Central Bank Announcements: Big News for Little People?

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Abstract

Little is known about the impact of central bank announcements on consumers' beliefs about policy relevant economic figures and through them on consumption/saving decisions. This paper focuses on perceptions (assessment of current rates) and expectations (assessment of future rates) of inflation and interest rates and confidence in these assessments. Based on a sound identification (surveying consumers shortly before and after the communication event), and relying on over 15 000 observations, spanning over 12 Fed press conferences between December 2015 and June 2018, we document the impact of the central bank communication on ordinary people. While announcement events have little measurable direct effect on average beliefs, they make people more likely to receive news about the central bank's policy. Conditioned on consumers' exposure to news, the direct effect is statistically and economically significant: informed consumers adjust beliefs and become more confident in them after announcements. While expectations and perception persistently overestimate inflation and interest rates, which we explain with pessimism (ambiguity-aversion), exposure to news significantly lowers expectation and perception errors, as well as the disagreement among consumers. These announcement-triggered adjustments in beliefs and confidence in turn affect reported consumption and investment choices.

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1 Introduction

Policy communication has long been a crucial tool for central banks to steer expectations, and arguably became more so with the onset of the most recent global financial crisis and the introduction of forward guidance. While there is plenty of empirical support for the impact of central bank announcements on financial markets and, to some extent, on professional forecasters, there is almost no evidence on how these announcements influence the mindset of consumers.[1] Consequently, Blinder et al. (2008) p. 941, emphasize, "Virtually all the research to date has focused on central bank communication with the financial markets. It may be time to pay some attention to communication with the general public." This is particularly relevant as expectations of market professionals and consumers may significantly differ.[2] Understanding the effect of a central bank's communication on the information set and the resulting beliefs and expectations of the general public is pivotal for central banks because the effectiveness of monetary policy depends on how well people understand its goals and strategies (Bernanke, 2007), and at the same time critical for ordinary people, as their potential non-response to or misinterpretation of the central bank's actions might reduce welfare by guiding into inferior choices. Our main interest in this paper is in identifying the impact announcements have on consumers' expectations and perceptions of inflation and interest rates, as well as on their confidence therein. We will also assess implications announcements have for consumers' savings and investment decisions.

The lack of empirical evidence on ordinary people's awareness of the moves of the central bank and on its implications is mainly due to the fact that existing datasets do not allow for a timely tracking of consumers's beliefs, and the information collected does not suffice for a complete assessment. Typical consumer surveys, like the University of Michigan Survey of Consumers, render monthly frequency data at best, which prevents exact identification as the change in expectations between months is blurred by multiple events happening within the same period, making the impact of a particular announcement unclear. To tackle this issue, we conduct a series of original surveys tailored to our needs both in terms of identification and in terms of variables capturing the effects of announcements. The surveys are administered in rounds of two, one just before and one right after a monetary policy announcement. This helps us precisely pinpoint the influence central bank announcements have on the mindset of consumers. The content of the survey is catered to our needs by having questions on expectations and perceptions

[1] Policy announcements by central banks have been shown to affect financial markets (see e.g. Conrad and Lamla (2010) for exchange rates, Faust et al. (2007) for interest rates and exchange rates, Rosa and Verga (2008) for asset prices), and there is some evidence that communication can improve professional forecasters' predictions of future interest rate changes, as compared to Taylor-rule based predictions (see, e.g., Sturm and de Haan (2011)). Sinha (2015) demonstrates forward guidance affects investors' beliefs about current and future risks as extracted from derivative prices.

[2] For example, Allcott (2011) finds U.S. consumers significantly overestimate future energy prices as compared to expectations derived from traded futures contracts.

on inflation and interest rates. We also ask about subjects' confidence in the estimated figure. Along with that, we control for the information set by asking whether people have recently heard news about monetary policy. Furthermore, we collect information on consumption and investment choices sensitive to interest rate and inflation, and, finally, we account for a large set of socioeconomic characteristics.

Specifically, we survey a stratified random sample of the general U.S. public up to two days before and after the Federal Open Market Committee press conference. We focus on the Federal Reserve Board because it is the only central bank at the time of writing of this paper, which began and was widely believed to continue to adjust their interest rate path after a decade of stable interest rates. This study covers the period from the first post-crisis interest rate hike in December 2015 to December 2017, including five changes in the target federal funds rate and at least one postponement of such a change. This gives us over 10 000 responses by representative individuals.

To fix ideas regarding the transmission channel we introduce a model of expectation formation for consumers, where expectations are determined by probabilistic decision weights consumers assign to possible realizations of inflation and interest rates. These decision weights (probability distributions) depend on exposure to and quality of news about the economy, as well as on consumers' characteristics such as uncertainty attitudes. Importantly, consumers in our model do not need to possess any special knowldge/skills to process the centra bank announcement, as the news coverage and expert opinions equip them with easily interpretable and ready to use information. An announcement by the central bank affects expectations of consumers in two ways: first, by increasing the probability of being exposed to news as the amount of news increases, and, second, by increasing the precision of the information about future developments, due to the actual content of the news. Hence if the central bank provides more precise information on future inflation and there are more news circulating, we expect a strong impact on expectations. If, however, there is little additional information content (e.g. a situation where interest rate moves are perfectly anticipated) and only few reports dealing with it, we would expect almost no measurable impact of the central bank announcement. More intriguing is the case of little policy surprise but a wide coverage of the policy decision in media - the news exposure channel predicts that even an anticipated policy announcement would change expectations (by updating the information sets).

Our empirical results strongly support this modeling approach. Announcements exert, unconditionally, little statistically significant effect on perceptions and expectations of either inflation or interest rates of consumers. Once we dissect this by looking at the relevance of exposure to news, data confirms that people adjust perceptions and expectations substantially. Furthermore, we show that announcements trigger an increased coverage of the relevant economic issues in the media and with this also increase the likelihood of consumers reading/viewing the news. Exposure to news, in turn, makes consumers able

to update their information set and beliefs. Interestingly, the marginal effect of news is stronger after the announcement.

With regards to implications, we obtain that news on central banks improve the quality of perceptions and expectations and raise respondents' confidence in their assessment of economic figures. Both channels - the level of expectations, and the confidence in it - have consequences for saving and consumption decisions.

These findings confirm and emphasise the relevance of the media news channel of the transmission of policy announcements, and characterise the mechanism of the impact announcements have on people's perceptions and expectations of interest rates and inflation. The existence of the media news channel was first suggested by Berger et al. (2011) who see two primary functions for the media: (1) dissemination of the information about the central bank decisions, and (2) improving the understanding of those decisions by the public. They analyse the media coverage of the ECB announcements and find that the tonality is typically favourable when policy news align with prior expectations of the market, and rather negative when policy changes come as a surprise. This critical assessment of the central bank policy announcements indicates that the media acts as a monitor for an independent central bank. Other studies, like Böhm et al. (2012) and Reid et al. (2011), confirm this monitoring role of the media for the Czech and the South African central banks, respectively, although find less evidence on the association between policy surprises and negative media tonality. While Berger et al. (2011) establish that central bank communication intensifies media coverage, its impact on expectations and decisions of the public remains unknown; in particular, it still needs to be shown that increased coverage (supply of news) leads to an increased exposure (absorption of news by consumers). This is exactly where we contribute.

Apart from documenting the media channel for consumers, our paper is related to the vast literature that investigates the effects of central bank communications in general. Announcements by central banks are known to affect asset prices as well as the mean and the variance of individual professional forecasters' expectations. Public expectations and the signaling channel of monetary policy transmission are at the centre of investigation in Melosi (2017), yet the focus is on producers' expectations, and the empirical benchmark is drawn from inflation expectations of professional forecasters. With regards to consumers' expectations, literature is scarce, although there has been now a growing interest in analyzing how their expectations and perceptions are formed and which factors drive them. Easaw et al. (2013) as well as Dräger and Lamla (2013) analyse how expectations of consumers are adjusted and which factors might affect the adjustment process. van der Cruijsen et al. (2015) distill from a survey how much consumers know about the ECB's objectives. Two recent papers have analysed to which extent consumers and professionals understand relevant economic concepts. Carvalho and Nechio (2014) use the Michigan survey of consumers to explore how many people are aware of the Taylor rule, while Dräger et al. (2016) look at both consumers and professionals and check whether

central bank communication can improve their understanding and increase the share of people whose expectations are consistent with a Taylor rule, the Phillips Curve and who are able to separate nominal from real figures; news on monetary policy are found to improve concistency.

The paper is structured as follows. Section 2 fixes definitions and places announcements and associated media coverage (news) in the context of transmission channels of monetary policy. In Section 3 we discuss the survey design. Sections 4, 5 and 6 provide the empirical analysis while section 7 concludes.

2 The model

Earlier studies of central bank transparency, for example by Cukierman and Meltzer (1986) and Faust and Svensson (2001), consider the impact of news about central banks and their policy on public beliefs and subsequently on the macroeconomic development. The core assumption in this literature is that expectations are rational, both on the part of the central bank and on the part of the public. If this holds, the press conference itself does not matter for expectations, yet the dissemination of news through media does. Departing from the rational expectations approach, Eusepi and Preston (2010) consider two regimes of expectation formation. First, before communication, people form "atheoretical" beliefs about a number of macroeconomic variables (as in a vector autoregression model). Communication then affects the mechanism of beliefs formation. When the central bank credibly announces its monetary policy and hence the future path of macroeconomic variables, such as inflation, output and nominal interest rates, people have to include this constraint in their expectation model.[3]

We also model an announcement as an event that changes the regime of expectations. However our focus is on the quality of information subjects use in building expectations, rather than on the mechanism of the expectations formation. To achieve this, it suffices to define expectations of some variable x that takes values $x_L..x_H$ in a standard way via its mathematical expectation $\mathbf{E}_f(x) = \sum_{x=x_L}^{x_H} f(x) \cdot x$ governed by the probability density f. The quality of information is then reflected in the properties of f. This approach relaxes assumptions on the exact content of the underlying information set (i.e. which macroeconomic variables are used to construct expectations) and on the functional form used to decribe the impact of observables on expectations, and yet it allows one to capture changes in the quality of the information set induced by the announcement and the effects of consumers' uncertainty attitudes. For example, beliefs before the announcement may be based on opinions of experts communicated through mass media. Implicitly, these

[3]Same approach is used in Eusepi and Preston (2012): "Unless the monetary and fiscal authorities credibly announce the policy regime in place, agents are assumed to lack knowledge of the policy rules. Because agents must learn from historical data, beliefs need not be consistent with the objective probabilities implied by the economic model. Expectations need not be consistent with implemented monetary and fiscal policy."

may correspond to evaluations of the previous path of policy and macrovariables, yet explicitly we do not require subjects to [be able to] judge on complicated economic issues themselves. Once communication takes place, expectations will be based on the new (updated) information set, but crucial for our conclusions is how this information interacts with probability weights given by f, and how subjects' uncertainty attitudes interact with the precision of information. Conveniently, in this framework we can distinguish between communications and the media coverage, which helps deliver testable hypotheses with regards to their impact on expectations, perceptions and confidence in them.

