in 1989. In this survey, we asked managers a wide range of questions about their inflation expectations, their individual and firm's characteristics, as well as about their knowledge and understanding of monetary policy. Following Binder (2015), we argue that many of our results extend to the U.S. using existing survey data. The New Zealand survey fills an important gap in our understanding of expectations. Previously, quantitative macroeconomic surveys had been available only for professional forecasters, very large firms, or households. The first two types are obviously extremely well-informed, and the latter tend to be poorly informed. Our survey focuses on decision-makers within a wide range of firms and therefore provides a much-needed middle ground for assessing the economic knowledge and understanding of individuals who make pricing, hiring and investment decisions in the economy.

Our results are not favorable to policymakers. Despite twenty-five years of inflation targeting in New Zealand, managers of firms there have been forecasting much higher levels of inflation than has actually occurred, at both short-run horizons and very long-run horizons. Their average perception of recent inflation is also systematically much higher than actual inflation. There is tremendous disagreement in the forecasts of firms, at all horizons, as well as disagreement about recent inflation dynamics. Firms also express far more uncertainty in their inflation forecasts than do professional forecasters. Other characteristics of firms' forecasts are also at odds with even weaker definitions of "anchored" expectations.

Because managers were surveyed on multiple occasions, we can consider the revisions in their forecasts. One would expect individuals whose forecasts are anchored to display only small revisions in their forecasts over time. Instead, we find that managers commonly report large revisions in their forecasts. Similarly, we find that managers who expect high inflation in the short run also tend to expect higher inflation in the long run, whereas the anchoring of expectations around a well-known target should imply little (or at least much less) comovement between short-run inflation expectations and longer-run inflation expectations. We show formally that each of these results corresponds to different definitions of anchored expectations, but our data from managers' inflation expectations systematically reject *all* definitions of anchoring that we consider.

How could twenty-five years of inflation targeting have so little effect on managers' inflation expectations? We find little evidence that managers question the credibility of the Reserve Bank of New Zealand (RBNZ): the vast majority of respondents believe that the central bank can control inflation at both long-run and short-run horizons. However, many respondents display surprisingly little knowledge about the institution itself. When asked who the Governor of the Reserve Bank of New Zealand is, only 30 percent get the correct answer (out of 4 possible answers), very few respondents know that the RBNZ has inflation targeting in its mandate, and even fewer can name the specific inflation target of the RBNZ. This suggests that knowledge about the RBNZ and its objectives remains very limited in New Zealand, even among firm managers.

Those managers who know more about the objectives of the RBNZ have much better information about recent inflation dynamics, make forecasts that are much closer to those of professional forecasters, and have less uncertainty in their inflation forecasts than others. They follow the news more closely than do other managers and report that news are more important to their business decisions. Significantly, these managers also report that they would be willing to pay much more for inflation forecasts (both in nominal terms and as a share of their firm's sales) than would managers who display less knowledge about monetary policy. This suggests that managers differ in their perceptions of the value of acquiring information about inflation and that these differences are reflected ex-post in their knowledge of both the central bank's actions and actual inflation dynamics.

What might explain these differences? Not surprisingly, more educated managers have systematically better knowledge of monetary policy. More interestingly, we find that some firm characteristics help predict a manager's knowledge of monetary policy in ways that are intuitive once interpreted in a rational inattention perspective (e.g. Sims 2003). For example, when firms face more competitors, then managers have more incentive to collect information about economic conditions and tend to make smaller errors about monetary policy. When firms sell a larger share of their products outside of New Zealand, managers have less incentive to track conditions in New Zealand and make larger errors

about monetary policy in New Zealand. Coibion, Gorodnichenko and Kumar (2015) similarly find that rational inattention motives can account for a non-trivial share of the size of errors that firm managers make about recent inflation dynamics.

While these observable firm characteristics clearly play an important role in accounting for differences in managers' knowledge about monetary policy and inflation, much of the heterogeneity in beliefs remains unexplained. To get at these deeper underlying differences, we conducted a smaller wave of the survey to extract narrative responses from managers about how they form and use their inflation expectations. These responses showed that differences in managers' inflation forecasts and perceptions do not reflect confusion about what inflation means. When asked to define inflation in open-ended questions, almost ninety percent do so correctly. Nor are managers prey to conspiracy theories about statistical agencies misrepresenting inflation numbers: the vast majority report that they believe that statistical agencies correctly measure inflation. Managers also agree to a surprising extent about inflation rates at the level of individual categories of goods. In fact, they agree *more* with each other about recent price changes for most categories of goods than they do about recent aggregate price changes. We document that the wide disagreement about the latter is instead driven primarily by disagreement among managers about the relative importance of different categories in constructing price indices (e.g. weights on house prices vs food prices vs gasoline prices).

We also asked firms about how they form their inflation expectations and what sources of information they use. In open-ended questions, most firms either responded (in almost equal proportion) that they relied on the media or that they relied on their personal shopping experience to inform them about prices. Those for whom the media was the primary source of information made smaller errors, on average, when asked about recent inflation dynamics. We also asked firms to quantitatively rank a wider set of information sources about inflation. This revealed that while only 20 percent of firms relied on professional forecasts, these firms had by far the best information about inflation. But, perhaps most strikingly, almost ninety percent of managers rated their personal shopping experience as very or extremely important to them in informing them about inflation, and seventy-six percent did so with gasoline prices. Hence, the vast majority of managers, even those who also follow newspapers and professional forecasts, report that their personal exposure to the individual prices that they face (and gasoline prices in particular) plays a large role in accounting for their inflation expectations. The majority of managers also report that the primary use of their inflation expectations is for their personal shopping decisions rather than in business decisions. The fact that most managers cite their personal shopping experience as both the primary source and the primary use of their inflation knowledge provides one rationale for why managers' expectations resemble those of households and why they disagree so much about the relevant weights to apply to different categories of goods in aggregating across them.

This is not to say that inflation expectations are irrelevant to managers' business decisions. When asked if higher inflation expectations on their part would specifically affect any of their business decisions (e.g. pricing, wages, etc.), most managers report that they would change some element of their business. Coibion, Gorodnichenko and Kumar (2015) found in an experiment that when managers were presented with information about the central bank's inflation target, they tended to significantly revise their inflation forecasts toward the target, especially if they were initially very uncertain about their forecast. Jointly, these results suggest that *if* central banks can more successfully communicate their objectives to the firm managers, then this should have repercussions on their economic decisions. The challenge for monetary policymakers, however, is that most managers currently appear to devote very little effort to tracking macroeconomic information, much less information from the central bank. Very few ever read monetary policy reports, receive twitter feeds from the RBNZ, or other forms of direct communication used by the RBNZ. This absence of even basic knowledge about the central bank of New Zealand on the part of business leaders suggests that monetary policies designed to operate through changes in the public's expectations, as induced primarily via communications policies, are unlikely to be very successful under current conditions.

New Zealand, because of its exceptionally long history of inflation targeting and stable inflation, is a particularly apt place to stage a survey to gauge the extent to which anchoring of expectations can be achieved. The finding that the inflation expectations of business leaders are no more anchored than those of households in New Zealand and the fact that few are even slightly knowledgeable about monetary policy is therefore particularly striking. But as documented in Binder (2015) and further extended here, many of our results carry over to the U.S., at least for the broader population. Using the Michigan Survey of Consumers and the New York Fed Survey of Consumer Expectations, we find all the same patterns in inflation expectations as we previously documented for managers of firms (as well as households) in New Zealand. Expectations in the U.S., therefore, appear just as unanchored as they do in New Zealand.

In addition, polling data for the U.S. similarly confirm that the U.S. public shows no more knowledge of monetary policy than that of New Zealand. Americans have great difficulty in identifying the chair of the Federal Reserve System and are generally unable to identify recent inflation dynamics with any degree of precision. When asked about inflation over 10 years, few are willing to confidently predict low levels of inflation, a finding that speaks either to low credibility of the Federal Reserve or, more likely, to the fact that most people don't know what reasonable ranges of inflation rates are. Nor do they seem to show much interest in learning about monetary policy. Twitter and Facebook followers of the entire Federal Reserve System are outnumbered by followers of the FBI and the CIA, and barely outnumber the followers of Ron Paul or Rand Paul. Paul Krugman single-handedly has almost twice as many twitter followers as the entire Federal Reserve system. Google searches confirm this paucity of interest: online searches for

macroeconomic variables like GDP, unemployment rate and inflation are consistently topped altogether by online searches for puppies.

This paper builds on a growing literature on central bank policies, communication and their effects on expectations, yielding mixed evidence on the degree to which inflation targeting anchors expectations (see e.g. the recent survey by Blinder et al. 2009). However, this work has focused almost exclusively on the expectations of financial markets or professional forecasters, primarily due to data limitations. One particularly remarkable exception is Binder (2015), who uses existing survey and polling data to assess what the U.S. public knows about monetary policy and on whose work we build explicitly. One implication of our results, along with Binder (2015)'s, is that future theoretical work should focus on models in which different types of agents (e.g. financial market participants vs. consumers or managers) form their expectations differently. Only with this type of model will we be able to fully understand how large the potential benefits might be from anchoring the expectations of consumers and managers.

Also particularly relevant to our work is the seminal firm-level survey of Blinder et al. (1998). While their survey focused primarily on the price setting decisions and cost structure within U.S. firms, we focus on the expectations of New Zealand managers, their acquisition of information, and their knowledge about monetary policy. However, in the sense that we aim to build a nationally representative quantitative survey of firm managers, we follow closely the approach pioneered by Blinder et al. (1998). This paper also builds on Coibion, Gorodnichenko and Kumar (2015), which first utilized the New Zealand survey of firms. We differ from the latter primarily in that we focus here on previously unexplored survey questions bearing on managers' knowledge about monetary policy, as well as a new wave of the survey that extracts, among other new questions, narrative answers from managers about the formation of their expectations.

Finally, our work relates closely to the literature on the nature of the expectations formation process for different economic agents. This literature explores the need for moving beyond the assumption of full information rational expectations. Lucas (1972), Mankiw and Reis (2002), Woodford (2002), Sims (2003), Gorodnichenko (2008), Mackowiack and Wiederholt (2009), Alvarez, Lippi and Paciello (2011) provide models that explore the implications of different ways of incorporating deviations from full information rational expectations. Empirically, such deviations have already found repeated support. Mankiw, Reis and Wolfers (2003), for example, emphasize the time variation in disagreement across agents, while Coibion and Gorodnichenko (2012, 2015a) emphasize the predictability in forecast errors of different agents. Andrade and Le Bihan (2013) provide evidence that European forecasters update their forecasts infrequently and in a manner consistent with imperfect information models. Carroll (2003) argues that information diffuses only gradually from professional forecasters to households. The direct evidence in this paper on how little firm managers know about the weights applied to different categories of goods in

measuring aggregate price levels or about the inflation target of the RBNZ confirms that, at least for these agents, full information is also likely a poor approximation.

This paper is organized as follows. Section 2 describes the survey. Section 3 presents evidence on the degree of anchoring of firms' expectations in New Zealand. In Section 4, we study how much firm managers in New Zealand know about monetary policy. Section 5 focuses on the sources of the differences in firms' inflation perceptions and forecasts, while section 6 extends these results to the U.S. Section 7 concludes.

2 Description of the survey

We implemented a quantitative survey of firms' expectations about macroeconomic conditions in New Zealand. Coibion, Gorodnichenko and Kumar (2015) provides a comprehensive description of the survey. In this paper we therefore discuss only the key features of the survey. We executed five waves of the survey over the period between September 2013 and August 2015. The first and largest wave of the survey was conducted between September 2013 and January 2014. After contacting around 15,000 firms, we attained a response rate of around 20 percent, recruiting a sample of 3,153 firms to participate in the survey. Subsequent waves were accomplished by recontacting firms from the first wave. The second wave, implemented between February and April 2014, received 714 responses. The third and fourth waves were in August-September 2014 and December 2014-January 2015 and received 1,607 and 1,257 responses respectively. In August of 2015, we also implemented a much smaller fifth wave (50 firms), which was aimed to collect responses to open-ended questions.

The main survey (wave #1) focused on collecting a wide range of information on the characteristics of the firm, their price setting decisions and expectations about recent and future inflation. Follow-up waves encompassed some repeat questions from the main survey but each also included new questions. The second wave, for example, not only asked firms about their beliefs of inflation but also about other macroeconomic indicators such as real GDP growth, unemployment and interest rates. The third wave primarily focused on collecting individual characteristics of the respondents, and the fourth wave explored how firms acquire and process new information. The smaller fifth wave explored central bank credibility, knowledge about inflation, and asked narrative questions from respondents. With the exception of a handful of cases, the survey collected responses from the *same* person within a given firm.

Firms were randomly chosen from four broad industries: manufacturing, retail and wholesale trade, construction and transportation, and professional and business services.[1] Phone interviews were done with

[1] The firm names and their basic details were purchased from the Kompass New Zealand and Knowledge Management Services databases. Prior to doing so, we used the Statistics New Zealand data for 2012 to compute the proportion of firms that fall into each employment size group (6 to 19 workers, 20 to 49 workers and >50 workers) for each sector so that we could match our population with the population of firms in the economy. For example, the manufacturing

the general managers[2] approximately ten days after the questionnaires had been emailed to them. Since manufacturing and professional and business services account for relatively large shares of GDP (Statistics NZ, 2012), we aimed to have two thirds of our sample from these two industries. The remaining one third is a combination of firms from other industries. We excluded industries related to the government, community service, agriculture, fishing and mining, and energy, gas and water from the sample. The combined employment of firms in our sample represents about 5 percent of total employment in New Zealand. While our sample is not drawn to be perfectly representative of the New Zealand economy, we can use sampling weights to adjust for the size distribution of firms and the industrial composition.[3] For the smaller fifth wave, we first grouped firms into four bins based on their inflation forecasts (e.g. 0-3 percent, 4-6 percent, 7-10 percent, more than 10 percent) in the previous waves. We then randomly selected firms from each group. Each group includes a similar number of firms and they are broadly representative of industry and size composition of firms in the overall sample.

The survey is unique in its breadth of coverage and the quantitative nature of the questions asked. While many surveys of firms exist, most tend to ask only qualitative questions. The few that ask quantitative questions tend to survey only a small and very unrepresentative group. For example, the RBNZ conducts a quarterly survey (namely, Survey of Expectations) of a sample of economists, business and industry leaders. This survey started in the late 1980s and its objective was to establish a database that might be useful for policy and research. Svensson (2015), for example, notes that inflation expectations from this survey have been only slightly above actual levels of inflation for much of the inflation targeting period. However, there exist several issues with this survey. First, the sample size is very small and targets respondents mainly from the financial and business services industry.[4] Second, the survey is not purely at the firm-level as it includes professional economists, market analysts and public commentators, albeit low in proportion. Third, the firms involved are typically very large ones, which is not at all representative of the New Zealand economy. For example, firms with more than one hundred employees represent less than 1 percent of all

industry in 2012 had around 67 percent of firms in the employment size group of 6 to 19 workers, 21 percent in the 20 to 49 workers and 12 percent in greater than 50 workers. Our population in manufacturing industry contained similar proportions. For other industries, their respective employment size proportions were computed and our population was constructed accordingly.

[2] Our objective was to contact top-level leaders of a firm. General managers, managing directors, directors, chief executive officers, principal legal executives, etc. are classified as "managers". 97 percent of respondents are classified as managers. Other respondents (3 percent) are marketing officers, industrial relations executives, product development officers, etc.

[3] See Coibion, Gorodnichenko and Kumar (2015) for more details, such as response rates for each wave of the survey. Using sample weights makes little difference for our results. See Table 1 and Appendix Table A1. The distribution of firms by size across industries in the sample and in the population is given in Appendix Tables A2 and A3.

[4] The breakdown of the sample in the last quarter (Q2, 2015): financial and business services = 91 respondents; agriculture = 11 respondents; labor = 4 respondents; others = 8 respondents.

firms in New Zealand but account for nearly all participants in the Survey of Expectations. Lastly, the sample is not random and is instead largely convenience-based.

3 Are Managers' Inflation Expectations Anchored in New Zealand?

Because there is no widely agreed-upon definition of "anchored" expectations, we consider five characteristics of inflation expectations that one might expect to observe depending on the specific definition or extent of anchoring of expectations. As we show below, these characteristics allow us to test five distinct definitions of anchored expectations, some of which are stronger than others. The first characteristic is whether average beliefs are close to the inflation target of the central bank. The second is whether beliefs are dispersed across agents. A third interpretation of anchored expectations is that they should imply that agents should be fairly confident in their forecasts, i.e. display little uncertainty, especially over the long-run. Fourth, revisions in forecasts should tend to be small, especially at longer horizons. And finally, there should be little comovement between long-run inflation expectations (which should be pinned down by the inflation target) and short-run inflation expectations (which should move with transitory shocks). We assess each of these in turn and relate them to specific definitions of anchored inflations. The five definitions of anchored expectations and how they relate to each of the five predictions are described in a Venn diagram in Figure 1.

