INFLATION EXPECTATIONS AS A POLICY TOOL?

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Abstract: We assess whether central banks should use inflation expectations as a policy tool for stabilization purposes. We review recent work on how expectations of agents are formed and how they affect their economic decisions. Empirical evidence suggests that inflation expectations of households and firms affect their actions but the underlying mechanisms remain unclear, especially for firms. Two additional limitations prevent policy-makers from being able to actively manage inflation expectations. First, available surveys of firms' expectations are systematically deficient, which can only be addressed through the creation of large, nationally representative surveys of firms. Second, neither households' nor firms' expectations respond much to monetary policy announcements in low-inflation environments. We provide suggestions for how monetary policy-makers can pierce this veil of inattention through new communication strategies. At this stage, the answer to the question of whether inflation expectations should be used as an active policy tool is "not yet".

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1. Introduction

Policy-makers have long understood the importance of communication strategies and the management of economic expectations. Since the early 1990s, central banks have become increasingly open in discussing their actions, objectives and views about the economy. This shift was motivated by the idea that clear communication can help reduce financial and economic volatility in response to central banks' decisions as well as augment the tool set of monetary policy (Blinder et al. 2008). For example, statements about the expected path of future short-term interest rates can affect contemporaneous long-term interest rates and therefore influence current economic conditions even in the absence of any immediate policy change.

The onset of the Great Recession and the constraints imposed by the zero-lower-bound (ZLB) on interest rates have brought these less traditional tools to the forefront of policy-making. Along with quantitative easing policies, forward-guidance about the path of future interest rates has become one of the primary tools through which central bankers try to affect economic outcomes. Discussion has also focused on alternative policies that can affect the economy contemporaneously through expectational channels, such as raising the inflation target or adopting nominal-GDP/price-level targets. At the heart of these policies lies a mechanism hinging on the inflation expectations of agents: convincing them that inflation will be higher in the future should, in the absence of interest rate policy offsets due to the zero bound, lower their perceptions of current real interest rates and therefore induce households and firms to increase their spending today. Higher expected inflation can also lead firms to immediately raise their prices in anticipation of rapidly declining relative prices, and workers may similarly bargain for larger nominal wage increases. Thus, policies directly impacting agents' inflation expectations can be used to stabilize economic conditions when traditional policy tools are limited.

Many policy-makers have been resistant toward this approach, likely because a central tenet of monetary policy-making over the last thirty years is that they should strive to "anchor" inflation expectations, rather than vary them for stabilization purposes. Yet many theoretical models suggest that communications policies that move expectations can be very powerful at the zero-bound, helping policy-makers stabilize both prices and output. Should policy-makers therefore reconsider their trepidation toward these types of policies? Can they work? Do households and firms really respond to changes in their inflation expectations? If so, is it feasible for policy-makers to affect these expectations in a way that enables them to treat expectations management as another policy tool? This paper provides a synthesis of what we know about these questions.

Our starting point is that it is important to draw a distinction between the inflation expectations of professional forecasters or financial market participants and those of households and firms. Central bank discussions and communications often focus on the former, and with good reason. How financial markets perceive the path of future monetary policy drives contemporaneous long-term interest rates and therefore

provides a direct transmission mechanism of monetary policy actions to households' and firms' decisions, even at the zero bound on short-term nominal interest rates. The new communications strategies pioneered by central banks since the 1990s have largely been successful in anchoring the long-run inflation expectations of financial markets in advanced economies. Descriptions of policy-makers' views of the economy and their expectations of future policy decisions through policy statements, speeches, and post-meeting press briefings have helped reduce financial market volatility.

However, theory suggests that the primary mechanism whereby inflation expectations affect households' decisions is through their perceived real interest rate, which depends not just on the nominal interest rates faced by agents but also on their expectations of future inflation. Similarly, firms' expectations of inflation should matter not only for their pricing and wage-setting decisions but also for their investment and hiring decisions via the role of perceived real interest rates and more broadly because of the relationship between inflation and real economic activity. Because our interest is in evaluating the scope for using the inflation expectations channel as a policy tool, our focus must be on the expectations of households and firms.

Importantly, the inflation expectations of these different agents are not interchangeable. We document a number of dimensions along which they differ. For example, while professional forecasters and financial market participants have inflation expectations that appear well-anchored (close to the inflation target on average with little cross-sectional variation), this is unambiguously *not* the case when it comes to households and firms. To shed light on whether the expectations channel can be a useful policy tool, it is therefore important to understand how the inflation expectations of households and firms are formed and how/whether they affect their economic decisions.

We review evidence on how various forces (shopping experience, salience of prices, informational interventions, etc.) influence the inflation expectations of households and firms. In contrast to professional forecasters and financial markets who seem to track macroeconomic developments closely and respond to policy shocks relatively quickly, households and firms are remarkably inattentive to inflation dynamics in developed countries that have experienced low inflation rates for several decades. In contrast, economic agents in high-inflation environments (e.g., Iran, Ukraine, Uruguay, Argentina, Israel) seem to pay considerable attention to inflation, indicating that the inattention to inflation and monetary policy conditions on the part of households and firms in advanced economies is likely a result of the successful monetary policies of the last thirty years. In the absence of much aggregate variation in inflation, these agents appear to have become reliant on the prices of goods they observe on a frequent basis, such as gasoline and food prices, to make inferences about broader price movements. As a result of the volatility in these prices and the heterogeneity of people's consumption baskets, we observe much more volatility in the inflation expectations of households and firms than we do for more informed agents like professional forecasters,

more disagreement both in terms of their beliefs about future as well as past inflation, and more uncertainty in their forecasts. In short, their expectations look anything but anchored.

This inattention to inflation and monetary policy on the part of households and firms in advanced economies could imply that their inflation expectations simply do not matter for their economic decisions, thereby rendering the inflation expectations channel ineffectual. This is, however, *demonstrably incorrect*. We review the burgeoning literature on inflation expectations and economic decision-making and argue that the evidence strongly suggests that there is indeed a causal and economically significant effect of inflation expectations on the economic choices of both households and firms. In the case of households, some of the evidence supports theoretical predictions that, at least at the ZLB, an exogenous increase in the inflation expectations of households leads them to increase their consumption, which should ultimately lead to higher inflation as well through general equilibrium effects.

For firms, inflation expectations clearly affect economic decisions but the mechanism through which this effect operates is not fully established yet. For example, evidence from New Zealand where there was no ZLB suggests that when firms raise their inflation expectations, they then tend to raise their employment and investment with little change in their prices. Newer evidence from Italy during a ZLB period suggests instead that raising the inflation expectations of firms there leads them to raise their prices but reduce their employment. Further work that clarifies both the direct effects of changes in inflation expectations on economic decisions, as well as their general equilibrium consequences, will be necessary before they can effectively be used as a direct policy tool.

Furthermore, there are two additional important issues that need to be addressed before the active management of inflation expectations is added to the roster of policy-makers' stabilization tools. The first is a simple measurement issue: do we know what agents' inflation expectations are? We discuss available surveys of inflation expectations of households and firms from many countries, focusing on how the surveys are conducted and how we can interpret their results. While household surveys are widely available and generally of high quality, surveys of firms' expectations are much more limited in availability, scope, and quality. We document a number of dimensions along which different surveys of firms depart from ideal survey design and argue that these limitations make the current measurement of firms' inflation expectations a binding constraint for their use in policy-making: if we cannot measure the policy instrument, it is unlikely to be a good candidate as a tool for economic stabilization. Because of the unique challenges associated with surveying firms, this constraint is unlikely to be relaxed without a concerted effort on the part of statistical agencies and/or central banks to implement new, large-scale surveys of firms in their countries.

The second major challenge to the use of inflation expectations as a policy tool is the abysmal track record of the typical communication strategies of central banks in affecting households' and firms' inflation expectations. We document this record in a number of ways, building on recent work that studies the inattention of economic agents, and in particular their lack of knowledge about inflation dynamics and monetary policy. We document, for example, that large policy change announcements in the U.K., U.S. and eurozone seemed to have only limited effects on the beliefs of households and firms, despite widespread news coverage. Only financial market participants and professional forecasters seem to pay much attention to the actions of monetary policy-makers. While this inattention to aggregate inflation and monetary policy in advanced economies may itself be a reflection of the success of policy-makers in keeping inflation low and stable over the last thirty years, it nonetheless presents a challenge for any policy-maker that now seeks to break through this veil of inattention.

Despite this inattention to monetary policy on the part of households and firms, recent evidence suggests that when households and firms are provided with explicit information about inflation or monetary policy, their inflation expectations respond very strongly. This indicates that there is scope for new and improved communication strategies on the part of policy-makers to use inflation expectations as a more direct policy tool for stabilization purposes. Furthermore, the magnitudes of the changes in inflation expectations from the provision of simple messages about recent inflation rates or the central bank's target dwarf the estimated effects of other policies like quantitative easing or forward guidance on nominal interest rates. This suggests that communications focused on the inflation expectations of households and firms should lead to much larger changes in perceived real interest rates—and therefore effects on economic activity—than policies that are currently used. A layered communication strategy, i.e. one that treats households/firms and financial markets differently, could therefore serve as a useful complement to current strategies that are almost exclusively targeting the latter.

Policy-makers can also vary the type of information provided depending on what the desired effect on expectations may be. Because households and firms adjust their beliefs in response to new information like Bayesians (i.e. putting some weight on the provided signal), policy-makers can emphasize different facts depending on whether they would like expectations to rise or fall. For example, providing information about the inflation target systematically moves agents' forecasts toward that target value. But policy-makers can emphasize other numerical values (e.g., recent inflation rates or price movements of specific goods) if they want to push expectations in a different direction. Because providing households and firms with these types of information has only short-lived effects on expectations (they generally die off within six months), policy-makers can generate transitory effects on expectations through short-lived communications campaigns or longer-lived effects through repeated exposure of agents to news. Central banks have

employed similar methods with financial markets (e.g. doing vs not doing forward guidance, changing the expected duration of zero interest rates, changing the nature of the guidance from time-dependent to state-dependent, etc.). The same principles of altering communications to the circumstances can be applied to a new layer of communications targeting households and firms.

Finally, we recommend that policy-makers exploit new ways of transmitting information to the public besides the traditional news media, and more in the spirit of public health campaigns that target specific subsets of the population. Much as corporate marketers and politicians are now exploiting new means of targeting narrower groups of individuals with messages tailored for specific groups, central banks could also target their information treatments more precisely through social media, targeted ad campaigns, etc. Such a targeted strategy can help generate larger movements in expectations by identifying and concentrating on populations that are relatively less informed or whose expectations tend to respond more to new information.

More targeted information treatments by monetary policy-makers could also help address one of the fundamental challenges associated with currency unions: the one-size-fits-all nature of traditional monetary policies. Consider, for example, a union in which the "North" is booming while the "South" is in recession. The central bank cannot accommodate both through changes in its interest rate instrument. However, targeted and differentiated communications strategies within each region could be used to try to lower inflation expectations in the North while raising them in the South, thereby generating lower perceived real interest rates in the region that needs monetary accommodation (South) while raising perceived real rates in the region that needs contractionary policy (North). Precise communications strategies could also be used to target specific industries or subgroups of the population. Layered communications strategies could therefore be used not only during zero bound periods but as a more general tool to address geographic or other economic imbalances within a common currency area. Indeed, Hayo and Neuenkirch (2014) and Ehrmann et al. (2013) find that subjective and objective knowledge about the ECB is positively correlated with the central bank's trust and credibility.

Because communication strategies that directly affect inflation expectations could ultimately provide policy-makers with a new and powerful stabilization tool during ZLB periods, address regional divides within currency areas even outside the ZLB, and enhance central bank credibility, their potential usefulness is high. We still lack a nuanced understanding of the mechanism through which inflation expectations affect decisions, clear measures of these expectations, and proven strategies to change them, so this policy tool is not yet ready for prime-time. But now is the time to make progress on all three fronts so that it can be deployed in the next crisis. With it, monetary policy-making may finally become more like a scalpel and less like a hammer.

The paper is structured as follows. Section 2 documents differences in the properties of inflation expectations across different types of agents, like households, firms, professional forecasters and financial market participants, to illustrate how they are not interchangeable. It also provides stylized facts on how the inflation expectations of households and firms are formed. Section 3 discusses recent empirical evidence on the effect of inflation expectations on households' and firms' economic decisions, which provides the basis for the potential use of inflation expectations as a policy tool but also illustrates the limitations to our current knowledge about the transmission of expectations to economic decisions. Sections 4 and 5 discuss two additional challenges that potentially limit the scope of such policies: measurement issues due to limited survey availability/quality (section 4) and the general insensitivity of households' inflation expectations to monetary policy decisions and announcements (section 5). Section 5 then proposes guidelines for new communication strategies that address these limitations. Section 6 concludes.

2. Characteristics and Determinants of Inflation Expectations

How are inflation expectations formed? Whose expectations should we care about? These have been perennial questions in macroeconomics and they do not have a simple answer. But they arise regularly in monetary policy discussions, as well as in many other settings.[1]

Whose expectations matter depends, of course, on the context. In the case of pricing decisions, it is the expectations of firms that are at stake. For consumption and savings decisions, household expectations are more relevant. In the determination of financial asset valuations, marginal investors are likely those whose expectations are most important. If the expectations of these different agents are the same, as they are in standard macroeconomic models, this distinction becomes moot. But in practice, this is very unlikely to be the case.

To illustrate these differences, Panel A of Figure 1 plots the time series of mean inflation 1-year ahead expectations in the U.S. for households (Michigan Survey of Consumers), professional forecasters (CPI forecasts from the Survey of Professional Forecasters (SPF) run by the Federal Reserve Bank of

[1] See for example Fed Chairwoman Janet Yellen's (2016) speech: "Another gap in our knowledge about the nature of the inflation process concerns expectations… Yet another unresolved issue concerns whose expectations--those of consumers, firms, or investors--are most relevant for wage and price setting, a point on which theory provides no clear-cut guidance. More generally, the precise manner in which expectations influence inflation deserves further study. Perhaps most importantly, we need to know more about the manner in which inflation expectations are formed and how monetary policy influences them". ECB Vice-President Vítor Constâncio (2017) has expressed a similar view: "For policy-makers, this [recent research] seems to suggest that there is an important role of the central bank in shaping the expectations of the general public, not only that of financial markets. It also suggests that more research is needed to understand the different factors that shape the inflation expectations of individual households…" See Coibion, Gorodnichenko and Kamdar (forthcoming) for a survey.

Philadelphia) and financial markets (Federal Reserve Bank of Cleveland). While these three measures of expectations tracked each other closely through the early 1990s, we can observe large wedges appearing between household expectations and those of professionals and financial market participants thereafter. For example, household expectations have averaged around 3.5% since the early 2000s while those of professionals averaged around 2%.

This difference is not unique to households. In April 2018, we conducted a survey of firms in the U.S., using panelists from a prominent nationally-representative survey of firms in manufacturing and services. Hundreds of top executives were asked to report their point forecasts for CPI inflation over the next twelve months. 55% reported that they simply did not know. Of the remaining respondents, the average forecast was 3.7%, well above what professional forecasters and financial market participants were expecting but close to the forecasts of households.[2]

Panel B reports equivalent forecasts of one-year-ahead inflation expectations as for the U.S. but now for households in the euro area (the European Commission survey of households, see Duca et al. 2017), professional forecasters (Survey of Professional Forecasters run by the European Central Bank (ECB)) and financial markets (1-year inflation swaps, ICAP and Thompson/Reuters). As in the U.S., household inflation expectations deviate systematically from the expectations of professionals and financial market participants. A similar feature can also be found in New Zealand (see Coibion, Gorodnichenko and Kumar (forthcoming); henceforth CGK), the first country to adopt inflation targeting over twenty-five years ago and in which inflation has remained relatively low and stable since. One might expect individuals there to provide an upper bound on how anchored inflation expectations can be, yet as can be seen in Table 1, households and firms in New Zealand still have expectations which deviate dramatically from those of professional forecasters. Households at the time, for example, were predicting inflation of well above 3% while firms in New Zealand surveyed in CGK displayed even higher mean forecasts of inflation. In contrast, professional forecasters were predicting inflation around only 2%.

Differences across groups are not limited to mean forecasts. As is well-known, disagreement about inflation among households dwarfs that among professional forecasters (e.g. Mankiw, Reis and Wolfers 2003). For example, in the U.S. in March 2018, the cross-sectional standard deviation of inflation forecasts across households in the Michigan Survey of Consumers was 3.0% but was only 0.4% in the SPF. Again, surveys of firms yield similar results as for households. In the April 2018 survey we ran of U.S. firms, we found a cross-

[2] While our analysis focuses on one-year-ahead inflation expectations of households and firms, long(er)-run inflation forecasts of these agents are strikingly similar to short-term inflation forecasts of these agents (e.g., Armantier et al. 2013, Coibion, Gorodnichenko and Kumar (forthcoming), Kumar et al. 2015). In a typical case, if a firm (household) expects inflation to be X% next year, it has approximately X% expectation for inflation 3 or 5 year into the future.

sectional standard deviation of 4.1% in inflation forecasts. Table 1 illustrates the same feature for New Zealand: disagreement among households and firms is an order of magnitude larger than it is among professional forecasters. Hence, along either metric, it is clear that one should not expect the inflation expectations of professional forecasters or those of financial market participants to be representative of the beliefs of households and firms. This does not imply that the expectations of the former are unimportant or irrelevant to monetary policy-making, but simply that if the channel we are interested in stems from the decisions of households and firms as well as their expectations—as in the case of the inflation expectations channel—then it is important to focus specifically on the expectations of these agents and not assume that they are well-represented by more readily-available measures. In this section, we consider a number of factors that, based on previous research, play an important role in how households and firms form their expectations.

2.1 Priors and perceptions of inflations

A particularly striking feature of household and firm beliefs over inflation, and one that was documented as early as Jonung (1981), is that they not only disagree about future inflation but they display almost the same amount of disagreement about recent inflation dynamics. Indeed, the strongest predictor of a household's inflation forecast is typically what they believe inflation has been over the recent past, something which is in principle readily available and which some other types of agents, like professional forecasters, do not disagree about. This finding has been documented in detail for households (see Ranyard et al. (2008) for a survey of this literature) and more recently for firms (e.g., CGK, Kumar et al. 2015). Table 1, for example, shows that the beliefs of households and firms in New Zealand about recent rates of inflation are disconnected from actual values and subject to similar disagreement among these agents, despite widespread availability of data on inflation. In a survey of German consumers in 2015, Dräger and Nghiem (2018) find that approximately 50% of respondents believed that inflation over the previous twelve months had been 5% or above, at a time when actual inflation was 0.3%. Duca et al. (2017) document a similar finding for the entire euro area: in 2015, the average perceived inflation rate among surveyed households across all euro-member countries was just under 5%.[3]

This inattention to recent inflation dynamics, however, varies with the economic environment. Households in high-inflation countries, like in Argentina, tend to be much better informed than households in low-inflation countries about inflation (Cavallo et al. 2017). A similar result obtains for firms: while firms in low-inflation environments tend to appear quite uninformed about recent inflation dynamics, this is much

[3] The perceived inflation rate stays high even after removing outliers, see Arioli et al. (2017).

less the case in higher-inflation countries like Uruguay (Frache and Lluberas 2017), Iran (Afrouzi et al. 2018), or Ukraine (Coibion and Gorodnichenko 2015b). This suggests that a full understanding of how households and firms form their expectations requires models that explicitly formalize how agents endogenously choose to allocate their attention to different variables in light of their economic circumstances (e.g., Reis 2006a, 2006b, Gorodnichenko 2008, Afrouzi 2018).

The economic environment that agents perceive to have experienced can shape their views in very long-lasting ways. For example, Ehrmann and Tzamourani (2012) and Malmendier and Nagel (2016) document that people who lived through a high inflation have systematically higher inflation expectations and stronger dislike for inflation than people who did not have this experience.[4] This gradual adjustment of beliefs to new economic settings carries over to how they respond to economic shocks and various informational treatments. For example, Armantier et al. (2016), Cavallo et al. (2017), and Binder and Rodrigue (2017) run experiments on households in which they are provided with new information and find that the adjustment of beliefs to new information is consistent with Bayesian updating. That is, economic agents update their beliefs depending on the strengths of their priors and signals. This behavior is consistent with economic agents being rational but facing informational rigidities. A particularly important source of signals about aggregate price levels emphasized by households and firms is the set of prices that they observe in their daily lives.