In this section we discuss the formation of expectations in a heterogeneous population. Expectations are rational, i.e. they reflect all available information, however members of the population differ in their information sets. Unlike professional forecasters (experts), ordinary consumers do not possess specialised knowledge to analyse all the information they potentially collect; they can base their expectations on the experts' forecasts, who collect and analyse this information for them. Experts' reports can be readily available, yet not all individuals would rationally choose to digest them: for example part of population may be rationally inattentive (Sims, 2003; Reis, 2006). Modelling the average belief in this setting therefore requires two steps: (1) aggregation of heterogeneous expectations of differently informed consumers, and, (2) a model of aggregation of experts' reports into expectations of those individuals who follow them. The latter step is required even though expectations of professional forecasters are assumed rational: while the error of expectations is on average zero, it may vary across individual reports, thus making them heterogeneous. This two-layer structure allows us to model simultaneously the differences in expectations between the informed and the uninformed public, as well as the impact of announcements on expectations - through their impact on the precision of experts' reports. The primary role of mass media in this context is in communicating experts' reports and policy announcements to the public. This can be done in different ways,[4] resulting in the ability of the media to affect the ratio between informed and uninformed public.

The issue of dispersed experts' opinions about monetary policy is partly studied in Ehrmann and Fratzscher (2013) who investigate whether members of monetary policy committees should communicate a collegiate (unified) view on monetary policy, or provide a diversity of opinions. They find, in particular: "more active as well as more consistent communication by committee members improves the predictability of monetary policy decisions significantly. This effect is sizeable as communication dispersion across committee members accounts on average for one third to one half of the market's prediction errors of FOMC policy decisions. Moreover, more active and more consistent communication are found to also reduce the degree of uncertainty about the future path of interest rates."

[4]For example, news may come on the front page, or at prime time on TV. They can also be made more accessible and less technical/boring, thus drawing more attention.

In our model the communication of the central bank's policy will be unanimous ex-post, yet the diversity of opinions will be present in the media reports at the ex-ante stage.

2.1 Expectation formation

There are two dates, $t = 0$ and $t = 1$. The economy consists of a monetary authority (the Central bank), a system of mass media, and the population (consumers) who form beliefs about inflation and interest rates. This formulation assumes there are also producers of goods and providers of financial services, so that inflation and interest rates are well defined and determined in respective markets, though these are not explicitly modelled. The population is of a size of continuum and consists of consumers of two types: fraction $a(t)$, denoted as type a, are aware of news reported by the mass media, while fraction $1 - a(t)$, denoted as type u, remain unexposed to news.[5] To fix ideas, consider consumer expectations of a specific interest rate, such as a car loan, denoted i^e. Extensions to expectations of inflation, as well as to perceptions of current rates, are discussed in Section 2.3. At each date, the average expected interest rate is given by the expectations $i^{e,a}(t)$ and $i^{e,u}(t)$ of the two main groups of consumers respectively:

$$i^e(t) = a(t) \cdot i^{e,a}(t) + (1 - a(t)) \cdot i^{e,u}(t) \tag{1}$$

There is also a finite number of experts who possess specialised knowledge about how the economy and the monetary authority work. Experts can be consumers, producers, or financial services providers. As experts are finite and the rest of the population has a mass of continuum, experts' beliefs have an infinitesimal share in the overall population and therefore do not explicitly enter the average expectation (1), yet they will affect it indirectly.

Expectations have two regimes - one before the policy of the Central bank is communicated, and one after. Under the latter regime, expectations are based on the signal that comes from the Central bank (even if it is transmitted by mass media), which we call Type 1 signal, and under the former they are shaped by a stream of experts' opinions, also transmitted by the mass media, which we call Type 2 signals.

2.1.1 Informed consumers post-announcement

The Type 1 signal communicates the policy [target] interest rate i^{CB}. Decision-makers face uncertainty with regard to (1) whether the central bank will meet the target, and (2) what the declared official rate implies for the consumer loan rate in question (such as a car loan rate; or, for inflation expectations, for "prices in general"). Policy communication

[5] Types may be seen as exogeneous to consumers and randomly drawn by nature, in which case $a(t)$ is the probability of being type a. In particular, this view is convenient to interpret the impact of mass media on $a(t)$: an increase in media coverage makes it more likely that consumers come across news, and hence probability of being informed goes up.

therefore signals some probability distribution $\rho^{CB} = \rho\left(i_0, i^{CB}\right)$ over possible realizations of i. Parameter i_0 here reflects available information about past macroeconomic path, including the previous policy rates. If there are no signals about the central bank policy, expectations are only governed by i_0 (this case is considered later for uninformed consumers).

As typical in surveys of expectations[6], the range of interest rate values is assumed limited by the interval of integers $i = i_L..i_H$, without loss of generality. Type 1 signal comes at $t = 1$. Expectations of type a subjects at $t = 1$ thus take the form:

$$i^{e,a}(1) = \sum_{i=i_L}^{i_H} \rho_i\left(i_0, i^{CB}\right) \cdot i = \mathbf{E}_{\rho^{CB}}(i) \tag{2}$$

A desirable property of a model of beliefs formation is consistency with an existing model of choice, such as expected utility. To introduce expected utility, associate states of nature with the realizations of the interest rate i and let $u(i)$ be the mapping from the states of nature to the von Neumann-Morgenstern utility index u, so that the expected utility is defined as $\mathbf{E}_f(u(i))$.

Definition 1 *Individual belief* $\mathbf{E}_f(i)$ *is consistent with expected utility if the individual's preferences with regards to choices that result in state dependent utilities* $u(i)$ *are represented with expected utility* $\mathbf{E}_f(u(i))$.

Consistency requires that the expected utility is formed by the same distribution of probabilities over the possible outcomes $u(i)$ as the one used to form expectations of the variable of interest, i. Note that here we assume that a unique probability ρ^{CB} can be inferred from the central bank communication. The is not necessarily the case before the announcement.

2.1.2 Informed consumers pre-announcement

Type 2 signal (mass media) communicates expert opinions on the interest rate the Central bank can set as a target. As opinions differ, the signal bears uncertainty about the target value, on top of uncertainties described in the previous subsection. Media reports communicate a finite number K of expert opinions that imply different target values i_k^{CB} and associated probability distributions $\rho^k = \rho\left(i_0, i_k^{CB}\right)$ over the possible values of i. We will assume that beliefs based on any of the expert reports before the announcement

[6]Many expectation surveys, both of consumers and experts, explicitly ask respondents to give probabilities or estimate likelihoods of a range of values of the forecasted variable in the future.

cannot be more precise than those based on the information that comes from the central bank:[7]

Assumption 1 *$Var_{\rho^k}(i) \geq Var_{\rho^{CB}}(i)$, for any k.*

Decision-makers aggregate these reports. One way to do so is to average them with appropriate weights μ_k for each opinion (see, e.g., Guerdjikova and Nehring (2014) who discuss rules subjects may follow to select optimal weights for various opinions). Another way would be to assume that subjects randomly choose with probability μ_k one of the opinions (similarly to Gul and Pesendorfer (2006) who axiomatize random choice behaviour consistent with random utility maximisation). In both cases, the representative informed agent follows a "weighted average" rule to aggregate opinions:

$$i^{e,a}(0) = \sum_{k=1}^{K} \mu_k \sum_{i=i_L}^{i_H} \rho_i\left(i_0, i_k^{CB}\right) \cdot i. \tag{3}$$

Due to linearity, we can denote $w_i = \mathbf{E}_\mu(\rho^k(i)) = \sum_{k=1}^{K} \mu_k \rho_i\left(i_0, i_k^{CB}\right)$ to re-write (3) as

$$i^{e,a}(0) = \sum_{i=i_L}^{i_H} w_i \cdot i = \mathbf{E}_w(i), \tag{4}$$

We now turn to properties of the decision weights used to aggregate beliefs arising from various conceivable distributions $\rho\left(i_0, i_k^{CB}\right)$. A suitable comparison benchmark are second-order expected utilities (SOEU), axiomatized, for example, by Klibanoff et al. (2005), Nau (2006), Neilson (2010). In these models subjects' decisions in uncertainty are governed by an expected value of expected utility, similarly, although not necessarily identical, to (3). Decisions are driven by subjects' attitudes to ambiguity, such as pessimism or optimism, which is important for our framework. We can apply the above definition of consistency to the distribution $f = \left\{f_k : f_k = \mathbf{E}_\mu(\rho^k)\right\}$, which itself is a weighted average of [conceivable] distributions of probability over states of nature:

Definition 2 *Individual belief $\mathbf{E}_f(i)$ is consistent with SOEU if there exists a probability distribution $\mu = (\mu_1, .., \mu_K)$ over conceivable probability distributions $\rho(i) \in \left\{\rho^k(i)\right\}_{k=1}^{K}$ over states of nature i such that $f = \{f_i : f_i = \mathbf{E}_\mu(\rho(i))\}$ and the individual's preferences with regards to choices that result in state-dependent utilities $u(i)$ are represented with*

$$\mathbf{E}_f(u(i)) = \mathbf{E}_{\mathbf{E}_\mu(\rho)}(u(i)). \tag{5}$$

[7] The assumption characterises beliefs of consumers, not those of experts. Experts may well believe some targets are more achievable than others, and therefore we cannot rule out that some experts have more doubt (and therefore less precise beliefs) about future rate i after the announcement then before. Since consumers have no special knowledge, the assumption requires they see experts opinions as less precise indication of future rates than the communication by the central bank. The assumption can however be replaced by a weaker requirement that beliefs implied by expert opinions are *on average* not more precise then the belief based on the central bank communication, $\mathbf{E}_\mu\left(Var_{\rho^k}(i)\right) \geq Var_{\rho^{CB}}(i)$, which suffices for Proposition 3 and further results to hold.

In our context, if there exists an expert whose opinion is seen as unambiguously correct, distribution μ is degenerate and assigns a weight of 1 to a particular $\rho^k = \rho\left(i_0, i_k^{CB}\right)$, in which case the above definition collapses to the expected utility case (Definition 1). A particular instance of this arises after the announcement, when distribution $\rho^{CB} = \rho\left(i_0, i^{CB}\right)$ is given the weight of 1. Generally, however, subjects face uncertainty driven by the multiplicity of expert opinions. Viewing this as Knightian uncertainty (ambiguity) allows us to relate expectations with subjects' ambiguity attitudes.

Theorem 1 *Belief formation rule (3) is consistent with SOEU if and only if the system of decision weights $\mu = (\mu_1, .., \mu_K)$ reflects subjects' attitudes to ambiguity. In particular, ambiguity aversion implies overweighting of worse and underweighting of better expected outcomes.*

As common in the literature, we will refer to ambiguity-averse subjects as pessimists, and assume that pessimism prevails, which is also consistent with typical findings.