For concreteness, suppose we have a measure one of agents indexed by $i \in [0,1]$. Let π_t denote inflation in this economy at time t. Let $F^i_{t+\tau|t}(.)$ be the CDF of i's time t belief about inflation at horizon $\tau \in \{0, \pm 1, \pm 2, \dots\}$. Finally let π^* be the central bank's inflation target. In this model, we only focus on bounded domain distributions for individuals, as first it is a reasonable assumption to make that no one assigns positive probability to infinite inflation or deflation, and second it makes the analysis more intuitive. Nevertheless, the results can be extended to unbounded distributions with proper adjustments of definitions. Proofs of all propositions and lemmas are in the Appendix.

Definition 1. We say inflation expectations at time t for any horizon $\tau \geq 0$ are ***ideally ϵ-anchored*** if the support of every agent's belief of inflation at that time and horizon lies within ϵ of the central bank's target, meaning that

$$F^i_{t+\tau|t}(\pi^* + \epsilon) - F^i_{t+\tau|t}(\pi^* - \epsilon) = 1, \forall i \in [0,1].$$

Proposition 1. (***Prediction 1: Average beliefs are close to the inflation target***) If inflation expectations at time t for any horizon $\tau \geq 0$ are ideally ϵ-anchored, then the average belief about inflation should lie within ϵ of the central bank's forecast/backcast, meaning that

$$bias_{t+\tau|t} \equiv \left|\overline{\pi_{t+\tau|t}} - \pi^*\right| < \epsilon.$$

where $\overline{\pi_{t+\tau|t}} = \int_0^1 \pi^i_{t+\tau|t}\, di$ is the average belief across agents and $\pi^i_{t+\tau|t} \equiv E^i_t\{\pi_{t+\tau}\} = \int_R \; x dF^i_{t+\tau|t}(x)$ is agent i's time t expectations of inflation at horizon τ.

Probably the most common interpretation of anchored expectations is that the average inflation forecast across agents, especially at longer horizons, remains stable and close to the central bank's inflation target (e.g. Ball and Mazumder 2014). Table 1 reports the average forecasts at the 12-month and the 5-to-10-year horizons for New Zealand firms in each survey for which these are available, as well as average firms' beliefs about inflation over the preceding twelve months. For comparison, we also report forecasts from the RBNZ, professional forecasts from Consensus Economics and household forecasts from the Survey of Households produced by the RBNZ. For each forecast horizon, firms' forecasts significantly exceed the inflation target as well as the forecasts of all other agents. They even exceed the forecasts of households, at least at 12-month horizons although not at long horizons.[5] Nor does the average firm forecast appear particularly stable over time. Over the course of 2014, the average 12-month ahead forecast of inflation fell by anywhere between 0.6 percentage points and 2.2 percentage points depending on how we truncate the sample.[6] In contrast, professional forecasters reduced their forecasts by 0.3 percentage points over the same time period on average and households by 0.4 percentage points. While one must bear in mind the short time frame, this survey evidence suggests that the average forecast across firms is neither close to the inflation target nor does it appear to be stable over time.

It is possible that firms' average inflation beliefs were temporarily driven higher in New Zealand at the time of the survey by some transitory changes in economic conditions that disproportionately affected their expectations relative to those of central bankers and those of households. For example, a boom in commodity prices could have raised inflation expectations temporarily. A weaker definition of anchored expectations could allow for time variation in average beliefs, but restrict the cross-sectional distribution of those beliefs.

Definition 2. We say inflation expectations at time t for any horizon $\tau \geq 0$ are ***strongly ϵ-anchored*** if the support of every agents' belief of inflation at that time and horizon lies within ϵ of the average belief, meaning that,

$$F^i_{t+\tau|t}\left(\overline{\pi_{t+\tau|t}} + \epsilon\right) - F^i_{t+\tau|t}\left(\overline{\pi_{t+\tau|t}} - \epsilon\right) = 1, \forall i \in [0,1].$$

[5] The RBNZ first asks households if they understand what inflation means. Only those households who do (approximately half) are then asked to provide inflation forecasts. In the firm survey, all firm managers are asked to provide inflation forecasts. However, as documented in section 5, most managers can correctly explain the meaning of inflation.

[6] The RBNZ's survey of households drops all forecasts above 15 percentage points and below -2 percentage points. Our "truncated" sample applies the same restrictions whereas our full sample includes all forecasts.

Proposition 2. (***Prediction 2: Beliefs should not be too dispersed across agents***): If inflation expectations at time t for horizon τ are strongly ϵ-anchored, then the dispersion of agents' beliefs about inflation should be less than ϵ, meaning that

$$sd_{t+\tau|t} \equiv \left[\int_0^1 \left(\pi^i_{t+\tau|t} - \overline{\pi_{t+\tau|t}}\right)^2 di\right]^{\frac{1}{2}} < \epsilon.$$

Lemma 1. If inflation expectations are ideally $\frac{\epsilon}{2}$-anchored, then they are strongly ϵ-anchored.

Note that, as established by Lemma 1, this is a weaker definition of anchored expectations. Table 1 reports the cross-sectional standard deviation in inflation forecasts at the same horizons as before. The dispersion in 12-month ahead inflation forecasts of firms exceeds that of households every quarter, which is already an order of magnitude larger than that of professional forecasters. Hence, there is little concentration of managers' beliefs about one-year inflation forecasts. The distribution of forecasts for inflation at the 5-10 year horizon is illustrated in Figure 2. While approximately 20 percent of firms forecasted a 2 percent rate consistent with the RBNZ's long run target, another 20 percent picked a much higher long-run forecast of 5 percent and another 20 percent predicted that inflation over the next 5-10 years would average between 5 percent and 10 percent. This dispersion in beliefs about long-run inflation is particularly difficult to reconcile with anchored inflation expectations.

We now consider three additional definitions of anchored expectations, each of which is conceptually distinct and weaker than strongly ϵ-anchored expectations.

Definition 3. We say inflation expectations at time t for any horizon $\tau \geq 0$ are ***weakly ϵ-anchored*** if the support of every agent's belief of inflation at that time and horizon lies within ϵ of that agent's belief, meaning that,

$$F^i_{t+\tau|t}\left(\pi^i_{t+\tau|t} + \epsilon\right) - F^i_{t+\tau|t}\left(\pi^i_{t+\tau|t} - \epsilon\right) = 1, \forall i \in [0,1].$$

Moreover, we say agent i is **ϵ-confident** of her forecast/backcast if her own perceived variance of this belief is less than ϵ^2:

$$E^i_t\left\{\left(\pi_{t+\tau} - \pi^i_{t+\tau|t}\right)^2\right\} < \epsilon^2.$$

Proposition 3. (***Prediction 3: Agents show confidence in their forecasts***): If inflation expectations are weakly ϵ-anchored for a given time and horizon then all agents are ϵ-confident of their forecasts.

Lemma 2. If inflation expectations are ideally or strongly $\frac{\epsilon}{2}$-anchored, then they are also weakly ϵ-anchored.

Under weakly anchored expectations, we now make no restrictions about agents having similar beliefs about long-run inflation or the central bank's target. Instead, the notion of targeting is now that each agent should be confident that inflation will be stabilized around whatever value each agent believes is the target, i.e. one should perceive little risk of either high or low inflation in the future so that the range of possible outcomes for inflation considered realistic by agents should be quite limited. Lemma 2 shows that this notion of anchoring is weaker than the previous two definitions.

In the 4th wave of the survey, we asked managers to assign probabilities to a wide range of possible inflation outcomes, allowing us to characterize the degree of uncertainty in their forecasts. From these distributional answers, we compute the standard deviation of each manager's forecast and report the distribution of these standard deviations in Panel A of Figure 3. The average standard deviation is 2 percentage points, so the firm managers on average report a lot of uncertainty around their forecasts. As Panel A also makes clear, there is considerable heterogeneity in the degree of uncertainty associated with individuals' forecasts. Panel B reports the average probability assigned by managers to each bin of the distribution. While most of the mass is assigned to bins ranging from 0 to 6 percent inflation, much higher inflation rates receive a significant weight on average as well.

An alternative definition of anchored expectations that is again weaker than strongly ϵ-anchored is to allow agents to have different beliefs about inflation targets, in which case one can observe both a mean forecast which deviates from the true target as well as a high dispersion in forecasts (since agents disagree about targets). This is formalized in the following definition.

Definition 4. We say inflation expectations of agent i for any horizon $\tau \geq 0$ are ***consistently ϵ-anchored*** at t, if the total change in the CDF of his belief from $t-1$ to t is less than ϵ in magnitude:

$$\int_R \left| F^i_{t+\tau|t}(x) - F^i_{t+\tau-1|t-1}(x) \right| dx < \epsilon$$

Proposition 4. (***Prediction 4: Agents display small forecast revisions***): The size of an agent's forecast revision of inflation at time t for any horizon $\tau \geq 0$ is less than ϵ if her inflation expectation for horizon τ is consistently ϵ-anchored at t.

Lemma 3. Define forecast revision for agent i at time t for horizon τ as $FR^i_{t+\tau|t} = \pi^i_{t+\tau|t} - \pi^i_{t+\tau-1|t-1}$. If inflation expectations for horizon τ are ideally $\frac{\epsilon}{2}$-anchored at $t-1$ and t, then they are also consistently ϵ-anchored. Moreover, if expectations for horizon τ are strongly $\frac{\epsilon}{2}$-anchored at $t-1$ and t, then they are also

consistently $(\epsilon + \delta')$-anchored where $\delta' \equiv \left|\int_0^1 FR^i_{t+\tau|t}\, di\right|$ is the absolute size of average forecast revision across agents.

Under this definition of anchoring, individuals' revisions in their inflation forecasts should tend to be small, as established in Proposition 4, since agents expect the central bank to be able to keep inflation stable over long enough horizons. Because our survey includes a panel dimension, we can examine this prediction using revisions in firms' inflation forecasts. In Figure 4, we plot the distribution of revisions of managers' 1-year inflation forecasts along with, for comparison, the distribution of revisions in their views about inflation over the previous 12 months. While one might expect the latter to display significantly more dispersion, the figure illustrates that the dispersion in revisions of forecasts at the 1-year horizon is almost as large: it is common in the survey to see revisions in 1-year forecasts of inflation that are 5 percentage points or more in absolute value. Given the stability of inflation in New Zealand over this time period, it is difficult to reconcile such dramatic revisions with any notion—weak or strong—of well-anchored expectations.

A final interpretation of anchored expectations comes from looking at the correlation of short-run and long-run expectations. Consider an extreme example of anchoring: if central banks are able to successfully stabilize beliefs about long-run inflation to a target, then short-run and transitory fluctuations in inflation and short-run inflation expectations should be unrelated to these longer-run beliefs. This is established more formally in the following definition and proposition.

Definition 5. Given a sequence $\{\epsilon_\tau\}_{\tau=0}^{\infty}$ at time t, we say inflation expectations are ***increasingly T-anchored*** at time t if for any $\tau \geq T$, expectations are strongly ϵ_τ-anchored.

Notice that increasingly T-anchored expectations is weaker than strongly anchored expectations when they are required to be strongly ϵ_τ-anchored for $\tau \geq 0$, as it does not impose any restrictions on expectations in the short-run horizons.

Proposition 5. (***Prediction 5: Long-run expectations should be unpredictable using short-run expectations***): Consider the following regression for time t data:

$$\pi^i_{t+\tau|t} = \alpha_\tau + \beta_\tau \pi^i_{t+1|t} + error_i$$

Now given the sequence $\{\epsilon_\tau\}_{\tau=0}^{\infty}$ such that $\lim_{\tau\to\infty} \epsilon_\tau \to 0$, suppose expectations are increasingly T-anchored for an arbitrary $T \geq 1$. Then $\lim_{\tau\to\infty} \beta_\tau = 0$.

Figure 5 documents that this prediction does not hold in our data: managers who expect higher short run inflation also tend to expect higher long run inflation. While one might still expect to find a positive slope between the two sets of expectations simply because the time horizon of the long-run expectations is not long enough (τ is too small), the size of the slope coefficient that we find is too large to be explained by this feature of the data. For example, if agents set their 5-10 year ahead forecasts equal to a weighted average of their 1-year ahead expectation and their expectation about long-run inflation, the implied slope of the relationship should be small (between 0.1 and 0.2 for 5-10 year ahead forecasts) whereas Figure 5 illustrates a slope of 0.70. Hence, the strength of the relationship between managers' long-run and short-run inflation expectations is much greater than one would expect to see under well-anchored expectations.

In short, the survey of firm managers in New Zealand suggests that no matter which definition of anchoring we adopt, and even using much weaker versions than commonly considered, the inflation expectations of firm managers do not conform in the least bit to the properties one would expect from agents with well-anchored expectations.

4 Credibility vs. Knowledge of RBNZ's Objectives

The apparently unanchored nature of inflation expectations in New Zealand, despite 25 years of inflation targeting and relatively stable inflation, seems puzzling. One reason why so many managers' long-run inflation forecasts might be so high is if the RBNZ is not viewed as a credible institution, i.e. managers' simply don't believe in the RBNZ's ability or willingness to achieve its long-run inflation objective. Another possibility is that many managers are unaware of the objectives of the central bank and of recent inflation dynamics. In this section, we try and differentiate between these two potential explanations.

In the fourth and fifth waves of the survey, we asked managers several questions designed to assess the extent of managers' knowledge of the objectives of the central bank and of monetary policy more generally. First, we posed the following question to them in the fourth wave of the survey:

"What is the main objective of the Reserve Bank?"

a. Keep the exchange rate stable	[23 percent]
b. Promote full employment	[25 percent]
c. Keep interest rates low and stable	[11 percent]
d. Keep inflation low and stable	[31 percent]
e. Help the government finance its spending	[10 percent]

Figures in squared brackets show the shares of responses.[7] Only 31 percent of respondents correctly chose *d*. Given that there were five choices available, this suggests that very few people know even in a broad sense the main objective of the RBNZ. We then asked the following question:

> **"What annual percentage rate of change in overall prices do you think the Reserve Bank of New Zealand is trying to achieve?"**
> *Answer:* …….. percent

We present a detailed distribution of responses in Table 2. Of the respondents, only 12 percent correctly responded 2 percent, although an additional 25 percent said either 1 percent or 3 percent, the bottom and top of the target range of the RBNZ. But 15 percent said the RBNZ's target inflation rate was 5 percent and 36 percent said the target was more than 5 percent, with 5 percent of respondents saying that the RBNZ's target inflation rate was 10 percent or more.

Finally, we asked managers the following:[8]

> **"What is the name of the Governor of the Reserve Bank of New Zealand?"**
> *a.* Graeme Wheeler [30 percent]
> *b.* Alan Bollard [39 percent]
> *c.* Bill English [17 percent]
> *d.* Charles Cowley [9 percent]
> *e.* I don't know [4 percent]

In this list, only two people (Wheeler and Bollard) are or were affiliated with the RBNZ and they obtained 69 percent of the responses. The correct answer (*a*) was again chosen by only 30 percent of respondents. The most popular response was the name of the governor (Bollard) who stepped down from the office more than two years before the survey.

Jointly, these questions point toward a pervasive lack of knowledge about monetary policy on the part of firm managers. In fact, only 10 percent of respondents answered all three questions exactly correctly. But those who answered all questions correctly displayed significantly better-behaved forecasts (in the sense of being closer to those of professionals): their mean long-run inflation forecast was exactly 2 percent with a cross-sectional standard deviation of just 1.2 percentage point, whereas all other respondents had a mean forecast of 3.7 percent with a standard deviation of 2.6 percentage points. Likewise, their mean short-term forecast was 2.6 percent (st.dev. 1.4 percentage points), while all other respondents had a mean of 5.2 percent (st.dev. 3.2 percentage points). They also had much better knowledge of recent inflation dynamics,

[7] Because of the large sample size, here and henceforth we can reject the null that the share of managers picking a given option is equal to 1/N, where N is the number of options in a multiple choice question.
[8] Graeme Wheeler was the governor of the RBNZ at the time of the survey (2015Q1). He had been the governor since September 2012. Alan Bollard was the governor of the RBNZ until September 2012. Bill English was the minister of finance at the time of the survey. Charles Cowley is a randomly chosen person in New Zealand.

with average backcasts of just 1.5 percent (st.dev. 0.6 percentage points) compared to 4.6 percent (st.dev. 2.4 percentage points) for other respondents.

Additional evidence does not suggest that the RBNZ suffers from a significant credibility problem. For example, among respondents who knew that the target inflation rate was centered at 2 percent, 89 percent forecasted that inflation over the next five to ten years would range from 1 and 3 percent, as illustrated in Table 2. Among those who knew that the main objective of the central bank was to keep inflation low and stable, the average long-run forecast of inflation was again 2 percent. This suggests that for the agents who know the central bank's objective, that objective is credible and embedded in their forecasts. The credibility of the RBNZ extends even to many of those who are incorrect about its actual inflation target: managers who think that the RBNZ's target is 3 percent report an average long-run inflation forecast of 3 percent and managers who think that the RBNZ's target is 4 percent report an average long-run inflation forecast of 4 percent.[9] So while they're incorrect about the value that the RBNZ is trying to achieve, their forecasts are consistent with the notion that the RBNZ will be able to achieve what they perceive to be its objective.

In the fifth wave of the survey, we posed two additional questions meant to directly address the credibility of the central bank. One question was:

"Do you think the central bank can control inflation over the next 5 to 10 years?"