2.2 Shopping experience

Shopping naturally offers people an opportunity to observe prices. Because prices and inflation rates can vary widely across households (e.g., Coibion, Gorodnichenko, and Hong 2015, Kaplan and Schulhofer-Wohl 2017, Johannsen 2014), people may extrapolate their own experiences to the aggregate economy. Consistent with this view, Bryan and Venkatu (2001), D'Acunto et al. (2018) and others document that women tend to have higher inflation expectations than men because women tend to do grocery shopping more frequently: once one conditions on exposure to frequent prices changes in stores, the systematic differences in inflation expectations between men and women disappear. In a similar spirit, Cavallo et al. (2017) found that recent shopping experience has a strong influence on inflation expectations: people tend to assign high weights to goods that they just purchased. Kumar et al. (2015) also find that shopping experience is a major source of information for firm managers in New Zealand when these managers form their inflation expectations. Johannsen (2014) reports that groups which experience more dispersed rates of

[4] More generally, there is a large literature (e.g., Souleles 2004, Ehrmann, Pfajfar, and Santoro 2017) relating inflation expectations/perceptions and various demographic characteristics of households.

inflation also tend to disagree more about inflation, consistent with shopping experiences parlaying into the inflation expectations of individuals.

Although consumers' inflation expectations appear to display excess sensitivity to price changes of products in their consumption baskets, consumer prices are not equal in influencing inflation expectations. For example, Harris et al. (2009), Coibion and Gorodnichenko (2015a), Wong (2015), and others find that U.S. consumers are sensitive to gasoline prices above and beyond what is justified by the share of expenditures on gasoline.[5] Panel A of Figure 2 illustrates this excess sensitivity of U.S. household inflation expectations relative to professional forecasters by plotting the two against the level of gasoline prices. There is a striking correlation between movements in the level of gasoline prices and the households' inflation expectations. On the other hand, the relationship between gasoline prices and predictions of professional forecasters is much weaker. The same pattern holds in the euro area, as illustrated in Panel B of Figure 2.[6]

Relatedly, food prices also appear to have a disproportionately significant effect on inflation expectations of households (e.g., Clark and Davig 2008). Coibion and Gorodnichenko (2015b) document that Ukrainian households' and firms' inflation expectations react strongly to changes in the exchange rate of the hryvnia (Ukrainian currency) and the U.S. dollar. Afrouzi et al. (2018) document a similar finding in Iran. A common theme across these studies is that salient prices of frequently-purchased, homogenous goods appear to strongly influence inflation expectations. One may rationalize this influence by appealing to costs of collecting and processing information: economic agents use easy-to-collect/digest prices correlated with inflation to inform themselves about aggregate inflation.

2.3 Media

Another natural source of information about inflation is media coverage of inflation. For example, Carroll (2003) documents that more intensive newspaper coverage of inflation dynamics closes the gap between the

[5] Central bankers are aware of this sensitivity. Yellen (2016): "[T]he longer-run measure of inflation expectations from the Michigan Survey has historically exhibited some sensitivity to fluctuations in current gasoline prices…" and "[A] monthly survey conducted by the Federal Reserve Bank of New York shows a noticeable decline over the past two years in household expectations for inflation three years ahead. However, these readings on shorter-term expectations may also be influenced by current gasoline prices." Carney (2013) made a similar observation, "[W]e've seen a bit in the past when you have a coincident survey [of the general public's inflation expectations] with something as obvious and important to people as energy prices move, you get these spikes."

[6] One would expect a weaker relationship between gas prices and household inflation expectations in the euro area than in the U.S. for at least two reasons. First, gasoline taxes are much higher in Europe, so a $1 increase in oil leads to a smaller percentage increase in gasoline prices in Europe than in the U.S. In addition, diesel is much more common in Europe than the U.S. (as is public transportation), making the price of basic gasoline less of a common price signal to households than in the U.S.

inflation expectations of households and those of professional forecasters. Subsequent work (e.g., Dräger 2015, Lamla and Maag 2012) finds similar effects for other countries. Using in-depth interviews of firm managers, Kumar et al. (2015) document that media is the main source of information for managers when they form inflation expectations. The available evidence, however, suggests that, in low-inflation countries, media coverage may be a relatively weak force in moving inflation expectations.[7] For example, Pfajfar and Santoro (2013) find that exposure to news about inflation leads consumers to a more likely revision of inflation expectations but a revised forecast is not systematically closer to a professional forecast.

2.4 Knowledge about Monetary Policy

An additional factor that can affect agents' forecasts is their understanding of monetary (and fiscal) policy. While there is an extensive literature studying how monetary policy affects the economic expectations of financial market participants and professional forecasters, evidence for the effects on households and firms is more limited.[8] Previous work has found that households who are more informed about the central bank's objectives or who have greater trust in the central bank tend to have better behaved inflation forecasts (e.g. Kamada, Nakajima, and Nishiguchi, 2015, Christelis et al. 2016). But informed/trusting households seem to be in short supply. Binder (2017), for example, uses a variety of polling data to show that most U.S. households are unaware of the Federal Reserve's leadership and objectives. In a similar spirit, Kumar et al. (2015) document that, among firm managers in New Zealand, only thirty percent can correctly identify the name of the Reserve Bank Governor (out of four choices) and 31% can identify the central bank's main objective as being to keep inflation low and stable (out of five choices). This result also extends to Europe. For example, van der Cruijsen et al. (2015) find that just over half of Dutch survey respondents correctly identified as a true statement (out of only two options) that the ECB targets a rate of inflation of close to but just below 2%.

In parallel surveys of U.S. firms and households in April 2018, we asked respondents what inflation rate the U.S. Federal Reserve was trying to achieve in the long run. The survey of firms was done through the

[7] Haldane (2017) made a similar observation: "Studies have examined the factors that influence how the media intermediate central bank messages. There is mixed evidence on how well the media performs this task. There is evidence the media leads to a better understanding of the ECB's monetary policy. But in the US and Germany, there is evidence the media may sometimes impair communication and bias opinion."

[8] In evaluating effects of central banks' policies on inflation expectations, the literature has largely focused on whether inflation targeting makes inflation expectations of financial markets and professional forecasts less sensitive to macroeconomic news shocks (e.g., Beechey et al. 2011, Gurkaynak et al. 2010). More recent studies examine how forward guidance changed expectations of these agents (e.g., Campbell et al. 2012, Andrade et al. 2015). Other work has sought to establish whether inflation targeting regimes have more anchored expectations of professional forecasters (Pierdzioch and Rülke 2013, Dovern et al., 2012).

same nationally-representative panel of executives in manufacturing and services in the U.S. as described in section 2 (i.e. from a pre-existing private survey of firms). The survey of households is described in more detail in Coibion, Gorodnichenko and Weber (2018) but consists of over 20,000 U.S. households participating in the AC Nielsen Homescan project. In each case, respondents were asked to report a point value as their answer but had the option to decline to answer. For comparison, we also report the distribution of beliefs about the RBNZ's inflation target from the survey of firms in New Zealand described in Kumar et al. (2015).

The resulting distributions of answers from each survey are plotted in Figure 3. In both U.S. surveys, respondents had the ability to select "I don't know" as a possible answer. In the case of U.S. firms, over 60% of respondents selected this option. Around 25% correctly selected 2% as the Federal Reserve's inflation target, with the vast majority of remaining respondents providing an answer greater than 2%. U.S. households yielded a similar distribution: around 20% correctly picked 2% while over 50% responded that they did not know or thought that the Fed's inflation target was 10% or more per year. These results reflect even less knowledge about monetary policy than in New Zealand, where around 35% answered 2% and approximately 50% were in the correct range of the RBNZ's inflation target range of 1-3% per year.

In Panel B, we also report results from a survey in Uruguay (described in Coibion, Frache, Gorodnichenko and Lluberas 2018) in which a representative sample of firms were asked about the central bank's inflation target, which is currently a range of 3% to 7%. Uruguay has experienced relatively high inflation in recent decades[9] and, as reported in Frache and Lluberas (2017), firms there are relatively more informed about inflation than firms in New Zealand. Consistent with this view, we find that firms in Uruguay are relatively well informed about the inflation target there: only about 5% report that they don't know the target and less than 20% picked a value for the target outside the target range. This provides further support for the notion that economic agents in higher and more volatile inflation environments are more informed about inflation and monetary policy.

2.5 Summary and Discussion

Different agents face different incentives and costs to acquiring and processing information. It should therefore not be surprising to find systematic differences across agents in terms of how they form their expectations. The inflation expectations of households and firms, in particular, deviate in systematic ways

[9] According to the Uruguayan National Institute of Statistics, Uruguay had an annual inflation rate of 6.6% in 2017. Between 2008 and 2018, the average inflation rate was 8.2% and the range was 6.6% to 9.8%.

from those of professional forecasters and financial market participants. As a result, those interested in identifying economic mechanisms that rely on the decisions and beliefs of households and firms should focus on the expectations of these agents and not assume that they are well-approximated by other more readily-available survey measures. They are not.

The inattention of households and firms to inflation and monetary policy in advanced economies is likely a reflection of policy-makers' success in stabilizing inflation around a low level for decades. This stability has reduced the benefit to being informed about aggregate inflation, leading many to rely on readily available price signals to make inferences about aggregate inflation. This inattention to aggregate information about inflation and monetary policy, however, need not imply that their beliefs do not affect their decisions. The channels running from expectations to actions are what we now turn to.

3 Do Inflation Expectations Affect Economic Decisions?

For inflation expectations to be useful as a policy tool, it is essential to know whether they affect economic decisions, as suggested by theory. In this section, we summarize and extend recent empirical evidence on the ways in which inflation expectations affect the economic decisions of both households and firms.

3.1 Consumers' Decisions and their Inflation Expectations

The standard (and primary) channel through which inflation expectations are expected to affect households' economic decisions is via a consumption Euler equation, which relates the expected growth in consumption to the expected real interest rate:

$$c_t = E_t c_{t+1} - \sigma[i_t - E_t \pi_{t+1}] = E_t c_\infty - \sigma \sum_{j=0}^{\infty} E_t\left(i_{t+j} - \pi_{t+1+j}\right)$$

or equivalently that current deviations of consumption from long-run levels (c_t) depend on whether current and future real interest rates ($i_t - E_t \pi_{t+1}$) are expected to be above or below normal. An increase in expected inflation $E_t \pi_{t+1}$ lowers the perceived real interest rate (for a fixed nominal interest rate i_t, as would be the case at the ZLB), thereby reducing the incentive to save and raising current consumption.

A large body of work now exists which tests this mechanism using household surveys of consumption and expectations. While early work on this found little evidence that high inflation expectations were associated with higher desired consumption (Bachmann, Berg and Sims (2015) using the Michigan Survey of

Consumers), subsequent work has found much more positive evidence. For example, using inflation expectations from the New York Fed's Survey of Consumer Expectations, Crump et al. (2015) estimate a value of 0.8 for intertemporal elasticity of substitution σ. Dräger and Nghiem (2018) find similar results for German households using a survey developed by the University of Hamburg. D'Acunto, Hoang, and Weber (2016) use survey data from the harmonized Survey of Consumers for German households and find that households with higher inflation expectations are more likely to report that now is a good time to buy. Ichiue and Nishiguchi (2013) find evidence consistent with the Euler equation using household survey data in Japan during the ZLB period. Pooling data from seventeen European countries, Duca et al. (2017) also find when households expect inflation to go up, they tend to be more positive toward spending on consumer durables.[10] Finally, Armantier et al. (2015) use an incentivized experiment to show that households act upon their reported inflation expectations which is consistent with Malmendier and Nagel (2016) documenting that inflation experiences shape not only inflation expectations but also financial choices of consumers (e.g., consumers who have lived through high inflation tend to invest less in nominal bonds and tend to borrow through fixed-rate mortgages).

One limitation faced by this literature is that causality from higher inflation expectations to higher desired levels of consumption does not automatically follow from the positive correlations between the two. A particularly striking paper therefore is by D'Acunto, Hoang, and Weber (2016), who use the pre-announced increase in the VAT in Germany in 2005 as a source of exogenous variation in inflation expectations of German households relative to those of other European countries. They find that the rise in inflation expectations of German households relative to comparable households in neighboring countries was associated with higher reported willingness to spend by these households, despite no differences in their expectations of future income and other forces. In contrast, Coibion, Gorodnichenko, Georgarakos and van Rooij (2019) study the effects of exogenously generated changes in inflation expectations (via randomized information treatments) among Dutch households and find that higher inflation lead to reduced spending on durable goods. The latter seems to reflect a perception on the part of households that higher inflation will lead to temporarily lower real income, which induces them to defer purchases of large durable goods. Jointly, these results therefore suggest that there is a causal chain running from higher inflation expectations to higher consumption levels, at least in the absence of offsetting interest rate responses such as during the zero-bound. However, the specific mechanism at work remains ambiguous.

[10] Related work has studied how inflation expectations affects other decisions they face, for example the composition of their assets (Vellekoop and Wiederholt 2017).

3.2 Firms' Decisions and their Inflation Expectations

With respect to how inflation expectations affect firms' decisions, empirical evidence is significantly more limited. This primarily reflects the fact that survey data on firms' inflation expectations is less readily available, as discussed in more detail in section 4. Nonetheless, recent work has begun to systematically exploit existing surveys of firms' expectations.

Particularly relevant is CGK. They implement a sequence of nationally representative surveys of firm managers in New Zealand starting in 2013. These surveys inquire as to managers' expectations of future inflation as well as other macroeconomic and firm-specific expectations, such as their expected hiring, pricing and investment decisions over the next six months. To assess the causal effect of inflation expectations on firms' decisions, they conduct the following experiment. In one of the waves of the survey, some managers were provided with information about the Reserve Bank of New Zealand's (RBNZ) inflation target while others—the control group—were provided no such information. Six months later, a follow-up survey was done to assess what actions firms had taken over the previous six months in terms of their prices, wages, hiring and investment. In addition, firms were asked again about their inflation expectations. Because the provision of information about the RBNZ's inflation target strongly affected inflation expectations but did not lead to changes in managers' expectations of other macroeconomic variables, this treatment (being provided information about the RBNZ's inflation target) can be interpreted as generating exogenous variation in inflation expectations which can then be used to assess the causal effect of these expectations on firms' economic decisions.

CGK document several findings from this experimental design. First, the provision of information led to a large and immediate downward revision of inflation expectations for firms who were initially uninformed about the target (i.e. those who thought the target was 4% or more). Second, this effect had almost completely dissipated within six months, suggesting that the provision of this type of information affects beliefs only for a limited duration. Cavallo et al. (2017) document a similar short-lived effect for consumers. Third, treated firms did not change their prices or wages in ways that were statistically or economically different from firms in the control group, despite the pronounced difference in their beliefs about inflation. Fourth, treated firms significantly reduced their hiring and investment relative to the control group. In other words, the exogenously generated reduction in inflation expectations led to a significant decline in firms' use of inputs into the production process, providing direct evidence of a causal mechanism running from firms' inflation expectations to their economic decisions.

A closely related paper that also provides evidence of a causal link from inflation expectations to firms' decisions is Coibion, Gorodnichenko and Ropele (2018, CGR henceforth). These authors exploit a quasi-

experiment in a survey of firm expectations in Italy. In 2012Q3, the survey randomly divided firms into two groups. One group (1/3 of respondents) was asked about their inflation expectations at different horizons, before being asked the remaining questions in the survey. The other group (2/3 of respondents) were first told what the most recent rate of inflation was in both Italy and the eurozone before being asked about their inflation expectations. Importantly, this split of firms was sustained over the next five years and firms in the treatment group were told the most recent values of inflation in each quarter of the survey. Unlike the one-time experimental provision of information considered in CGK, the Italian case provides an example of a repeated and long-lived information treatment that generates significant and persistent differences in inflation expectations across firms over time. Because firms are asked about their economic decisions in each wave (price changes and employment), this design can be used to study how exogenous variation in inflation expectations affects prices and employment decisions over time. The sample covers a ZLB period thus providing a direct assessment of how firms can respond to attempts to raise inflation expectations.

This alternative quasi-experiment generates a number of results that mirror those found by CGK in New Zealand. First, the selective treatment of some firms with information about recent inflation is a strong instrument for inflation expectations of firms, generating pronounced exogenous variation in inflation expectations. Second, the effects of the information treatment are again short-lived: information treatments die out after about six months, very similar to that found in CGK. Hence, persistent differences between the beliefs of the two groups of firms only happen because of the repeated treatment of firms with new information. Third, CGR find a limited effect of inflation expectations on prices: firms with higher inflation expectations charge higher prices over the first few months but these effects dissipate rapidly and the passthrough is limited (for a one percentage point increase in inflation expectations, firms raise prices by at most 0.2 percentage points). Andrade et al. (2018), using inflation expectations data from a representative survey of manufacturing firms in France, similarly document that higher inflation expectations are followed by rising prices on the part of firms.

Despite these similarities, CGR find a dramatically different effect in how inflation expectations translate into the employment decisions of firms: firms with higher inflation expectations reduce their employment over the next year, the opposite reaction from that found in New Zealand. They also report reduced plans for future investment plans over the same horizon. These results apply to various subsamples based on firms' size, location, sector, and export status.

One possible explanation for why this difference occurs suggested by CGR is that, unlike in New Zealand, changes in the inflation expectations of firms in Italy are associated with changes in their other economic expectations: higher inflation expectations from the treatment lead Italian firms to become more pessimistic about the overall economy both contemporaneously and in the future, more pessimistic about the business

conditions facing their specific firm, more pessimistic about their ability to access credit, and more uncertain about the future. Firms with exogenously higher inflation expectations also report that they feel a greater need to raise prices because they foresee higher prices for raw materials but a need to reduce prices because of lower demand for their products. In short, an increase in inflation expectations from the information treatment in Italy is perceived like a negative supply shock to the economy and the firm, whereas firms in New Zealand do not materially change their expectations of other macroeconomic variables when they exogenously change their inflation expectations.

These results suggest several important policy implications. First, the mapping from inflation expectations to firms' actions appears to depend on context (e.g. macroeconomic conditions, the ability of the central bank to stabilize the economy, etc.) and may have unintended effects. For example, CGR estimates indicate that raising inflation expectations at the ZLB can result in lower employment and investment, which is counter to predictions of standard macroeconomic models. Second, shaping inflation expectations can influence inflation directly: if a firm can be convinced that inflation will be higher in the future, it may raise prices in response thus generating a higher inflation now. Again, the link between inflation expectations and pricing decisions of firms should be explored further, but results in CGR imply that such direct effects on inflation may be possible and thus management of inflation expectations can offer a new tool to control inflation and more broadly the economy.

3.3 Summary and Discussion

The previous two sections show that there is clear empirical evidence supporting causal effects from inflation expectations to economic decisions of households and firms, although the specific channels and mechanisms remain in doubt for both firms and households. Furthermore, we have focused only on the direct effects of these policies on each type of agent and abstracted from the general equilibrium effects each of their responses would subsequently induce. Despite these caveats, these results suggest that, in principle, there is scope for policy-makers to affect inflation expectations for stabilization purposes. For this to be successful, however, requires two additional ingredients. First, policy-makers must be able to measure inflation expectations of these agents to gauge how much policy action is needed. Second, policy-makers need specific communication tools to affect these expectations. In the next two sections, we consider issues associated with each of these dimensions.

4 Measuring Inflation Expectations

The ability of policy-makers to gauge their effect on inflation expectations hinges on the availability of high-quality surveys of households' and firms' expectations. To what extent do existing surveys meet the standards one would expect? The answer depends largely on the type of agent.

Household surveys have long been in existence for most advanced economies. For example, the U.S. has the Michigan Survey of Consumers and the New York Fed's Survey of Consumer Expectations (SCE). The United Kingdom has the Barclays Basix and Bank NOP surveys. The European Commission organizes a harmonized survey of households for all European Union countries, although these are implemented by the statistical agencies of member nations. In each case, surveys are done monthly or quarterly using a large (generally greater than a thousand) representative group of households. The Bank of Japan runs the Opinion Survey. Households are asked to provide a point estimate for future price changes or assign weights to different ranges of possible outcomes. Questions are generally phrased in terms of "overall prices in the economy" although some (like the New York Fed's SCE) emphasize inflation rates of a specific price index. These surveys are generally viewed as being of very high quality due to their large and representative cross-samples as well as their high-frequency and long availability.

In contrast, the availability of surveys of firms in most countries is much more limited (Table 2). There are few surveys that ask for quantitative inflation expectations of firms and those that do tend not to be nationally representative. The phrasing of questions varies widely, as does the way in which respondents can respond (e.g. point estimates vs ranges, sizes of bins offered, etc.). In contrast to households, there has been little work done to characterize the sensitivity of firms' responses to different types of survey questions. It remains unclear how important it is to have a representative sample of firms across industries and size. There is even ambiguity about whether one can or should measure firms' expectations of aggregate inflation by asking them about their expectations of their own firm's price changes or unit costs.