2.1.3 Uninformed consumers

Beliefs of type u consumers are governed by some probability distribution $\kappa(i_0)$ unaffected by signals of Type 1 or 2. They may still be based on historical macroeconomic data, such as the past observed rate i_0.

$$i^{e,u}(0) = i^{e,u}(1) = \sum_{i=i_L}^{i_H} \kappa_i(i_0) \cdot i = \mathbf{E}_\kappa(i) \tag{6}$$

What determines distribution κ? We assume uninformed subjects face white noise[8] with regards to possible future developments: any value i can equally realize with any probability, i.e. any probability distribution over i is equally possible:

$$\Pr\left\{\Pr(i^*) = x_1\right\} = \Pr\left\{\Pr(i^*) = x_2\right\}, \forall i^* \in [i_L, i_H]; \forall x_1, x_2 \in [0,1].$$

White noise is characterised by a fixed mean value and a finite variance. In a discrete space, the number of all possible probability distributions over i is finite, denote this number with $N(i_L, i_H)$. The "mean probability" that i takes value i^* is then

$$\overline{\Pr}(i) = \sum_{r=0}^{1} \frac{1}{N(i_L, i_H)} \cdot r = \overline{\Pr}(i'), \forall i, i' \in [i_L, i_H],$$

[8] White noise in information systems can be defined as "a signal with equal intensity of all frequencies"; in our context "frequencies" are bits of information that imply a particular distribution of probabilities over i, hence the definition we use in the text.

identical across all values of i, and the mean value of i communicated by the white noise is

$$m = \sum_{i=i_L}^{i_H} \overline{\Pr}\,(i) \cdot i,$$

We align the mean value of the noise with the past observed rate, which reflects all available information of uninformed subjects; they receive none of the two signals above, and the rest of their information set is not explicitly modelled[9]:

$$m = i_0.$$

However this mean is an objective characteristic (model parametrization) of the noisy signal. Uninformed consumers process all signals that form the white noise, just as their informed counterparts do with signals from experts. Specifically, they weigh each probability distribution r^n (the counterpart to probability distribution ρ^k conceived by informed subjects from an opiniion of expert k) out of $N(i_L, i_H)$ possible distributions (the counterpart to the number of experts K in informed subjects' beliefs) with a decision weight μ_n. This defines distribution κ, which replaces the objective mean probability $\overline{\Pr}(i)$:

$$\kappa_i = \mathbf{E}_\mu(r(i)) = \sum_{n=1}^{N(i_L,i_H)} \mu_n \cdot r_i^n(i_0), \tag{7}$$

By Theorem 1, decision weights μ_n reflect subjects' ambiguity attitudes, same as they do in the model of aggregation of expert beliefs for informed subjects (3). For example, pessimism implies that κ, formed from the white noise, assigns higher probabilities to higher values of possible realizations of the interest rate. Expectations are then formed as formulated in (6). A key assumption that we make about the uninformed subjects is thus that their beliefs are unaffected by signals.

Assumption 2 *Distribution κ is unaffected by news, and in particular $Var_\kappa(i)|_{t=0} = Var_\kappa(i)|_{t=1} = Var_\kappa(i)$.*

While in the above we have assumed that the underlying signal of uninformed subjects is white noise, this assumption can be relaxed by assuming some information content of the underlying set of signals. Important is that this signal remains invariant to signals, as in Assumption 2, and is less informative than the other two signals.

Assumption 3 $Var_\kappa(i) > Var_w(i)$.

The above assumption is made for the "weighted" distributions that describe beliefs of informed (w) and uninformed (κ) subjects, both of which are identical monotonic

[9]This requires an appropriate definition of i_L and i_H so that they are symmetrical around i_0, given the uniform distribution of values in the white noise. Note that, conditional on the information set, expectations are still rational as they are based on all available information.

transformations of the underlying signals, and hence the assumption reflects on the quality of signals rather than on subjects' beliefs.

2.1.4 Aggregate beliefs

By combining (1), (2), (4) and (6), we now represent the aggregate belief in the economy as

$$i^e = \begin{cases} a(0) \cdot \mathbf{E}_w(i) + (1 - a(0)) \cdot \mathbf{E}_\kappa(i) & \text{if} \quad t = 0, \\ a(1) \cdot \mathbf{E}_{\rho(i^{CB})}(i) + (1 - a(1)) \cdot \mathbf{E}_\kappa(i) & \text{if} \quad t = 1. \end{cases} \tag{8}$$

Equation (8) relates expectations of interest rates to (i) the fraction of population $a(t)$ exposed to policy news before ($t = 0$) and after ($t = 1$) the announcement, (ii) uncertainty of media communication (through w_i), and (iii) uncertainty about how policy rate i^{CB} translates in the observed rate i (through $\rho\left(i_0, i^{CB}\right)$). This highlights two possible channels through which policy communication can have an impact on expectations. First, this is through signalling the distribution $\rho\left(i_0, i^{CB}\right)$ that differs from the system of weights w_i implied by expert views; both distributions govern informed beliefs pre- and post-announcement and determine both the expected rate and the uncertainty around this expectation (e.g. as given by the variance). Second, the impact may come through a change in the fraction of informed subjects, $a(t)$. Both channels work through subjects' exposure to policy news.

The following two hypotheses test the underlying structural assumptions of the model, such as the split between informed and uninformed subjects and the variability of their shares around the announcement event.[10]

Hypothesis 1 *If an announcement affects average expectations, it does so via subjects who are exposed to policy news; the effect on beliefs of uninformed subjects is nil,* $i^{e,u}(0) = i^{e,u}(1)$.

Given policy announcements attract great deal of attention from mass media, we expect that the fraction of informed subjects increases after an announcement.

Hypothesis 2 *Announcements raise exposure to policy news,* $a(1) > a(0)$.

2.2 Effects of announcements and news

This section derives testable implications of the model for the expected rate, the error of expectations, the dispersion of beliefs in the population, and the precision of beliefs at individual level and on average in the population.

[10] Hypotheses testing the model predictions follow in the next section.

2.2.1 Expected rate

We now state the main implication of the model with regards to the directional change in expectations if the policy rate does not change (or if changes in the policy rate are marginal). This condition is imposed with the objective to isolate the announcement effect from the effect of a change in the policy rate. Given changes in policy rates happen currently rarely, and, when they happen, the increases are minimal, this assumption is highly relevant for the current policy situation.

Proposition 1 *Assume there is no change in the policy rate. If respondents are pessimistic then*

1. $i^a(1) < i^a(0) < i^u$, *and*
2. *if* $a(1) \geq a(0)$ *then* $i^e(1) < i^e(0)$.

The intuition behind this proposition is as follows. No change in the policy rate corresponds to centering of the pre- and post-announcement [objective] distributions of probability over possible realizations of consumer loan rates at the same mean value. Facing uncertainty, pessimistic consumers bias their views towards the worse outcomes, which correspond to higher interest rates on loans. The after-announcement beliefs formation (2) is free of the pessimistic bias. The removal of the pessimistic bias drives expectations downwards.[11]

Hypothesis 3 *A policy announcement lowers expectations, and more so for the informed public.*

Alternatively, the same result may be seen from the perspective of the effect exposure to news has on expectations. The following hypothesis directly follows from part 1 of Proposition 1.

Hypothesis 4 *Exposure to news lowers expectations. Exposure to news produces a stronger effect on expectations after the announcement than before.*

2.2.2 Error of expectations

If the policy is not perfectly anticipated, there exists an error of expectations, which, for the informed (exposed to news) population and some objectively known value of consumer interest rate $i\left(i^{CB}\right)$ that corresponds to the policy rate i^{CB}, can be defined as

$$err_w = \left|i\left(i^{CB}\right) - \mathbf{E}_w\left(i\right)\right| \tag{9}$$

[11] It is possible to show that the result holds even if consumers still exhibit some pessimistic bias after the announcement, as in **?**. Key to the proof is in the reduction of the variance by Assumption 3.

The error of expectations after the announcements is defined similarly to the above, one only needs to replace index w with ρ^{CB}. The nature of the error is in the aggregation of information from multiple sources. Although we assume experts' opinions are rational, they can still make errors in predicting the policy rate: these errors average to zero over the long time span or over a large enough number of experts. If the number of experts is small, the error would be stochastic, with a mean of zero, but not necessarily zero at any particular instance in time. If the number K of expert opinions is large enough, they on average perfectly predict the policy rate: [12]

$$\sum_{k=1}^{K} \frac{1}{K} \sum_{i=i_L}^{i_H} \rho_i \left(i_0, i_k^{CB}\right) \cdot i = \mathbf{E}_{\rho(i^{CB})}\left(i\right).$$

Existing research suggests, at least with regards to inflation expectations, that households systematically overestimate inflation, see for example, Menz and Poppitz (2013) and references therein; Carroll (2006) explains this with the presence of some "social transmission" of expectations that happens through conversations with neighbors, while Capistrán and Timmermann (2009) provide an explanation based on consumers' loss aversion, which is closer to our approach as it refers to consumers' psychological attitudes. In our model, an alternative explanation of the error arises from the way expert opinions are aggregated. This error does not need to average to zero. By assuming that the majority of the population are pessimistic and overweigh worst outcomes, we can characterise the error: informed pessimistic subjects overestimate inflation; a reduction in uncertainty through policy communication moves expectations downwards and reduces the error of expectations. [13] The following is the counterpart of proposition 1 for expectation errors.

Proposition 2 *Assume there is no change in the policy rate. If respondents are pessimistic then*

1. $err_\kappa > err_w \geq err_{\rho^{CB}}$, *and*
2. *if* $a\left(1\right) \geq a\left(0\right)$ *then* $a(0) \cdot err_w + (1 - a(0)) \cdot err_\kappa \geq a(1) \cdot err_w + (1 - a(1)) \cdot err_{\rho^{CB}}$.

The second part of the proposition measures the effect of the announcement on the overall population, while the first part formulates it for the informed public only. As we assume no impact of the announcement on the uninformed public, the overall effect is expected to be smaller.

Hypothesis 5 *Expectation error is smaller after the announcement than before. The effect is stronger for the informed public.*

[12] The uniform distribution of decision weights $\frac{1}{K}$ reflects no preferences towards any source of information. This differs this construct from expectations formed by the informed public, who assign weights that incorporate their preferences, i.e. ambiguity attitudes.

[13] If the majority of subjects are optimists, the error of the expectations still will be reduced but the expectations would go upwards.

As expectations are biased upwards, the same assumption implies informed subjects have lower expectations than those uninformed.

Hypothesis 6 *Expectation error of uninformed subjects is greater than that of informed subjects.*

2.2.3 Population-wide dispersion of beliefs (disagreement)

Uncertainty about the expected value manifests both in the dispersion of individual reported beliefs (disagreement among subjects) and in the confidence of each respondent in their reported value (precision of individual beliefs). We first address the former and turn to the latter in the next subsection. The disagreement is due to heterogeneity of expectation formation processes (Mankiw and Reis, 2002). In the model we only distinguish between informed (type a) and uninformed (type u) subjects and assume homogeneous beliefs within each group. Further assumptions are needed to describe heterogeneity within each of these groups, which would unnecessarily complicate the model. Instead, we substitute these assumptions by hypothesizing that there is less heterogeneity in the informed subgroup, and even more so after the announcement [14]:

Hypothesis 7 *The variance of the distribution of expected rates in the informed subsample is smaller than in the uninformed subsample; in the informed subsample variance is lower after the announcement, then before.*

This hypothesis is linked to albeit distict from our Assumption 3 which describes the information strength of the signals via variances of probability distributions *individual* subjects use to form expectations. Effectively, we now assume that what holds at the individual level, also applies to aggregate distributions. Note that our model describes a representative agent, while, as noted above and as we observe in the data, people within each cohort can differ and have different beliefs. What we require is consistency of representative beliefs with beliefs of the population: if our representative subject runs a survey of all people in the country, he would elicit exactly the same beliefs as those described by Assumption 3. In this sense, Hypothesis 7 follows directly from this assumption.