The point was to assess whether managers believe that the central can achieve its inflation target over a medium to long time horizon. Out of the fifty respondents in the fifth wave, forty-nine responded yes and only one thought that the central bank could not control inflation over this time horizon. This indicates broad support on the part of managers for the view that monetary policymakers can achieve their medium to long-run policy objectives.

We also asked respondents the following question:

"Do you think the central bank can control inflation in the next 12 months or so?"

This question asks respondents whether they think central banks can control inflation over a horizon as short as one year. Strikingly, forty-seven out of fifty responded yes. Thus, the vast majority of firm managers assign tremendous credibility to the central bank since they believe it can control inflation even at short horizons.

[9] At higher levels of beliefs about the RBNZ's inflation target, the relationship between the target and managers' forecasts becomes flatter, with forecasts no longer rising one-for-one with targets but still increasing in the belief over the target.

We interpret these results as suggesting that the credibility of the RBNZ appears to be well-established in New Zealand. The issue instead appears to be that many managers are relatively uninformed about the practical objectives and targets of the central bank, and this lack of quantitative information is reflected in the forecasts that they report. Indeed, as documented in Table 2, managers who are uninformed about the RBNZ's target inflation rate also tend to be much less informed about recent inflation dynamics and their forecasts are also associated with much more uncertainty. Given the ease with which information about monetary policy can be accessed, it may seem surprising that so many managers of firms are not more informed about it.

What could account for these differences in knowledge about monetary policy? One possibility could be that more educated managers simply know much more about monetary policy than others, but as column (7) of Table 3 reveals, there are few differences in the average education levels across groups. Another possibility is that managers value information about monetary policy, or inflation more generally, differently. To assess this, we asked managers about their willingness to pay for monthly forecasts of inflation, as well as for forecasts of other macroeconomic variables. The results, presented in columns (2)-(3) of Table 3, indicate that firm managers who correctly reported low values of the RBNZ's inflation target also reported being willing to pay much more, both in dollar terms or as a share of firm sales, for inflation forecasts on average than managers who reported higher target values, whereas no such striking pattern exists for other macroeconomic variables (columns (4)-(5)). This finding confirms that managers do indeed seem to assign very different values to information about inflation, and that these valuations are reflected in their knowledge of both monetary policy and inflation dynamics.

Also consistent with an information channel is the frequency with which managers follow news about the economy. We asked managers about the frequency (daily, weekly, monthly, quarterly, semiannually, annually, less than annually) with which they followed news about the economy from media sources as well as, in a separate question, from official public sources (such as monetary policy reports). Results, converted into answers in months, are presented in columns (8) and (9) of Table 3 for each group of managers that gave a common answer as to the RBNZ's inflation target. Managers who were aware of the low inflation target followed media reports closely (once every 3-5 months on average) but this attention to news declines sharply with higher inflation targets, before stabilizing for managers who reported targets of 5 percent or more at an average frequency of approximately once per year. An identical pattern occurs with news from public sources, albeit at lower frequencies.

We also asked firm managers to describe how informative for their business decisions (on a scale of 1 for irrelevant to 6 for extremely worthwhile) they found different types of news reports: TV, newspapers, monetary policy reports, and different kinds of direct communications from the RBNZ. Results are plotted in Figure 6, averaged across managers depending on their answers about the RBNZ's target rate

of inflation. Managers who said the target was either 1 or 2 percent report that TV and newspapers are quite useful to their business decisions, consistent with their frequent use of these media documented in Table 3, and also report some usefulness for monetary and Treasury reports. However, the perceived usefulness of all these media for business decisions declines sharply for managers who reported higher inflation targets. None of the managers report much usefulness for their business decisions from direct communications by the central bank via email, RSS, or Twitter.

Why might different managers perceive the value of information about inflation to be different? One possibility is that the characteristics of the firm in which they work influence their perception of the value of information about inflation. For example, column (6) of Table 3 documents pronounced differences in the average slope of the firm's profit function with respect to firm's price, as defined in Coibion, Gorodnichenko and Kumar (2015), depending on how managers responded to questions about the RBNZ's inflation target.[10] Steeper profit functions imply that information should be more valuable to the firm, and consistent with this incentive effect, we find that managers who report low values of the RBNZ's target rate (and therefore have better information about monetary policy) also tend to work for firms which have steeper profit functions and so in which information is more valuable. This suggests that the characteristics of the firm might be important in explaining the underlying differences in how managers value information about inflation and monetary policy.

We investigate whether the characteristics of managers and firms are correlated with a manager's knowledge of monetary policy more formally as follows. We consider two types of errors made by managers: errors specific to the target (the absolute deviation of their perception of the RBNZ target rate from 2 percent) and overall errors in answering questions (the sum of the number of answers they got wrong on the three survey questions on monetary policy). We then regress each of these manager-specific errors on a set of firm-specific characteristics including: a firm's age, employment at the firm, labor's share of total costs, foreign sales as a share of total revenues, the number of competitors reported by the manager, the average profit margin of the firm, the price of the firm's main product relative to that of its competitors, and the absolute slope of the firm's profit function. All but the last variable come directly from survey questions asked of managers, and the slope is constructed from other questions asked of the manager. We also control for individual characteristics of the manager, such as their age, years of schooling, income, and tenure at the firm. Finally, we include industry fixed effects.

A few results (Table 4) stand out as particularly robust. First, the number of competitors faced by a firm is systematically associated with smaller errors about the RBNZ's inflation target and about monetary

[10] The slope of the profit function is calculated as follows. A firm is asked to report by how much (in percent) it would change the price of its main product if it were to do so for free and by how much this price change would translate into increased profits as a share of firm's revenue. The slope is the change in profit divided by the percent change in the price.

policy more generally. One might interpret this as higher competition inducing managers to pay more attention to economic conditions, including monetary policy, to avoid being driven out of business. We also find that firms which receive more of their sales from abroad make bigger errors about monetary policy in New Zealand, which likely reflects their reduced incentive to track New Zealand's economy relative to that of their trading partners. More years of schooling on the part of managers are systematically associated with smaller errors about monetary policy. Interestingly, managers of larger firms make larger errors both about the RBNZ's inflation target as well as about monetary policy more broadly. Hence, these results confirm that characteristics of the firm play some role in accounting for the knowledge of monetary policy and inflation that managers display. However, because much of the variation remains unexplained, we turn to a more narrative approach to assess in more depth how managers form and use their inflation expectations.

5 What Do Managers Know about Inflation? How Do They Learn? Does It Matter?

Since the properties of firm managers' inflation expectations and perceptions appear to be so at odds with anchored expectations, we consider in this section three general sets of questions. First, what do managers actually know about inflation? Perhaps many are confused about the concept or do not understand how it is measured. Second, where do managers get the information that goes into their beliefs about inflation and inflation expectations? Does it come from professional forecasters and statistical agencies, the media, or is it based on their daily experience with prices, either through their professional experience with competitors and clients or through their own shopping experience? Third, do their inflation expectations matter for any of the decisions that they make as managers? We address each of these in turn.

5.1 What Do Managers Know about Inflation?

Given the properties of firm managers' perceptions and expectations of inflation described in the previous sections, one might wonder to what extent they are knowledgeable about what inflation means or how it is measured as well as the sources of their information about inflation used to formulate their inflation expectations. The smaller fifth wave of the survey was designed to address these points, using a combination of quantitative and narrative questions. Because narrative questions are much harder to implement on a vast scale, we restricted the sample to fifty firms drawn from different bins of the inflation expectation distribution (~12-13 firms each from bins of firms who had previously forecasted inflation of 0-3 percent, 4-6 percent, 7-10 percent, and >10 percent). As before, we asked managers of these firms to state their inflation expectations over the next 12 months and perceptions of inflation over the previous 12 months.

We first assessed their basic knowledge of the term "inflation" by asking them "*What is your understanding of the term inflation?*" This is the exact same open-ended question which is posed to households in the RBNZ survey. We graded managers' narrative answers on a scale ranging from 0 to 2

points. Our reference answer was "Inflation is *the increase (or change) [1 point] in the general (average) price level of goods and services [1 point]* in the economy." Hence, managers received one point for recognizing that inflation captures a change in price levels and a second point for recognizing that it measures economy-wide prices. Using this grading scheme, no managers received a grade of 0. Only eight managers got a score of 1, so 86 percent of managers in this sample were able to correctly define inflation. Of the eight who made a mistake, three stated that inflation measured food or "basic" commodity prices. The remaining five made statements inconsistent with inflation capturing the change in prices.[11] There is little difference in the perceived inflation rates or expectations of managers across the two groups, suggesting that these differences in understanding of the concept of inflation play little role in accounting for the heterogeneity in managers' forecasts. In contrast, households in the RBNZ survey fail to correctly identify inflation at much higher rates. For example, in the May 2015 survey, 52 percent of respondents could identify inflation. So firm managers display a much better understanding of the meaning of the term inflation than households.

Another reason why firm managers might hold inflation expectations and perceptions so at odds with recent inflation measurements is that they do not believe official inflation statistics. To address this possibility, we asked firm managers in the fifth wave of the survey the following question:

> **"Do you think official inflation data are credible in the sense that it reflects the true rate at which overall prices in the economy change?" [Yes/No]**

Eighty-six percent of firms responded that official inflation data are credible, whereas fourteen percent expressed skepticism. The average inflation forecast of managers who do not believe official inflation data is only 1 percentage point higher than that of managers who do believe official inflation data. As a result, skepticism about the quality of official inflation statistics can explain neither the high mean of managers' inflation forecasts nor the dispersion in those forecasts.

If firm managers understand the concept of inflation and believe that government officials correctly measure inflation, how can they then perceive such different levels of inflation than what is measured by statistical agencies? Given that aggregate inflation is a weighted average of inflation for different categories of goods, two non-exclusive explanations are possible. One is that firms assign different weights to categories of goods than statistical agencies (e.g. overweight gasoline price movements). Another is that firms are mistaken about the sizes of price changes for certain categories of goods (e.g. think food prices went up more than they did). To assess these two explanations, we asked firms in the fifth wave to report how much weight they believe statistical agencies assign to different categories of goods and services when

[11] For example, one manager stated that inflation is the average price in the economy. The others said something akin to "when prices change, inflation changes."

constructing overall price measures for New Zealand.[12] The specific set of categories includes house prices, stock prices, food prices, healthcare costs, gasoline prices, the cost of rent, and car prices. We then asked firms to report their beliefs about price changes over the last twelve months for each of the same categories.

The results are presented in Table 5, along with the actual weights applied to these categories in the construction of the Consumer Price Index (CPI) and the actual inflation rates for each category of goods. Managers' average beliefs about the weights on housing prices (22 percent), stock prices (8 percent), and gasoline prices (19 percent) far exceed the true values (4, 0, and 5 percent respectively). In contrast, managers significantly underestimated the weight assigned to food prices (belief of 9 percent vs. true value of 19 percent). There are also some notable differences between managers' beliefs about inflation at the category levels and actual inflation rates. They significantly underestimated inflation in stock prices (belief of 4 percent vs. actual change of 13 percent) but overestimated inflation in car prices (by 7 percentage points) and food prices (by 4 percentage points).

To quantify the relative importance of these two channels, it is useful to introduce some notation. Denote the actual weight for subcategory s with w_s^a and perceived weight with $w_{s,i}^p$ for firm i. Likewise, define the actual inflation rate for subcategory s with π_s^a and perceived inflation with $\pi_{s,i}^p$ for firm i.
The contribution of price changes in these specific categories to actual aggregate inflation is

$$\tilde{\pi}^a = \sum\nolimits_s w_s^a \pi_s^a.$$

Equivalently, we construct firm *i*'s perceived contribution of these categories to aggregate inflation as

$$\tilde{\pi}_i^p = \sum\nolimits_s w_{s,i}^p \pi_{s,i}^p.$$

The error that firm *i* makes about this contribution can be decomposed as:

$$\tilde{\pi}_i^p - \tilde{\pi}^a = \sum\nolimits_s w_{s,i}^p \pi_{s,i}^p - \sum\nolimits_s w_s^a \pi_s^a$$

$$= \left\{\sum\nolimits_s w_s^a \left(\pi_{s,i}^p - \pi_s^a\right)\right\} + \left\{\sum\nolimits_s \left(w_{s,i}^p - w_s^a\right)\pi_s^a\right\} + \left\{\sum\nolimits_s \left(w_{s,i}^p - w_s^a\right)\left(\pi_{s,i}^p - \pi_s^a\right)\right\}$$

The first term captures the contribution of the manager's errors about category-specific inflation rates. The second term captures the contribution of the manager's errors about the weights applied to each category. The final term captures the covariance between errors in weights and errors in inflation rates across categories.

Results of this decomposition are reported in Table 5. First, we report average values of the error across all firms, as well as average values of each of the terms in the decomposition. The average manager

[12] The specific phrasing of the question was "How much weight do you think statistical agencies place on each of the following categories of prices when constructing overall price measures for New Zealand? (these do *not* need to sum to 100 percent). Please provide percentage answers."

error is 1.7 percentage points, implying that they overestimated on average the positive effect of these categories on aggregate inflation. Errors about category-level inflation rates contributed about 1.2 percentage points out of the 1.7 percentage points. Hence, much of the average error can be explained by the fact that, on average, managers significantly overestimated the increase in food prices. The contribution of errors about weights is smaller, 0.8 percentage points out of the 1.7 percentage points, and comes primarily from the fact that managers overestimated the weights on housing and stock prices. The negative covariance term is driven largely by stock prices and food prices, in which respondents over(under) estimated the weights but under(over) estimated the inflation rate. These results suggest that managers' errors about recent inflation rates for specific categories of goods, particularly food prices, can account for much of their average misperceptions of aggregate inflation.

However, another feature worth noting in Table 5 is that the cross-sectional standard deviations of inflation perceptions for most categories of goods are relatively low. In fact, for all but stock prices and gasoline prices (two very volatile price series), *there is actually less disagreement among managers about inflation at the category level than there is about aggregate inflation*. This suggests that disagreement about category level inflation rates among managers is unlikely to be able to account for the amount of disagreement that we observe in beliefs of managers about aggregate inflation rates. Consistent with this, we report in Table 5 the cross-sectional standard deviations of each term in the decomposition of the errors above. Disagreement among managers about the weights assigned to different categories accounts for three times more of the dispersion in inflation errors than disagreement about category-specific inflation rates. Hence, this result suggests that the primary source of the large disagreement that we observe in managers' perceptions of recent inflation rates is differences in opinion about the relative importance of different categories of goods in the measurement of inflation.[13]

5.2 What Sources of Information Do Managers Use to Form Inflation Expectations?

For managers to hold such different expectations about inflation, they must rely on different sources on information to form their expectations. We investigate the source of managers' inflation expectations in

[13] This result is not sensitive to the particular decomposition we used. For example, another decomposition is $\tilde{\pi}_i^p - \tilde{\pi}^a = \sum_s w_s^a(\pi_{s,i}^p - \pi_s^a) + \{\sum_s(w_{s,i}^p - w_s^a)(\pi_{s,i}^P - \tilde{\pi}_i^p)\} + \tilde{\pi}_i^p\{\sum_s w_{s,i}^p - \sum_s w_{s,i}^a\}$ where the first term is the same as before, the second measures the extent to which agents place too much (too little) weight on categories of goods for which inflation is higher (lower) than average, and the third term captures potential errors from assigning too much or too little cumulative weights to all of the listed categories of goods (since the weights don't need to sum to one). This decomposition also implies that average errors primarily reflect errors about category level-inflation rates (since the first term in this decomposition is identical to ours). It similarly implies that the cross-sectional dispersion in inflation forecast errors is largely due to differences in beliefs about weights, since the cross-sectional standard deviation of the second term is almost three times that of the first term, about the same ratio as in our original decomposition. We are grateful to David Romer for suggesting this alternative way of decomposing forecast errors.

two ways. First, in the fifth wave of the survey, we asked managers the following open-ended question: "*How do you typically form your inflation expectations?*"

Managers provided four general types of responses, as summarized in Table 6. First, 47 percent of respondents stated that they relied primarily on media sources for their information about inflation. These respondents tended to have much better information about recent inflation dynamics than others, with average absolute backcast errors being smaller by one percentage point on average and lower inflation forecasts as well. The second most common answer, accounting for 43 percent of respondents, was that they relied on their personal shopping experience to inform them about price changes. Many respondents emphasized housing prices as a particularly important source of information. In contrast to managers who rely on media for their information, respondents who use their personal shopping experience to inform them about inflation tended to have larger errors about recent inflation dynamics than other firms and higher inflation forecasts. The remaining two categories account for much smaller shares of respondents, approximately 10 percent each. One answer is that managers discuss inflation with coworkers or family members ("meetings and discussions"). These respondents tend to have relatively good information about inflation. The other group states that they rely on their competitors' or suppliers' prices to make inferences about aggregate inflation. This group has the largest average errors about recent inflation. While there are differences in beliefs within each group, these results do suggest that the average effect of the main source of information for inflation can be very large: the average difference in inflation backcast errors can be as large as 1.6 percentage points.