In the next few sections, we provide new results on the extent to which these different factors matter for the interpretation of survey responses, then draw some conclusions about how well currently available surveys across countries actually measure the inflation expectations of firms in those countries. To assess the sensitivity of answers to survey design, we will primarily rely on a sequence of firm surveys done in New Zealand between 2013 and 2017. These surveys are discussed in detail in Kumar et al. (2015) and CGK. Over 3,000 firms were first surveyed in 2013Q4 and three follow-up surveys were done over the next two years on subsets of these firms. A new panel of over 2,000 firms was drawn in 2016Q2 with a single follow-up survey being done on a subset of these firms six months later. To evaluate various elements of survey design, we provided random subsets of firms with different formulations of questions about inflation, allowing us to study how these questions affect responses. In what follows we provide key takeaways from our analysis.

4.1 Point Forecasts vs Distributions

While there are numerous benefits of having access to an economic agent's distribution of subjective expectations (Manski 2004), respondents may have a hard time understanding questions about distributions of their beliefs and may exhibit a lower response rate (Kleinjans and van Soest 2010). We find that managers have high consistency in their responses to questions eliciting point estimates of future inflation[11] and questions eliciting probability distributions of future inflation[12] (see Appendix Table A1). Specifically, the correlation between the point prediction and the mean implied by the reported distribution is about 0.9, which is considerably higher than the corresponding magnitude for household surveys. Thus, although consumers often struggle with answering probability distribution questions (Fischhoff and Bruine de Bruin 1999, Bruine de Bruin et al. 2000), firm managers answer coherently across the two types of questions and bias is unlikely in the distribution-type questions for this type of economic agents.

4.2 Wording of Inflation Forecast Questions

Currently available surveys of consumers and firms display considerable heterogeneity in the wording of questions used to elicit inflation expectations. The definitions of inflation range from "the change in the prices you pay" to "inflation as measured by the Consumer Price Index". Few even use the word "inflation". Although this may seem to be a trivial difference in the wording, Armantier et al. (2013) and Bruine de Bruin et al. (2012) document that the phrasing of inflation questions matters for how households interpret and respond to questions.

In one wave of the New Zealand survey, firms were randomly assigned to answer versions of the inflation expectation questions formulated in terms of "prices overall in the economy", "overall inflation rate", and "inflation rate (specifically the Consumer Price Index)". We find that firm managers do not appear to have systematic biases or exhibit difficulties with interpreting the questions: first and second moments of the responses are similar across the wordings (Appendix Table A2). Thus, managers' answers about inflation do not appear to be disproportionately sensitive to the language used in the question.

[11] The point forecast is based on the following question: "During the next twelve months, by how much do you think prices will change overall in the economy? Please provide an answer in percentage terms."

[12] Specifically, participants are asked "Please assign probabilities (from 0-100) to the following range of overall price changes PER YEAR in the economy over the next twelve months for New Zealand: (note that the probabilities in the column should sum to 100)."

4.3 Expectations of Aggregate vs Respondent-Specific Variables

While the objective of many surveys is to measure firms' expectations of aggregate inflation, some surveys attempt to measure these expectations by asking firms to report their projected dynamics of firm-level variables such as their own prices or their own unit costs. For example, the Atlanta Fed's Business Inflation Expectations (BIE) survey asks firms about their expectations of future changes in their unit costs rather than their expectations of aggregate inflation. This measure is conceptually different from inflation, but it may be associated with similar results in aggregate. To establish whether this difference in the objects of inflation expectation questions is material for measuring aggregate inflation expectations, we asked firms in the New Zealand survey to report their expectations about their future unit costs and expectations about aggregate inflation.

We find (Appendix Table A3) that the mean (median) response about firm-specific variables is consistently lower than the mean (median) response about aggregate inflation. This pattern applies not only to expected changes but also to perceived inflation (that is, inflation that happened in the previous twelve months) and actual changes in firm-level variables (that is, actual change in unit costs or prices in the previous 6 or 12 months). The dispersion of inflation expectations and perceptions tends to be larger than the dispersion in expected or actual changes in firm-level variables. Most importantly, we observe that firm-level responses about unit costs or prices are effectively uncorrelated with their expectations and perceptions of aggregate inflation.[13]

We find similar patterns in the U.S. when we compare the distribution of responses about unit costs in the BIE survey and the distribution of point predictions about aggregate inflation in the survey of firms that we ran in April 2018 (Figure 4). Specifically, in the April 2018 wave of the surveys, the BIE responses are generally centered at 2.3 percent (standard deviation is 1.4), while the mean response (after censoring responses greater than 10 percent) of inflation expectations in our survey is 3.6 percent (standard deviation is 2.0). That is, the distribution of responses about aggregates is tangibly shifted to the right and is more dispersed.

[13] Interestingly, the BIE had two special questions in the July-2015 and September-2014 waves to elicit firms' expectations about aggregate inflation so that we can compare responses about aggregate and firm-level variables. Similar to the survey in New Zealand, expected changes in unit costs are lower and less dispersed than changes in the CPI or "prices overall in the economy". Although the magnitudes of the differences are somewhat smaller, we argue below that some of the compression in the moments is due to the particular survey design of the BIE inflation expectation questions.

Our results suggest that whether a survey asks respondents to report firm-specific or aggregate measures of price change may influence both the level and heterogeneity of responses. These differences are important because both moments are informative about how agents form expectations and how successful central banks are in anchoring inflation expectations. Furthermore, we document that asking firm managers about changes in unit costs or prices of their firms can bear little connection to what firms project for macroeconomic variables.

4.4 Sensitivity of Inflation Expectations to the Design of Questions

In the baseline structure of probability questions in our survey of New Zealand managers, we present respondents with a broad spectrum of possible outcomes ranging from "More than 25%" to "Less than -25%" (which is similar to the wide grid of possible inflation outcomes in the Survey of Consumer Expectations run by the Federal Reserve Bank of New York). In contrast, other surveys often present fewer and/or narrower options. For example, an occasional question about core CPI in the BIE survey has a top bin of "4 percent and above", while the bottom bin is "zero or less" (that is, price decline).[14] Relatedly, point forecasts are often formulated as multiple-choice questions where the number of options is fairly constrained. For example, the Business Outlook Survey run by the Bank of Canada offers only four options for point predictions of CPI inflation: "less than 1%", "between 1% and 2%", "between 2% and 3%", and "above 3%". Given considerable variation in point predictions of managers in New Zealand and more generally households in the U.S. and other countries, such limited scales of possible answers may prime respondents to report predictions in the middle of the provided range or lump responses at the boundaries of the range thus possibly biasing reported inflation expectations.

To assess the quantitative importance of variation in the scale provided in questions eliciting expectations of firm managers, we randomized a set of questions presented to firms. Specifically, the first group of firms is presented with the CPI question in the Atlanta Fed's BIE format. The second group is presented with a grid as in the New Zealand survey (NZ grid).

For each question and firm, we compute the mean and standard deviation (a measure of uncertainty) implied by the reported density. Then we calculate moments across firms for these two statistics. We find (Appendix Table A4) that using a larger number of bins covering a broader set of possibilities for the core CPI inflation

[14] The wording of the occasional BIE question for core CPI inflation is "Please indicate what probabilities you would attach to the various possible percentage changes to the CORE (excluding food and energy) CONSUMER PRICE INDEX over the next twelve months (values should sum to 100%)." Firms assign probabilities to 10 bins running from "4 percent or more" to "will decline" at 0.5 percentage point increments.

rate yields results similar to those of the percent change in general level of prices (our baseline question about "change in prices overall"). Using the same question in the BIE format produces a mean forecast similar to the mean in the baseline format of the question. However, the cross-sectional dispersion of implied means across firms is considerably smaller than in the NZ grid (1.30 vs. 2.37). Furthermore, the implied uncertainty (measured as the standard deviation of the reported probability distribution) is nearly four times smaller in the BIE format than in the NZ grid (0.26 vs. 0.94). This pattern suggests that the BIE format can overstate the degree of anchoring of inflation expectations in the sense of Kumar et al. (2015).

To understand the source of these differences across the grids as well as the variables used to measure inflation expectations, we plot the average (across firms) densities for the different formats of survey questions. Figure 5 demonstrates that managers assign much greater probability to outcomes outside the range of the BIE grid. Specifically, when we use the NZ grid, managers give 24 percent probability to inflation being greater than 6 percent which is greater than the mid-point of the top bin of the BIE grid. If we cumulate probability across NZ bins to match the top bin in the BIE grid, managers give nearly 50 percent probability of inflation being greater than 4 percent for the NZ grid and 33 percent for the BIE grid. That is, although there is considerable lumping of responses at the top bin of the BIE grid, this lump is smaller than the cumulative probability managers assign on the NZ grid. This pattern is consistent with responses being affected by the menu of options in the BIE survey question and some of the probability mass being shifted toward the center of the offered menu.[15]

In summary, the distribution of probability questions (or multiple-choice questions for point predictions) should be calibrated to match the distribution of unconstrained point forecasts. If the grid of possible outcomes is constrained or not properly centered, elicited inflation expectations may paint a distorted picture. Specifically, inflation expectations may be less responsive to shocks and may appear more anchored than they actually are.

4.5 Designing a Sampling Frame of Managers

A basic question for the design of a survey of price-setters is the sampling frame and the representativeness of the sample of respondents. In household surveys, previous work has documented that expectations differ systematically along different characteristics of individual respondents, such as their age, gender, education,

[15] Relatedly, we see that responses on the BIE grid are such that the probability of deflation (in this case only one option: "less than 0%") is almost zero. For the NZ grid, on average probability of deflation is approximately 5 percent. Note that the NZ grid is centered at zero while the BIE grid is centered at 2 percent. As a result, respondents to the BIE grid may be primed to avoid reporting extreme outcomes like deflation.

and income. As a result, household surveys aim to create a distribution of respondents which is representative along these observable characteristics. With firm managers, it is less clear whether one should want a sample which mimics the population of managers along these same characteristics, or whether one would want a sample which matches the distribution of the characteristics of the firms for which they are employed.

To assess this question, we consider how expectations of manager respondents in the New Zealand survey correlate with both observable characteristics of respondents (age, gender, income, and education) versus the observable characteristics of the firms (age, size, industry, markups, etc.) at which they are employed. We find (Appendix Table A5) that while some of personal characteristics are significantly correlated with respondents' expectations, the predictive power of these characteristics is low ($R^2 \leq 0.1$). In contrast, the explanatory power of firms' variables (along with industry fixed effects) is quite high ($R^2 \approx 0.8$). When we include both firm characteristics and individual characteristics in the regression, much of the explanatory power coming from individual characteristics disappears whereas the firm characteristics continue to have significant predictive power. In other words, there seems to be very little value added in ensuring that respondents mimic the demographic characteristics of managers overall. Instead, a well-designed survey should capture the distribution of firm characteristics among the population of firms in the economy.

4.6 How Do Existing Surveys Fare?

These results highlight a few characteristics that well-designed surveys of firms' inflation expectations should exhibit: 1) because firm characteristics matter for expectations, surveys should use stratified random sampling from the universe of firms and have broad coverage of industries and firm sizes, 2) questions on inflation expectations should ask for point forecasts or present a sufficiently broad set of quantitative bins as to characterize the full distribution of beliefs, and 3) questions on inflation expectations should ask about firms' beliefs regarding aggregate inflation, not firm-specific concepts. From the broader literature on survey design, surveys should also have a large number of respondents and should avoid all forms of priming of respondents, e.g. providing them with additional information before asking questions.

How do existing surveys of firms conform to these guidelines? Overall, quite poorly. Table 3 summarizes major surveys of firms' expectations currently available for a range of countries and how they fare along these metrics. Most surveys fail along several dimensions. Many, like the Canadian Conference Board or the Livingston survey in the U.S (now run by the Federal Reserve Bank of Philadelphia), use a sampling frame that is not nationally representative ("convenience sampling"). Many of these same surveys consist almost exclusively of larger firms in the economy, with relatively small cross-sections (50-80 respondents

per wave is common). Convenience sampling and relatively small cross-sections also characterize surveys in the Czech Republic, New Zealand, Poland and Sweden. The BIE survey run by the Federal Reserve Bank of Atlanta is limited to the six states that are included in the Sixth District of the Federal Reserve system and does not ask firms explicit questions about aggregate inflation. The U.K. survey of firms run by the Confederation of British Industry similarly does not ask firms about their expectations of aggregate inflation and covers only a subset of industries.

Another common stumbling block for surveys of firms is "priming" of answers, either by providing respondents with information or using bins that limit the scope of possible answers. The survey of firms run by the Bank of Italy, as described in section 3.2, provides most firms with information about recent inflation in Italy and the euro area before asking them about inflation. Firms who are provided with this information display much less disagreement and have forecasts that track recent inflation much more closely than firms who are not. The Business Outlook Survey run by the Bank of Canada offers only four options for point predictions of CPI inflation: "less than 1%", "between 1% and 2%", "between 2% and 3%", and "above 3%".

The European Commission reports results of a "harmonized" survey of firms across all members of the European Union. These surveys are run by the national statistical institutes of each member country, but a minimum number of questions were made consistent across countries by the European Commission (EC) and aggregated values of these questions are then provided to the EC by member statistical institutes. Unfortunately, different surveys are used for different industries (e.g. there is one survey for the industrial sector and a different survey for the service sector). In addition, the harmonized survey questions that refer to aggregate inflation are only qualitative in nature (i.e. will prices "go up", "go down" or "stay the same"?), making them of limited practical use for measuring the level of firms' inflation expectations.

The Bank of Japan's "Tankan" survey, which began including questions on aggregate inflation in 2014, covers 10,000 firms on average per wave, making it the largest survey of firms anywhere (Muto 2015).[16] While the survey asks firms to provide quantitative forecasts of inflation, it gives them the opportunity to respond "I don't know." Approximately 20 percent of respondents choose "I don't know (or have a clear view)" for 1-year ahead inflation forecasts and around 40 percent make that choice for 3-year and 5-year ahead inflation forecasts. The survey of U.S. firms that we ran in April 2018 similarly gave respondents the option of choosing "I don't know" and about 55% responded that way. Unfortunately, those who choose "I don't know" are almost certainly not a random subset from the overall distribution of beliefs, making the

[16] The Tankan survey of the Bank of Japan is also exceptional in that it reports an average response rate of 99% (Muto 2015).

resulting mean forecasts a biased representation of actual forecasts of firms. While we cannot quantify the resulting bias at this stage, the high fraction of respondents who select it suggests that this feature should be avoided in future survey designs and instead surveys should nudge respondents to provide e.g. ranges.

To the best of our knowledge, the surveys of firms which best match our desiderata are those in Ukraine and Uruguay. The National Bank of Ukraine runs a survey of around 1,000 firms per quarter (see Coibion and Gorodnichenko 2015b), selected in a nationally representative way, and these firms are asked well-defined questions about inflation expectations. The central bank of Uruguay also runs a well-designed survey of firms on a quarterly basis. While the cross-section of approximately 300 respondents per wave is somewhat small, it has an extensive panel dimension which can be particularly useful for researchers and has quantitative questions on inflation expectations at different horizons (see Frache and Lluberas 2017). The fact that no major advanced economy has a survey of firms that compares to those in Ukraine and Uruguay is striking and a major stumbling block to the use of inflation expectations as a policy tool.

4.7 Summary and Discussion

Most advanced economies have well-designed representative surveys of households' inflation expectations. In contrast, most existing surveys of firms' inflation expectations appear to suffer from fundamental design flaws that call into question the resulting measurements. Whether it be that firms are not asked about aggregate inflation (Atlanta Fed's BIE survey, U.K. survey), firms are not randomly selected or representative of the broader distribution of firms (e.g., U.K. or Sweden), questions about inflation are not quantitative or too restrictive to be informative (e.g. Bank of Canada, European Commission), or any of the other shortcomings described above, few surveys of firms are sufficiently well-designed as to be very informative about the inflation expectations of firms in their respective economies. At a minimum, these limitations in available surveys should give policy-makers pause before using them as an explicit guide in policy decisions.

Filling this important measurement gap will require the development of nationally representative firm level surveys by government authorities. Even administratively-run "mandatory" surveys of firms tend to achieve response rates of only 70-80% (see Bloom et al. 2017). Privately administered surveys achieve much lower response rates and still require enormous expenses due to the difficulty of inducing business executives to respond, unlike household surveys. As a result, this gap cannot be filled by academics relying on research grants. Only central banks and statistical agencies have the resources and authority to create the type of large-scale, high-frequency and nationally representative surveys of firms needed to provide high-quality

measures of firms' inflation expectations appropriate for policy-making. If Ukraine and Uruguay can create such surveys, we see no reason why major advanced economies cannot do so as well.

5 Breaking through the Veil of Inattention

Above and beyond measurement issues, a necessary condition for policy-makers to be able to use inflation expectations as a stabilization tool is that economic agents' beliefs respond to the policies and announcements. Indeed, as Blinder (2018) observes, there should be a sender and a receiver for communication to be effective. Since expectations are not directly under the control of policy-makers, they should be thought of as indirect instruments that can be moved through the more direct tool of communication strategies. In this section, we review previous experiences with monetary policy announcements and their effects on inflation expectations. Even large monetary policy announcements during and since the Great Recession had little if any discernible impact on households and firms' views about the future. We then provide some suggestions as to how policy-makers could revise their communications strategies to more directly and successfully alter the economic expectations of different agents.

5.1 Monetary policy announcements and expectations

Monetary policy announcements have effects on financial markets that occur within minutes. Central bankers now often conduct extensive question-and-answer sessions with the media after policy meetings. Forecasters and analysts can be immediately found on the news explaining the potential implications of monetary policy actions. Does this instantaneous diffusion of news following large policy announcements affect the economic perspectives of households and firms?

In this section, we consider the extent to which consumers, professional forecasters and financial markets in the U.S., U.K. and euro area reacted after some important announcements from the monetary authorities during and following the last financial crisis. The objective is to try to evaluate if these announcements had an impact on agents' inflation expectations or other indicators that might indicate that this type of communication has some effect on their behavior.

5.1.1 The Case of the U.S.

We focus on four episodes in which the Federal Reserve undertook significant policy actions. The first is the interest rate cut in August 2007. We then consider the announcements of Quantitative Easing (QE) 1 in

November 2008 and QE2 in November 2010. Finally, we consider the announcement of the 2% inflation target by the Federal Reserve in January 2012.

We begin with the response of professional forecasters to this news to provide a benchmark for how relatively attentive agents are likely to respond to these policy announcements. Our source of information is the Survey of Professional Forecasters from Bloomberg, in which forecasts can be updated as frequently as daily. We count the monthly changes in predictions from the forecasters to see if they react to this news by changing their analyses. Figure 6 shows the number of changes in the predictions from professional forecasters. We see that in general there is an increase in the number of changes in the prediction of forecasters around these announcements. The changes are particularly striking for QE1, QE2 and the 2% inflation target. This seems to indicate that professional forecasters are reacting to the announcement. In the same spirit, we can assess how financial markets reacted after these changes. We use the TED spread as a measure of credit risk and the 5-year inflation swap to gauge the response of financial market participants. We can use daily data which can better isolate these announcements from other events that might have happened in that period. Figure 7 shows the TED spread and the 5-year inflation swap in a 2-month window around the events. As with professional forecasters, we observe clear reactions in financial markets. 5-year inflation swaps react after these events with QE2 and the inflation targeting announcement yielding particularly large effects. The TED spread shows smaller changes that might be possible considering that these are periods of high uncertainty.

The response of the expectations of professional forecasters and financial markets to the inflation targeting announcement is somewhat surprising. As already discussed, these agents are very well-informed when it comes to inflation dynamics and the objective of the central bank, so one might have expected very little effect on their beliefs from the Federal Reserve's formal adoption of a target that had long been already understood in the financial community as an informal target. These movements in expectations therefore represent a lower bound of what we would expect to see for households and firms given how much less informed the latter appear to be when it comes to inflation and monetary policy.

To evaluate consumers' reaction, we use the Survey of Consumers (MSC) conducted by the University of Michigan. Looking at the average response of households in the MSC in Figure 8, we find little visible response to any of the announcements. Binder (2017) similarly notes that household inflation expectations in the U.S. did not appear to respond in a meaningful way to the Federal Reserve's announcement of an inflation target. Consistent with the general inattention paid by households to inflation in general, this suggests that even the adoption of a formal inflation target on the part of the Federal Reserve did not feed

into household inflation expectations and they appear to be, at least in the current environment, look largely invariant to monetary policy announcements and decisions. [17]

To assess how such inattention to what should be large and visible economic announcements can occur, we consider responses to the following question in the MSC: "During the last few months, have you heard of any favorable or unfavorable changes in business conditions?" We use this question to evaluate how consumers are receiving information about different types of policies. Answers are separated by the type of news. We focus on monetary news to see if announcements are reaching households. To quantify the exposure of these announcements, we use a measure of how the media covered these events. This measure is constructed by counting all the news articles that have the phrase "Federal Reserve" in the New York Times ("Fed news"). We have monthly data for both measures. Figure 9 plots time series of monetary news and Fed news for a 13-month window around the announcements. We can see that these big announcements seem to have been covered by the media (or at least the New York Times), as we see a reaction of the amount of news related to the Federal Reserve. Despite this upsurge of news reports, we see little reaction in terms of households reporting receiving more information about monetary policy. The percentage of households who heard about monetary news changes little and in some cases we even see declines around the main event. Jointly, this indicates that the increased news coverage in major news media sources is either not seen by most households or ignored by them when they read the news.