2.2.4 Precision of individual beliefs (confidence)

To deliver a testable result for the precision of individual expectations of individual subjects, recall that w is a mixture probability distribution resulting from compounding μ and ρ^k. Properties of compound distributions deliver the following proposition:

Proposition 3 *If there exist* $k_1 < k_2 \leq K$ *such that* $\mathbf{E}_{\rho^{k_1}}(i) \neq \mathbf{E}_{\rho^{k_2}}(i)$ *then* $Var_w(i) > Var_{\rho^{CB}}(i)$.

[14] Alignment of beliefs due to an inflow of information is demonstrated, for example, in Vinogradov (2012)

It follows that if there are at least two different expert opinions, the belief of the informed public before the announcement is less precise than that after the announcement. To generalize this result for the whole sample, first define the average precision of expectations in the population before and after the announcement as

$$\overline{Var}\left(i^{e}\right)=\begin{cases} a\left(0\right)\cdot Var_{w}\left(i\right)+\left(1-a\left(0\right)\right)\cdot Var_{\kappa}\left(i\right) & \text{if} \quad t=0, \\ a\left(1\right)\cdot Var_{\rho^{CB}}\left(i\right)+\left(1-a\left(1\right)\right)\cdot Var_{\kappa}\left(i\right) & \text{if} \quad t=1. \end{cases} \tag{10}$$

This definition aggregates variances in the sense of obtaining the average value in the sample. Note that this is different from the dispersion of beliefs discussed above. A survey typically allows one to estimate individual subjects' confidence in their answers, or the variance of the probability distribution reported by each individual subject for expected values. These individual values are then averaged across all survey participants. By definition of the average precision and by Assumption 2 the average effect on the whole sample is smaller than the impact on informed subjects only. The following proposition establishes under which conditions we are to expect any effect on average precision in the sample.

Proposition 4 *If* $Var_{w}\left(i\right)>Var_{\rho^{CB}}\left(i\right)$ *then announcements improve the average precision of expectations as long as* $a\left(1\right)>0$. *If* $Var_{w}\left(i\right)=Var_{\rho^{CB}}\left(i\right)$ *then the average precision improves iff* $a(1)>a(0)$.

Under the assumptions of proposition 3, if there is at least one consumer who receives policy news after the announcement, $a(1)>0$ then announcements strictly improve average precision of beliefs. This result may appear paradoxical because it allows for a reduced exposure to news after the announcement, which is theoretically possible. However the result holds because even if less subjects are exposed to news after the announcements, previously informed subjects (who were type a at $t=0$ and became type u at $t=1$) do not forget information they possessed at $t=0$, and for them still holds $Var_{w}\left(i\right)<Var_{\kappa}\left(i\right)$. For this reason, an announcement can not lead to a reduction in the average precision of beliefs. An additional channel through which an announcement contributes to an improvement in the precision of beliefs is by informing more subjects at $t=1$ than were informed at $t=0$. The proposition characterises the improvement in the average precision of beliefs due to the central bank announcement. The effect is due both to informing subjects about the true (most precise) distribution ρ and to reducing the fraction of uninformed subjects. The second part of the proposition emphasises that if there is no policy uncertainty, so that expert opinions produce the same precision of beliefs as the actual announced rate, $Var_{w}\left(i\right)\approx Var_{\rho^{CB}}\left(i\right)$ then policy announcement can still have an impact on the precision of beliefs by ensuring $a(1)>a(0)$. This is exactly what Hypothesis 2 states.

As long as an empirically obtained measure of confidence in reported forecasts represents the precision of individual beliefs, the following hypothesis follows from the results in this subsection.

Hypothesis 8 *Announcement improves both the confidence of informed respondents and the average confidence in reported beliefs in the sample. The latter effect is smaller than the former.*

2.3 Expected inflation and perceptions of current rates

Above we considered the formation of interest rate expectations. Same considerations apply to the formation of inflation expectations, with a proper re-definition of the probability distribution $\rho\left(i^{CB}\right)$ to apply to the range of possible inflation values $\pi = \pi_L..\pi_H$:

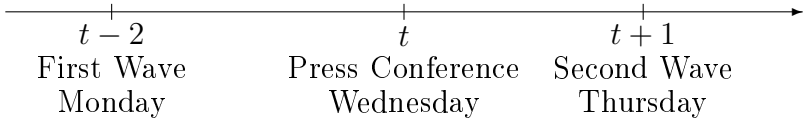
$$\pi^e(1) = \sum_{i=\pi_L}^{\pi_H} \rho_\pi\left(i^{CB}\right) \cdot \pi \tag{11}$$

Similarly, the discussion can be extended to perceptions of both interest rates and inflation. The range of possible values $i_L..i_H$ and $\pi_L..\pi_H$ should then be interpreted as uncertainty consumers face in determining the current rate: they are asked about "prices in general" or an interest rate for a "typical borrower", which makes the "correct" values not directly observable. Similarly to the formation of expectations, "correct" values of the current rate and past inflation can be reported by experts, and need then to be obtain through the variety of expert reports through aggregation, as described above. The impact of the policy announcement comes then from the macroeconomic outlook linked to the announcement, which aligns heterogeneous views of consumers on current rates. The remainder of the model and the hypotheses are then the same as above. When discussing the empirical results, we will refer to hypotheses stated above with application to both inflation and interest rates, expected as well as perceived, and respectively confidence therein.

3 Survey design and data

To collect data, we designed a 15-questions survey. Having the survey short keeps subjects motivated (Vinogradov and Shadrina (2013)) and helps achieve high completion rates. The survey begins with 4 Michigan-type questions on current and expected inflation and interest rates (to set the benchmark, the survey asks about the interest rate on a car loan of \$10 000). Each of them is accompanied by a confidence question "How confident are you in this answer?" with answers on a 5-point scale from "absolutely sure" to "absolutely unsure". We then explore subjects' financial and consumption decisions in the current situation by asking "If you had \$1000 how would you use it now?" Respondents need to

Figure 1: Timeline Survey



allocate this amount between stocks, safe assets, time deposits, mortgage repayment, or consumption. Further questions are devoted to subjects' characteristics such as financial literacy and uncertainty attitudes. We assess financial literacy by asking how many of the four shown statements (equivalent to QK4 b and QK5 a, b and c in INFE (2011)) are true. As all these statements in the question are true, the answer gives us a measure of financial literacy on the scale 0-4. The questions on uncertainty attitudes confront respondents with hypothetical situations of choice between a risky and a safe option (measure of risk-aversion) and between an option with a 50/50 chance of success and an option with an unknown probability of success (measure of ambiguity attitude, (Ellsberg, 1961)). Finally, the last part of the survey explores what and through which channels subjects heard about the Fed's policy. The full questionnaire is in Appendix A.

Data are collected via Surveymonkey.com, a online platform to conduct surveys, which is increasingly popular in economics research (e.g. Solnick and Hemenway (2009), Wiswall and Zafar (2015)). Surveymonkey incentivise respondents by making a donation to a charity of their choice upon completion of the survey. Alternative platforms (e.g. Qualtrics, as in Bursztyn et al. (2014)) offer a similar service, yet with a different incentives scheme (participants are directly paid for responses). Surveymoney.com invites registered users (only users over 18 years old) to participate in the survey, sample selection is random, stratified to ensure distribution matches general US population. The provider also supplies data on age, gender, household income, US region and the device type respondents use. These serve as the source of our demographics variables. Each round of the survey is timed around a FOMC press conference. First wave invitations are sent out on Monday morning, 2 days before the Wednesday's press-conference, and the second wave invitations are sent out on Thursday, see Figure 1. Each wave targets 400-600 responses (the targeted number of responses was increased in the second half of 2017); usually this target is achieved within 6 hours (typically with extra responses above the target), which gives us two non-overlapping cross-sections of expectations and perceptions taken within a maximum of 5 days between each other, minimizing the impact of other possible macroeconomic factors. The pre-announcement cross-section thus serves as a control group (no announcement effect), and the post-announcement group is the treatment. In this paper we report results from 10 rounds of the survey that took place between December 2015 and June 2018. Table 1 presents summary statistics of main variables, while Figure 2

Table 1: Summary Statistics

variable	mean	median	sd
Past Inflation (PastInfl)	7.67	5.00	8.49
Expected Inflation (ExpInfl)	6.90	5.00	7.82
Past Interest Rate (PastRate)	7.69	6.00	5.92
Expected Interest Rate (ExpRate)	8.69	7.00	6.23
Confidence Past Inflation	0.43		0.49
Confidence Expected Inflation	0.38		0.48
Confidence Past Interest Rate	0.42		0.49
Confidence Expected Interest Rate	0.33		0.47
News Fed	0.33		0.48
Announcement	0.50		0.50
Gender	0.45		0.50

Notes: Results based on full sample of approx 15.000 observations

depicts the aggregated distributions of reported beliefs with regards to past and present inflation and interest rates.

The summary statistics indicate rather high inflation expectations with values 5 as median. Note that consumers are commonly found to overestimate inflation rates (e.g. the Michigan Survey). Econometrically a level difference is not relevant as long as the survey responses are meaningfully correlated with the true inflation perceptions/expectations. To check this we calculate the the correlation coefficient between reported past inflation and with professional forecaster inflaton expectations. The resulting correlation cofficient between perceived inflation base on our data and the official CPI figure is 0.5. Furthermore, the correlation coefficient between expected inflation in our data and the survey of professional forecasters is 0.27. This positive and statistically significant co-movement between reality and perceptions/expectations is reassuring.

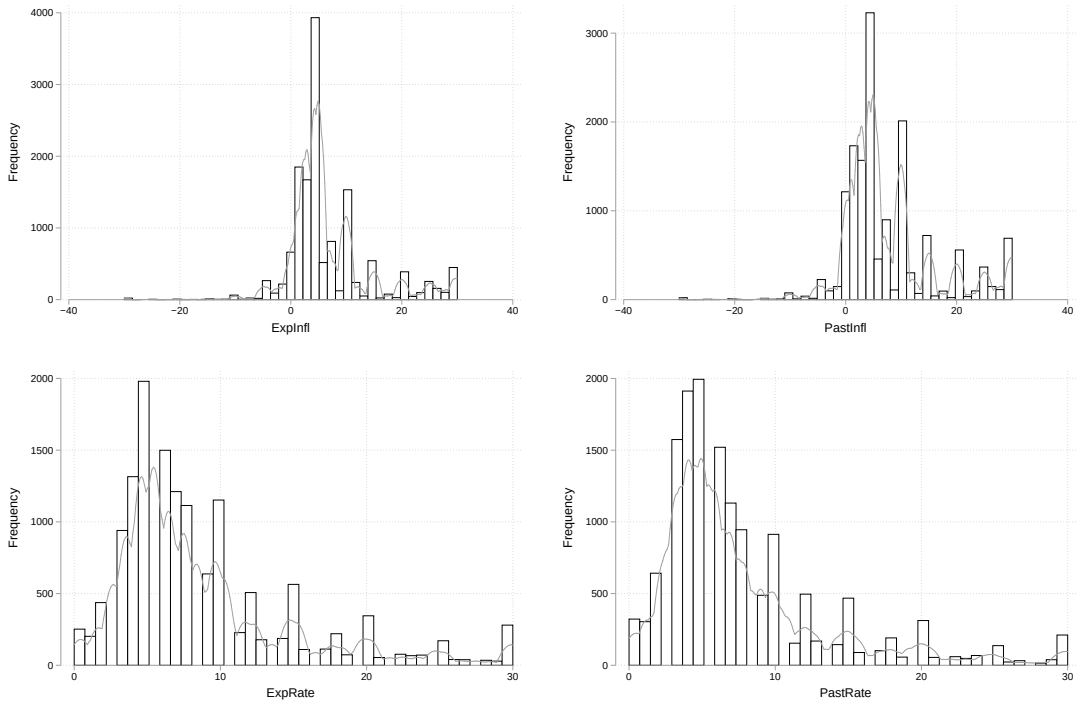
Not surprisingly, confidence in future rates is lower than in current rates: 41-42% respondents say they are confident in their perception of the past rate while only 32-36% are confident in their estimate in the future rates.