To investigate this insight in more detail, we also asked respondents to rank the importance of different sources of information to them in forming their inflation expectations on a scale of 1 (lowest) to 5 (highest). The specific sources were a) family and friends, b) employees and colleagues, c) customers and suppliers, d) gas prices, e) personal shopping experience, f) government agencies, g) business associations, chambers of commerce and trade fairs, h) media (TV, newspapers, etc.) and i) professional forecasts. The average ranks given by managers are listed in the first row of Table 7. Consistent with the narrative responses, two of the most highly ranked categories are personal shopping experience and media. In addition, these results highlight the particular importance of gasoline prices as a reference point to managers for making inferences about broader inflation movements: 76 percent of managers rank gasoline prices as very important or extremely important (rank of 4 or 5) to them in forming their inflation expectations. This is consistent with the argument of Coibion and Gorodnichenko (2015b) that households place a disproportionate amount of weight on oil/gasoline prices in forming their inflation expectations.

Table 7 also presents average ranks assigned to categories by managers who rate specific categories as very or extremely important to them, as well as average backcast errors and inflation forecasts for these groups of firms. In addition, Table 7 presents the correlation matrix of ranks given by respondents to

different sources of information. These jointly yield several results. First, managers who rate professional forecasters as very or extremely important to them have much better perceptions and forecasts of inflation on average than other firms. These managers also tend to rely on media and employees/colleagues more than other firms. However, only 20 percent of managers rate professional forecasts as being this important. Second, as found with the narrative questions, managers who rate media as very or extremely important to them also have better information about inflation than other firms on average. Approximately 54 percent of managers rate media as very or extremely important to them.

Third, and perhaps most strikingly, 88 percent of managers rate their personal shopping experience as very or extremely important to them. Even among those respondents who utilize professional forecasts and media reports extensively, the average ratings on personal shopping experience continue to be very high. This suggests that personal shopping experience is a more important source of information to most managers than might have been implied by the narrative approach, in which managers seem to generally report only their first source of information. Because shopping experiences are likely to be so heterogeneous across agents, both in terms of the prices they pay and the share of expenditures they allocate to different categories of goods, the systematic importance of an individual's shopping experience suggests a very natural source for the wide variation that we observe in beliefs about inflation across managers.

5.3 How Do Managers Use Their Inflation Expectations?

Does it make any difference to a manager's decisions whether they expect inflation to be 1 percent or 5 percent? One way to answer this would compare the decisions of different managers who hold different inflation expectations, but this approach would require us to be able to control for a wide array of factors relevant for each manager's decision. Instead, we used hypothetical questions to investigate how managers would response to changes in their expectations. In the fifth-wave of the survey, we asked managers an open-ended question about how inflation expectations affect their decisions. They were asked

"How do you typically use your inflation expectations?"

Managers gave four general types of answers, as summarized in Table 8. Twelve percent responded that inflation expectations mattered for their pricing decisions, 14 percent of managers mentioned their wage-setting decisions, and 18 percent specified their investment decisions. Strikingly, two-thirds of managers reported that the primary use of their inflation expectations was for their own personal use, in terms of consumption and savings. Hence, similarly to how most managers relied on their personal experience as consumers to inform them about aggregate inflation developments, we now find that managers report that the primary use of their inflation expectations is for their personal decision-making rather than for the economic decisions of the firm. This provides a novel justification for why managers' inflation expectations

resemble those of households in so many ways: their primary use is for their personal consumption and saving decisions.

Of course, the fact that managers respond to an open-ended question by saying that they use their inflation expectations mainly for their own consumption and saving decisions, as did the majority of the respondents, does not imply that these managers do not use their inflation expectations at all for their business decisions, only that the latter are secondary to their use for personal decisions. In the 3rd wave of the survey, we asked managers more restrictive hypothetical questions focusing specifically on each of prices, wages, employment and investment decisions:

> "**If you thought overall prices in the economy over the next 12 months were going to rise by more than what you are currently forecasting, would you be more likely to [increase/decrease/no change] your [prices/employment/investment/wages]?**"

Only 25 percent of managers reported that higher inflation expectations would have no effect on any of their economic decisions, whereas 75 percent would respond along at least one margin. Hence, most managers do report that changes in their inflation expectations would induce them to alter some of the economic choices made by their firm.

The responses for each individual variable are presented in Table 9. Approximately 35 percent of firms report that they would charge higher prices, whereas between 25 percent and 30 percent of firms report that they would raise wages, employment or investment. Almost no firms would decrease any of these variables. Table 9 also considers pairs of answers across variables. Few firms would adjust along more than one margin in these pairings: just 13 percent of firms would raise prices and wages, 8 percent of firms would raise employment and wages, and 9 percent of firms would raise investment and employment. Instead, the majority of firms would pursue adjustment along a single margin, although the specific margin they choose is difficult to predict. The key result from this survey question is that most firm managers appear to treat their inflation expectations as one of the inputs into their decision process. This implies that *if* policymakers can change managers' inflation expectations, then one should expect some economic repercussions through pricing, wage, employment and investment decisions to occur.

6 Results for the United States

While New Zealand presents a particularly interesting case study for inflation expectations given its long experience with inflation targeting, one would like to know whether the characteristics documented in the previous section extend to other countries. In this section, we revisit whether a) the inflation expectations of the U.S. public also appear unanchored and b) the U.S. public displays the same knowledge of monetary policy as firm managers in New Zealand. Because no broad quantitative survey of firm managers exists for

the U.S., we focus primarily on the Michigan Survey of Consumers (MSC), the Survey of Consumer Expectations (SCE), and the Survey of Professional Forecasters (SPF) but, following Binder (2015), use additional polling data[14] as well when available.

6.1 Are the U.S. Public's Inflation Expectations Anchored?

We revisit the five characteristics of "anchored" expectations that failed to be present in New Zealand. First, we examine whether average beliefs are close to the inflation target of the central bank. Table 10 shows that both short-term and long-term inflation expectations of households hover between 3.1 and 4.4 percent, well above the Federal Reserve's 2 percent inflation target. In contrast, professional forecasters predict inflation close to the official target at all horizons. The actual rate of inflation over the 2013Q4-2014Q4 period was less than 2.4 percent. Strikingly, the magnitudes are similar to New Zealand's counterparts.[15]

Second, we explore whether economic agents in the U.S. disagree about the future course of inflation. We find that while the cross-sectional dispersion of projections made by professional forecasters is small (approximately 0.4 percentage points), the dispersion is an order of magnitude larger for households (approximately 4 percentage points at short horizons and somewhat smaller for longer horizons). Hence, along this metric as well, the U.S. public's inflation expectations look no more anchored than those of New Zealand.

Third, we investigate how much confidence agents have in their forecasts. The Survey of Consumer Expectations asks respondents to assign probabilities to 10 inflation bins. Using this information, we can calculate the implied standard deviation, a measure of forecast uncertainty. We find (Panel A of Figure 7) that although there is considerable heterogeneity across U.S. consumers, they are generally very uncertain in their predictions: the mean standard deviation is approximately 3 percentage points, which is comparable to the mean forecast of consumers. Panel B of Figure 7 also shows that, on average, consumers assign more than 50 percent probability to inflation in the U.S. being greater than 4 percent over the next 12 months and over the next three years. Other survey evidence corroborates this result. For example, Binder (2015) compiles extensive poll evidence that consumers have little confidence in low and stable inflation. According to the Retirement Confidence Survey, in years 2012 and 2013, only 6 percent of respondents

[14] The polling data reported here were obtained from searches of the iPOLL Databank and other resources provided by the Roper Center for Public Opinion Research, University of Connecticut.

[15] Neither the MSC nor the SCE asks people to report current or past inflation. A poll by the Pew Research Center for the People and the Press Poll asked the public about whether recent inflation data was closer to 1, 5, 10, or 20 percent. The most common answer, with 49 percent of responses, was "don't know/refused to answer" and the mean response was 7.4 percent, well above the actual inflation rate of approximately 1 percent. (See Binder (2015) for more details.) Thus, similar to consumers in New Zealand, consumers in the U.S. appear to have a perception of inflation well above actual figures.

claimed to be very confident that inflation will remain moderate over the next 10 years and will average no more than 4 percent in the next 10 years. At the same time, approximately 60 percent of respondents stated that they are either not at all confident or not too confident in these outcomes. In addition, Binder (2014) shows that confidence in forecasts as measured by the rounding of point predictions has shown little change since the mid-1980s. These patterns are similar to those observed in New Zealand.

Fourth, we consider the size of revisions in inflation forecasts. Figure 8 presents both 1-year and 3-to-5-year ahead inflation forecasts. As was the case with consumers and firm managers in New Zealand, the average absolute size of revisions is very large for U.S. consumers. Households frequently revise their inflation forecasts by as much as five percentage points or more. Binder (2015) shows that the share of MSC respondents who revise their inflation forecasts has been between 70 and 80 percent since the early 1980s. In contrast, revisions in inflation forecasts for professional forecasters are much smaller and resemble what one would expect to see under anchored expectations, in sharp contrast to those of U.S. households.

Finally, we regress long-run inflation forecasts on short-term inflation forecasts. We do so both in levels (as with the New Zealand data) but also using revisions in both short-run and long-run forecasts at the individual level since this type of panel data is available for the U.S. in the MSC, the SCE and the SPF. Similar to New Zealand, long-term forecasts are highly sensitive to movements in short-term forecasts for consumers in the U.S. (Table 11). This sensitivity remains large even after controlling for consumer fixed effects. Furthermore, controlling for outliers tends to yield even higher estimates of the sensitivity: a one percentage point increase in short-term inflation forecast can be associated with as much as one percentage point increase in long-term inflation forecast. These sensitivities are broadly in line with the sensitivity estimated for managers in New Zealand. On the other hand, the sensitivity is much weaker for professional forecasters.

6.2 What Does the U.S. Public Know about Monetary Policy?

Given the apparent lack of anchoring in the inflation expectations of the U.S. public, we would like to know to what extent this reflects shortages in knowledge about monetary policy and recent inflation dynamics as opposed to a lack of credibility on the part of the Federal Reserve. As with New Zealand, we consider how well the public knows the chair of the Federal Reserve as a simple measure of how informed they are about recent monetary policy actions and discussions. Binder (2015) documents that the public is largely unaware of who is the chair of the Fed. In a number of polls asking the public to pick the name of the chair from four options, between 20 and 50 percent of respondents simply refuse to answer these multiple choice questions, while approximately one-third tend to pick the correct answer out of four names. The lowest share of correct answers was for Janet Yellen in the September 2014 poll (24 percent), but this was only

six months after she became chair which may explain her lower name recognition. These relatively low shares of correct answers are very close to those observed in the survey in New Zealand, suggesting a similar lack of awareness of the leadership of the central bank in New Zealand as in the U.S. among much of the broader public.

Just as we found that the general managers of firms in New Zealand did not seek out information about monetary policy, we can explore whether the U.S. public tries to access information about monetary policy directly from the source via social media. Table 7 presents numbers of Facebook and Twitter followers for each of the Federal Reserve Banks, as well as the Federal Reserve System as a whole. As of June 30th, 2015, the entire Fed system had 702,955 followers on Twitter. For comparison, the U.S. State Department had twice as many followers, the FBI had 470,000 more, and the CIA had 120,000 more followers on Twitter. In fact, the voice of the entire Federal Reserve system on Twitter is single-handedly dwarfed by that of Paul Krugman, who has almost twice as many followers. Even Ron Paul and Rand Paul each have almost as many followers as the entire Federal Reserve System. Binder (2015) documents similar evidence.

Data from Google Trends also allows us to verify the extent to which the U.S. public seeks out information about macroeconomic conditions online. Figure 9 plots the volume of online Google searches for macroeconomic variables like GDP, inflation and the unemployment rate in the U.S. since January 2004. For comparison, we also plot the total volume of searches for puppies, which is approximately three to four times as high. Strikingly, with the onset of the Great Recession, there is only a slight increase in the volume of searches for macroeconomic variables, and it reverses in 2009. Binder (2015) finds a very similar pattern for an alternative, but related set of searches.

But just as in New Zealand, the fact that much of the U.S. public does not actively seek out information about macroeconomic conditions or monetary policy does not mean that it necessarily views this information as unimportant. A poll from CNN and the Opinion Research Council in 2011 asked respondents to evaluate how important different issues would be to their vote for the 2012 presidential elections. 68 percent of respondents rated inflation as extremely important or very important to them. This combined share of importance put it just below terrorism and taxes in importance to the public and above the war in Afghanistan, illegal immigration, guns, the situation in Libya at the time, abortion and gay marriage (see Figure 10), despite the fact that the president's influence on inflation is much more limited than on any of these other issues. In similar spirit, Binder (2015) shows that there has been an increasing trend in the share of people claiming that they are hurt by inflation.

A likely reason for the apparent lack of active interest in monetary policy may be the view that it is a difficult topic to understand. The history of monetary policy communications is, of course, not one of openness with the public. While central banks like the Federal Reserve have over the last two decades

become increasingly communicative with the public, this increase in communication may not necessarily have helped matters much for the general public. Hernandez-Murillo and Shell (2014), for example, analyze the complexity of FOMC statements since the early 1990s and find that the length and reading level associated with these statements has increased significantly over time. For example, in the mid-1990s, a typical FOMC statement was approximately 100 words and required a 12th grade reading level to understand. By 2014, the length of the statement was six times as long, and the reading level was effectively for PhDs. Not surprisingly, when the U.S. public is asked how well they understand monetary policy, they tend to express some hesitation. In July 2014, a poll from the Associated Press asked respondents to indicate how easy or hard they felt it was to understand Federal Reserve policy on interest rates. While 27 percent of respondents claimed it was very easy or somewhat easy, 70 percent of respondents expressed difficulty understanding monetary policy, with a quarter of respondents saying it was "very hard". Blinder (2015) presents additional evidence documenting the complexity of the Federal Reserve's communication. In short, despite dramatic changes in the communications strategy of the Federal Reserve over the last twenty years, the U.S. general public appears to remain profoundly uncertain about what exactly the Federal Reserve does.

7 Conclusion

After twenty-five years of largely successful inflation targeting in New Zealand, the inflation expectations of households and managers there do not appear particularly well anchored. Managers of firms there disagree dramatically about recent and future inflation levels, even at long horizons, and many are poorly informed about the RBNZ's inflation target. Most managers appear to rely to a large extent on their personal shopping experience to make inferences about aggregate inflation, and are particularly sensitive to gasoline prices, much as is the case with households in the U.S. Indeed, along most metrics, the expectations of managers are much more similar to those of households than those of professional forecasters. Since neither group appears to be well-informed about monetary policy overall, this suggests that central banks' communications strategy changes of the last twenty years have not had the desired effects on this segment of the population, even if they may have been more effective with professionals or financial market participants. In short, while this state of affairs may be better than what New Zealand had before adopting inflation targeting (we do not have data on inflation expectations covering this period), in absolute terms the properties of inflation expectations and perceptions of inflation appear to score poorly along basic metrics of how anchored expectations are.

The lack of awareness by the general public, including firm managers, of the actions and objectives of monetary policymakers in a low-inflation environment is particularly problematic in periods when central bankers are seeking to affect inflation expectations through forward guidance. Because such policies

are designed to have real effects precisely by generating changes in agents' inflation expectations and therefore in their perceived real interest rates, the fact that the public may largely be unaware of the policies or of their implications for aggregate prices implies that their effects will most likely be limited, or at least much less than predicted by models with full information rational expectations agents. At least some central bankers are aware of the limited power of their promises.[16]

Coming to terms with these limited, heterogeneous information sets on the part of households and firms, not just in terms of contemporaneous economic conditions but also about the objectives of the central bank, will be challenging from a modeling point of view. For example, Coibion and Gorodnichenko (2011) show that strategic interaction of firms with different practices for pricing and acquisition of information has important implications for macroeconomic dynamics and policy design. However, this and related research abstract from heterogeneity and interaction of expectations across firms, households, professional forecasters, financial markets and the central bank. Indeed, most macroeconomic models do not include financial markets or professional forecasters and thus how these arguably better-informed agents influence macroeconomic outcomes is not understood well. Future work should shed new light on the optimal way for central banks to release information in a way that informs not just professional forecasters and financial market analysts but also the broader public. Only then may inflation targeting finally achieve its full promise.

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[16] Meyer (2006) notes, "Greenspan believes that inflation expectations can best be anchored by a history of having achieved price stability rather than by a mere promise to do so."