5.1.2 The Case of the U.K.

Like in the U.S., there were a number of notable policy announcements made by the Bank of England following the financial crisis. We focus on the following three: Quantitative Easing in March 2009 (QE1), October 2011 (QE2) and July 2012 (QE3). We use the Bank of England's Survey on Consumer Expectations, a quarterly survey conducted by the Bank of England since 2001 of a representative group of consumers aged 16 years or older. This survey not only includes questions about inflation expectations but also asks respondents about their opinions regarding the work of the Bank of England.

As illustrated in Panel A of Figure 10, there is little indication that inflation expectations rose sharply around the time of these events, much as was the case in the U.S. When we examine the evolution of consumers' expectations about the interest rate (Panel B), we also see that there are no changes around the

[17] Lamla and Vinogradov (2019) use high-frequency surveys of U.S. consumers to study how monetary policy announcements alter consumer expectations as well as knowledge about policy. Lamla and Vinogradov find that beliefs of consumers surveyed just before an announcement are nearly identical to beliefs of consumers surveys just after an announcement.

announcements. Between the second quarter of 2009 and 2010, the survey included another question asking respondents whether they had heard about quantitative easing policies. Following the announcement of QE1, we find that the proportion of consumers that declare that they have no idea about the evolution of interest rates remains constant or increases. About 50% of the respondents stated that they have not heard at all about that policy. Less than 20% said that they have heard a lot about it. This shows that even if this was an exceptional policy, U.K. consumers seemed to be largely unaware of it.

5.1.3 The Case of Eurozone

Finally, we explore what happened with big ECB policy announcements, focusing on four specific episodes: the purchasing of Spanish and Italian bonds (August 9, 2011), 0% interest rate and "whatever it takes" (July 26, 2012), Quantitative Easing (March 9, 2015), and QE tapering (December 8, 2016). Turning first to financial market responses, we examine how the 5 years inflation swap and the difference between the 10-year and 2-year German bund reacted around these announcements. We use daily data and a two-month window as in the U.S. For these variables we see some reactions around the day of these announcements (Figure 11). In the case of the 5 years inflation swap we see moderate changes the day of the events, especially the day of the announcement of the 0% interest rate. In the case of the German bund spread we see bigger changes around the events, with direction that depends on the type of the news.

On the other hand, households' inflation expectations appear to be rather insensitive to the announcements (Figure 12). For example, the ECB's announcement of its quantitative easing program in March 2015 had no discernible effect on mean one-year-ahead inflation expectations of eurozone consumers, which is similar to the behavior of U.S. consumers in response to the QE announcement by the Federal Reserve.

While we do not have access to time-series data on inflation expectations of U.S. firms, we use a unique survey of firms run by Deloitte to study the evolution of firms' expectations in Europe. This survey of Chief Financial Officers (CFOs) across countries in Europe (both within the eurozone and outside of it) begins in 2015S2 and continues on a semi-annual basis thereafter. This time period includes the QE Tapering announcement which had a discernible effect on financial markets. The Deloitte Survey does not inquire as to CFOs' inflation expectations, but it does ask about their expected capital expenditures and employment over the following twelve months as well as how uncertain they are about the economic outlook. As a result, we can assess whether this announcement had any effect on CFOs' other economic expectations. We report mean responses for countries in the euro area for which we have access to the Deloitte Survey (Germany, France, Italy, Spain, and Finland) and selected non-euro countries (Turkey, Poland, Russia, Sweden, and Norway) for comparison. There is little discernible pattern around the time of the announcements (Figure

13). For most economic variables, firms do not seem to become significantly more optimistic or pessimistic than those outside the eurozone. There is a non-trivial decline in optimism about future capital expenditures, but a similar albeit smaller decline also takes place in non-euro countries, making it difficult to argue that the effect stems primarily from the policy announcement.

In short, across geographic areas, we find little evidence that households and firms respond strongly to monetary policy announcements, even when these receive pronounced coverage in the main media outlets. These results are notably different from what has been previously documented for fiscal policies. D'Acunto et al. (2016), for example, find that an announcement related to increases in value added taxes in Germany had a strong effect on consumers' inflation expectations and on their spending decisions. Similarly, Kueng (2016) finds that spending of high-income households increases strongly in response to announcements that raise their expected after-tax lifetime permanent income in the U.S.

5.2 Policy solutions to break the veil of inattention

Given this apparent inattention paid to inflation and monetary policy by households and firms in advanced economies that have experienced low inflation for decades, how can policy-makers possibly affect their expectations in order to achieve more stable economic outcomes? Fortunately, a growing literature on the effects of information on agents' beliefs provides a basis for new communication strategies for policy-makers.

5.2.1 Communication to the public can work

While the veil of inattention may give the appearance that policy-makers will never be able to affect agents' expectations sufficiently to affect their economic decisions, recent experimental evidence suggests otherwise. Specifically, a number of recent papers use information treatments to households and firms and find that these treatments have large and immediate effects on agents' inflation expectations. For example, Armantier et al. (2016) use randomized control trials to provide information about professionals' inflation forecasts to households and find that, relative to a control group that received no such treatment, their inflation forecasts respond strongly to the information and in the expected direction. This effect is particularly strong for households whose beliefs are initially further from the mean and who are more uncertain about inflation. Binder and Rodrigue (2017) find a similar result in a separate experiment providing information about recent inflation or about the central bank's inflation target to households.

This strong response of inflation expectations to information treatments is not limited to households. CGK document a similar finding for firms in New Zealand: providing managers with information about inflation

or monetary policy can lead to large changes in the inflation forecasts of managers, especially those who are most uninformed. The strength of this effect can also be seen in the unique experiment provided by the Bank of Italy's randomized provision of information about recent inflation to Italian firms. As described in section 3.2, starting in 2012Q3, some firms in this survey were asked about inflation without being provided any additional information whereas other firms in the survey were first told about recent inflation values. As can be seen in Figure 14, this provision of information to agents led to large deviations in inflation expectations across the two groups of firms depending on recent inflation dynamics in Italy, with treated firms having expectations that tracked inflation much more closely as well as displaying much less disagreement amongst themselves about the path of future inflation. Another experiment in this spirit is described in Frache and Lluberas (2017). They document that Uruguayan firms have to obtain information about recent inflation when renegotiating wages at fixed times during the year. They find that when firms undergo this information treatment, their forecasts of inflation improve significantly relative to firms that do not have to acquire information about inflation that month.

5.2.2 Simple messages are better

How strongly agents respond to new information depends on the nature of the information provided to them, the source of that information, and how much they already know. As a result, we should expect some forms of information treatment to be more powerful than others, which is precisely what this line of research has documented. For example, Armantier et al. (2016) find that providing households with information about professionals' forecasts of inflation (which they generally don't know or observe) has larger effects on their inflation expectations than providing them information about food inflation (which they are generally more confident about). Binder and Rodrigue (2017) find that effects on households' beliefs when providing information about recent inflation or the Federal Reserve's inflation target are approximately the same. CGK find similar effects on inflation expectations when treating firms with information about the central bank's inflation target, recent inflation dynamics or the forecasts of professional forecasters. However, providing participants with information about the forecasts of other firms has much smaller effects on their beliefs, consistent with them viewing these as providing less reliable information. CGR find that Italian firms which receive information about recent inflation respond approximately as much to this information as firms which are told about the ECB's inflation target.

If agents' beliefs are so sensitive to information about recent inflation and the inflation target in experiments, why don't central bankers' policy announcements have more discernible effects on the expectations of households and firms, as documented in section 5.1? One reason is that these agents may not be exposed to this news, a possibility to which we return below. But it could also be the case that the way in which the news is presented to them is not comprehensible to them. To assess this possibility,

Coibion, Gorodnichenko and Weber (2018) provide different information treatments to U.S. households, including not just simple statements about recent inflation or the central bank's target (as done in previous work), but also by providing randomized subsets of households with either the FOMC statements or *USA Today*'s news coverage of the FOMC announcements or FOMC forecasts. They find that providing households with FOMC statements has no statistically significant marginal effect on agents' beliefs relative to simply telling them about recent inflation dynamics (Table 4). This is consistent with Hernandez-Murillo and Shell (2014) showing that statements by the FOMC have become increasingly difficult to understand over time and now require a Ph.D. to fully understand.[18] Reading news coverage of FOMC decisions has an even smaller effect on households' inflation forecasts than reading FOMC statements. This suggests that policy-makers cannot rely on news media to make their policy decisions and announcements sufficiently clear for the general population to process. Simply providing FOMC forecasts is as powerful as giving recent inflation figures. The current "Fed-speak" approach is not a particularly successful communication strategy with respect to the general public.

At the same time, Table 4 illustrates the potential power of a layered communication strategy that successfully reaches households. Providing information to these agents about recent inflation or the central bank's inflation target moves average inflation expectations (and therefore perceived real interest rates) by around 2 percentage points on average. In contrast, estimates of the effects of quantitative easing and forward guidance point to effects on long-term interest rates of around 50 basis points (e.g., Chodorow-Reich 2014). The effect of communication treatment on perceived real interest rates is therefore *an order of magnitude* larger than the types of policies currently used at the ZLB.

A successful communication strategy that aims to affect the expectations of firms and households should therefore consist of much more accessible messages.[19] Multi-layered presentation (that is, presentation of the same material in a sequence of messages with different levels of complexity) of a central bank's policies may be a more effective way to reach the public as is shown in randomized control trials (Haldane and McMahon, 2018).

[18] Bulir, Jansen, and Cihak (2012) document that other central banks tend to have equally complex communication.

[19] For comparison, Mervyn King (2007) delivers a representative central banker's view of communications: "Explaining our analysis at some length is a richer source of information for markets than code words or statements about the future path of interest rates. Less weight should be placed on the short statements that are published with the announcements of our decisions because such statements, as we have seen elsewhere, run the risk of becoming monetary policy by code word. They do not help markets understand how we are likely to react to future data." Our results suggest that, when it comes to firms and households rather than financial markets, monetary policy by "code word" may be a much more successful strategy. More elaborate messages, however, can help with a more positive coverage of policy decisions by the media (Berger, Ehrmann, and Fratzscher 2011).

5.2.3 Target the message to the scenario

In a communication campaign, a central bank has a choice over which message to share with the public. For example, with forward guidance policies, policy-makers first make a choice over whether or not to engage in such a policy at different times. They then choose whether to engage in a time-dependent or state-dependent approach. With the former, they face a choice of an expected duration to announce while under the latter they must decide on what state-contingencies to announce. With a layered communication strategy targeting the inflation expectations of households and firms, policy-makers would similarly have flexibility over the intensity of the communication campaign as well as the nature of the communication. The growing empirical evidence on how households and firms react to information treatments strongly supports the notion that they respond in a Bayesian manner, i.e. forming new beliefs that depend both on their original belief and the signal they receive. Hence, policy-makers can push inflation beliefs either up or down depending on which information they choose to provide. Clearly no policy institution will want to release information that is factually incorrect, but there are different facts that they can choose to emphasize.

To illustrate this point, consider the case of Italy in 2014. Inflation was running below 1% and expectations of firms were around 1.5%. Giving firms information about recent inflation tended to lower their inflation expectations, as is evident from the difference in beliefs between firms that were told this information and firms that were not (Figure 14). But giving them information about the ECB's inflation target of just below 2% would have tended to raise them. By choosing which information to stress, policy-makers can therefore guide expectations in a direction that helps stabilize economic outcomes. Because economic conditions change over time, the message will likely need to change as well.

5.2.4 Repeat the message

Another lesson from the recent literature using experimental treatments is that the effect of information on households' and firms' beliefs is short-lived. For example, CGK perform an experiment in which firm managers were provided with information about the Reserve Bank of New Zealand's inflation target. As discussed above, this information had a large and immediate effect on the reported inflation forecasts of relatively uninformed managers. However, when these were surveyed again six months later, the beliefs of the treated group were not meaningfully different than those of the control group who did not receive the information. The effect of the information treatment on beliefs had fully dissipated within six months.

Other work has found similar transitory effects of information treatments. For example, CGR use the fact that information treatments to Italian firms vary over time with the level of inflation to assess how long-lived the effects of each information treatment are. They find that while the contemporaneous effects on inflation expectations are large, these fade quickly and appear to have dissipated after around six months, similar to the finding in CGK. Frache and Lluberas (2017) similarly find large forecast revisions each time firms in Uruguay are forced to renegotiate wages and acquire information about inflation. Since this happens every six months on average, this again implies that information treatments on firms have only short-lived effects. Cavallo et al. (2017) also report that the effects of informational treatment for consumers dissipate within six months.

The transitory nature of information treatments on inflation expectations of firms and households implies that policy-makers need to pursue a repeated set of announcements when they seek to affect these agents' expectations in a persistent manner. One-time announcements may have immediate and long-lived effects on the expectations of professional forecasters and financial market participants; they have no such effects on other agents' expectations. Policy-makers should therefore consider pursuing systematic communication campaigns that repeatedly target the relevant audience when that audience involves firms or households.

5.2.5 Take the message directly to the target audience

In an early contribution, Berger, Ehrmann and Fratzscher (2011) asked, "The commercial success of a private firm crucially depends on its ability to reach its customers and to convey a favorable image of its products and corporate identity—but does the same apply to policy institutions?" After studying media coverage of the ECB's decisions, their answer is a conditional yes with the effectiveness of policy communication being potentially clouded by the media. Indeed, the weak responses of household and firm expectations to significant monetary policy announcements documented in section 5.1 indicates that relying on traditional media channels to diffuse policy messages is unreliable. First, the media tends to disproportionately cover negative news (Hamilton 2004). Second, many households do not follow standard news outlets. Third, even when they are exposed to media articles on monetary policy, households do not respond strongly to their news content compared to simpler messages, as shown in Table 4. Having a significant impact on the inflation expectations of these agents will therefore require more targeted "marketing" strategies.

There is an extensive history of policy-making institutions developing messages meant to shape the general public's opinion that can help serve as a guide. Public health messages have long advertised the dangers of certain behaviours through aggressive advertising campaigns in magazines, billboards and television. Each

year, there are seasonal campaigns to induce people to take the flu shot or, in the case of the U.S., to induce people to sign up for health care during "open season". Campaigns like these are not limited to health issues however. For example, following the passage of the 2001 Bush tax cuts, the Internal Revenue Service sent letters to American taxpayers letting them know they would be receiving a check in the mail as a result of the policy and that this check was not considered taxable income. The introduction of the euro to the public was similarly preceded by an extensive publicity campaign by the ECB.

The growth of social media can facilitate this targeted approach. Much like corporate advertising and political messages are now targeted to well-defined audiences that are likely to respond to the information, central banks could pursue ad-based communication strategies that focus on specific groups. Such an approach would avoid working through the news media, which much of the population does not follow closely or does not treat as very informative, as illustrated in Table 4. Ads with clear narratives could break through this intermediation flow and allow the central bank to directly reach new audiences.[20]

Targeted messages that reach the relevant audience can also help reduce regional disparities in economic activity in a way that aggregate policy actions (like interest rate changes) cannot. This can therefore help mitigate one of the major limitations of common currency areas, namely the inability to "tailor" policy to local conditions. Consider for example the hypothetical case of a currency bloc with one region that is booming (call it the North) and one that is in recession (call it the South), such that aggregate interest rate changes cannot simultaneously stabilize both regions. A campaign that raises inflation expectations in the South but lowers them in the North via targeted messages to each can thereby lower real interest rates in the former while raising them in the latter.

6 Conclusion

The onset of the zero-bound on interest rates generated a need for new monetary policy strategies. One such commonly discussed approach is a more active management of inflation expectations. If policy-makers can alter agents' inflation expectations, then perceived real interest rates can be altered even in the absence of

[20] In a recent speech, Haldane (2017) emphasizes the importance of narratives: ""[W]hen it comes to assessing the impact of central bank actions on the trust and understanding of the public, little if any attention has been paid to some of the richer informational channels through which news might spread between people. For example, the recent work of George Akerlof and Robert Shiller has emphasized the role of "popular narratives" in shaping the public's expectations and decisions. Story-telling is the ultimate communications device. History is no more than a sequence of stories. These stories spread word by word, mail by mail, Tweet by Tweet. They obey the same laws of motion as epidemics, with viral spread beyond a tipping point. And in a world of modern media, these popular narrative epidemics are probably spreading further and faster than ever previously. This matters for individuals' feelings and decisions and, potentially, for macro-economic behavior."

changes in nominal interest rates, presumably leading to changes in consumption and investment decisions. Furthermore, shaping inflation expectations of price-setters can have a direct effect on price changes, thus providing another channel to control inflation. Our reading of recent evidence makes us cautiously optimistic about the future of this policy option, although it is not yet ready for full deployment. There is now robust evidence on the causal effect of inflation expectations on the decisions of households and firms, which suggests that this tool has potential. However, we note several caveats. First, the specific mechanisms linking inflation expectations and economic decisions are not yet clearly identified, which we view as a call to academics for continuing this burgeoning research agenda. Second, we lack high-quality surveys of firms' expectations, which we similarly view as a call for statistical agencies to develop and field new nationally representative surveys of firms. Third, in low-inflation environments, central banks face the inattention of households and firms to monetary policy announcements, which calls for new communications strategies on the part of central banks.

The current era of low interest rates combined with a possible recession in the coming years suggests that the need for non-traditional monetary policies is likely to grow. Limited fiscal space resulting from the last recession will make the issue of having a wide range of non-traditional monetary tools even more pressing, both because fiscal stimuli are unlikely to be forthcoming and growing debt levels are likely to raise new concerns about the solvency of some national governments. Pursuing new research on expectations, fielding new surveys and developing innovative communications strategies are steps that we can take now in anticipation of future challenges to monetary policy.

But the management of expectations by policy-makers has scope that extends well beyond getting around the zero-bound constraint on interest rates. Because communication can be targeted to different regions, different industries and different groups, this policy tool can in principle be used to affect economic activity in a much more precise and targeted manner than the bludgeon of nominal interest changes. While central banks have long focused on financial markets and how monetary policy actions affect and pass through the financial system, expectations management represents a policy tool to precisely and directly affect consumers and firms while side-stepping the financial system. While this is unlikely to be a panacea for all of our economic woes, the development of such a tool could be exceptionally useful for economic stabilization, especially when fiscal policy-makers are missing in action.

Finally, improved and layered communication strategies would ultimately enhance the credibility of central banks and help protect their independence. It is short-sighted to believe that simply being successful in keeping inflation low and stable is sufficient to ensure that the central bank is credible and its independence insured. If most economic agents are unaware of the central bank's success, then how can it be viewed as having credibility? Yet the irony of the Lucas critique is that successfully generating a low-inflation

environment reduces the incentives of agents to track inflation. As they optimally choose to become more inattentive to aggregate inflation dynamics, the central bank will generally can be viewed as *less* credible over time, not more. A layered communication strategy that directly targets the beliefs of households and firms can therefore serve not only to enhance economic stability but also to sustain the credibility of the central bank and thereby help protect its independence.