We also employ CPI data to calculate perception errors for inflation and the Survey of Professional Forecasters data to measure the expectation gap between consumers and forecasters (this proxies for the error of expectations).

Along with the data from our surveys, in order to identify the surprise components we employ the CNBC survey of financial market participants on their expectations of the Fed's interest path.[15]

[15]The CNBC surveys represent the opinions of a small number, varying from 39 to 48 in the surveys we use, of the nation's top money managers, investment strategists, and professional economists who responded to CNBC's invitation to participate in an online survey.

Figure 2: Distribution of Individual Perceptions and Expectations



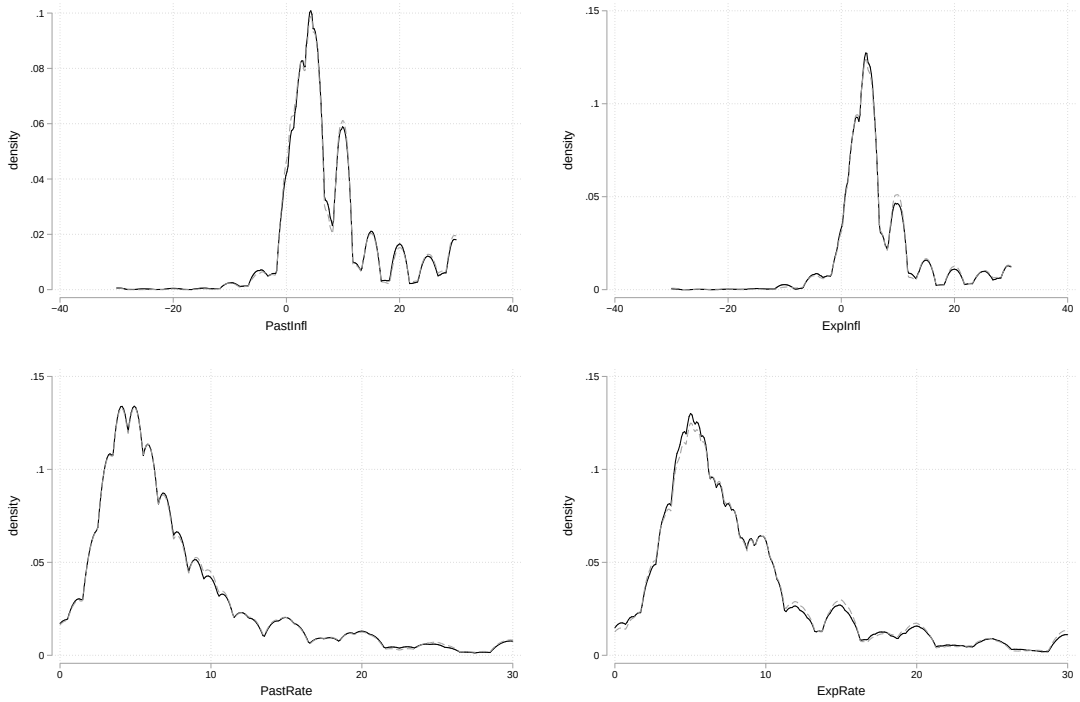
4 Results

4.1 Mean Effects

We start our analysis by looking at the densities of expectations and perceptions of inflation and interest rates before and after the announcement, using the complete available dataset. In Figure 3 each panel plots two distributions (kernel densities): the darker line is for the pre-announcement, and the light-grey line is for the post-announcement distribution. While we observe a slightly increased concentration of the post-announcement densities with a shift to the left, the changes are not substantial; yet the strongest effect obtains for the perceptions of the current rate. This observation is quite surprising at a first glance as it seems that the announcement effect on expectations and perceptions of both inflation and interest rates is quite small. One should remember, however, that we are dealing here with the general public which are not as attentive to economic matters as professionals. Furthermore, our model indicates that the effect of Announcement strongly depends on the quality of the signal and the saturation of news among the populations.

Hence, attention and the resulting information set of consumers are crucial. Consumers might be unaware of the announcement, for which reason its overall effect on expectations is blurred by the large share of consumers that did not update their information set. To test the relevance of the exposure to news, Figure 4 compares expectations and perceptions of consumers that heard some news about the Fed's monetary policy with those who did not receive any such news. Similarly to Figure 3, we use kernel densities, marking expectations and perceptions of subjects who were not exposed to news with the darker

Figure 3: Effects of Monetary Policy Announcement Events



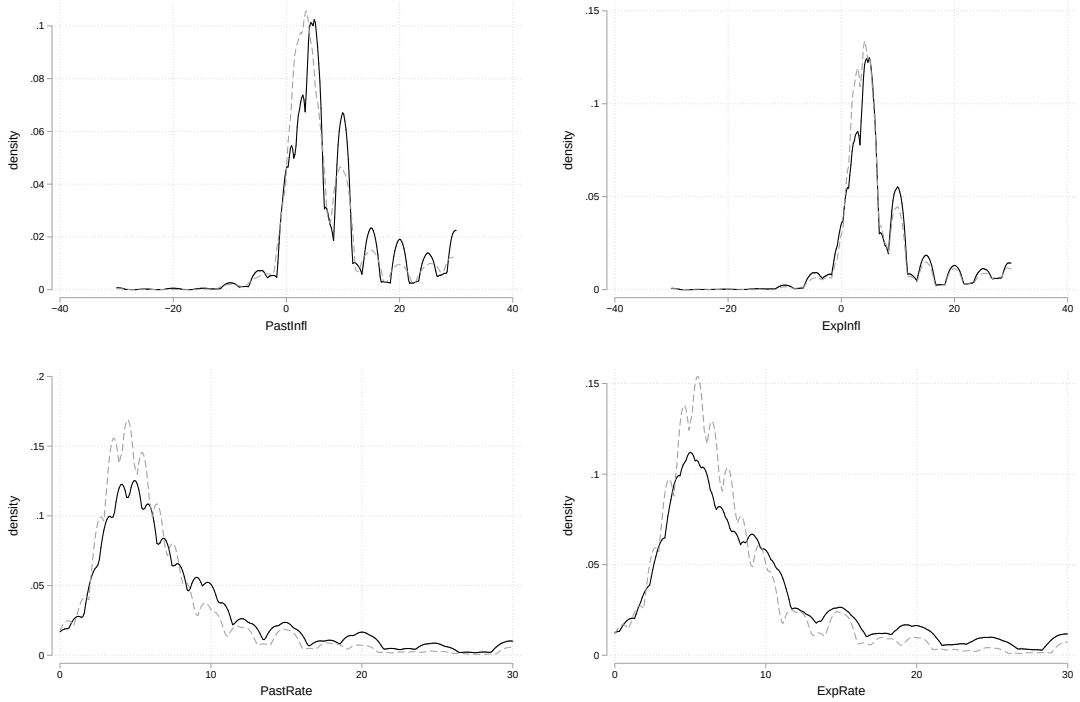
Notes: Kernel density plots. Black line shows the distribution 1-2 days before the announcement, grey line depicts the distributions 1-2 days after the announcement.

line, and using the grey line for consumers reporting that they heard some news on the Fed policy. Figure 4 reveals a substantial and statistically significant difference[16] between the two cohorts. Generally, the densities are more centered, and perceptions and expectations are less dispersed for consumers who heard the news. These observations confirm our Hypothesis 1: the primary effect of announcements works via subjects exposed to news.

For a more rigorous analysis we estimate several regressions. First, we regress the announcement effect and the news effect, both represented by dummy variables (taking a value of 1 if a response comes from an after-announcement wave of the survey, or if the subject reports having heard news about the Fed, respectively) on perceptions and expectations of inflation and interest rates. This tests if there is an adjustment in the mean following the announcement or news. We use ordinary least squares and control for a large set of socioeconomic characteristics like gender, age, region and financial literacy; we also include survey fixed effects (in particular, this removes the effect of any announced change in the policy rate on beliefs). For each dependent variable we run two regressions. In the first regression we include the announcement dummy, and in the second one, in addition to it, we include the exposure to news dummy. Results are in Table 2. Overall, we observe that announcement effects have a negative sign but are statistically insignificant. These results are as expected (announcements affect beliefs, Hypothesis **??**, and this holds even

[16] We use the Kolmogorov-Smirnov and the Epps-Singleton two-sample test of similarity of distributions, both leading to qualitatively identical results, not rejecting similarity of distributions before and after the announcement, but strongly rejecting similarity of distributions generated by different exposure to news at $p < .001$.

Figure 4: Effects of Monetary Policy News



Notes: Kernel density plots. Grey line shows the distribution of consumers that heard news about the Fed, black line depicts the distributions consumers that heard no news about the Fed.

though interest rates are almost unchanged, **??**), however a large share of individuals (on average 64%, see Table 1) did not receive any news on the Fed, for which reason the announcement effect is rather low, as formulated in Hypothesis **??**. If we add now the news variable we see that news is statistically significant in all specifications, except inflation expectations, consistent with Hypothesis 6. The effect is slightly higher for interest rates and past economic figures (perceptions). Informing the public about past variables removes uncertainty about them, hence hearing news should imply a stronger adjustment of perceptions than that of expectations, as future outlook is still uncertain. Similarly, central banks have more direct control of the interest rate than the inflation rate which might explain the slightly stronger effect of the exposure to news on interest rates.

So far we have highlighted the crucial importance of news for expectations and perceptions. Our expectations formation model however highlights that announcements by central banks work directly – by providing additional clarification and certainty about the future, and indirectly – by increasing the amount of news regarding monetary issues being circulated. To confirm Hypothesis 2, that announcement events raise exposure to policy news, presumably by triggering media reports about the Fed, we calculate the share of people that have received news before and after the announcement: while 31% of consumers receive news already before the announcement, this share rises significantly to approximately 40% in the first two days after the announcement (unconditional average, 36%, is reported in summary statistics, Table 1). Notably, the trigger effect of announce-

Table 2: Effects of News and Announcements on the Perceptions and Expectations of Inflation and Interest rates

	(1) PastInfl b/se	(2) PastInfl b/se	(3) ExpInfl b/se	(4) ExpInfl b/se	(5) PastRate b/se	(6) PastRate b/se	(7) ExpRate b/se	(8) ExpRate b/se
Announcement	-0.141	-0.118	0.116	0.123	-0.004	0.047	0.034	0.088
	(0.11)	(0.12)	(0.09)	(0.09)	(0.07)	(0.07)	(0.08)	(0.08)
NewsFed		-0.259*		-0.073		-0.572***		-0.577***
		(0.13)		(0.10)		(0.08)		(0.09)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.025	0.025	0.020	0.020	0.024	0.029	0.033	0.036
N	10459.000	10459.000	11233.000	11233.000	10722.000	10722.000	11188.000	11188.000

Table 3: Impact of announcements on exposure to news

	(1) est1 b/se	(2) with controls b/se
NewsFed Announcement (d)	0.078*** (0.01)	0.098*** (0.01)
Survey	No	Yes
Demographics		
Regional		
N	15169.000	12523.000

Note: Marginal Effects reported

ments might be even stronger as shortly before the meeting there are already news issued speculating about the outcome of the upcoming Fed meeting.