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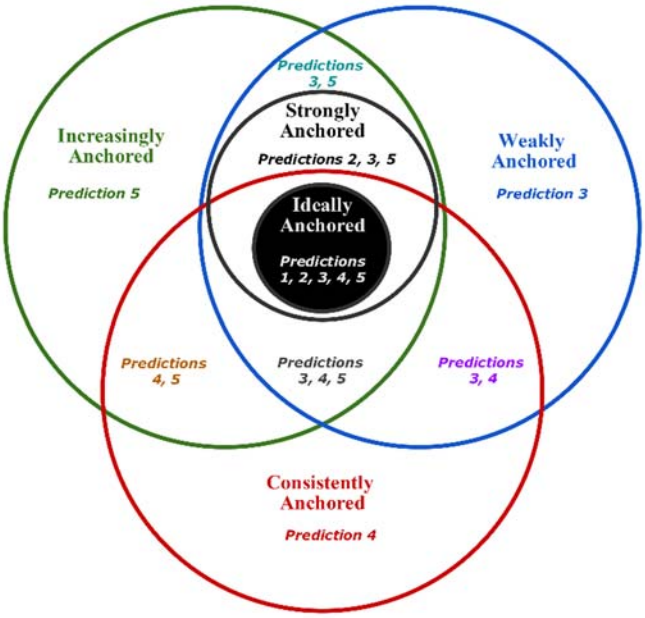
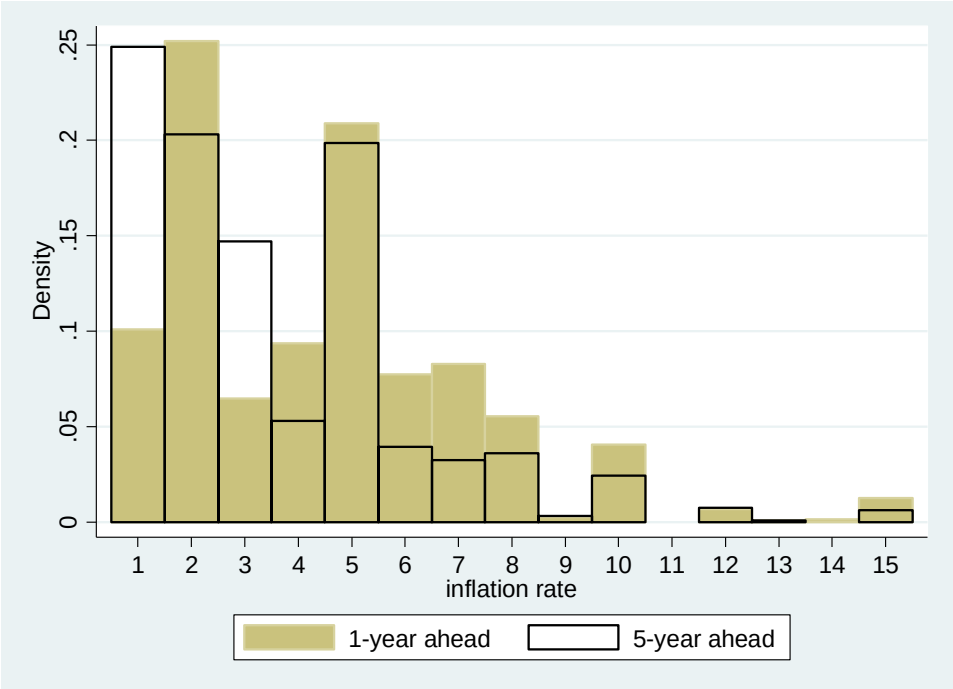
Figure 1: Definitions of Anchored Expectations and Associated Predictions.



Notes: The figure shows how the five definitions of anchored expectations, and their predictions, relate to one another. Causality is established in the sense that if expectations are ideally ϵ_τ-anchored for all $\tau \geq 0$ given an arbitrary sequence of $\{\epsilon_\tau\}_{\tau=0}^{\infty}$, then expectations are also strongly, weakly, consistently, and increasingly anchored according to $\{\epsilon_\tau\}_{\tau=0}^{\infty}$, up to a scale.

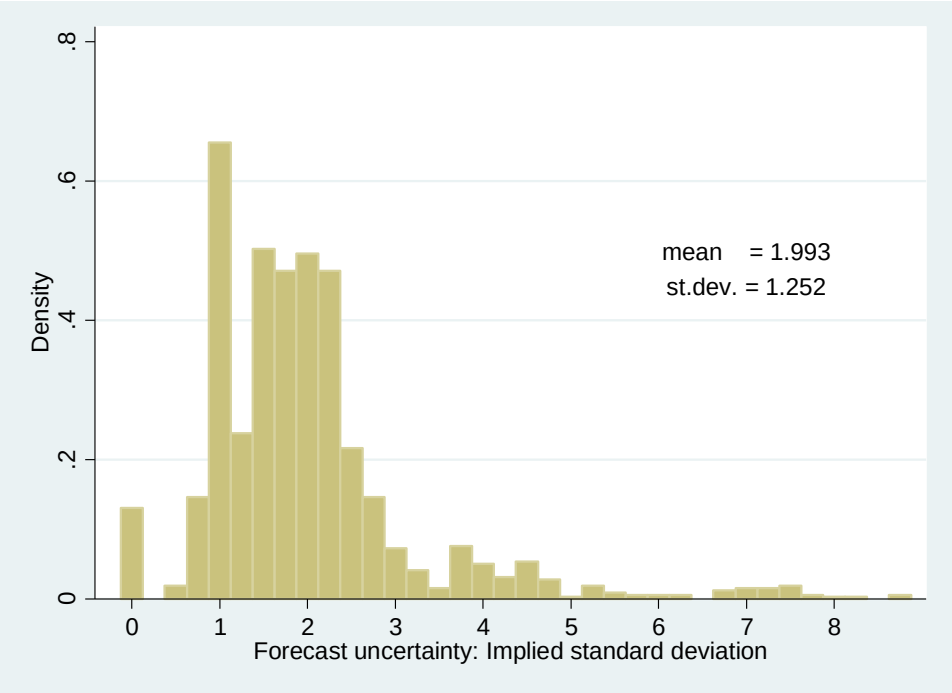
Figure 2. Distributions of Inflation Forecasts



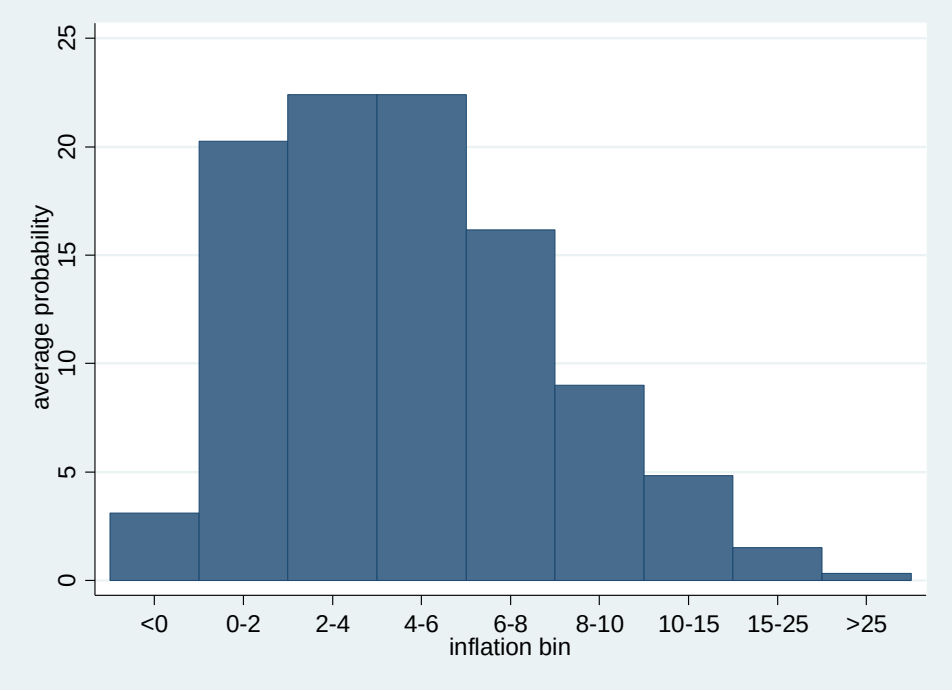
Notes: The figure reports the distribution of 1-year ahead and 5-to-10-year ahead inflation forecasts in the third wave of the survey (2014Q3). The survey questions are: "During the *next twelve* months, by how much do you think overall prices in the economy will change? Please provide an answer in percentage terms." and "Over the next five to ten years, at what average percentage rate *per year* do you think that overall prices in the economy will be changing?"

Figure 3. Uncertainty in Managers' Inflation Forecasts

Panel A: Distribution of uncertainty (implied standard deviation) across managers

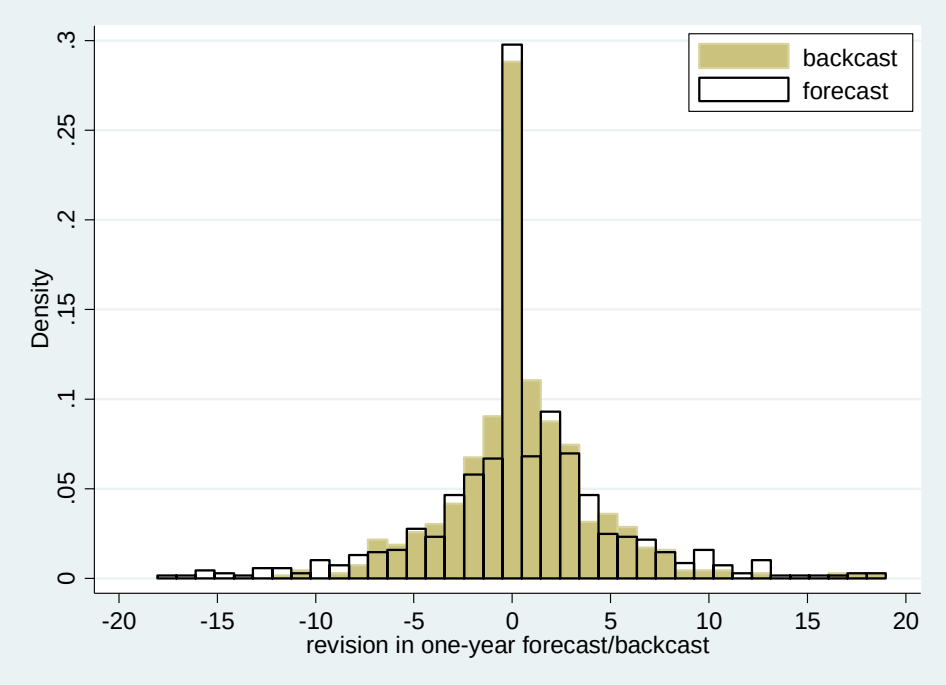


Panel B. Average probability assigned to inflation bins



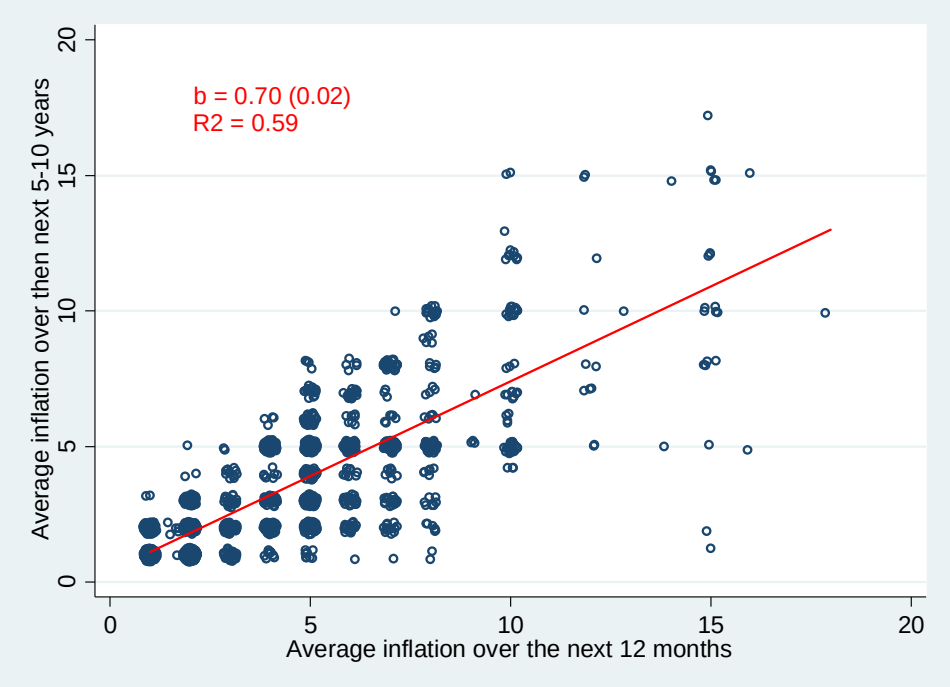
Notes: The survey question asks managers to assign probabilities to nine bins. For each respondent, we construct a measure of uncertainty as the standard deviation of the reported distribution. Panel A plots the distribution of this measure of uncertainty across managers. Panel B plots the average (across firms) probability assigned for each inflation bin.

Figure 4. Revisions of inflation forecasts and backcasts (one-year inflation)



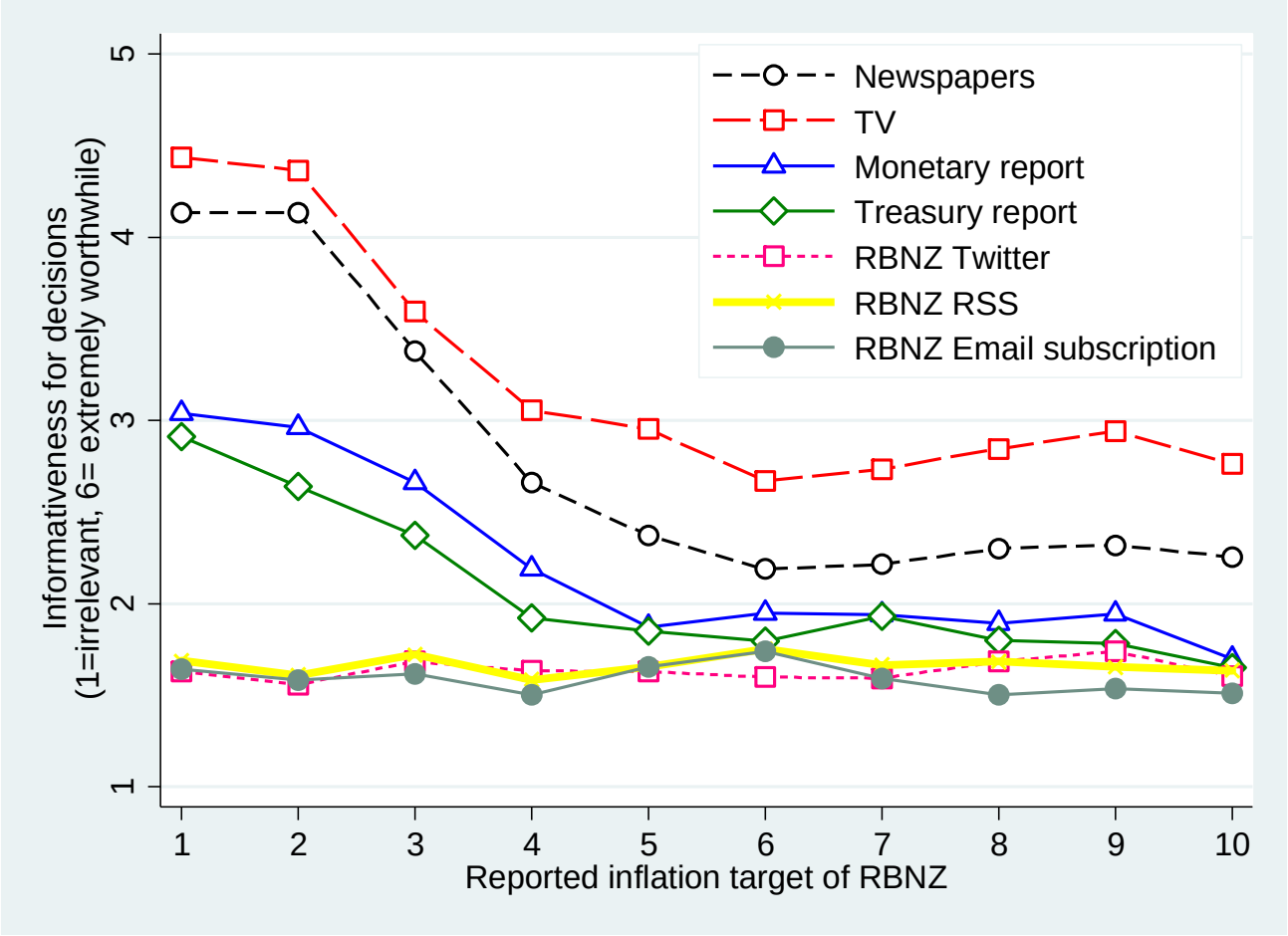
Notes: The figure plots the distribution of revisions in one-year inflation forecasts (white bars) and revisions in backcasts of inflation over last 12 months (brown bars).

Figure 5. Short-term vs. long-term inflation expectations



Notes: The figure shows the relationship between 1-year ahead and 5-to-10-year ahead inflation forecasts in the third wave of the survey (2014Q3). The survey questions are: "During the *next twelve* months, by how much do you think overall prices in the economy will change? Please provide an answer in percentage terms." and "Over the next five to ten years, at what average percentage rate *per year* do you think that overall prices in the economy will be changing?".