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Table 1. Comparison of inflation forecasts across economic agents

		Central Bank	Professional Forecasters	Households	Firms
Panel A. Inflation expectations in the USA					
2018Q1	Mean	1.9	2.2	3.0	3.7
	St.Dev.	(0.2)	(0.4)	(2.6)	(2.6)
Panel B. Inflation expectations in New Zealand					
2016Q4	Mean	1.7	1.6	2.8	2.7
	St.Dev.		(0.2)	(2.6)	(2.4)
2016Q2	Mean	1.6	1.3	2.3	2.8
	St.Dev.		(0.2)	(2.1)	(2.3)
2014Q4	Mean	1.1	1.7	3.1	4.5
	St.Dev.		(0.3)	(2.0)	(2.8)
2014Q3	Mean	1.6	1.9	3.5	4.1
	St.Dev.		(0.2)	(2.4)	(2.5)
2014Q1	Mean	1.9	2.0	3.7	6.1
	St.Dev.		(0.3)	(2.1)	(2.7)
2013Q4	Mean	1.3	2.0	3.6	5.3
	St.Dev.		(0.2)	(2.4)	(3.2)
Panel C. Inflation perceptions in New Zealand					
2016Q4	Mean			2.4	n.a.
	St.Dev.			(2.4)	n.a.
2016Q2	Mean			1.8	2.6
	St.Dev.			(1.5)	(2.1)
2014Q4	Mean			2.9	3.9
	St.Dev.			(2.2)	(2.4)
2014Q3	Mean			2.9	n.a.
	St.Dev.			(2.0)	n.a.
2014Q1	Mean			2.9	5.5
	St.Dev.			(1.8)	(3.3)
2013Q4	Mean			3.1	4.4
	St.Dev.			(2.0)	(3.5)

Notes: The sources of data for Panel A are as follows: "Central bank" are from FOMC Projections materials (March 21, 2018; PCE deflator; available at https://www.federalreserve.gov/monetarypolicy/fomcprojtabl20180321.htm), "Professional Forecasters" are from the Survey of Professional Forecasters (SPF; CPI; 2018Q1), "Households" are from the Michigan Survey of Consumers (MSC; "prices in general"; 2018Q1), and "Firms" are from the PMI Markit Survey ("prices in general"; April 2018). Panels B and C are taken from Kumar et al. (forthcoming). "Central Bank" forecasts (CPI) are from Monetary Policy Statements of the Reserve Bank of New Zealand. "Professional Forecasters" are from Consensus Economics (CPI). "Households" are from the Reserve Bank of New Zealand's Survey of Households (the survey elicits inflation expectations only from households who can define inflation). "Firms" are from the survey run in Kumar et al. (forthcoming). St.Dev. reports the cross-sectional standard deviation (disagreement) of forecasts. St.Dev. for Central Bank in Panel A reports the difference between the upper and lower ends of central tendency.

Table 2. Selected Surveys and Firms' Inflation Expectations

Country	Institution	Respondents	Price Definition	Sampling	Freq.	Start date	Bins	Horizon	Question
Canada	Conf. Board of Canada	Firms	Prices in general	Convenience	Quarterly	1997	9	6 months	Do you expect prices, in general, in Canada to increase over the next six months at an annual rate of
Canada	Central bank	Firms	Inflation (CPI)	Quota	Quarterly	1997	4	1 year	The firm's expectation for the average annual rate of inflation over the next two years as measured by the consumer price index (CPI) is: …
Czech Republic	Central bank	Firms	Inflation (CPI)	Representative	Quarterly	1999	open	1 and 3 years	What year-on-year consumer price change in per cent do you expect in the next 12 months?
EU Members	European Commission	Firms	Prices for consumers	Probabilistic sample	Monthly	1985	(up/down/ same)	1 year	By what percentage you would say that prices will increase for the consumer in the next 12 months?
Iran	Central Bank	Mnfg. Firms, ≥100 workers	Inflation	Probabilistic Sample	Quarterly	2016	open	1 year	What do you think the [yearly] inflation will be during the next year?
Israel	Ungar and Zilberfarb (1993)	Firms	Inflation (CPI)	Representative	Quarterly	1980	open	1-4 quarters	The cumulative inflation rate (not monthly average), in %, which is expected for the following periods is as follows: The next 12 months
Italy	Central bank	Firms	Inflation	Probabilistic sample	Quarterly	1999	open	1 year	The last [month] consumer price inflation, measured by the 12-month change in the harmonized index of consumer prices was equal to [IT] in Italy and to [EA] in the euro area. What do you think it will be in Italy.
Japan	Central bank	Firms	Prices in general (CPI)	Probabilistic sample	Quarterly	2014	10	1, 3, and 4 years	What are your institution's expectations of the annual % change in general prices (as measured by the CPI) for one year ahead, three years ahead, and five years ahead, respectively?
New Zealand	Central bank	Firms and professionals	Inflation (CPI)	Convenience	Quarterly	1987	open	3 months and 1 year	What annual % change do you expect in the CPI for the:
Poland	Central bank	Firms	Prices	Sector representation	Quarterly	2008	5	1 year	In … [month with the latest data is available] of the current year, the CPI (inflation) was equal to x% in annual terms. In the enterprise's opinion, during the next 12 months prices:
South Africa	Central bank	Firms and consumers	Inflation (CPI)	Convenience	Quarterly	2000	open	1 year	What do you expect the average headline inflation rate (as measured by the % change in the CPI) to be during the year
Sweden	Central Bank	Firms with ≥200 workers	Inflation (CPI)	Random	Quarterly	2000	open	1 year	n.a.
UK	Confed. of British Industry	Firms	Prices of competition	Convenience	Quarterly	2008	4	1 year	What has been the % change over the past 12 months in the general level of output prices in the UK markets that your firm competes in, and what is expected to occur over the next twelve months?
Ukraine	Central bank	Firms	Inflation	Random	Quarterly	2006	8	1 year	How do you think the level of consumer prices will change in the next 12 months?
USA	Atlanta Fed	Firms	Individual unit costs	Non-random (regional)	Monthly	2011	5	1 year	Projecting ahead, to the best of your ability, please assign a percent likelihood to the following changes to unit costs over the next 12 months.
USA	Livingston, Philly Fed	Large Firms	Inflation (CPI)	Convenience	Semi-Annual	1946	open	1 year	n.a.
Uruguay	Central bank	Firms	Inflation (CPI)	Representative	Monthly	2009	open	1 year	What do you believe is going to be the change in the CPI?
Turkey	Central Bank	Manufacturing Firms	Inflation (PPI)	Sector representation	Monthly	1987	open	1 year	What is your expectation for inflation (producer prices) rate over the next 12 months (as an annual percentage)?

Table 3. Selected Surveys and Firms' Inflation Expectations

Country	Institution	Representative Sample	Heterogenous sample	Monthly or Quarterly Frequency	Large Sample Size (>350)	No Priming	Quantitative Question	Many/wide bins	Distributional question	Aggregate Inflation
Canada	Conference Board of Canada	✕	✓	✓	✓	✓	✕	✓	✕	✓
Canada	Central bank	✕	✓	✓	✕	✕	✕	✕	✕	✓
Czech Republic	Central bank	✓	✓	✓	✕	✓	✓	-	✕	✓
EU Members	European Commission	✓	✓	✓	✓	✓	✕	✕	✕	✓
Iran	Central Bank	✓	✕	✓	✓	✓	✓	-	✕	✓
Israel	Ungar and Zilberfarb (1993)	✓	✕	✕	✕	✕	✓	-	✕	✓
Italy	Central bank	✓	✕	✓	✓	✕*	✓	-	✕	✓
Japan	Central bank	✓	✓	✓	✓	✓	✕	✓	✕	✓
New Zealand	Central bank	✕	✕	✓	✕	✓	✓	-	✕	✓
Poland	Central bank	✕	✓	✓	✕	✕	✕	✕	✕	✓
South Africa	Central bank	✕	✕	✓	✓	✓	✓	-	✕	✓
Sweden	Central Bank	✕	✕	✓	✕	✓	✓	-	✕	✓
UK	Confederation of British Industry	✕	✓	✓	✓	✓	✓	-	✕	✕
Ukraine	Central bank	✓	✓	✓	✓	✓	✕	✓	✕	✓
USA	Atlanta Fed	✕	✕	✓	✕	✕	✕	✕	✕**	✕
USA	Livingston, Philadelphia Fed	✕	✕	✕	✕	✓	✓	-	✕	✓
Uruguay	Central bank	✓	✕	✓	✕	✓	✓	-	✕	✓
Turkey	Central Bank	✓	✕	✓	✓	✓	✓	-	✕	✓

Notes: Column "Representative sample" indicates whether firms in a survey are representative of the group that is being surveyed. Column "Heterogeneous sample" indicates if a sample of firms covers various types (size, sector, etc.) of firms so that the resulting sample represents or resembles the population of firms in the economy. Column "Large Sample Size" indicates if a survey has more than 350 firms with non-missing responses. Column "No priming" indicates whether a survey does not provide information to firms before eliciting expectations, does not restrict the sample in any particular way (e.g., does not exclude firms that do not understand the concept of inflation), and does not restrict possible responses (e.g., does not present firms with a limited set of possible responses). Column "Quantitative question" indicates if firms are free to report an unrestricted inflation forecast (i.e., responses are not restricted to a binned/range/multiple-choice menu). Column "Many/wide bins" indicates whether a survey allows firms to choose from a wide and detailed range of possible responses if quantitative response are not available. Column "Distributional question" indicates whether a survey elicits a probability distribution for future inflation. Column "Aggregate Inflation" indicates whether a survey asks firms to report an aggregate measure of inflation, changes in prices overall, etc. (rather than firm's unit costs or prices). * last month annual inflation is given to 2/3 of the firms and firms are not allowed to report "extreme" values. ** distributional questions are asked in occasional modules

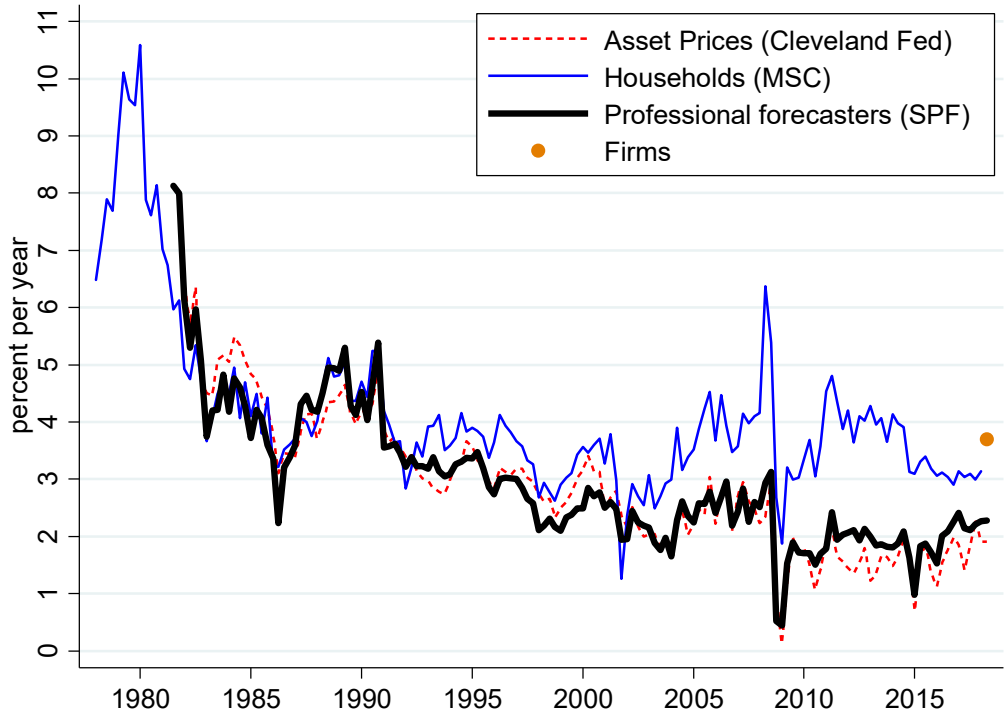
Table 4. Treatment effects

Treatments	Outcome: forecast revision					
	Immediate revision		Revision after 3 months		Revision after 6 months	
	(1)	(2)	(3)	(4)	(5)	(6)
T5 (pop growth)	-0.218**	-0.269**	-0.074	-0.097	0.086	0.096
	(0.105)	(0.109)	(0.090)	(0.093)	(0.102)	(0.104)
T6 (UE)	-0.337***	-0.330***	-0.231**	-0.250***	-0.116	-0.115
	(0.104)	(0.109)	(0.093)	(0.096)	(0.101)	(0.103)
T4 (gas prices)	1.491***	1.430***	-0.169*	-0.190**	-0.121	-0.117
	(0.114)	(0.119)	(0.092)	(0.095)	(0.102)	(0.103)
T2 (past inflation)	-1.039***	-1.111***	-0.014	-0.067	0.276***	0.251**
	(0.104)	(0.109)	(0.091)	(0.094)	(0.102)	(0.104)
T3 (inflation target)	-0.996***	-1.034***	-0.329***	-0.394***	0.032	-0.017
	(0.102)	(0.109)	(0.091)	(0.095)	(0.101)	(0.103)
T7 (Fed inflation forecast)	-1.071***	-1.143***	-0.220**	-0.240**	0.162	0.142
	(0.102)	(0.108)	(0.093)	(0.095)	(0.101)	(0.103)
T8 (FOMC statement)	-1.197***	-1.213***	-0.138	-0.163*	0.078	0.075
	(0.103)	(0.108)	(0.092)	(0.095)	(0.104)	(0.107)
T9 (USA today coverage)	-0.444***	-0.528***	-0.196**	-0.211**	0.117	0.104
	(0.105)	(0.109)	(0.092)	(0.095)	(0.101)	(0.103)
Remove outliers	Yes	Yes	Yes	Yes	Yes	Yes
Using sampling weights	Yes	Yes	Yes	Yes	Yes	Yes
Controls for demographics	No	Yes	No	Yes	No	Yes
Observations	19,269	17,629	13,339	12,553	11,716	11,223
R^2	0.048	0.061	0.002	0.012	0.002	0.015

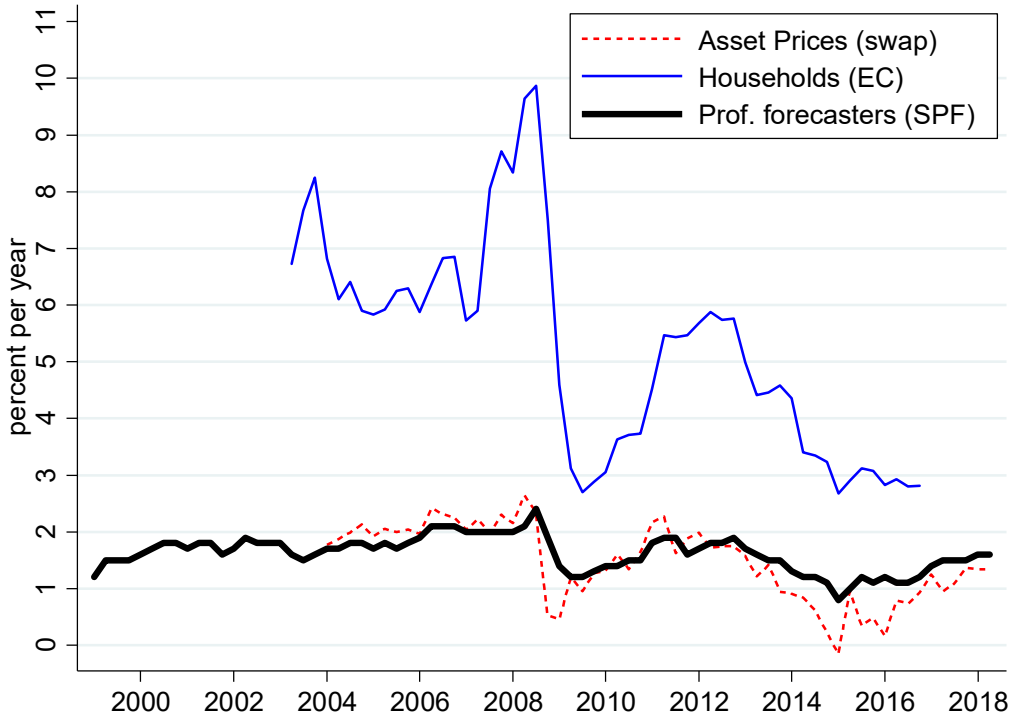
Notes: The table reports estimated effects of providing information (indicated in the left column) to households participating in the AC Nielsen Homescan panel. For treatment "pop growth", households are informed that population in the U.S. grew 2% over the last three years. The dependent variable is equal to (post-treatment one-year-ahead inflation expectations) minus (pre-treatment one-year-ahead inflation expectations). Pre-treatment expectations are computed as the implied mean of expected inflation distribution over the next year. Post-treatment expectations are elicited as point forecasts. In columns (1)-(2), posterior beliefs are measured immediately after treatments whereas in columns (3)-(4) and (5)-(6) they are measured in follow-up waves three and six months later respectively. Source: Coibion, Gorodnichenko and Weber (2018). Robust standard errors are reported in parentheses. ***, **, * indicate statistical significance at 1, 5 and 10 percent levels.

Figure 1. One-Year-Ahead Inflation Expectations for Different Agents

Panel A: United States



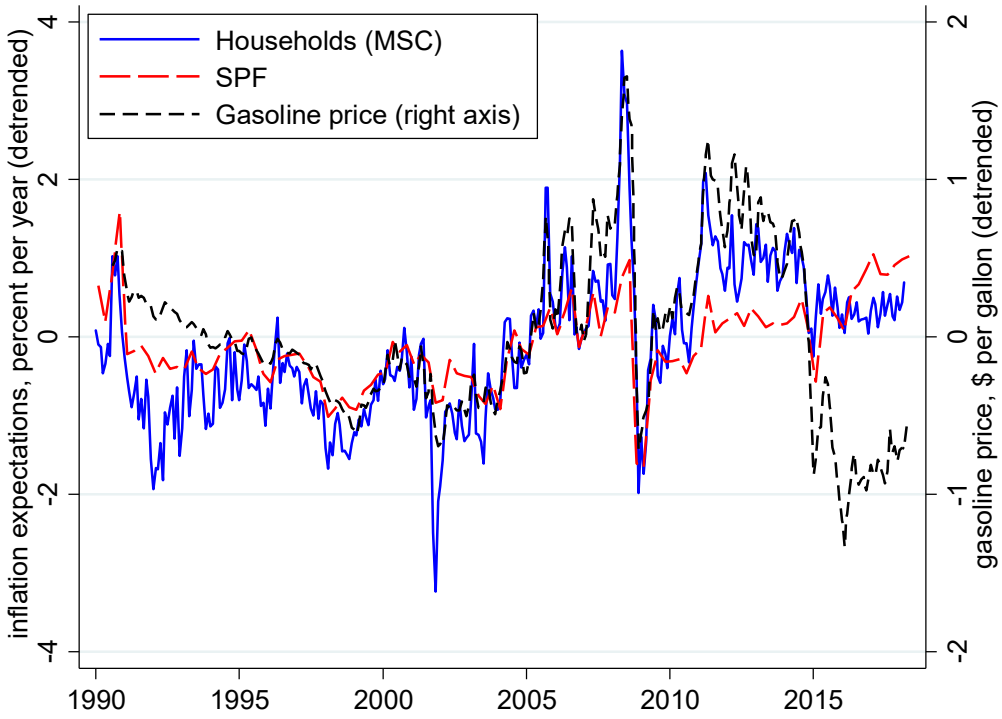
Panel B: Euro-Area



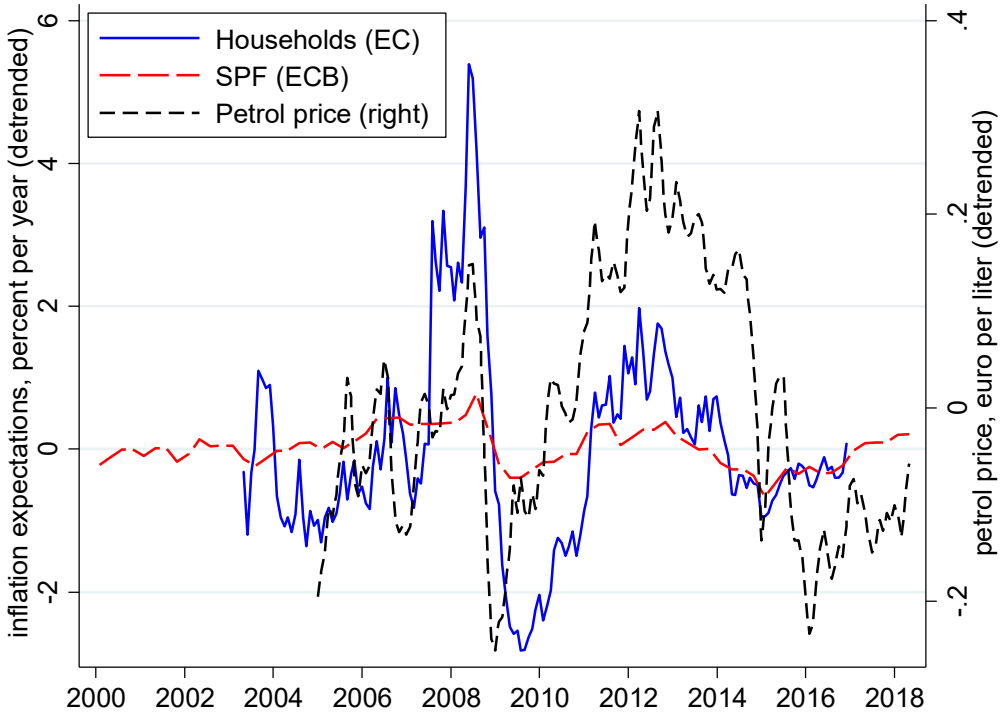
Notes: Panel A reports U.S. time series for expectations of financial markets (reported by the Federal Reserve Bank of Cleveland), households (Michigan Survey of Consumers), professional forecasters (Survey of Professional Forecasters run by the Federal Reserve Bank of Philadelphia), and firms (run on an established panel of firms). Panel B reports eurozone time series for expectations of financial markets (inflation swaps, ICAP and Thompson Reuters), households (European Commission, reported in Duca et al. 2017), and professional forecasters (Survey of Professional Forecasters run by the European Central Bank).