We test this conjecture more directly by running a probit regression where we explain the probability of an individual receiving news about the fed with announcements taking place (more news are expected in the days after the announcement). As the coverage of the Fed meeting may be intensifying already shortly before the announcement when journalists and experts start discussing potential outcomes and their implied consequences, it is fair to say we estimate a lower bound of the announcement effect.[17] Table 3 shows the estimation results. In column one we estimate a bi-variate system, while in column 2 we control for the whole set of socioeconomic characteristics and survey fixed effects. In both estimations the coefficient estimate is highly significant indicating that announcements increase the probability of receiving news about the Fed by 10%.

Now we know that announcement triggers news. However, in our model the information content of news becomes richer (the signal is more precise) after the announcement as central banks reveal new information to the public. Hypothesis 4 implies that news after the announcement should have a higher impact (greater coefficient estimate) on the mean. To test this we re-run the same model as in Table 2 but add an interaction term between News and Announcement. This interaction terms indicates if news become, less or more important for the adjustment in the level of expectations and perceptions after the announcement of the central bank. Results are presented in Table 4. We observe that the interaction effect is strongly significant for inflation perceptions and expectations: news after the announcement lead to a greater adjustment in expectations and perceptions than news before the announcement. Interestingly, while this channel is insignificant for interest rates it has still the negative as for inflation perceptions and expectations. This could be reasoned by a higher predictability related to a period with rare and minor interest changes and interest movements.

[17] If we compare after-announcement data with, for instance, a week beforehand, we would likely observe a stronger movement in news. Yet this would come at the cost of weaker identification.

Table 4: Impact of News before and after Announcement

	(1) PastInfl b/se	(2) PastInfl b/se	(3) ExpInfl b/se	(4) ExpInfl b/se	(5) PastRate b/se	(6) PastRate b/se	(7) ExpRate b/se	(8) ExpRate b/se
NewsFed=1	-0.279**	0.085	-0.061	0.347**	-0.563***	-0.540***	-0.563***	-0.454***
	(0.13)	(0.18)	(0.10)	(0.14)	(0.08)	(0.11)	(0.09)	(0.12)
Announcement=1		0.152		0.440***		0.069		0.180
		(0.14)		(0.11)		(0.09)		(0.11)
NewsFed=1 X Announcement=1		-0.682***		-0.808***		-0.054		-0.230
		(0.24)		(0.18)		(0.14)		(0.16)
Constant	7.279***	7.228***	5.514***	5.329***	7.045***	7.014***	7.795***	7.717***
	(0.25)	(0.26)	(0.18)	(0.18)	(0.15)	(0.15)	(0.17)	(0.17)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.023	0.024	0.019	0.021	0.028	0.029	0.036	0.036
N	10459.000	10459.000	11233.000	11233.000	10722.000	10722.000	11188.000	11188.000

Table 5: Impact of News before and after Announcement on Inflation Error and Expectations Gap

	(1)	(2)	(3)	(4)	(5)	(6)
	ape	ape	ape	aeg	aeg	aeg
	b/se	b/se	b/se	b/se	b/se	b/se
Announcement=1	-0.202	-0.177	0.122	0.008	-0.005	0.200
	(0.11)	(0.12)	(0.15)	(0.12)	(0.12)	(0.18)
NewsFed=1		-0.308*	0.089		0.130	0.401
		(0.17)	(0.25)		(0.16)	(0.25)
NewsFed=1 X Announcement=1			-0.771**			-0.525
			(0.29)			(0.32)
Constant	4.745***	4.906***	4.790***	4.051***	3.980***	3.911***
	(0.34)	(0.32)	(0.32)	(0.21)	(0.21)	(0.20)
Survey	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.028	0.028	0.029	0.021	0.021	0.021
N	9389.000	9389.000	9389.000	9354.000	9354.000	9354.000

Table 6: News, Announcements, and Variance of expectations.

News	**PastRate**	**ExpRate**	**PastInfl**	**ExpInfl**
0	8.71	7.99	6.32	6.67
1	8.00	7.43	4.93	5.16
Unconditional	8.51	7.81	5.94	6.25

Announcement	**PastRate**	**ExpRate**	**PastInfl**	**ExpInfl**
Conditional on News=1				
Before	8.21	7.55	4.96	5.13
After	7.82	7.33	4.90	5.19
Unconditional	8.00	7.43	4.93	5.16

Finally, we turn to our predictions with regards to the error of expectations, Hypothesis **??** and the results in Proposition 2, according to which we should expect a reduction in the expectation error after the announcement, and more so in the cohort of subjects exposed to news. Table presents the results of the same estimations as in Tables 2 and 4, yet with the dependent variables defined as the absolute difference between the perceived inflation and the actual inflation rate (variable absolute perception error "ape") and the absolute difference between the expected inflation and the expectation of professional forecasters (expectations gap variable, "aeg"). Indeed, the perceived inflation error reduces with announcement, and even stronger with exposure to news, as predicted, however we observe nil effect for the expectations gap. The latter is most likely due to a strong co-movement in the expectations of professional forecasters (who serve as a benchmark for the "correct" expectation) and ordinary consumers. This negative result provides an additional support to the need to pay attention to the impact of central bank announcements on consumers as the latter respond to announcements the same way as professional forecasters do.

4.2 Confidence

Given there is a link between the *sample* variance of expectations and variances of probability distributions underlying *individual* expectations, we turn in this section to the sample variances first. According to our Hypothesis 7, announcements should reduce the variance of expectations. To test this we first split the sample into people that heard news and those unaware of the central bank news and investigate whether the variation of expectations is different across these cohorts. As a second step, we focus on people that have received news and check whether announcements has any impact on the variance of beliefs in this group. As shown in Table 6, the variance of expectations and perceptions is lower in the cohort that receives news. Announcement, however, has a marginal effect. This is not unexpected as there haven't been major surprises during our sample period that would imply a substantial difference between what experts have been expecting and what the central bank actually announced. Striking is that in the cohort of consumers

Table 7: News, Announcements, and Confidence in expectations.

News	**PastRate**	**ExpRate**	**PastInfl**	**ExpInfl**
0	0.39	0.29	0.40	0.33
1	0.49	0.41	0.50	0.46
unconditional	0.42	0.33	0.43	0.38

Announcement	**PastRate**	**ExpRate**	**PastInfl**	**ExpInfl**
Conditional on News=1				
0	0.53	0.43	0.53	0.48
1	0.47	0.39	0.48	0.45
unconditional	0.49	0.41	0.50	0.46

exposed to news we still observe quite a variation in their assessment of past inflation even though it has a lower variance after announcements: note, past inflation has the highest variance of all indicators!

Hypothesis 8 predicts that announcements improve consumers' confidence in expectations and perceptions. In Table 7 we calculate the share of consumers that are confident [18] in their reported beliefs before and after the announcement and conditional on whether they heard news about the Fed or not. Similar to the effects on the level of expectations and perceptions, we find no evidence of any direct impact of announcements on confidence. However, conditioning on exposure to news produces a sizable effect: for instance, only 28% of consumers who heard no news are confident in their estimates of future interest rates, while in the cohort of those who have heard the news this share increases to 41%. Interestingly the positive effect of receiving news on confidence is more pronounced for future assessment than for perceived current/past economic figures.

To confirm these results and to test their significance, we investigate the importance of announcements and news for the probability of being confident [19] in a probit regression, conditional on a vast array of socioeconomic characteristics, region, financial literacy and time effects. As in the level analysis, we observe no direct effect of announcements along with a noticeable indirect effect via news. Consistent with Table 7, the regression results in Table 8 show that on average exposure to news increases the probability of being confident in the perceptions of current economic figures by roughly 8% and expectations of future figures by 9%. This is a remarkably sizable effect, amounting to 25-30% of the mean level of confidence (see Table 1) given that we do not account for the quality and the content of the news received. Interestingly, news matter more for the assessment of the future as compared to the current situation. In line with the idea of providing guidance this is exactly what a central bank intend to accomplish.

[18] A respondent is classified as confident if (s)he indicates confidence of 4 or 5 on the five-point scale, otherwise we deem the respondent as lacking confidence.

[19] Again, the corresponding dummy takes a value of 1 if the respondent's reported confidence is 4 or 5 on the five-point scale, and zero otherwise.

Table 8: Effects of News and Announcements on Confidence

	(1) PastInfl b/se	(2) PastInfl b/se	(3) ExpInfl b/se	(4) ExpInfl b/se	(5) PastRate b/se	(6) PastRate b/se	(7) ExpRate b/se	(8) ExpRate b/se
main								
Announcement (d)	0.001	-0.007	0.001	-0.006	-0.002	-0.009	0.008	0.000
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
NewsFed (d)		0.078***		0.076***		0.068***		0.081***
		(0.01)		(0.02)		(0.02)		(0.01)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	7976.000	7976.000	7926.000	7926.000	7515.000	7515.000	7848.000	7848.000

Marginal effects

Table 9: Effects of News and Announcements on Confidence

	(1) PastInfl b/se	(2) PastInfl b/se	(3) PastInfl b/se	(4) ExpInfl b/se	(5) ExpInfl b/se	(6) ExpInfl b/se	(7) PastRate b/se	(8) PastRate b/se	(9) PastRate b/se	(10) ExpRate b/se	(11) ExpRate b/se	(12) ExpRate b/se
main												
Announcement	0.007		0.065**	-0.005		0.017	-0.019		0.022	0.001		0.039
	(0.02)		(0.03)	(0.02)		(0.03)	(0.02)		(0.03)	(0.02)		(0.03)
NewsFed		0.189***	0.290***		0.214***	0.274***		0.178***	0.258***		0.228***	0.307***
		(0.03)	(0.04)		(0.03)	(0.04)		(0.03)	(0.04)		(0.03)	(0.04)
NewsFed × Ann.			-0.193***			-0.109**			-0.147***			-0.148***
			(0.05)			(0.05)			(0.05)			(0.05)
Constant	0.205***	0.106*	0.082	0.022	-0.092	-0.098*	-0.011	-0.117**	-0.125**	-0.255***	-0.378***	-0.393***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
r2												
N	10459	10459	10459	11233	11233	11233	10722	10722	10722	11188	11188	11188

Finally, we test the interaction between Announcement and News as done beforehand. Table 9 contains the regression results which show that the effect seems not always positive. While News particularly improve the confidence, post announcement there could be detrimental effects. One potential reason for that could be additional news that might have changed the assessment of current or the outlook on the economcy

To conclude this section, announcements affect not only the level of expectations and perceptions, but also the uncertainty individual consumers face when assessing policy relevant variables, as reflected in their confidence in their estimates. In times of ultra low interest rates it might be even argued that providing certainty is at least as important as steering expectations.