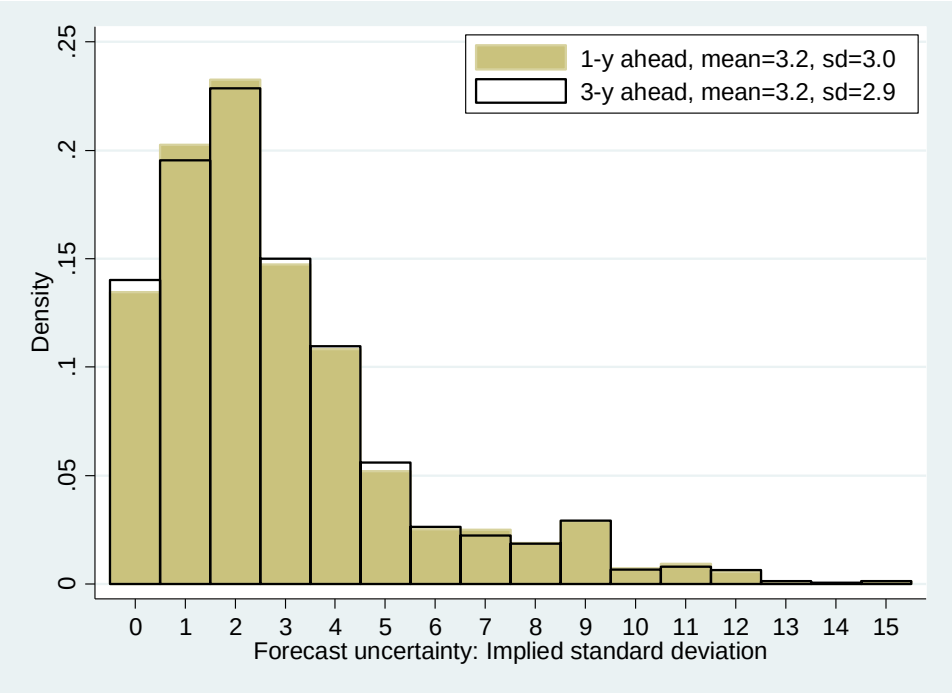
Figure 6: Informativeness of Different Types of Media



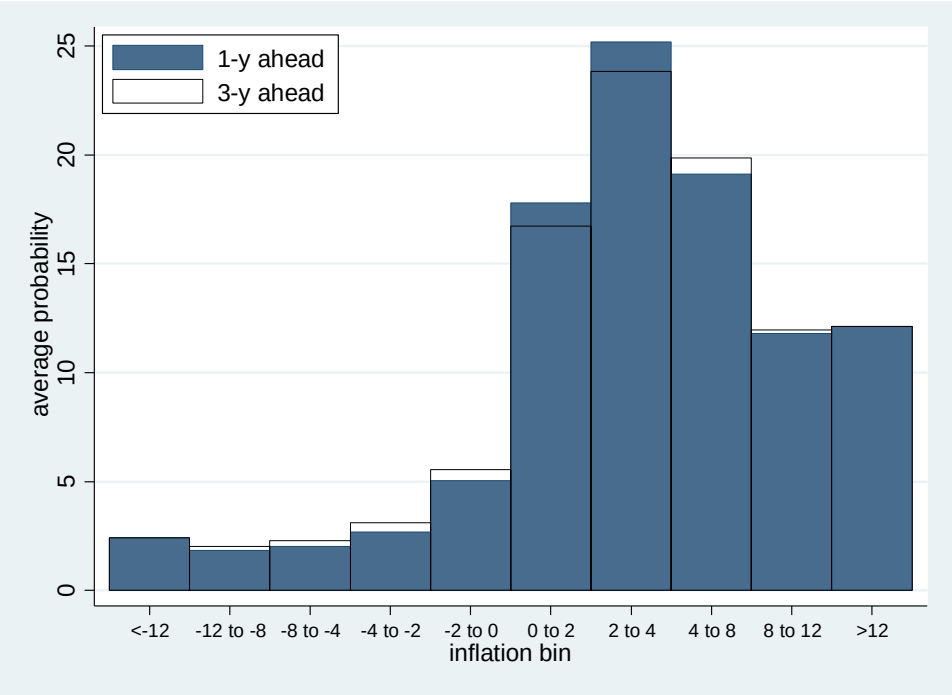
Notes: The figure plots the mean informativeness for decisions of each type of media for all managers who reported that the inflation target for the RBNZ was one of the values on x-axis.

Figure 7. Uncertainty in Consumers' Inflation Forecasts, U.S.

Panel A: Distribution of uncertainty (implied standard deviation) across consumers

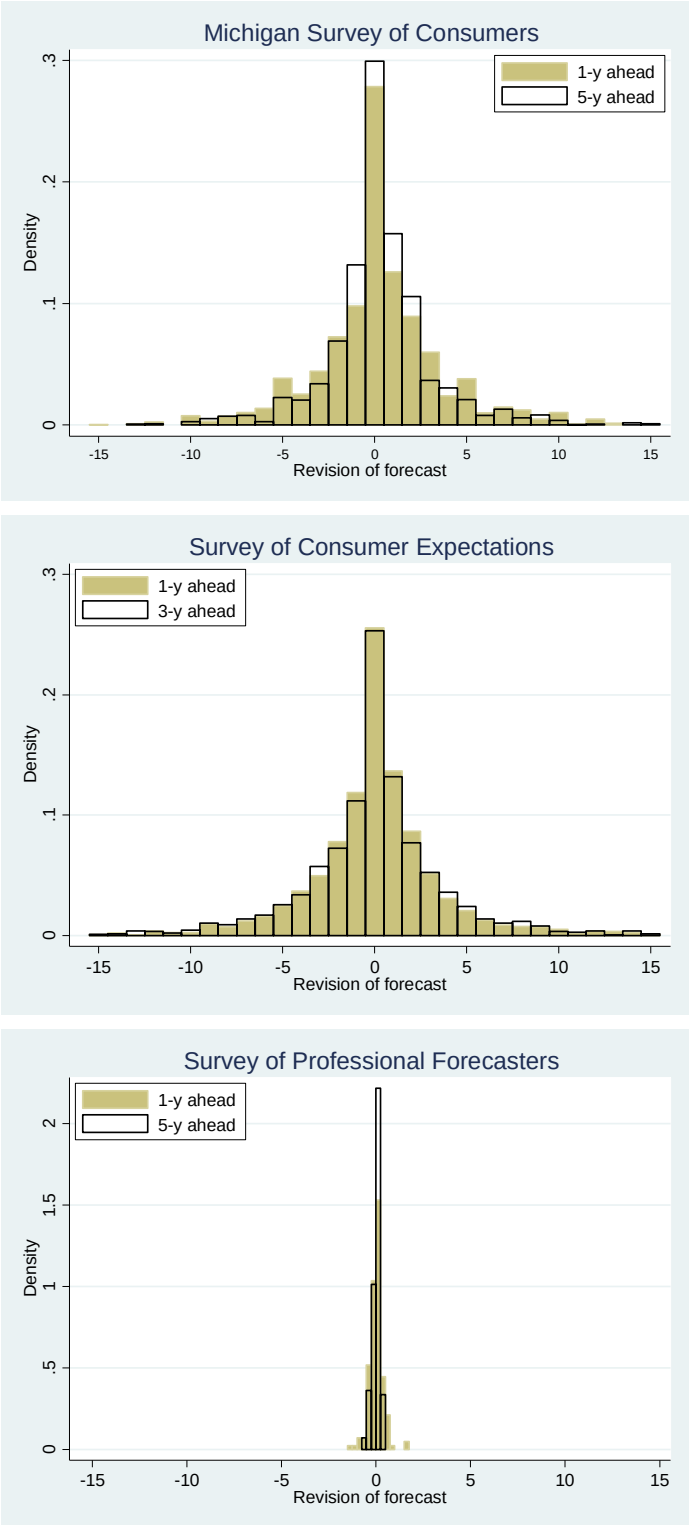


Panel B. Average probability assigned to inflation bins



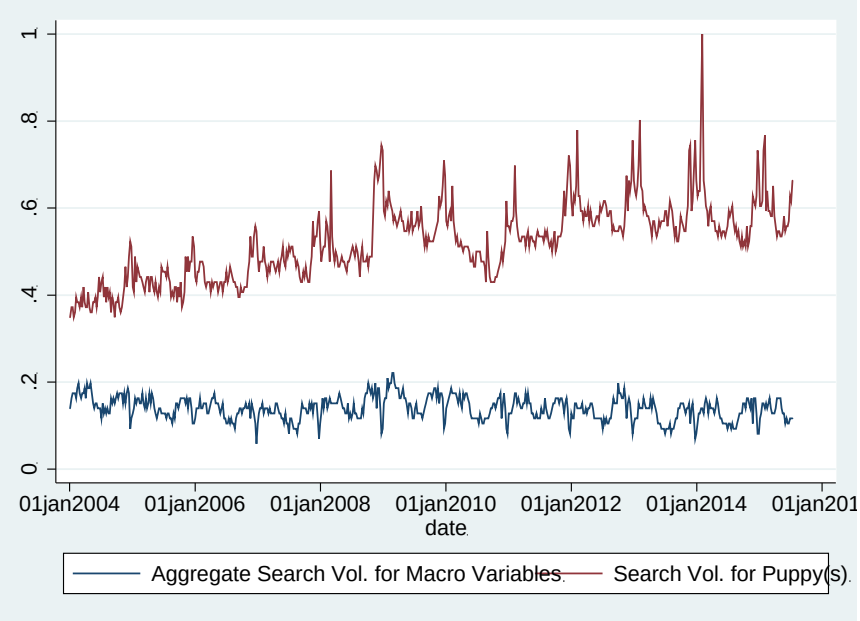
Notes: A question in the Survey of Consumer Expectations asks consumers to assign probabilities to ten bins. For each consumer, we construct a measure of uncertainty as the standard deviation of the reported distribution. Panel A plots the distribution of this measure of uncertainty across consumers. Panel B plots the average (across consumers) probability assigned for each inflation bin. The sample period covers 2013Q4-2014Q4.

Figure 8: Forecast Revisions by U.S. Households and Professional Forecasters



Notes: In each panel, brown bars are for the distribution of revisions in long-term (3- or 5-year-ahead) inflation forecasts. White bars are for the distribution of revisions in short-term (1-year) inflation forecasts.

Figure 9: U.S. Google Searches for Macroeconomic Variables vs. Puppies



Notes: The figure plots the volume of online Google searches for macroeconomic variables (GDP, inflation and unemployment rate) vs. puppies. Source: Google Trends.

Figure 10: Relative Importance of Inflation as an Issue to the U.S. Public

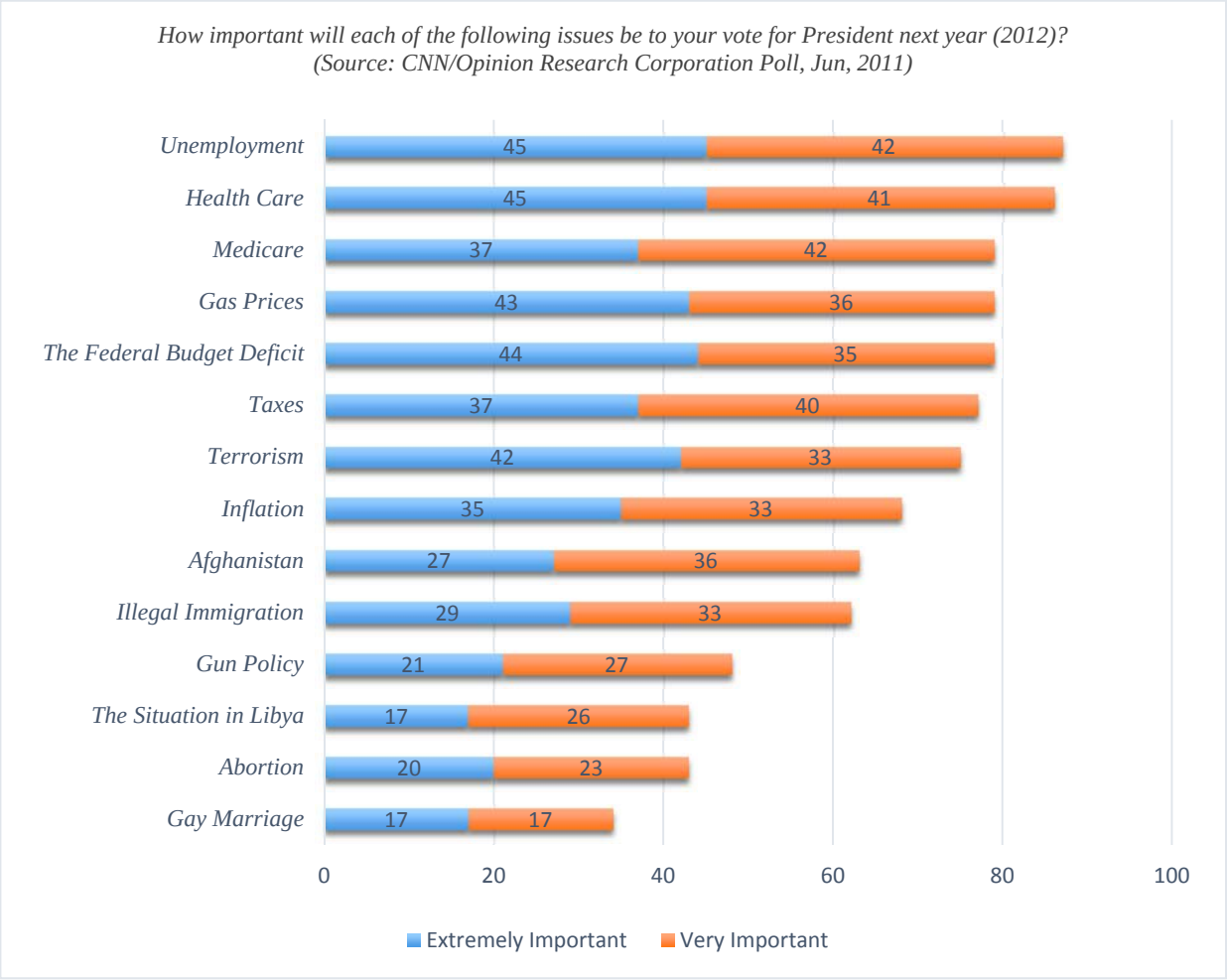


Table 1: Inflation Forecasts of Firm Managers and Others for New Zealand

Survey Date	Recent data	Forecasts, percentage points							Nowcasts/Backcasts, percentage points			
		Central Bank	Professional forecasters		Households		Firms		Households		Firms	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: 1-year inflation												
2013Q4	1.5	1.3	2.0	0.2	3.4	2.0	5.3	3.1	2.9	1.8	4.8	3.5
2014Q1	1.5	1.9	2.0	0.3	3.6	1.8	5.9	2.8	2.9	1.6	5.3	3.3
2014Q3	1.6	1.6	1.9	0.2	3.5	2.2	4.3	2.5	2.9	1.9	n.a.	n.a.
2014Q4	1.0	1.1	1.7	0.3	3.1	1.9	4.7	2.8	2.8	1.8	4.3	2.5
Panel B: 5-to-10 year inflation												
2014Q3	2.1	2.1	2.1	n.a.	4.1	2.8	3.4	2.4	-	-	-	-

Notes: The table presents inflation forecasts of the RBNZ (column 2), mean forecasts from surveys and the cross-sectional standard deviations of these forecasts (columns 3-8). Columns 9-12 report nowcasts/backcasts of inflation over the last 12 months. Column (1) reports most recently available inflation data at the time of the surveys. Professional forecasts are from Consensus Economics. Household forecasts are from the Survey of Households produced by the RBNZ. Central Bank forecasts are from Monetary Policy Reports of the RBNZ. Consistent with how the RBNZ calculates moments of household expectations, we exclude responses of firms' managers that are greater than 15 percentage points or less than -2 percentage points. Results for non-truncated data are reported in Appendix Table A1. Moments for firms are calculated without weights. Results with sample weights are reported in Appendix Table A1.

Table 2: Perceived RBNZ Inflation Target and Managers' Inflation Forecasts

Perceived Inflation target of the RBNZ	Share of managers reporting a target	Inflation forecast: mean			Inflation forecast: standard deviation			Inflation forecast: average uncertainty	Average inflation backcast
		1 year, wave 4	1 year, wave 3	5-10 year, wave 3	1 year, wave 4	1 year, wave 3	5-10 year, wave 3	1 year, wave 4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	14.96	3.1	2.7	2.2	2.2	2.0	1.8	1.64	2.6
2	12.41	2.8	2.5	2.1	1.5	1.4	1.3	1.68	2.3
3	10.26	4.1	3.6	3.0	2.4	2.1	1.9	1.91	3.1
4	11.46	5.7	5.2	4.1	3.2	2.9	2.7	2.24	5.6
5	14.96	5.9	5.3	4.1	3.2	2.7	2.4	2.10	6.1
6	8.91	5.4	5.0	3.9	2.9	2.7	2.8	2.05	6.1
7	7.80	5.8	5.4	3.7	3.6	2.8	2.2	2.16	6.3
8	8.75	6.7	6.2	4.8	3.6	3.0	3.2	2.38	6.6
9	5.49	5.7	5.2	4.0	3.1	2.5	2.6	2.02	7.3
10+	5.01	6.4	6.0	5.0	2.9	2.8	3.0	2.05	8.2

Notes: Columns (2)-(4) report mean inflation forecasts at different horizons for various waves of the survey. Columns (5)-(7) report cross-sectional standard deviation of inflation forecasts at different horizons for various waves of the survey. Column (8) reports average (across firms) standard deviation of inflation forecast implied by the probability distribution reported by firms' managers. Column (9) shows the average perceived inflation rate over the previous 12 months.