Figure 2. Household Inflation Expectations and Gasoline (Petrol) Prices

Panel A: U.S.



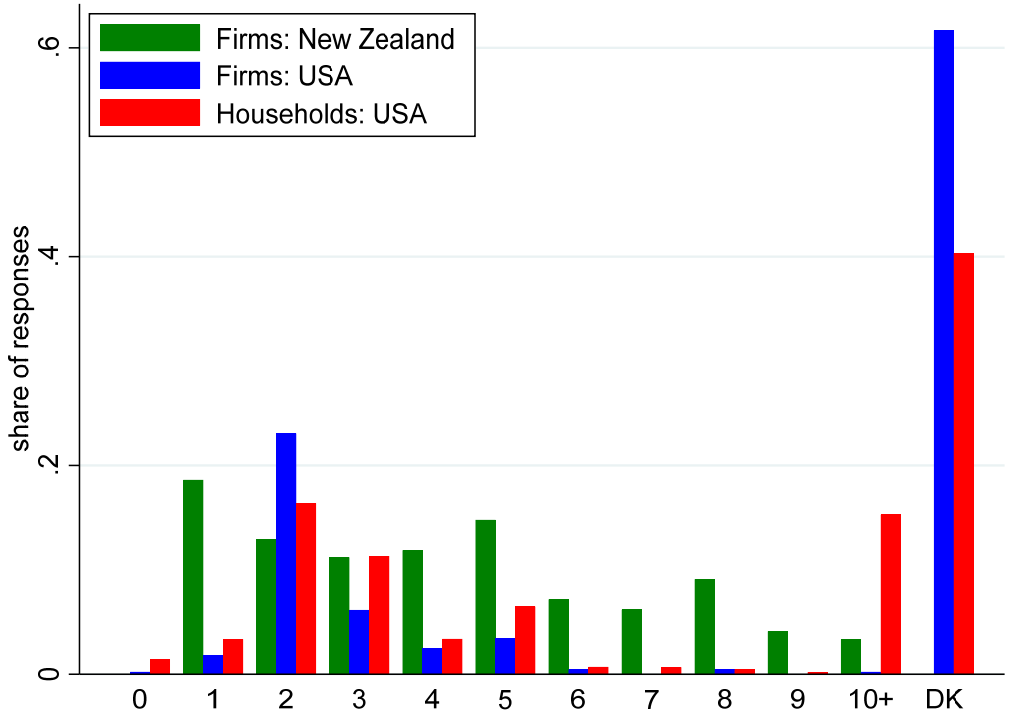
Panel B: Euro area



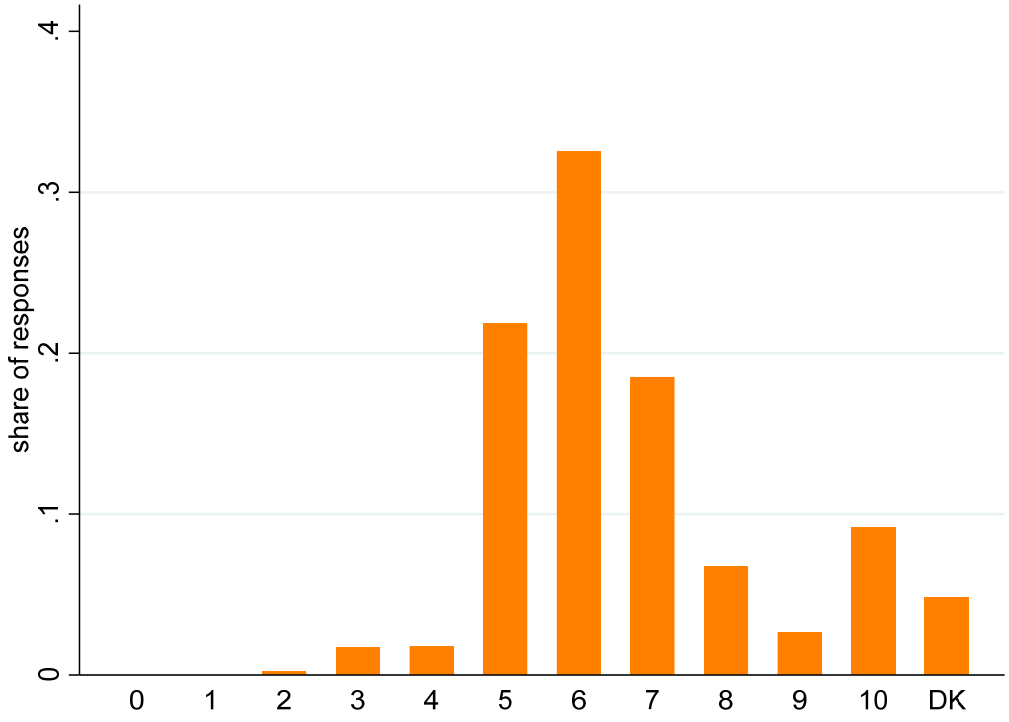
Notes: The figure reports time series of inflation expectations of households and professional forecasters as well as gasoline (petrol) prices. All series are linearly detrended.

Figure 3. Beliefs about Central Bank's Inflation Target

Panel A: Beliefs in the U.S. and New Zealand

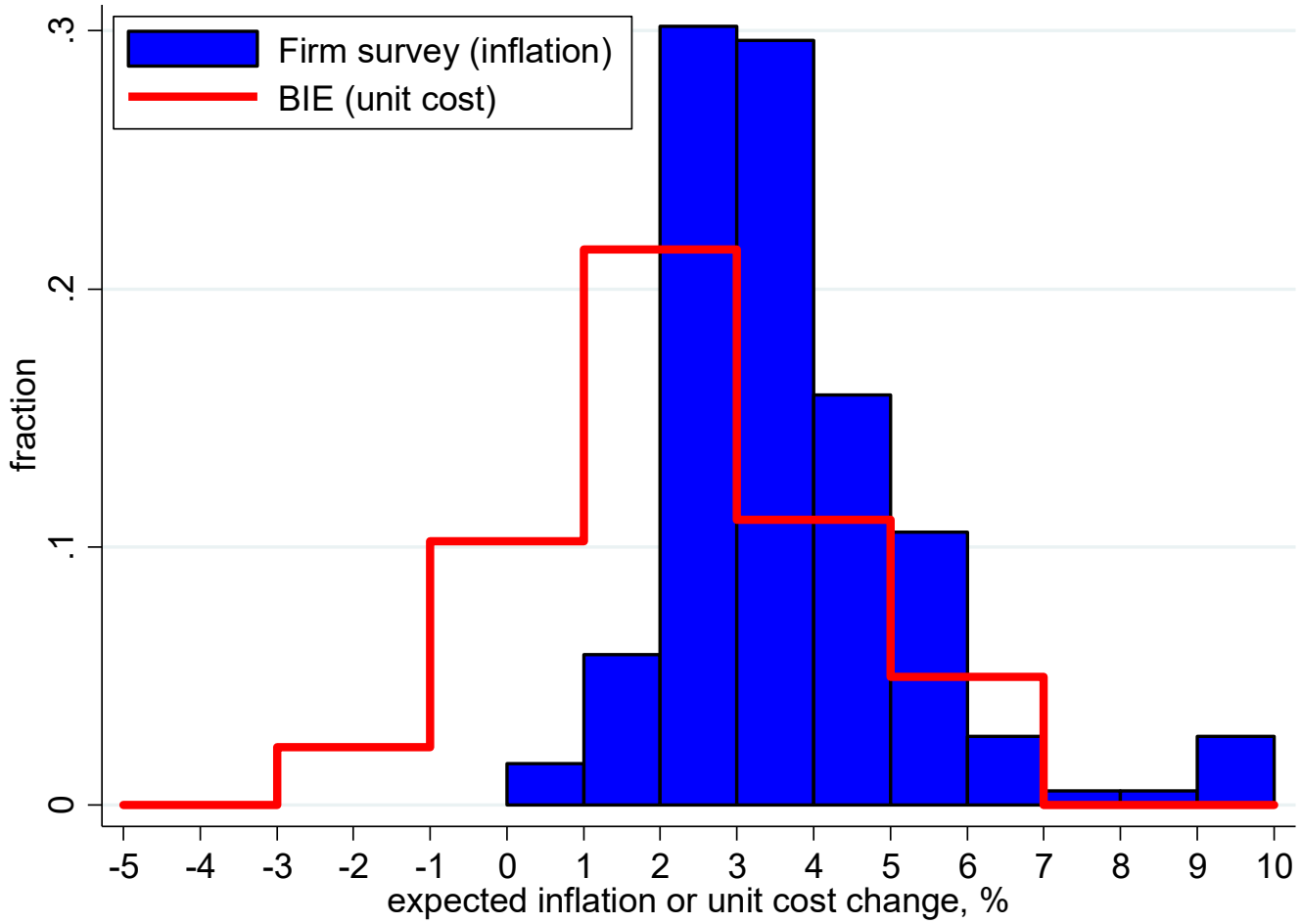


Panel B: Beliefs in Uruguay



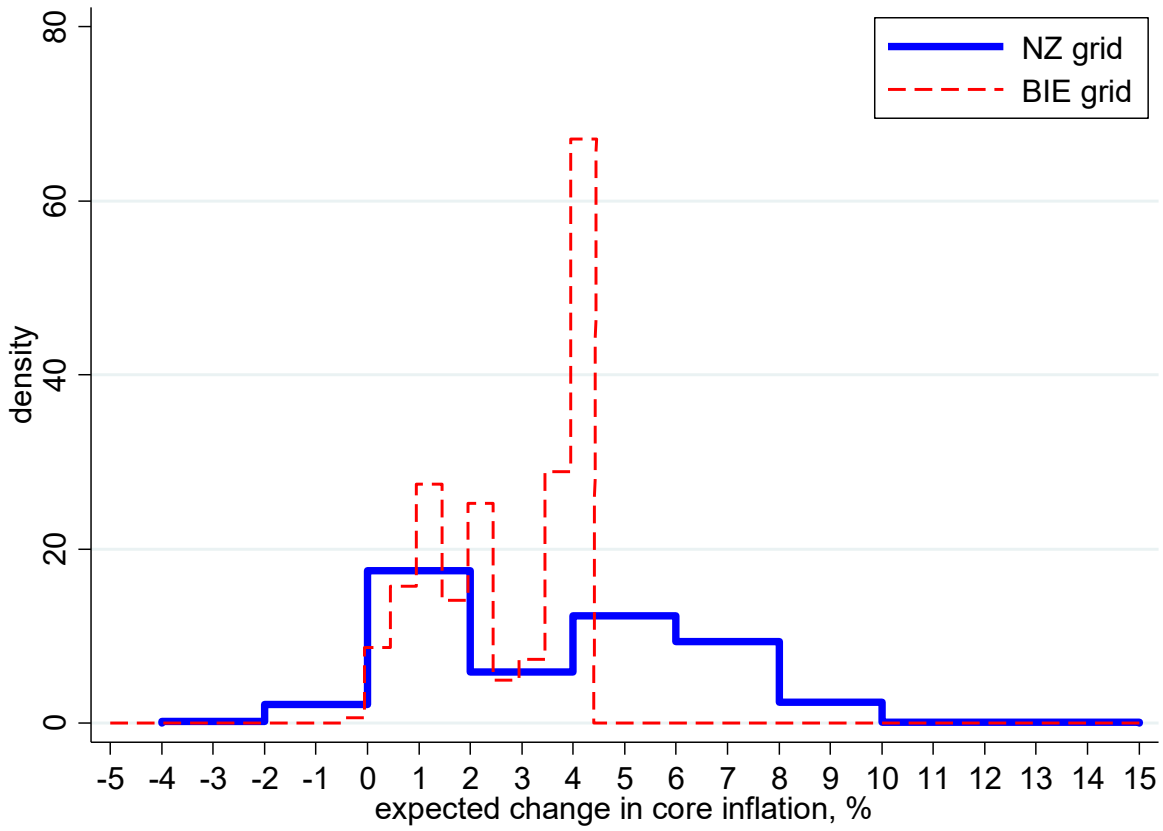
Notes: The figure shows the distribution of how households and firms perceive inflation targets of central banks. DK means "do not know". 10+ includes responses of 10% or more. Inflation target in the U.S. is 2% (Panel A). Inflation target in New Zealand is 1% to 3% (Panel A). Inflation target in Uruguay is 3% to 7% (Panel B).

Figure 4. Comparison of Surveys of Firms' Expectations in the U.S..



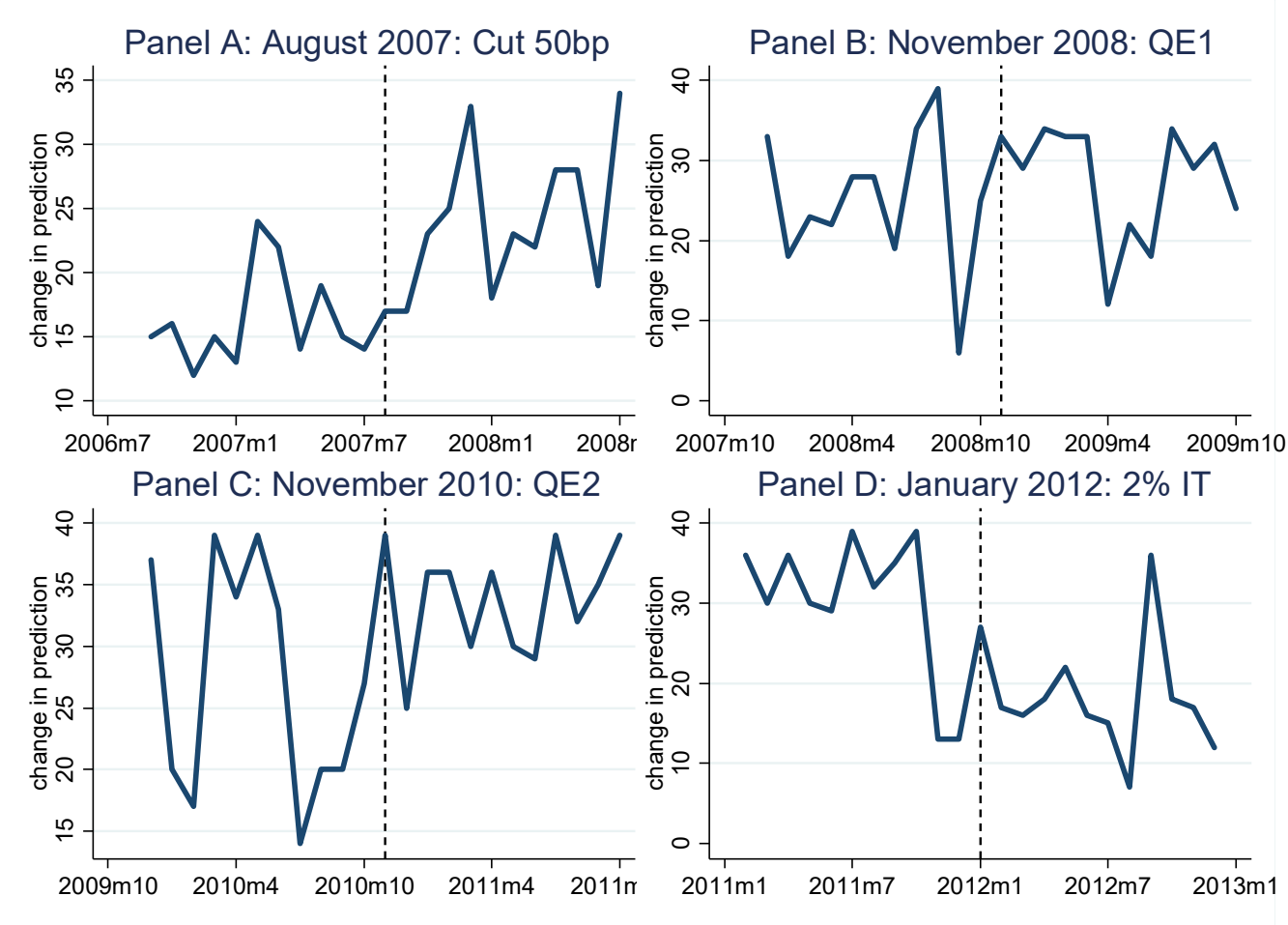
Notes: The figure shows the distribution of responses in the Business Inflation Expectations (BIE) survey run the Federal Reserve Bank of Atlanta and in a survey of firms we ran using a pre-existing nationally representative panel of firms in the U.S. ("Firm survey"). The BIE survey asks respondents to report their expected change in unit costs (the question is "Projecting ahead, to the best of your ability, please assign a percent likelihood to the following changes to unit costs over the next 12 months."). Possible answers are: "Unit costs down (<-1%)", "Unit costs about unchanged (-1% to 1%)", "Unit costs up somewhat (1.1% to 3%)", "Unit costs up significantly (3.1% to 5%)", and "Unit costs up very significantly (>5%)". Our survey asks respondents to report their point predictions for one-year-ahead inflation (the question is "What do you think will be the inflation rate (for the Consumer Price Index) over the next 12 months? Please provide an answer in an annual percentage rate.").

Figure 5. Effects of bins on reported distributions of expected inflation.



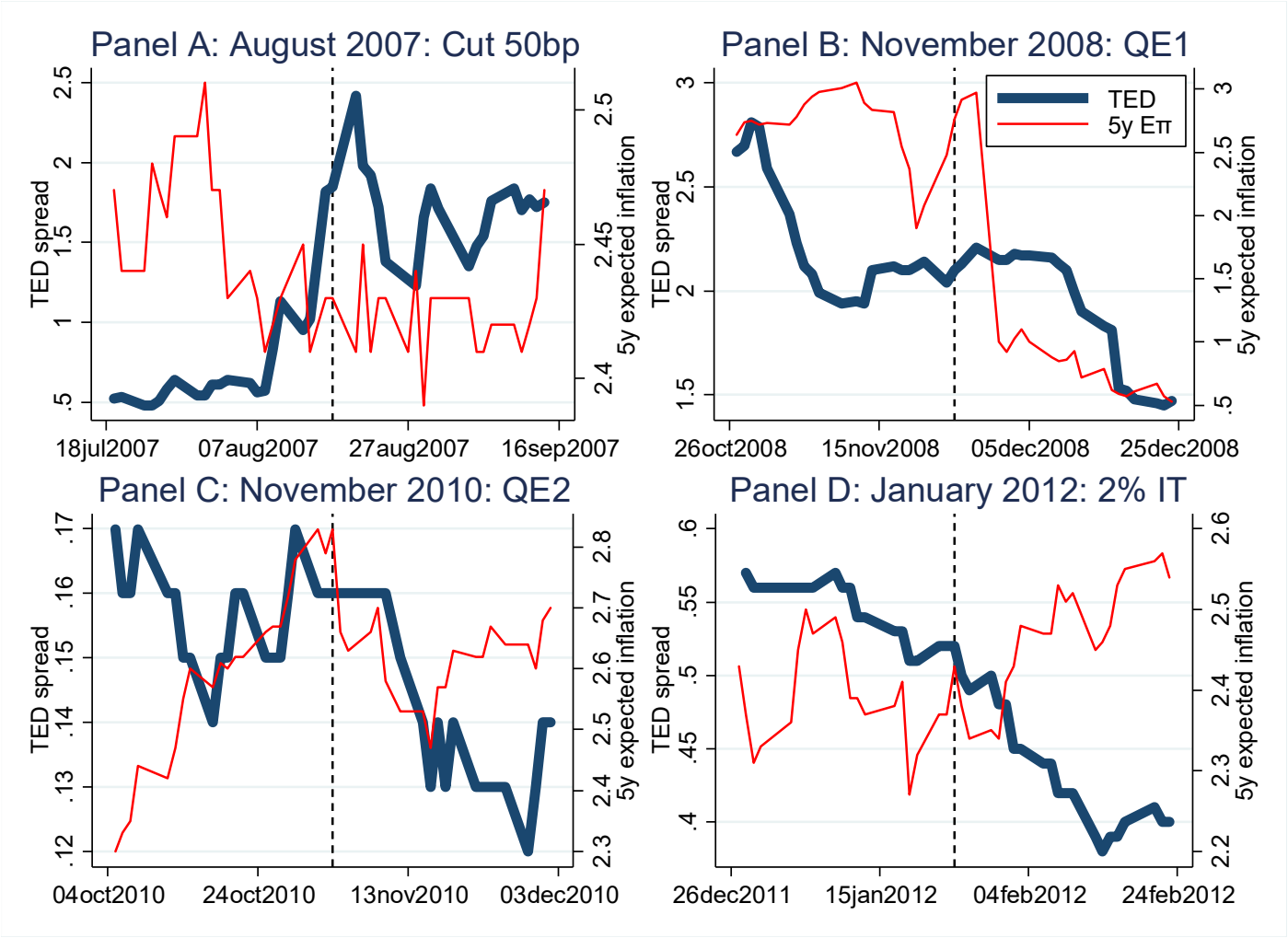
Notes: The figure report average (across firms) probabilities assigned to expected inflation intervals for different survey designs of the probability distribution questions.