5 Robustness

6 Implications

We have so far established that being exposed to the central bank news significantly affects consumer beliefs, while the policy announcement events have both the minor direct (only on perceptions, by informing the public about the current macroeconomic situation) and a substantial indirect (by drawing more media attention and increasing the share of informed individuals) effects on beliefs and confidence. Does this matter for consumption decisions? In our survey respondents answer a question "If you had an extra $ 1000 now, how much of this amount, in dollars, you would spend in the current situation on the following: stocks, safe assets, term deposit, mortgage contribution, buy durable goods, or other household expenses" (the exact wording is in the Appendix). We use their answers to this question to (a) test whether they reported beliefs are consistent with these reported investment/consumption choices, and (b) identify implications of monetary policy announcement on everyday consumption choices of ordinary people. As standard in the literature, we expect that investment/consumption decisions depend on the ex-ante real interest rate, defined as the expected interest rate minus the expected inflation. This is a consumer-specific variable, identified from the expectation part of the survey. Literature suggests consumption is an increasing function in real interest rate (Hall, 1988; Mankiw, 1981), moreover, durable goods expenditures are even more sensitive to changes in the interest rate than other household spendings (Mankiw et al., 1985). The same holds for risk-free savings (Fry, 1980); risky investment, on the contrary, is lowered by higher real rates (Mundell, 1963). Greater macroeconomic uncertainty increases precautionary savings (Ghosh and Ostry, 1997) while it reduces risky investment (Aizenman and Marion, 1993; Price, 1996; Ghosal and Loungani, 2000; Servén, 2003). These findings specify relationships we hypothesise between relevant investment/consumption variables, on the

dependent side, and ex-ante real interest rate and confidence with regards to it, on the explanatory side.

Results are in Table 10. In these estimates, we construct the expected real rate variable by subtracting inflation expectations from the expected interest rate, described and analysed in the preceding parts of the paper. A respondent is deemed confident in his assessment of the real rate, if he reports confidence at levels 4-5 out of 5 in each of the constituent variables. Confidence in this exercise proxies an individual's perception of aggregate uncertainty.

As conjectured, the expected real rate has a negative impact on risky investment decisions and positive on consumption, while confidence has an opposing effect on these variables. Note the lower and less significant effect of both on safe savings: the tradeoff is mainly between risky investments and durable consumption.

In table **??** we add the news variable and interact it with both explanatory variables. Quite interesting is the interaction between news and those variables. We see that news interacted with real rate leads to more investment in one off mortgage payments perhaps as anticipating rising interest rates while confidence with news lowers the response.

This result confirms that consumers' investment and consumption decisions are indeed highly correlated with their expectations, but even more importantly - with their confidence in their own beliefs. As we have shown, policy communication by central banks affects both.

7 Conclusion

While there is ample evidence of financial markets' reaction to central bank announcements, little is known on how consumers and the greater public receive this information and how they respond to it. To address the issue, we have generated a new dataset by repeatedly running a survey of U.S. consumers just before and right after Fed press conferences, ensuring sound identification of the announcement factor. This new data allows us to track the influence of announcements on perceptions and expectations of relevant variables as well as consumers' confidence therein and enables us as to track consumption and investment implications as well.

In this paper we have shown that central bank announcements influence consumers' perceptions and expectations of inflation and interest rates by increasing the exposure of people to monetary policy news coming through various media (the "news channel") and by adding or confirming information. Central bank announcements, as such, guarantee, strictly speaking, no updating of the information set. Only if they trigger significant coverage in the media, central banks can influence and steer perceptions and expectations of the public. While the existence of this transmission channel has been agreed upon in the academic literature, it was hard to clearly identify it, quantify its importance and explore its implications.

Table 10: Implications of Expectations and Confidence for Investment and Consumption Decisions

	(1) Stocks b/se	(2) Safe b/se	(3) Deposit b/se	(4) Mortgage b/se	(5) Durable b/se	(6) Other b/se
ExpRealrate	-1.802***	0.045	-0.587	0.354	2.117***	2.136***
	(0.39)	(0.36)	(0.31)	(0.41)	(0.42)	(0.47)
CONFRealrate	40.410***	22.699**	7.251	25.864**	-35.355***	-21.036*
	(8.71)	(8.47)	(7.72)	(9.32)	(9.02)	(9.31)
Constant	192.770***	229.571***	138.096***	247.675***	315.425***	519.742***
	(4.55)	(4.44)	(4.15)	(4.95)	(4.90)	(5.00)
Observations	7331	7454	6396	7231	7561	9249

For instance, we find that exposure to news about the Fed lowers perception of the current interest rates and expectations of the future ones by around 1%. This result obtains despite no announcements of monetary easing in the period covered, highlighting the importance of updating the information set of consumers element by the news coverage. Furthermore announcements improve the quality of perceptions and expectations by reducing the absolute gap relative to published CPI rates or expectations by professional forecasters.

On top of that, we have been able to characterise the effectiveness of the news channel in terms of individual consumers' confidence: exposure to news about the Fed makes respondents more confident in their estimates of both inflation and interest rates, perceived and expected. Hence we show that announcement mediated through news increases the quality of judgment of economically relevant variables and reduced the uncertainty around those. Hence even if there is not additional or new information confirmation and reassurance of certain policy paths has an effect.

Our analysis highlights the importance of media as a transmission device between the central bank and the greater public. As such, it justifies the great efforts of central banks over the last 20 years to become more transparent. In particular, it reflects the importance of press conferences, which draw significant attention of media outlets, as a crucial tool in managing the expectations of the greater public. Looking further ahead our paper would justify a higher engagement of central banks in social media to make sure that the information/news reaches a wider audience.

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Appendix

A Survey questionnaire

Thank you for participating in our survey. We are interested in your view on current and future prices, inflation and interest rates in the United States.

The survey consists of 15 questions. It usually takes less than 5 minutes to answer them (most participants do this in 3 minutes). No special knowledge is required. There is no right or wrong answer to our questions. In fact, any answer is correct as long as it truly reflects your opinion. All responses are anonymous.

If you decide to quit the survey at any stage, please let us know why, by using a special comment field available at each page. You will also be able to give us some general feedback in the end.

Thank you for your help, and welcome to the survey!

1. From your perspective, by how much did prices in general change during the past 12 months? Please use the drop-down menu below. For example, if you think prices on average have decreased by about 5%, choose "down by 5%"; if you think they have risen by 5%, choose "up by 5%".

Answer options: dropdown scrollable menu with options from "up by 30%" to "down by 30%".

2. How confident are you in this answer?

Answer options: Absolutely sure, Rather sure; Neither sure, nor unsure; Rather unsure; Absolutely unsure.

3. What annual interest rate do you think an average US citizen would be charged, if they take a car loan of $ 10,000 this week? Please use the drop-down menu below.

Answer options: dropdown scrollable menu with options from "0%" to "30% and above".

4. How confident are you in this answer?

Answer options: Absolutely sure, Rather sure; Neither sure, nor unsure; Rather unsure; Absolutely unsure.

5. By how much do you think prices in general will change during the next 12 months? Please use the drop-down menu below. For example, if you think prices on average will decrease by about 5%, choose "down by 5%"; if you think they will rise by 5%, choose "up by 5%".

Answer options: dropdown scrollable menu with options from "up by 30%" to "down by 30%".

6. How confident are you in this answer?

Answer options: Absolutely sure, Rather sure; Neither sure, nor unsure; Rather unsure; Absolutely unsure.

7. What annual interest rate do you think an average US citizen will be charged, if they take a car loan of $ 10,000 in a year from now? Please use the drop-down menu below.

Answer options: dropdown scrollable menu with options from "0%" to "30% and above".

8. How confident are you in this answer?

Answer options: Absolutely sure, Rather sure; Neither sure, nor unsure; Rather unsure; Absolutely unsure.

9. If you had an extra $ 1,000 now, how much of this amount, in dollars, you would spend in the current situation on the following (you can also allocate the whole amount to just one option):

- Stocks (mutual funds)
- Safe assets (401k, pension funds, treasury bills)
- Term deposit for 3 months or more
- Mortgage contribution (raise mortgage deposit or make an extra payment)
- Buy a car, holiday trip, jewellery or durable goods like a fridge/freezer
- Other household expenses

Answer options: free text box for each option with control that the input content is a number and the sum of all numbers equals 1000.

10. In your opinion, how many of the following four statements are true?

a) An investment with a high return is likely to be high risk.

b) High inflation means that the cost of living is increasing rapidly.

c) It is usually possible to reduce the risk of investing in the stock market by buying a wide range of stocks and shares.

d) If you put $ 100 into a no fee savings account with a guaranteed interest rate of 2% per year, at the end of five years there will be over $ 110.

Answer options: - none of them is true - 1 is true - 2 are true - 3 are true - all 4 of them are true

11. Consider a lottery ticket with a 50% chance of winning $ 100,000 and 50% chance of getting nothing. What is the LOWEST AMOUNT of money you would accept in exchange for this lottery ticket? We assume that you would also be happy to swap the lottery ticket for any amount higher than the one you indicate.

Answer options: from $ 60,000 to $ 5,000 with step $ 5,000, and additional two options of $ 1,000 and $ 500.

12. Consider two urns, each containing 100 balls coloured either red or blue.

Urn A contains red and blue balls in an unknown proportion. Urn B contains 50 red balls and 50 blue balls.

You will get a prize if you draw a RED ball. From which urn would you draw - from urn A or B?

Answer options: - Urn A (unknown proportion) - Urn B (50/50)

13. Consider the same two urns as above, again each containing 100 balls coloured either red or blue.

Urn A contains red and blue balls in an unknown proportion. Urn B contains 50 red balls and 50 blue balls.

You will get a prize if you draw a BLUE ball. From which urn would you draw - from urn A or B? w

Answer options: - Urn A (unknown proportion) - Urn B (50/50)

14. During the last week, have you heard any news about the monetary policy of the Federal Reserve (Fed)? What did you hear?

Answer options:

- I have NOT heard any news about the Fed policy
- I have heard that the Fed would raise interest rates
- I have heard that the Fed would keep interest rates at the current level
- I have heard that the Fed would lower interest rates
- I have heard some other news about the Fed, namely:

15. During the last week, what were your main sources of information on economic and business conditions? Please choose up to three options.

Answer options:

- Official sources (like the webpages of the White House, the Government, statistical agencies or the Fed)
- Articles in specialised newspapers (like Financial Times, The Wall Street Journal, The Economist) - online or in print
- Articles in general interest newspapers - online or in print
- Other Internet sources (for example, blogs, discussion forums, etc.)
- News programmes on television and radio
- Other programmes on television and radio
- Employer and colleagues
- Friends and relatives
- I did not come across any information on economic and business conditions
- Other sources of information (please specify) - [open text box]

Thank you for taking part in our survey!

B Proofs

Proof of Theorem 1.

Proof. The proof follows from the possibility of the linear representation of SOEU in KMM, as sketched below. In the KMM version of SOEU, the DM maximises the weighted sum of expected utilities:

$$\sum_{k=0}^{m} \mu_k \cdot \psi\left(\mathbf{E}_{\pi_k}(u)\right),$$

where ψ is a map from reals to reals, and reflects the subject's ambiguity attitude: it is linear for ambiguity-neutral subjects, and concave for ambiguity-averse. Take any one particular value of μ and the respective term in the above sum, and represent it as

$$\mu_k \cdot \psi\left(\mathbf{E}_{\pi_k}(u)\right) = \phi\left(\mu_k\right) \cdot \mathbf{E}_{\pi_k}(u),$$

where

$$\phi\left(\mu_k\right) = \mu_k \cdot \frac{\psi\left(\mathbf{E}_{\pi_k}(u)\right)}{\mathbf{E}_{\pi_k}(u)} \tag{12}$$

is the transformation of μ that reflects subjects' ambiguity attitudes. Note that for each μ_k the distribution π_k is uniquely determined, hence for a given u the term $\mathbf{E}_{\pi_k}(u)$ is

known. Given ambiguity attitudes ψ, (12) uniquely determines transformation $\phi(\mu(\pi)) = \phi(\mu_k)|_{k=0..m}$.