Table 3: Value of News for Firm Managers in New Zealand

Perceived Inflation target of the RBNZ	Share of managers reporting a target	Willingness to pay for having access to professional forecast: Inflation $/year	Inflation percent of sales	GDP $/year	Unempl. $/year	Abs. slope of the profit function	Average years of schooling	Frequency of following media news about economy, "update in X months"	Frequency of reading public sources, once in X months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	14.96	195	0.018	125	118	1.08	15.74	3.7	6.7
2	12.41	202	0.017	130	121	1.13	15.61	4.2	7.3
3	10.26	172	0.015	126	126	1.13	15.22	6.9	10.1
4	11.46	126	0.010	149	129	1.01	15.63	9.8	12.9
5	14.96	110	0.007	151	127	1.01	15.24	10.9	14.6
6	8.91	106	0.008	143	136	0.98	15.16	11.7	14.8
7	7.80	104	0.007	149	137	1.00	15.36	11.4	14.3
8	8.75	107	0.008	150	134	0.89	15.35	11.5	14.5
9	5.49	101	0.007	165	132	0.93	15.12	11.8	14.6
10+	5.01	98	0.006	141	127	1.01	15.35	11.5	15.0

Notes: Columns (2), (4) and (5) report the average dollar amount managers are willing to pay for a professional forecast per month. Column (3) report the average percent of annual sales managers are willing to pay for a professional forecast of inflation per month. Column (6) report the average slope of the profit function with respect to the price of a firm's main product. Column (7) reports the average years of schooling of respondents. Column (8) shows the frequency at which managers update their information about the state of the economy. Column (9) reports the frequency at which managers check public sources (e.g., Treasury Reports, Monetary Reports). Frequencies in columns (8) and (9) are reported in "per month" format.

Table 4: Correlates of Knowledge of Monetary Policy

	Absolute error in the perception of the central bank's target rate of inflation			Count of errors in the answers about the objectives, target and governor of the RBNZ		
	(1)	(2)	(3)	(4)	(5)	(6)
Firm characteristics						
Log(Age)	0.086		0.052	0.077		0.129*
	(0.077)		(0.129)	(0.059)		(0.074)
Log(Employment)	0.216**		0.259**	0.259***		0.210***
	(0.092)		(0.128)	(0.070)		(0.073)
Labor's share of costs	-0.010		-0.014	-0.010		-0.014**
	(0.007)		(0.010)	(0.006)		(0.006)
Foreign trade share	0.021***		0.018***	0.009***		0.008***
	(0.004)		(0.005)	(0.003)		(0.003)
Number of Competitors	-0.011**		-0.017***	-0.006		-0.008**
	(0.005)		(0.006)	(0.004)		(0.004)
Avg. margin	0.013*		0.006	0.001		-0.000
	(0.007)		(0.010)	(0.006)		(0.006)
Price rel. to competitors	0.011*		0.011	0.004		0.004
	(0.006)		(0.008)	(0.005)		(0.005)
Abs. slope of profit function	-0.226***		-0.142	-0.056		-0.081
	(0.087)		(0.138)	(0.075)		(0.080)
Manager characteristics						
Age		-0.014*	-0.014		-0.008	-0.007
		(0.007)	(0.009)		(0.005)	(0.005)
Years of schooling		-0.069***	-0.051*		-0.042**	-0.041**
		(0.023)	(0.030)		(0.018)	(0.019)
Tenure		0.038***	0.001		0.026***	-0.006
		(0.008)	(0.014)		(0.006)	(0.008)
Income		0.003*	0.001		0.001	0.001
		(0.001)	(0.002)		(0.001)	(0.001)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,253	1,138	1,141	1,256	1,141	1,141
R-squared	0.243	0.194	0.179	0.154	0.122	0.161

Notes: The table reports results of regressing errors about objectives, target and governor of the RBNZ on a set of firm and manager characteristics indicted in the left column. In columns (1)-(3), the dependent variable is the absolute error in the perception of central bank's target rate of inflation. In columns (4)-(6), the dependent variable is the count for wrong answers for three questions asking respondents to report the RBNZ's objective, target and governor. If all answers are correct, the count is equal to zero. In all answers are wrong, the count is equal to three. Robust standard errors are reported in parentheses. ***, **, * indicate statistical significant at 1, 5, and 10 percent levels.

Table 5: Managers' Perceptions of Construction of Inflation

	Perceived		Actual	
	weight	Inflation, percent	Weight	Inflation, percent
Housing prices	21.7	7.5	4.4	5.3
	(14.3)	(1.6)		
Stock prices	8.4	3.7	0.0	13.3
	(5.7)	(2.8)		
Food prices	8.9	4.0	18.8	0.2
	(8.1)	(2.0)		
Healthcare costs	8.4	0.7	4.0	1.8
	(6.4)	(1.7)		
Gasoline prices	18.9	-6.3	4.7	-7.4
	(12.7)	(6.0)		
Cost of rent	9.4	3.5	9.4	2.3
	(6.4)	(1.8)		
Car price	10.3	3.3	3.3	-3.8
	(9.7)	(1.6)		
Implied inflation contribution $(\tilde{\pi}_i^p, \tilde{\pi}^a)$, percentage points	1.79 (2.12)		0.08	
Error $(\tilde{\pi}^p - \tilde{\pi}^a)$, percentage points		1.71 (2.12)		
Of which				
$\sum_s w_s^a (\pi_{s,i}^p - \pi_s^a)$		1.18 (0.48)		
$\sum_s (w_{s,i}^p - w_s^a)\pi_s^a$		0.78 (1.48)		
$\sum_s (w_{s,i}^p - w_s^a)(\pi_{s,i}^p - \pi_s^a)$		-0.24 (1.85)		

Notes: The top panel of the table shows perceived and actual inflation for subcategories of the Consumer Price Index as well as perceived and actual weights for these subcategories. The middle panel shows the perceived and actual contribution of these subcategories to aggregate CPI inflation. The bottom panel decomposes the difference between the perceived and actual contributions.

Table 6: Narrative Responses to How Managers Form their Inflation Expectations

How do you typically form your inflation expectations?	Share of managers	Absolute backcast error, percentage points		Inflation forecast, percentage points	
		Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)
Media	0.47	2.61	1.78	3.65	2.45
Meetings and discussions	0.10	3.10	1.52	4.00	1.22
Shopping experience	0.43	4.27	1.47	4.95	1.12
Prices of competitors and suppliers	0.10	4.50	2.17	5.20	2.39
Total		3.31	1.81	4.24	1.95

Notes: The left column of the table indicates the main source of information or way of forming expectations. Narrative responses may be classified into several categories. We could not classify one response into any of the four groups indicated in the left column of in the table.

Table 7: Quantitative Responses to How Managers Form their Inflation Expectations

		Importance of information source										
	Share of managers	Family and friends	Employees & colleagues	Customers & suppliers	Gas prices	Personal shopping experience	Government agencies	Business associations, fairs	Media	Professional forecasts	Average abs. backcast error	Average inflation forecast
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
All firms	1.00	2.12	1.88	1.68	4.14	4.42	1.74	1.82	3.54	2.42	3.27	4.18
Statistics if response is "very important" or "extremely important" for												
Family and friends	0.06	4.67	4.00	1.67	4.00	3.67	1.67	2.00	2.33	2.67	3.37	4.67
Employees & colleagues	0.08	3.25	4.50	2.00	4.25	4.00	2.00	1.75	2.75	2.75	2.95	3.75
Customers & suppliers	0.04	1.00	1.50	4.50	4.00	4.50	2.50	3.00	4.00	2.50	2.70	4.50
Gas prices	0.76	2.24	1.82	1.74	4.53	4.63	1.79	1.76	3.50	2.42	3.03	3.95
Personal shopping experience	0.88	2.07	1.77	1.68	4.25	4.64	1.77	1.86	3.64	2.48	3.14	4.11
Media	0.54	2.00	1.81	1.59	4.07	4.44	1.70	1.81	4.81	2.96	2.42	3.59
Prof. forecasts	0.20	2.00	2.10	1.30	3.90	4.30	1.30	1.50	4.80	4.40	1.65	2.20
Correlation matrix												
Family and friends		1.00										
Employees & colleagues		0.34	1.00									
Customers & suppliers		-0.13	0.15	1.00								
Gas prices		0.11	-0.14	-0.07	1.00							
Personal shopping experience		-0.14	-0.27	-0.01	0.65	1.00						
Government agencies		-0.10	0.09	0.31	0.15	0.09	1.00					
Bus. associations, fairs		-0.11	0.12	0.31	-0.21	-0.07	0.38	1.00				
Media		-0.15	-0.06	-0.05	0.02	0.21	-0.05	-0.02	1.00			
Prof. forecasts		0.03	0.10	0.01	-0.14	-0.11	-0.29	-0.07	0.48	1.00		

Notes: Respondents are asked to assess importance of various sources of information for their formation of inflation expectations. The scale runs from 1 ("not important") to 5 ("extremely important"). The table reports average responses. These responses were collected in the 5th wave of the survey.

Table 8: Narrative Responses to How Managers Use their Inflation Expectations

How do you typically use your inflation expectations?	Share of managers	Absolute backcast error, percentage points		Inflation forecast, percentage points	
		Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)
Personal use	0.67	3.35	1.78	4.15	1.82
Price-setting decisions	0.12	2.20	1.64	3.33	2.88
Wage-setting decisions	0.14	4.27	2.07	4.43	1.51
Investment decisions	0.18	3.03	1.58	5.11	2.15
Total	1.00	3.26	1.84	4.18	2.01

Notes: The left column of the table indicates the use of inflation expectations. Narrative responses may be classified into several categories. We could not classify one response into any of the four groups indicated in the left column of in the table.

Table 9: How Managers Would Respond to Higher Inflation Expectations

Panel A.

	Response		
Variable	increase	no change	decrease
Price	0.354	0.604	0.042
Wage	0.253	0.727	0.019
Employment	0.274	0.715	0.011
Investment	0.293	0.694	0.013

Panel B.

	Wage response		
Price response	increase	no change	decrease
Increase	0.130	0.217	0.007
no change	0.114	0.480	0.011
Decrease	0.009	0.030	0.002

Panel C.

	Employment response		
Wage response	increase	no change	decrease
Increase	0.082	0.167	0.004
no change	0.184	0.536	0.007
Decrease	0.007	0.012	0.000

Panel D.

	Employment response		
Investment response	increase	no change	decrease
Increase	0.089	0.200	0.004
no change	0.182	0.504	0.007
Decrease	0.002	0.011	0.000

Notes: Panel A presents shares of managers responding “increase”, “decrease”, or “no change” to the survey question is “If you thought overall prices in the economy over the next 12 months were going to rise by more than what you are currently forecasting, would you be more likely to [increase/decrease/no change] your [prices/employment/investment/wages]?” Panels B-D show breakdowns of how managers responded to pairs of questions.

Table 10: Inflation Forecasts of Firm Managers and Others for the U.S.

Survey Date	Recent data	Central Bank	Survey of Professional Forecasters		Households: Michigan Survey of Consumers		Households: Survey of Consumer Expectations	
			Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: 1-year-ahead inflation forecast, percentage points								
2013Q4	1.4	1.5	1.9	0.5	3.7	3.8	4.4	4.5
2014Q1	2.1	1.8	1.9	0.5	4.1	4.0	4.2	4.3
2014Q2	2.4	1.8	1.9	0.5	4.0	3.5	4.3	4.4
2014Q3	1.2	1.8	2.1	0.5	3.9	3.7	4.2	4.3
2014Q4	-0.9	1.3	1.9	0.5	3.1	3.6	n.a.	n.a.
Panel B: long-term inflation forecast, percentage points								
2013Q4		2.0	2.1	0.4	3.4	3.2	4.4	4.5
2014Q1		2.0	2.1	0.4	3.4	3.1	4.1	4.4
2014Q2		2.0	2.2	0.3	3.5	3.0	4.3	4.6
2014Q3		2.0	2.2	0.4	3.3	2.9	4.2	4.5
2014Q4		2.0	2.1	0.3	3.1	2.7	n.a.	n.a.

Notes: The table presents inflation forecasts of the Federal Reserve System (Economic Projections of Federal Reserve Board Members and Federal Reserve Bank Presidents), mean forecasts from surveys and the cross-sectional standard deviations of these forecasts (columns 3-8). For the Survey of Consumer Expectations, we use mean inflation forecast implied by distribution of respondents' expectations about future inflation. The horizons of the long-term forecasts are 5 years, 5 years, and 3 years for the Survey of Professional Forecasters, the Michigan Survey of Consumers, and the Survey of Consumer Expectations, respectively. For the projections of the central bank, we use "longer run" projections in Panel B and the middle of the central tendency range for CPI for the next calendar year.

Table 11. Correlation between short-term and long-term inflation forecasts, USA.

	Level			3-month revision			6-month revision		
	OLS	WGT	RREG	OLS	WGT	RREG	OLS	WGT	RREG
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: SCE, truncated sample, 3-year ahead forecast									
1-y ahead	0.672***	0.671***	0.932***	0.477***	0.505***	0.681***	0.507***	0.557***	0.723***
forecast	(0.012)	(0.017)	(0.003)	(0.026)	(0.030)	(0.005)	(0.037)	(0.043)	(0.008)
N. obs.	17,854	17,849	17,854	8,288	8,288	8,288	3,513	3,513	3,513
R2	0.392	0.371	0.879	0.203	0.221	0.664	0.211	0.258	0.701
Panel B: SCE, full sample, 3-year ahead forecast									
1-y ahead	0.562***	0.586***	0.984***	0.399***	0.412***	0.706***	0.386***	0.424***	0.857***
forecast	(0.022)	(0.035)	(0.001)	(0.034)	(0.049)	(0.002)	(0.046)	(0.070)	(0.003)
N. obs.	20,573	20,565	20,573	10,031	10,030	10,031	4,275	4,275	4,275
R2	0.295	0.299	0.984	0.141	0.143	0.944	0.135	0.136	0.960
Panel C: SCE, implied point prediction, 3-year ahead forecast									
1-y ahead	0.787***	0.783***	0.975***	0.643***	0.623***	0.815***	0.647***	0.662***	0.829***
forecast	(0.009)	(0.014)	(0.002)	(0.019)	(0.027)	(0.005)	(0.024)	(0.034)	(0.007)
N. obs.	20,567	20,559	20,567	10,047	10,046	10,047	4,285	4,285	4,285
R2	0.571	0.571	0.936	0.350	0.339	0.756	0.373	0.402	0.781
Panel D: MSC, truncated, 5-year ahead forecast									
1-y ahead	0.442***	0.444***	0.420***				0.349***	0.355***	0.285***
forecast	(0.012)	(0.014)	(0.005)				(0.027)	(0.031)	(0.011)
N. obs.	10,443	10,320	10,443				2,371	2,352	2,371
R2	0.280	0.281	0.428				0.159	0.166	0.231
Panel E: MCE, full sample, 5-year ahead forecast									
1-y ahead	0.442***	0.445***	0.411***				0.336***	0.350***	0.283***
forecast	(0.012)	(0.013)	(0.004)				(0.026)	(0.029)	(0.009)
N. obs.	10,588	10,464	10,588				2,440	2,420	2,440
R2	0.301	0.306	0.470				0.171	0.185	0.281
Panel F: SPF, 5-year ahead forecast									
1-y ahead	0.565***		0.598***	0.169***		0.146***	0.191***		0.163***
forecast	(0.035)		(0.028)	(0.034)		(0.029)	(0.035)		(0.032)
N. obs.	286		286	244		244	238		238
R2	0.572		0.619	0.105		0.095	0.125		0.097
Panel G: SPF, 10-year ahead forecast									
1-y ahead	0.474**		0.468**	0.057**		0.050**	0.056*		0.065**
forecast	(0.037)		(0.033)	(0.028)		(0.021)	(0.029)		(0.026)
N. obs.	285		285	244		244	237		237
R2	0.398		0.408	0.014		0.024	0.012		0.025

Notes: The table reports results of regressing long-term inflation forecasts (or forecast revisions) on short-term inflation forecasts (or forecast revisions). Forecasts in panels A-C are from the Survey of Consumer Expectations (SCE). Forecasts in panels D and E are from the Michigan Survey of Consumers (MSC). Forecasts in panels F and G are from the Survey of Professional Forecasters (SPF). In Panels A and D, the sample includes only respondents reporting inflation forecasts less than 15 percent in absolute value. Panels A and B use point predictions reported in the SCE. Panel C uses mean predicted inflation implied by the reported probability distribution in the SCE. Columns (1), (4), and (7) report estimates without using sampling weights. Columns (2), (5) and (8) use sampling weights in estimation. Columns (3), (6), and (9) use Huber robust regression to downweigh the importance of outliers and influential observations. The sample period covers 2013Q-2014Q4. Robust standard errors are reported in all columns but columns (3), (6), and (9). Standard errors are reported in columns (3), (6), and (9).***, **, * indicate statistical significance at 1, 5 and 10 percent.