Figure 6. Change in forecasts in Bloomberg's SPF.



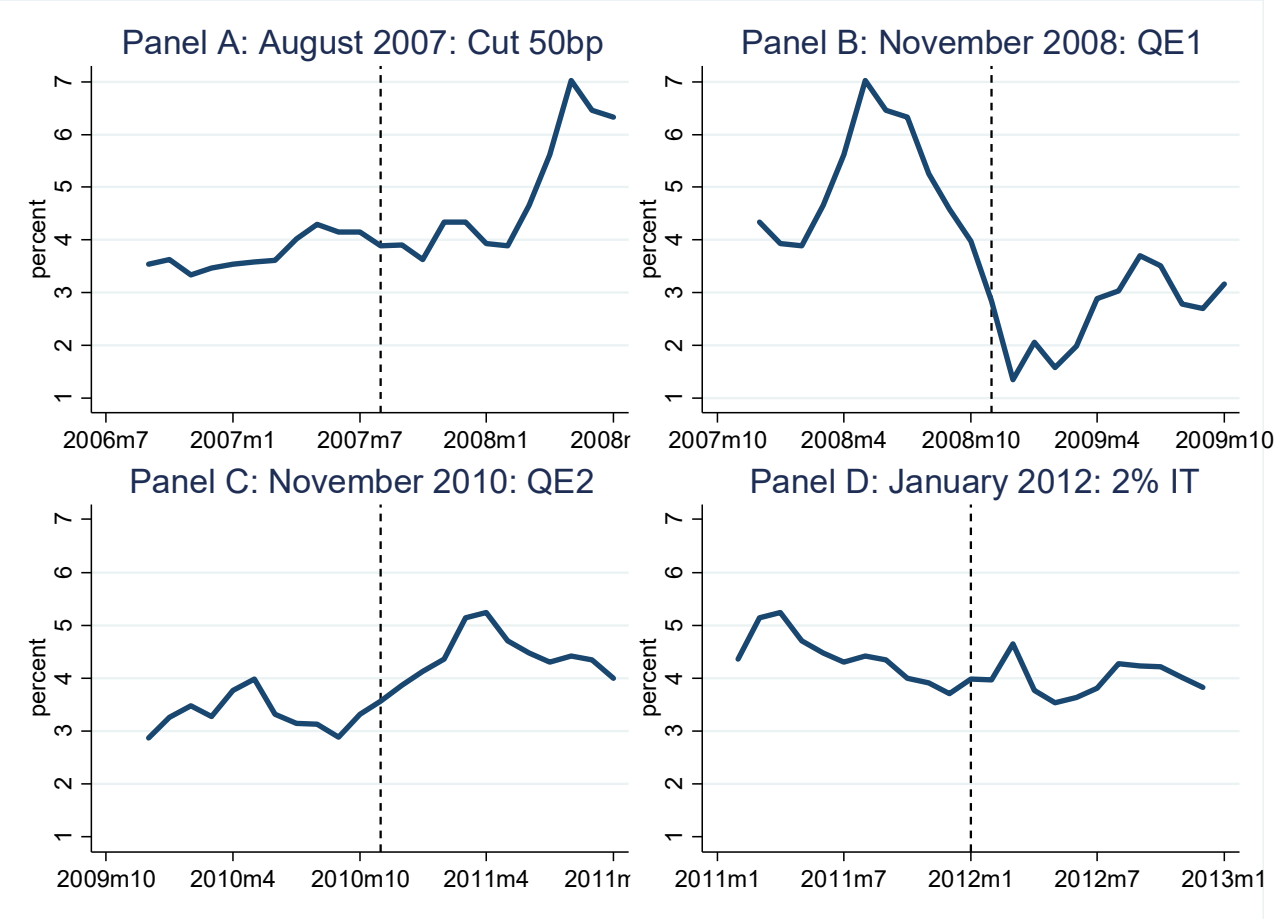
Notes: These figures show the number of changes in predictions made by professional forecasters in a given month according to the survey of professional forecasters conducted by Bloomberg. The vertical lines show relevant events or announcements related to the Federal Reserve. Panel A shows the 50-basis-point cut in the policy rate on August 17, 2007. Panel B shows the announcement of the first quantitative easing policy on November 25, 2008. Panel C shows the announcement of the second quantitative easing policy on November 3, 2010. Finally, Panel D shows the announcement of the 2% inflation target by the Federal Reserve on January 25, 2012.

Figure 7. Reaction of financial markets to Fed announcements.



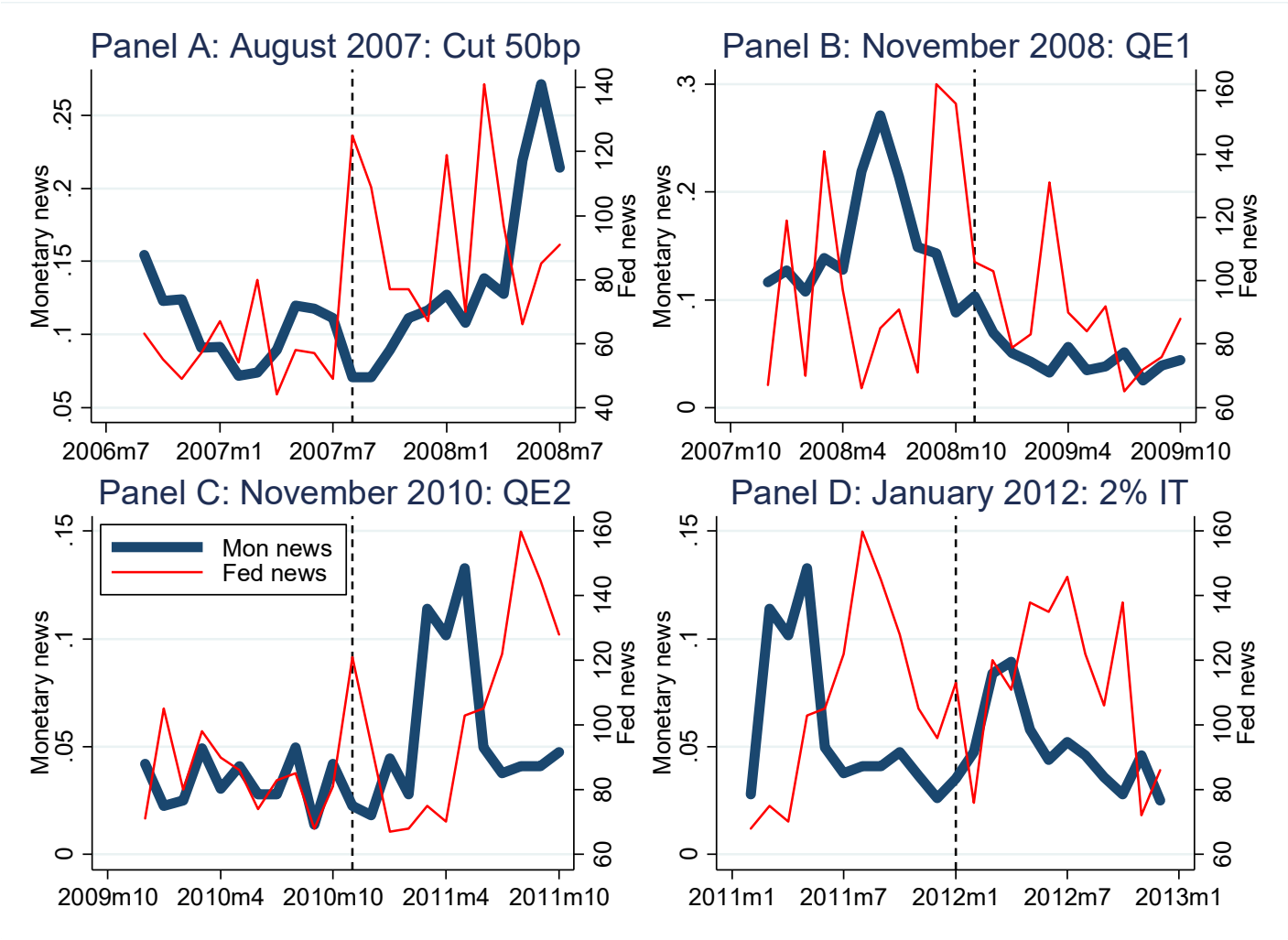
Notes: These figures show the TED spread (black, thick line) and the 5-year forward inflation rate expectation (red, thin line) at a daily frequency. Source: FRED. Panel A shows the 50-basis-point cut in the policy rate on August 17, 2007. Panel B shows the announcement of the first quantitative easing policy on November 25, 2008. Panel C shows the announcement of the second quantitative easing policy on November 3, 2010. Finally, Panel D shows the announcement of the 2% inflation target by the Federal Reserve on January 25, 2012..

Figure 8. Inflation expectations in MSC.



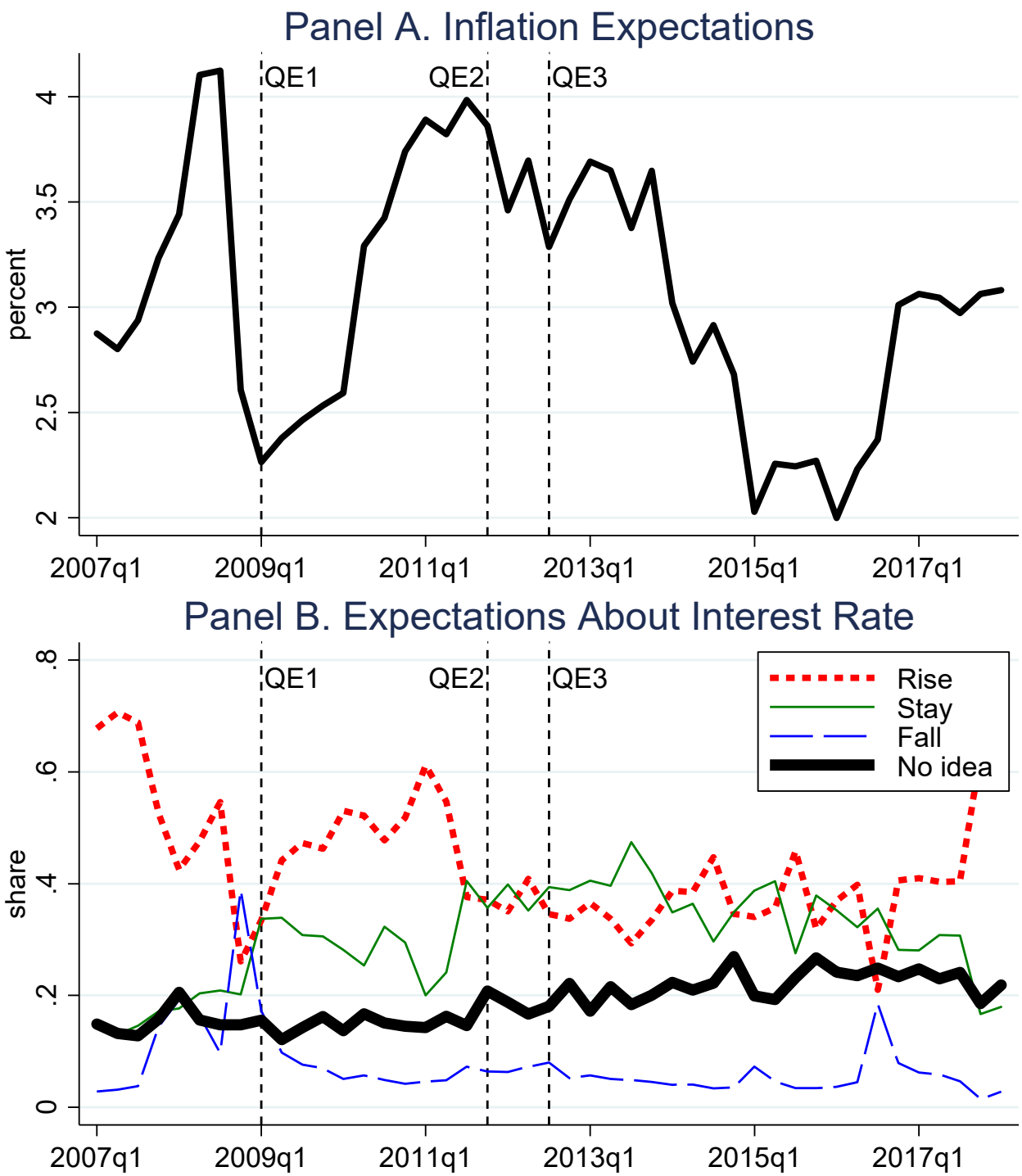
Notes: These figures plot the weighted average for the inflation expectation of consumers in the Michigan Survey of Consumers. Panel A shows the 50-basis-point cut in the policy rate on August 17, 2007. Panel B shows the announcement of the first quantitative easing policy on November 25, 2008. Panel C shows the announcement of the second quantitative easing policy on November 3, 2010. Finally, Panel D shows the announcement of the 2% inflation target by the Federal Reserve on January 25, 2012.

Figure 9. News heard by people in MSC and media coverage of the Fed.



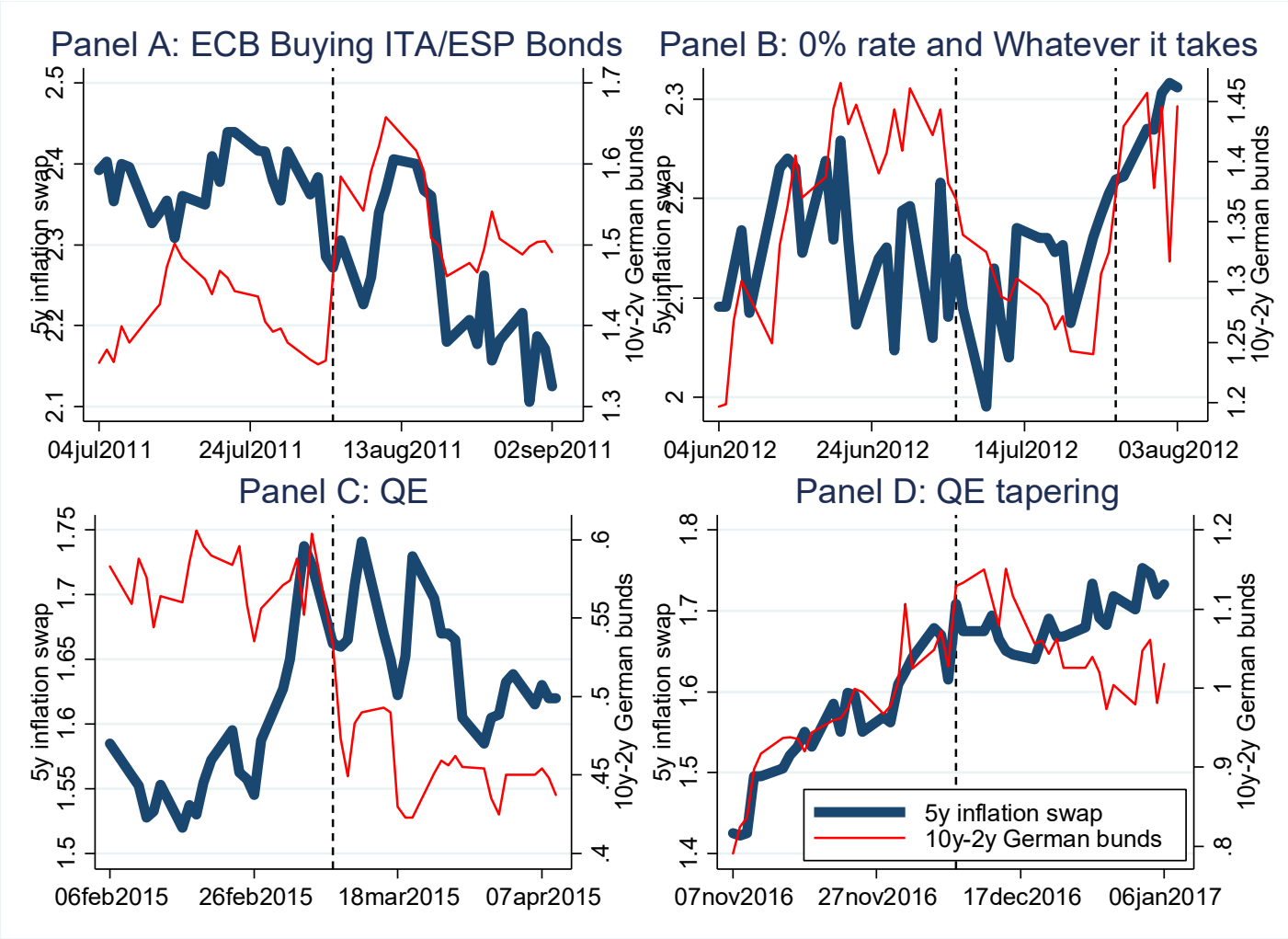
Notes: The black, thick line shows the share of consumers that say that have heard an economic news story related to monetary policy in the Michigan Survey of Consumers. The red, thin line shows the amount of news articles in a month in the New York Times that contained "Federal Reserve" according to Lexis-Nexis. Panel A shows the 50-basis-point cut in the policy rate on August 17, 2007. Panel B shows the announcement of the first quantitative easing policy on November 25, 2008. Panel C shows the announcement of the second quantitative easing policy on November 3, 2010. Finally, Panel D shows the announcement of the 2% inflation target by the Federal Reserve on January 25, 2012.

Figure 10. UK case.



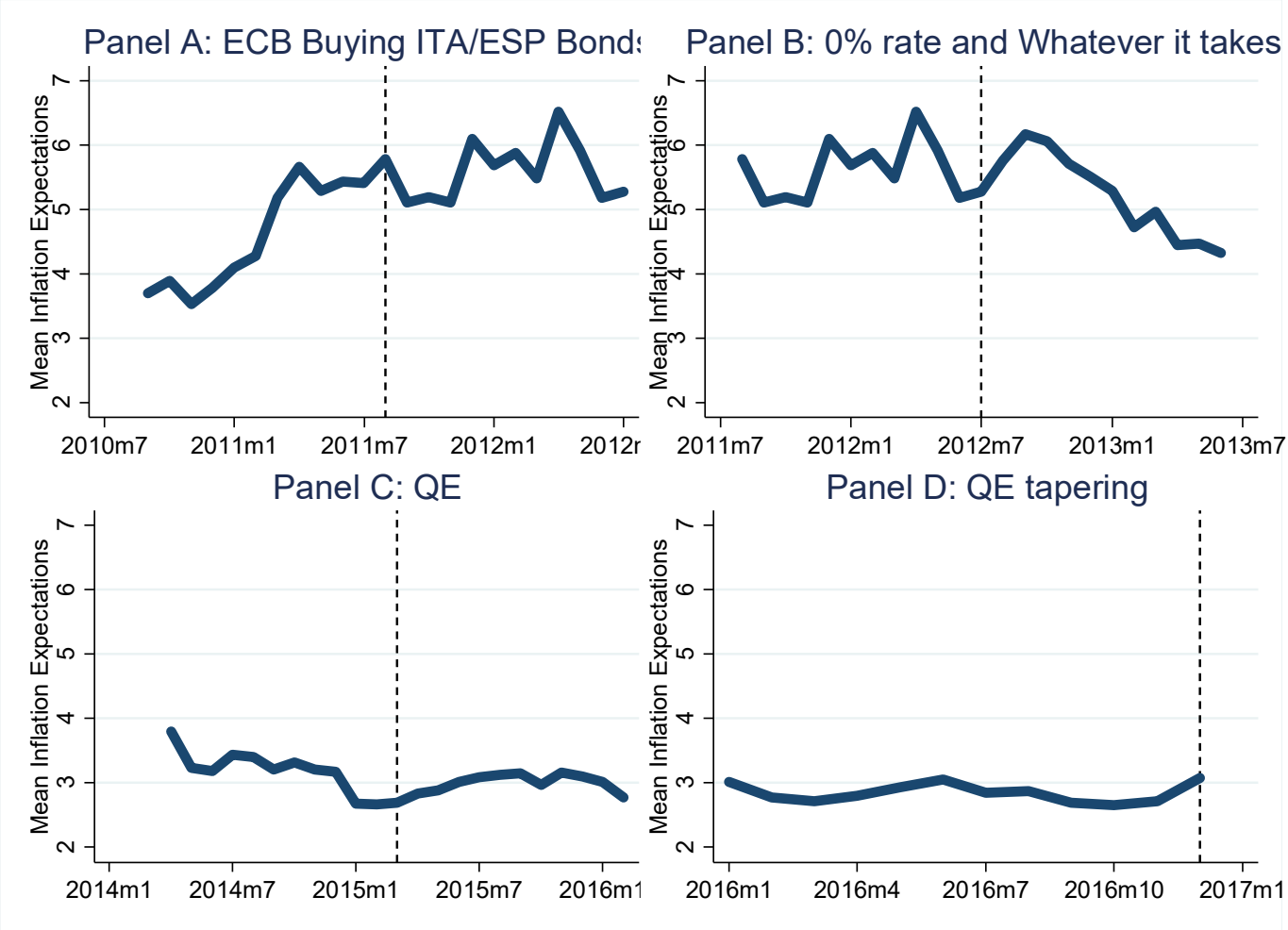
Notes: Panel A shows the weighted average of inflation expectations in the Bank of England/TNS Inflation Attitudes Survey. As respondents have to answer in bins, we take the middle point for each middle bin. For the bin "Go Down" we impute a value of -1 and for "Go up by 5% or more" we impute 6%. Panel B shows the results of the question regarding the expectations of interest rates of respondents in the same Survey. "Rise" adds the ratio of respondents that answer "Rise a lot" or "Rise a little", "Stay" corresponds to the answer "Stay about the same", "Fall" aggroups the answers "Fall a little" and "Fall a lot" and "No Idea" is the ratio of respondents that answers that. QE1 corresponds to the first quantitative easing (QE) policy conducted by the Bank of England in March 2009. QE2 is May 2012 and QE3 is in November 2012.

Figure 11. Financial markets and ECB policy announcements.



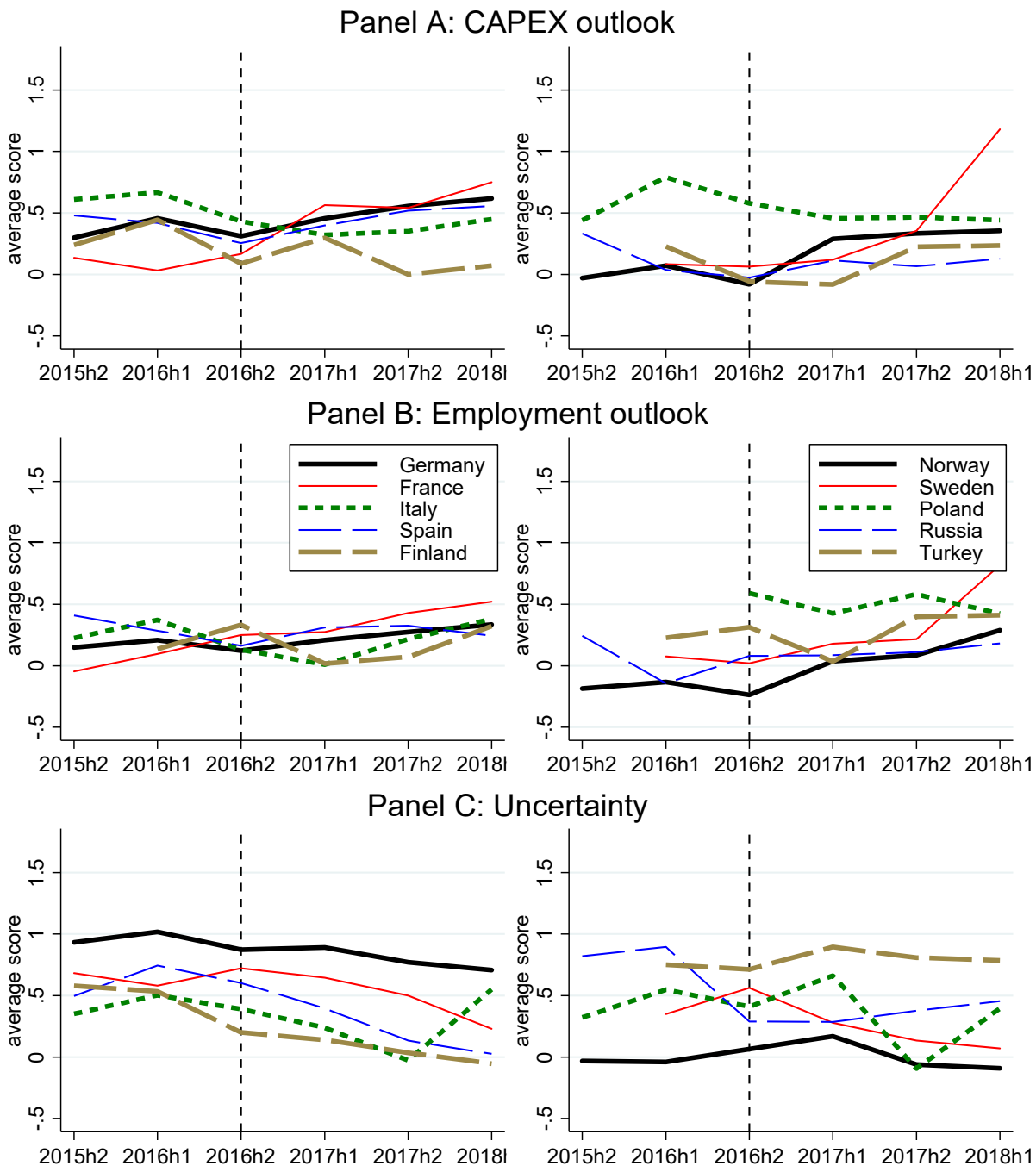
Notes: This panel shows the 5-years inflation swap and the difference between the 10-year German bund and 2-year German bund at a daily frequency. All data are from Bloomberg. Panel A shows the movements around the purchasing of Spanish and Italian bonds on August 9, 2011. Panel B shows the movements around when the ECB set the policy interest rate at 0% on July 5, 2012 and when ECB president Mario Draghi announced that the ECB was prepared to do "whatever it takes" to preserve the euro on July 26, 2012. Panel C plots the movements around the quantitative easing policy conducted by the ECB on March 9, 2015 and Panel D plots around the announcement of the quantitative easing tapering on December 8, 2016.

Figure 12. Households' inflation expectations and ECB policy announcements.



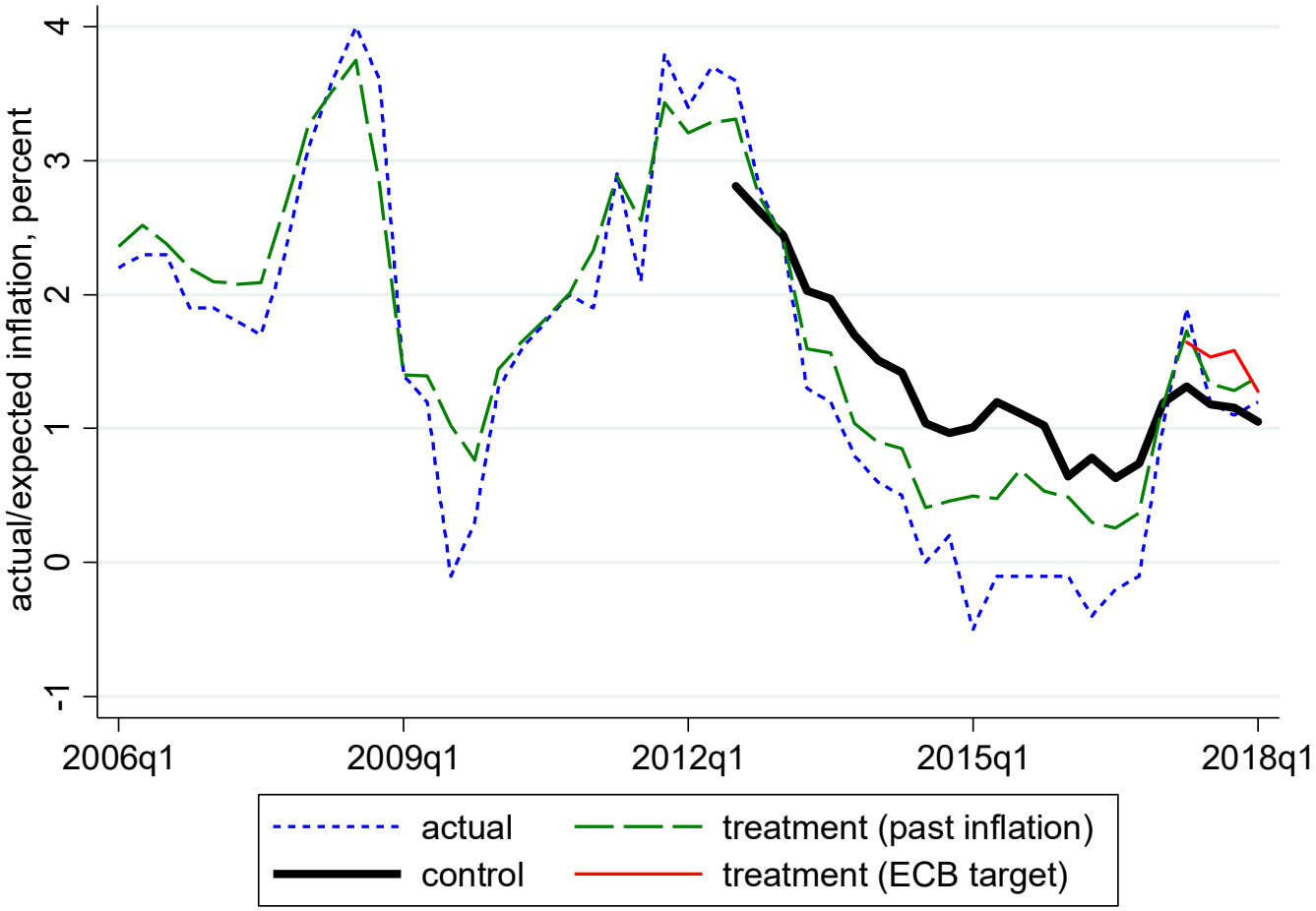
Notes: This figure shows the mean one-year-ahead inflation expectation in the eurozone according to Duca et al (2017). Panel A shows the movements around the purchasing of Spanish and Italian bonds on August 9, 2011. Panel B shows movements around when the ECB set the policy interest rate at 0% on July 5, 2012 and when president Mario Draghi announced that the ECB was prepared to do "whatever it takes" to preserve the euro on July 26, 2012. Panel C plots the movements around the quantitative easing policy conducted by the ECB on March 9, 2015. Panel D plots the movements around the announcement of the quantitative easing tapering on December 8, 2016.

Figure 13. Expectations of Chief Financial Officers and ECB policy announcements.



Notes: These figures show the simple country average in the Deloitte Survey of Chief Financial Officers (CFOs) around the announcement of the QE tapering in December 2016. Panel A shows the result to the question that asks about the evolution of CAPEX of the company in the next 12 months. The lines indicate the average score where if they answer "Decrease significantly" we computed -2, if CFOs answer "Decrease somewhat" -1, 0 for "No change", 1 if the answer is "Increase somewhat" and 2 if the CFOs answer "Increase significantly". Panel B shows the average score for a similar question about the number of employees. The coding of scores is the same. Finally, Panel C plots the answer for the question where CFOs were asked to rate the overall level of uncertainty that the firm is facing. It takes on -2 if the answer is "Very low level of uncertainty", -1 for "Low level…", 0 for "Normal level…", 1 for "High level…" and 2 for "Very high level of uncertainty".

Figure 14. Inflation expectations after treatment in Italy.



Notes: The blue, dashed line shows the actual inflation rate in Italy. The thick, black, solid line shows one-year-ahead inflation expectations of firms in the control group. The long-dash, green line shows inflation expectations of the firms treated with recent inflation statistics (that is, firms are told recent inflation rate before firms are asked to report their inflation expectations). The thin, red line shows inflation expectations of the firms treated with the ECB's inflation target (that is, firms are told the ECB inflation target before firms are asked to report their inflation expectations). Source: Coibion, Gorodnichenko and Ropele (2018).

Appendix Tables

Appendix Table A1. Point estimate vs. mean implied by the probability distribution.

	Wave 6			Wave 7		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Moments						
	Mean	Median	St.dev.	Mean	Median	St.dev.
Mean forecast implied by the distribution, $\bar{F}_{it}\pi_{t+1}$	2.59	1.40	2.48	2.65	1.20	2.69
Point forecast, $F_{it}\pi_{t+1}$	2.75	2.00	2.34	2.74	2.00	2.38
Panel B. Regression						
Dependent variable, $\bar{F}_{it}\pi_{t+1}$	OLS	Huber	Quantile	OLS	Huber	Quantile
Regressor, $F_{it}\pi_{t+1}$	0.982***	0.965***	0.966***	1.074***	1.086***	1.024***
	(0.013)	(0.007)	(0.023)	(0.015)	(0.015)	(0.009)
Constant	-0.111**	-0.010	0.007	-0.297***	-0.336***	-0.119**
	(0.052)	(0.025)	(0.058)	(0.062)	(0.058)	(0.057)
Observations	2,032	1,987	2,032	1,399	1,371	1,399
R^2	0.863	0.930		0.900	0.918	

Notes: The sample is from CGK. $\bar{F}_{it}\pi_{t+1} = \sum_j \bar{\pi}_j \omega_{ijt}$, where i indexes respondents, t indexes time, j indexes inflation bins, $\omega_{ijt}$is the weight assigned to bin j by manager i at time t, $\bar{\pi}_j$ is the midpoint of bin j. $F_{it}\pi_{t+1}$ is the point prediction. All moments and regressions are computed using employment-based sampling weights. Robust standard errors are reported in parentheses. ***, **, * shows statistical significance at 1%, 5%, and 10% levels respectively.

Appendix Table A2. Responses to baseline and alternative formulations of inflation expectation questions.

Variation in the wording	N	Inflation forecast, one-year ahead			Inflation forecast, 5-10-years ahead			Inflation backcast, previous 12 months	
		Mean	St.dev.	Uncertainty	Mean	St.dev.	Uncertainty	Mean	St.dev.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A. "By how much do you think prices will/have change(d) overall in the economy"	679	3.72	2.55	1.02	3.29	2.49	1.04	3.42	2.22
B. "What will be/has been the overall inflation rate over the next/last 12 months"	681	3.73	2.54	1.04	3.31	2.50	1.11	3.40	2.27
C. "What will be/has been the inflation rate (specifically the *Consumer Price Index*) over the next/last 12 months"	680	3.71	2.53	1.04	3.31	2.46	1.04	3.43	2.26

Notes: Notes: The table reports basic moments for inflation forecasts solicited via different wordings (shown in the left column) in the following questions

During the last twelve months, by how much do you think prices changed overall in the economy? Please provide an answer in percentage terms.

During the next twelve months, by how much do you think prices will change overall in the economy? Please provide an answer in percentage terms

During the next 5-10 years, by how much do you think prices will change overall in the economy? Please provide an answer in percentage terms.

with the corresponding versions soliciting probability distributions. Uncertainty is computed as $\sigma_{it} = \sqrt{\sum_j \left(\bar{\pi}_j - \bar{F}_{it}\pi_{t+1}\right)^2 \omega_{ijt}}$ where $\bar{F}_{it}\pi_{t+1} = \sum_j \bar{\pi}_j \omega_{ijt}$, i indexes respondents, t indexes time, j indexes inflation bins, ω_{ijt} is the weight assigned to bin j by manager i at time t, $\bar{\pi}_j$ is the midpoint of bin j. The sample is from CGK.

Appendix Table A3. Expectations of future inflation vs. future changes in own prices.

	N	Mean	Median	St.dev.	Correlation with expected/perceived inflation
	(1)	(2)	(3)	(4)	(5)
Panel A. Survey of firm managers, New Zealand					
Wave 3					
Expected inflation, 12-month ahead	1,601	4.48	4.00	2.97	1.00
Expected change in own unit cost, 12-month ahead	1,601	2.80	2.00	3.01	-0.01
Wave 6					
Expected inflation, 12-month ahead	2,032	2.75	2.00	2.35	1.00
Expected change in own unit cost, 6-month ahead	2,032	1.27	1.00	1.88	-0.08
Expected change in own price (main product), 6-month ahead	2,032	0.55	0.50	1.11	-0.01
Expected change in own price (main product), 12-month ahead	2,032	0.59	0.50	1.17	-0.04
Perceived inflation, previous 12 months	2,032	2.58	2.00	2.08	1.00
Change in own unit cost, previous 12 months	2,032	1.37	1.00	2.11	-0.11
Change in own price (main product), previous 6 months	2,032	0.56	0.50	1.28	-0.001
Wave 7					
Expected inflation, 12-month ahead	1,399	2.74	2.00	2.38	1.00
Expected change in own unit cost, 6-month ahead	1,399	0.46	0.00	1.47	0.02
Expected change in own price (main product), 6-month ahead	1,399	0.35	0.10	0.82	0.02
Expected change in own price (main product), 12-month ahead	1,399	0.21	0.00	0.98	0.09
Panel B. Business Inflation Expectations survey, Federal Reserve Bank of Atlanta					
July 2015					
Expected change in unit cost, 12-month ahead	221	1.98	1.94	1.48	-
Expected change in CPI, 12-month ahead	221	2.59	2.00	2.14	-
September 2014					
Expected change in unit cost, 12-month ahead	190	2.06	2.05	1.59	-
Expected change in CPI, 12-month ahead	190	3.68	3.00	2.84	-

Notes: The table reports basic moments of expected inflation for various survey designs. The sample in Panel A is from CGK.

Appendix Table A4. Effects of bin size and distribution on reported inflation expectations.

One-year ahead forecast	N	mean	median	st.dev.	uncertainty	Correlation with the change in the general level of prices
	(1)	(2)	(3)	(4)	(5)	(6)
Change in prices overall	2,032	2.59	1.40	2.48	0.92	1.00
Core CPI						
Baseline NZ grid (dispersed/many bins)	1,011	2.58	1.40	2.37	0.94	0.90
BIE grid (concentrated/few bins)	1,021	2.26	2.10	1.30	0.26	0.85

Notes: The table compares basic moments of expected inflation across survey designs. Mean in column (2) reports average implied mean expected inflation across firms. Median in column (3) reports the median implied expected inflation across firms. St. dev. in column (4) reports cross-sectional variation of implied means across firms. Uncertainty (column 5) is the average (across firms) standard deviation of reported probability distributions. Column (6) reports correlation between i) the implied mean for change in prices overall and ii) a given alternative measure of inflation expectations. The sample is from CGK.

Appendix Table A5. Predictors of inflation expectations.

	(1)	(2)	(3)
Firm characteristics			
Log(Age)	0.203***		0.231***
	(0.045)		(0.078)
Log(Employment)	0.600***		0.797***
	(0.108)		(0.127)
Labor's share of costs	-0.009*		0.000
	(0.005)		(0.007)
Foreign trade share	0.013***		0.008*
	(0.004)		(0.004)
Number of Competitors	-0.009***		-0.006
	(0.002)		(0.004)
Avg. margin	-0.002		0.012**
	(0.004)		(0.005)
Manager characteristics			
Age		0.003	-0.002
		(0.008)	(0.005)
Female		0.177	-0.036
		(0.190)	(0.093)
Education:			
Some college		1.018***	0.320***
		(0.257)	(0.112)
College		0.689***	0.087
		(0.198)	(0.108)
Graduate (MA+)		0.033	-0.089
		(0.210)	(0.135)
Tenure		0.074***	0.003
		(0.016)	(0.009)
Income		0.003**	-0.001
		(0.002)	(0.001)
Industry FE	Y	Y	Y
Observations	2,960	1,380	1,371
R2	0.838	0.076	0.901
R2 (industry fixed effects only)	0.812	-	0.872

Notes: The table reports results for the Huber robust regression. The dependent variable is the 12-month ahead inflation forecast from Wave #1 survey. Industry fixed effects are for 3-digit industries. The omitted category for manager's education is "high school diploma or less." Sample weights are applied to all specifications. The sample is from CGK. Robust standard errors (clustered at the 3-digit ANZ SIC level) are reported in parentheses. ***, **, * denotes statistical significance at 1%, 5%, and 10% levels respectively