Table 12: Social Media Following of the Federal Reserve and Others

Group	*Facebook Likes*	*Twitter Followers*	*Name*	*Facebook Likes*	*Twitter Followers*
Federal Reserve Banks	21,796	702,955	Federal Reserve	-	268,258
			Federal Reserve Bank of Atlanta	1,854	33,932
			Federal Reserve Bank of Boston	-	31,947
			Federal Reserve Bank of Chicago	-	45,640
			Federal Reserve Bank of Cleveland	1,506	26,920
			Federal Reserve Bank of Dallas	-	31,030
			Federal Reserve Bank of Kansas City	-	14,385
			Federal Reserve Bank of Minneapolis	811	29,261
			Federal Reserve Bank of New York	7,787	86,991
			Federal Reserve Bank of Philadelphia	1,254	34,767
			Federal Reserve Bank of Richmond	432	20,895
			Federal Reserve Bank of St. Louis	4,416	49,411
			Federal Reserve Bank of San Francisco	3,736	29,518
Government Branches	1,718,409	3,477,296	U.S. Dept. of Energy	69,084	249,663
			U.S. Dept. of Homeland Security	320,261	663,009
			U.S. Dept. of Justice	183,507	880,396
			U.S. Dept. of State	1,103,944	1,408,592
			U.S. Dept. of Treasury	41,613	275,636
CIA	440,716	818,493			
FBI	1,235,614	1,170,177			
Paul Krugman	-	1,374,547			
Ron Paul	1,287,106	549,344			
Rand Paul	2,024,694	637,037			

Notes: Facebook and twitter pages were accessed on June 30th, 2015.

ONLINE APPENDIX

Appendix Table A1. Effect of using weights and truncation of the sample on basic moments for inflation forecasts and perceived inflation in New Zealand.

Survey Date	Sample and weights					
	Full sample		Truncated sample with sample weights		Full sample with sample weights	
	Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: 1-year-ahead inflation forecasts, percentage points						
2013Q4	7.1	5.9	5.3	3.3	6.5	5.0
2014Q1	7.5	5.0	6.0	2.7	8.0	5.7
2014Q3	4.4	2.8	4.3	2.5	4.5	2.9
2014Q4	4.9	3.1	4.8	2.9	5.0	3.2
Panel B: 5-to-10-year-ahead inflation forecast, percentage points						
2014Q3	3.5	2.6	3.6	2.5	3.7	2.8
Panel C: 1-year inflation nowcasts/backcasts, percentage points						
2013Q4	5.3	4.2	4.3	3.5	5.1	4.6
2014Q1	5.9	4.3	5.8	3.4	6.9	5.4
2014Q3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2014Q4	4.3	2.5	4.1	2.3	4.1	2.5

Notes: The table presents inflation forecasts/nowcasts/backcasts of firms' managers. *Truncated sample* refers to when we exclude responses that are greater than 15 percentage points or less than -2 percentage points. *Full sample* includes all observations. Moments in columns (3)-(6) are constructed using sample weights. See the text and note to Table 1 for more details. Sample weights are based on firm counts. Results are similar if weights are based on employment counts.

Appendix Table A2. Distribution of firm sizes (firm count) in the survey data vis-à-vis census data.

Employment size	Finance, Insurance, and Business services				Manufacturing				Other services			
	survey			census	survey			census	survey			census
	raw	weight A	weight B		raw	weight A	weight B		raw	weight A	weight B	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
					Panel A: Share in the total number of firms							
6-9	0.27	0.42	0.43	0.43	0.24	0.33	0.34	0.33	0.29	0.44	0.44	0.43
10-19	0.31	0.34	0.34	0.33	0.36	0.33	0.35	0.33	0.32	0.35	0.35	0.34
20-49	0.27	0.17	0.16	0.16	0.23	0.22	0.19	0.22	0.26	0.16	0.15	0.16
50-99	0.13	0.04	0.04	0.04	0.14	0.07	0.07	0.07	0.12	0.04	0.05	0.05
100+	0.02	0.03	0.03	0.04	0.03	0.05	0.06	0.05	0.01	0.01	0.02	0.03
					Panel B: Share in the total employment							
6-9	0.07	0.13	0.13	0.13	0.06	0.08	0.08	0.08	0.09	0.18	0.18	0.15
10-19	0.15	0.20	0.20	0.18	0.15	0.14	0.14	0.14	0.18	0.27	0.26	0.22
20-49	0.31	0.23	0.22	0.20	0.25	0.24	0.21	0.20	0.36	0.29	0.26	0.24
50-99	0.31	0.11	0.12	0.12	0.31	0.17	0.17	0.16	0.32	0.16	0.17	0.15
100+	0.17	0.32	0.33	0.38	0.23	0.37	0.40	0.43	0.05	0.09	0.13	0.24
					Panel C: Average firm size							
6-9	7.4	7.4	7.4	7.3	7.7	7.8	7.8	7.3	7.4	7.4	7.4	7.2
10-19	13.8	13.9	13.9	13.3	13.7	13.8	13.7	13.4	13.9	13.8	13.8	13.3
20-49	32.4	32.3	32.3	29.7	36.1	36.5	36.3	29.7	33.0	32.7	32.6	29.2
50-99	68.5	68.3	68.2	68.4	73.6	74.0	73.6	69.8	63.9	63.9	63.3	68.6
100+	247.8	246.1	241.5	260.7	220.9	243.9	241.2	252.1	128.4	119.1	118.1	191.9

Notes: Columns (1), (5),and (9) report distributions in the survey without weights. Columns (4), (8), and (12) report distributions in the population (Census). Columns (2), (3), (6), (7), (10), and (11) reports distribution after applying weights to match the distribution in the population. Sample "weight A" is based on firm count. Sample "weight B" is based on firm employment.

Proofs.

Proof of Proposition 1.

Suppose expectations are ideally ϵ-anchored at time t for horizon τ, then $\forall i \in [0,1]$ we have

$$\pi^i_{t+\tau|t} = \int_{\pi^*-\epsilon}^{\pi^*+\epsilon} x dF^i_{t+\tau|t}(x) \leq \pi^* + \epsilon$$

Similarly we can show that $\pi^i_{t+\tau|t} \geq \pi^* - \epsilon$. Hence,

$$\begin{aligned}
&\left(\pi^i_{t+\tau|t} - \pi^*\right)^2 < \epsilon^2 \Rightarrow \int_0^1 \left(\pi^i_{t+\tau|t} - \pi^*\right)^2 di < \epsilon^2 \\
\Rightarrow &\int_0^1 \left(\pi^i_{t+\tau|t} - \int_0^1 \pi^i_{t+\tau|t} di + \int_0^1 \pi^i_{t+\tau|t} di - \pi^*\right)^2 di < \epsilon^2 \\
\Rightarrow &\int_0^1 \left(\pi^i_{t+\tau|t} - \int_0^1 \pi^i_{t+\tau|t} di\right)^2 di + \int_0^1 \left(\int_0^1 \pi^i_{t+\tau|t} di - \pi^*\right)^2 di < \epsilon^2 \\
\Rightarrow &\, bias^2_{t+\tau|t} + \int_0^1 \left(\pi^i_{t+\tau|t} - \int_0^1 \pi^i_{t+\tau|t} di\right)^2 di < \epsilon^2
\end{aligned}$$

Thus, $bias_{t+\tau|t} < \epsilon$. Q.E.D.

Proof of Proposition 2.

Notice that similar to proof of Proposition 1 we can show that as expectations are strongly ϵ-anchored,

$$\left(\pi^i_{t+\tau|t} - \int_0^1 \pi^i_{t+\tau|t} di\right)^2 < \epsilon^2, \forall i \in [0,1] \Rightarrow \int_0^1 \left(\pi^i_{t+\tau|t} - \int_0^1 \pi^i_{t+\tau|t} di\right)^2 di < \epsilon^2 \Rightarrow sd_{t+\tau|t} < \epsilon.$$

Note that we cannot say anything about the bias relative to the central bank's target here as being strongly anchored does not imply anything about expectations being close to that of the central bank's. Q.E.D.

Proof of Lemma 1. Suppose inflation expectations are ideally $\frac{\epsilon}{2}$-anchored, then from proof of Proposition 1 recall that

$$\pi^i_{t+\tau|t} < \pi^* + \frac{\epsilon}{2}, \forall i \in [0,1] \Rightarrow \int_0^1 \pi^i_{t+\tau|t} di < \pi^* + \frac{\epsilon}{2} \Rightarrow \int_0^1 \pi^i_{t+\tau|t} di - \epsilon < \pi^* - \frac{\epsilon}{2}$$

Now, since $F^i_{t+\tau|t}\left(\pi^* - \frac{\epsilon}{2}\right) = 0, \forall i \in [0,1]$ and any CDF is weakly increasing, we must have

$$F^i_{t+\tau|t}\left(\int_0^1 \pi^i_{t+\tau|t} di - \epsilon\right) = 0, \forall i \in [0,1].$$

Similarly,

$$\pi^i_{t+\tau|t} > \pi^* - \frac{\epsilon}{2}, \forall i \in [0,1] \Rightarrow \int_0^1 \pi^i_{t+\tau|t} di > \pi^* - \frac{\epsilon}{2} \Rightarrow \int_0^1 \pi^i_{t+\tau|t} di + \epsilon > \pi^* + \frac{\epsilon}{2}.$$

Again, since $F^i_{t+\tau|t}\left(\pi^* + \frac{\epsilon}{2}\right) = 1, \forall i \in [0,1]$, and any CDF is weakly increasing, we must have

$$F^i_{t+\tau|t}\left(\int_0^1 \pi^i_{t+\tau|t}di+\epsilon\right)=1,\forall i\in[0,1].$$

Thus,

$$F^i_{t+\tau|t}\left(\int_0^1 \pi^i_{t+\tau|t}di+\epsilon\right)-F^i_{t+\tau|t}\left(\int_0^1 \pi^i_{t+\tau|t}di-\epsilon\right)=1,\forall i\in[0,1].$$

which implies that expectations are strongly ϵ-anchored. Notice that the reverse does not need to be true as being strongly anchored does not imply anything about expectations being close to the forecast of the central bank. Q.E.D.

Proof of Proposition 3.

Notice that

$$\begin{aligned}E^i_t\left\{\left(\pi_{t+\tau}-\pi^i_{t+\tau|t}\right)^2\right\}&=\int_{\pi^i_{t+\tau|t}-\epsilon}^{\pi^i_{t+\tau|t}+\epsilon}\left(x-\pi^i_{t+\tau|t}\right)^2dF^i_{t+\tau|t}(x)\\&<\epsilon^2\int_{\pi^i_{t+\tau|t}-\epsilon}^{\pi^i_{t+\tau|t}+\epsilon}dF^i_{t+\tau|t}(x)\\&=\epsilon^2.\end{aligned}$$

Q.E.D.

Proof of Lemma 2.

Recall from proof of Lemma 1 that if expectations are ideally $\frac{\epsilon}{2}$-anchored, then

$$\pi^i_{t+\tau|t}<\pi^*+\frac{\epsilon}{2},\forall i\in[0,1]\Rightarrow\pi^i_{t+\tau|t}-\epsilon<\pi^*-\frac{\epsilon}{2}$$

Now, since $F^i_{t+\tau|t}\left(\pi^*-\frac{\epsilon}{2}\right)=0,\forall i\in[0,1]$ and any CDF is weakly increasing, we must have

$$F^i_{t+\tau|t}\left(\pi^i_{t+\tau|t}-\epsilon\right)=0,\forall i\in[0,1].$$

Similarly,

$$\pi^i_{t+\tau|t}>\pi^*-\frac{\epsilon}{2},\forall i\in[0,1]\Rightarrow\pi^i_{t+\tau|t}+\epsilon>\pi^*+\frac{\epsilon}{2}.$$

Again, since $F^i_{t+\tau|t}\left(\pi^*+\frac{\epsilon}{2}\right)=1,\forall i\in[0,1]$, and any CDF is weakly increasing, we must have

$$F^i_{t+\tau|t}\left(\pi^i_{t+\tau|t}+\epsilon\right)=1,\forall i\in[0,1].$$

Thus,

$$F^i_{t+\tau|t}\left(\pi^i_{t+\tau|t}+\epsilon\right)-F^i_{t+\tau|t}\left(\pi^i_{t+\tau|t}-\epsilon\right)=1,\forall i\in[0,1].$$

Q.E.D.

The argument is identical to proving that if expectations are strongly $\frac{\epsilon}{2}$-anchored then they are also weakly ϵ-anchored.

Proof of Proposition 4.

For this proof we are going to use the identity that for any given random variable X with CDF $F(.)$,

$$E\{X\} = \int_0^{+\infty} \big(1 - F(x)\big)dx - \int_{-\infty}^{0} F(x)dx.$$

Now, let $FR^i_{t+\tau|t} \equiv E^i_t\{\pi_{t+\tau}\} - E^i_{t-1}\{\pi_{t+\tau-1}\}$, and notice that

$$\begin{aligned}
\left|FR^i_{t+\tau|t}\right| &= \Big| \int_0^{+\infty} \left(1 - F^i_{t+\tau|t}(x)\right) dx - \int_{-\infty}^{0} F^i_{t+\tau-1|t-1}(x)dx \\
&\quad - \int_0^{+\infty} \left(1 - F^i_{t+\tau|t}(x)\right) dx + \int_{-\infty}^{0} F^i_{t+\tau-1|t-1}(x)dx \Big| \\
&= \left| \int_R \left(F^i_{t+\tau|t}(x) - F^i_{t+\tau-1|t-1}(x)\right) dx \right| \\
&\leq \int_R \left|F^i_{t+\tau|t}(x) - F^i_{t+\tau-1|t-1}(x)\right| dx \\
&< \epsilon.
\end{aligned}$$

Q.E.D.

Proof of Lemma 3.

Notice that if inflation expectations for horizon τ are ideally $\frac{\epsilon}{2}$-anchored at t and $t-1$, then

$$\int_R \left|F^i_{t+\tau|t}(x) - F^i_{t+\tau-1|t-1}(x)\right| dx = \int_{\pi^* - \frac{\epsilon}{2}}^{\pi^* + \frac{\epsilon}{2}} \left|F^i_{t+\tau|t}(x) - F^i_{t+\tau-1|t-1}(x)\right| dx < \int_{\pi^* - \frac{\epsilon}{2}}^{\pi^* + \frac{\epsilon}{2}} 1.\, dx = \epsilon$$

meaning that expectations are consistently ϵ-anchored.

Now, for the second part of the lemma, suppose inflation expectations for horizon τ are strongly $\frac{\epsilon}{2}$-anchored at t and $t-1$. Let for this part of proof

$$a \equiv \min\{\overline{\pi_{t+\tau|t}}, \overline{\pi_{t+\tau-1|t-1}}\}, b \equiv \max\{\overline{\pi_{t+\tau|t}}, \overline{\pi_{t+\tau-1|t-1}}\}$$

Notice that $b - a = \overline{FR_{t+\tau|t}} = \delta$.

Now observe that

$$\begin{aligned}
\int_R \left|F^i_{t+\tau|t}(x) - F^i_{t+\tau-1|t-1}(x)\right| dx &= \int_{a - \frac{\epsilon}{2}}^{b + \frac{\epsilon}{2}} \left|F^i_{t+\tau|t}(x) - F^i_{t+\tau-1|t-1}(x)\right| dx \\
&< \int_{a - \frac{\epsilon}{2}}^{b + \frac{\epsilon}{2}} 1.\, dx = b - a + \epsilon = \delta + \epsilon
\end{aligned}$$

Meaning that expectations are consistently $(\epsilon + \delta)$-anchored. Q.E.D.

Proof of Proposition 5.

The regression coefficient is given by

$$\beta_\tau = \frac{\int_0^1 (\pi^i_{t+\tau|t} - \overline{\pi_{t+\tau|t}})(\pi^i_{t+1|t} - \overline{\pi_{t+1|t}})di}{\int_0^1 \left(\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}\right)^2 di}$$

Now notice that for $\tau \geq T$, since expectations are strongly ϵ_τ-anchored, we have

$$\begin{aligned}
\int_0^1 \left(\pi^i_{t+\tau|t} - \overline{\pi_{t+\tau|t}}\right)\left(\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}\right)di &= \int_{\left\{i:\pi^i_{t+1|t} > \overline{\pi_{t+1|t}}\right\}} \left(\pi^i_{t+\tau|t} - \overline{\pi_{t+\tau|t}}\right)\left(\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}\right)di \\
&+ \int_{\left\{i:\pi^i_{t+1|t} < \overline{\pi_{t+1|t}}\right\}} \left(\pi^i_{t+\tau|t} - \overline{\pi_{t+\tau|t}}\right)\left(\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}\right)di \\
&< \epsilon_\tau \int_{\left\{i:\pi^i_{t+1|t} > \overline{\pi_{t+1|t}}\right\}} \left(\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}\right)di \\
&- \epsilon_\tau \int_{\left\{i:\pi^i_{t+1|t} < \overline{\pi_{t+1|t}}\right\}} \left(\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}\right)di \\
&< \epsilon_\tau \int_0^1 |\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}|di
\end{aligned}$$

Similarly, we can show that

$$\int_0^1 \left(\pi^i_{t+\tau|t} - \overline{\pi_{t+\tau|t}}\right)\left(\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}\right)di > -\epsilon_\tau \int_0^1 |\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}|di$$

Thus,

$$|\beta_\tau| < \epsilon_\tau \frac{\int_0^1 |\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}|di}{\int_0^1 \left(\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}\right)^2 di}$$

So, as long as $\int_0^1 \left(\pi^i_{t+1|t} - \overline{\pi_{t+1|t}}\right)^2 di \neq 0$, $\beta_\tau \to 0$ as $\epsilon_\tau \to 0$. Q.E.D.