For example, ambiguity-aversion is reflected in concavity of ψ, hence $\psi(\mathbf{E}_{\pi_k}(u) \cdot 1) \geq \mathbf{E}_{\pi_k}(u) \cdot \psi(1)$. In a normalised case, $u(0) = \psi(0) = 0$ and $u(1) = \psi(1) = 1$, we obtain $\psi(\mathbf{E}_{\pi_k}(u) \cdot 1) \geq \mathbf{E}_{\pi_k}(u)$ and hence ambiguity-averse subjects are characterised with $\phi(\mu_k) \geq \mu_k$, i.e. they place more emphasis on distributions π that lead to lower expected utilities than the highest possible.

Ambiguity-neutrality implies $\phi(\mu_k) = \mu_k$, i.e. no transformation of the underlying "signal" about possible probability distributions π. ■

Proof of Lemma 3.

Proof. For compound distributions holds

$$Var_w(i) = \mathbf{E}_\mu\left(Var_{\rho^k}(i)\right) + Var_\mu\left(\mathbf{E}_{\rho^k}(i)\right),$$

where Var_w is the variance operator for distribution w, and $\mathbf{E}_w$ is the respective mathematical expectation operator.

From $Var_{\rho^k}(i) \geq Var_\rho(i)$ obtain $\mathbf{E}_\mu\left(Var_{\rho^k}(i)\right) \geq Var_\rho(i)$ and use $Var_\mu\left(\mathbf{E}_{\rho^k}(i)\right) > 0$. ■

Proof of Proposition **??**.

Proof. Re-order probability distributions ρ^k monotonically in variances: $Var_{\rho^k}(i) \leq Var_{\rho^{k+1}}(i)$. Define $\widehat{k} : Var_{\rho^k}(i) < Var_\rho(i)$ and $Var_{\rho^{\widehat{k}+1}}(i) \geq Var_\rho(i)$. Focus on distributions μ such that the following condition is met:

$$\sum_{k=1}^{\widehat{k}} \mu_k Var_{\rho^k}(i) + \sum_{k=\widehat{k}+1}^{K} \mu_k Var_{\rho^k}(i) + Var_\mu\left(\mathbf{E}_{\rho^k}(i)\right) > Var_\rho(i).$$

These distributions meet $\sum_{k:Var_{\rho^k}(i)<Var_\rho(i)} \mu_k < \widehat{\mu} = \sum_{k=1}^{\widehat{k}} \mu_k$. If $\widehat{k} = 0$ (all expectations before announcement are less precise than after) then $\widehat{\mu} = 0$, and all distributions μ meet the condition. The existence of the threshold is guaranteed by the assumption that at least some distributions ρ^k meet $Var_{\rho^k}(i) \geq Var_\rho(i)$. To show this, assume that there is only one such distribution, with number K. We can then write

$$\sum_{k=1}^{K-1} \mu_k Var_{\rho^k}(i) + \mu_K Var_{\rho^K}(i) + Var_\mu\left(\mathbf{E}_{\rho^k}(i)\right) > Var_\rho(i).$$

Due to $\mu_K = 1 - \sum_{k=1}^{K-1} \mu_k = 1 - \widehat{\mu}$, and by noting that the ordering of ρ^k implies $Var_{\rho^1}(i) \leq Var_{\rho^k}(i)$ for any k, the left-hand side is equivalent to

$$\begin{aligned} & \sum_{k=1}^{K-1} \mu_k Var_{\rho^k}(i) + (1-\widehat{\mu}) \cdot Var_{\rho^K}(i) + Var_{\mu}\left(\mathbf{E}_{\rho^k}(i)\right) \\ > & \sum_{k=1}^{K-1} \mu_k Var_{\rho^1}(i) + (1-\widehat{\mu}) \cdot Var_{\rho^K}(i) + Var_{\mu}\left(\mathbf{E}_{\rho^k}(i)\right) = \\ = & \widehat{\mu} \cdot Var_{\rho^1}(i) + (1-\widehat{\mu}) \cdot Var_{\rho^K}(i) + Var_{\mu}\left(\mathbf{E}_{\rho^k}(i)\right). \end{aligned}$$

We only need to require that

$$\begin{aligned} & \widehat{\mu} \cdot Var_{\rho^1}(i) + (1-\widehat{\mu}) \cdot Var_{\rho^K}(i) + Var_{\mu}\left(\mathbf{E}_{\rho^k}(i)\right) > Var_{\rho}(i) \Leftrightarrow \\ & \widehat{\mu} < \frac{Var_{\rho}(i) - Var_{\rho^K}(i) - Var_{\mu}\left(\mathbf{E}_{\rho^k}(i)\right)}{Var_{\rho^1}(i) - Var_{\rho^K}(i)}. \end{aligned}$$

The sign flips due to $Var_{\rho^1}(i) - Var_{\rho^K}(i) < 0$. Also note that $Var_{\rho}(i) - Var_{\rho^K}(i) < 0$, which ensures the right-hand side is strictly positive. This completes the proof of the existence of $\widehat{\mu}$. ■

Proof of Proposition 4.

Proof. First assume $a(1) > a(0)$ and show this implies an increase in average precision. Some uninformed subjects become informed, precision of their beliefs improves and becomes $Var_{\rho^{CB}}(i)$.

$$\begin{aligned} a(0) \cdot Var_w(i) + (1-a(0)) \cdot Var_{\kappa}(i) &> a(1) \cdot Var_{\rho^{CB}}(i) + (1-a(1)) \cdot Var_{\kappa}(i) \\ a(0) \cdot (Var_w(i) - Var_{\kappa}(i)) &> a(1) \cdot \left(Var_{\rho^{CB}}(i) - Var_{\kappa}(i)\right) \\ \frac{a(1)}{a(0)} &> \frac{Var_{\kappa}(i) - Var_w(i)}{Var_{\kappa}(i) - Var_{\rho^{CB}}(i)} = \widehat{a}. \end{aligned}$$

The sign flips due to division by a negative term. By the information strength assumption $Var_{\kappa}(i) > Var_w(i) > Var_{\rho^{CB}}(i)$ holds $0 < \widehat{a} < 1$ and therefore $a(1) > a(0)$ is always true.

Second, assume $a(1) < a(0)$. The fraction of informed subjects shrinks, some of them become uninformed, yet it is unreasonable to assume their precision becomes Var_{κ} as this would be equivalent to disregarding information they had before announcement. More precisely, for time $t = 1$ the average precision is given by: $a(1) \cdot Var_{\rho^{CB}}(i) + (1-a(0)) \cdot$

$Var_\kappa(i) + (a(0) - a(1)) \cdot Var_w(i)$. By manipulations as above obtain that if $a(1) > 0$ then condition

$$\begin{gathered} a(0) \cdot Var_w(i) + (1 - a(0)) \cdot Var_\kappa(i) \\ > \\ a(1) \cdot Var_{\rho^{CB}}(i) + (1 - a(0)) \cdot Var_\kappa(i) + (a(0) - a(1)) \cdot Var_w(i). \end{gathered}$$

is equivalent to $Var_w(i) > Var_{\rho^{CB}}$, which always holds by the information strength assumption.

For the second part:

$$\begin{aligned} a(0) \cdot Var_w(i) + (1 - a(0)) \cdot Var_\kappa(i) &> a(1) \cdot Var_{\rho^{CB}}(i) + (1 - a(1)) \cdot Var_\kappa(i) \\ a(0) \cdot (Var_w(i) - Var_\kappa(i)) &> a(1) \cdot \left(Var_{\rho^{CB}}(i) - Var_\kappa(i)\right) \\ \frac{Var_w(i) - Var_\kappa(i)}{Var_{\rho^{CB}}(i) - Var_\kappa(i)} &< \frac{a(1)}{a(0)} \\ \frac{a(1)}{a(0)} &> \frac{Var_\kappa(i) - Var_w(i)}{Var_\kappa(i) - Var_{\rho^{CB}}(i)} = \widehat{a}. \end{aligned}$$

If $Var_\kappa(i) > Var_w(i) > Var_{\rho^{CB}}(i)$ then $0 < \widehat{a} < 1$, and therefore $a(1) > a(0)$ suffices to ensure the above inequality. ■

C Additional results

Table 11: Implications News Confidence

	(1) Stocks b/se	(2) Safe b/se	(3) Deposit b/se	(4) Mortgage b/se	(5) Durable b/se	(6) Other b/se
ExpRealrate	-1.641***	-0.176	-0.841*	-0.065	1.150*	1.153*
	(0.41)	(0.45)	(0.38)	(0.52)	(0.54)	(0.57)
NewsFed=1	142.137***	47.293***	38.464***	23.350*	-38.106***	-47.714***
	(10.11)	(9.63)	(9.21)	(10.75)	(10.50)	(10.70)
NewsFed=1 × ExpRealrate	1.681	1.354	1.372*	1.487	2.494**	2.313*
	(0.87)	(0.78)	(0.67)	(0.86)	(0.85)	(1.01)
CONFRealrate=1	22.070*	18.212	0.026	36.877**	-40.527***	-19.128
	(9.75)	(10.49)	(9.06)	(11.80)	(11.30)	(11.58)
CONFRealrate=1 × NewsFed=1	10.988	1.285	9.057	-32.136	20.795	3.546
	(18.08)	(17.66)	(16.45)	(19.36)	(18.77)	(19.43)
Constant	142.569***	214.090***	125.936***	240.783***	328.795***	536.499***
	(4.92)	(5.36)	(4.92)	(6.00)	(6.00)	(6.09)
Observations	7331	7454	6396	7231	7561	9249

Table 12: Interest Rate Surprises and News

	(1) PastInfl b/se	(2) PastInfl b/se	(3) ExpInfl b/se	(4) ExpInfl b/se	(5) PastRate b/se	(6) PastRate b/se	(7) ExpRate b/se	(8) ExpRate b/se
Announcement	-0.024	-0.023	0.227	0.223	-0.214	-0.214	-0.087	-0.088
	(0.22)	(0.22)	(0.20)	(0.20)	(0.15)	(0.15)	(0.16)	(0.16)
NewsFed	-0.728***	-0.447	0.033	0.275	-1.289***	-1.139***	-0.999***	-0.821***
	(0.24)	(0.29)	(0.21)	(0.27)	(0.16)	(0.20)	(0.17)	(0.22)
surprise		1.593		2.766		1.065		1.116
		(2.14)		(1.93)		(1.48)		(1.58)
NewsFedSurp		-5.186		-4.412		-2.762		-3.289
		(3.26)		(2.94)		(2.25)		(2.41)
Survey	No	No	No	No	No	No	No	No
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.017	0.017	0.009	0.009	0.045	0.046	0.046	0.047
N	5110.000	5110.000	5110.000	5110.000	5110.000	5110.000	5110.000	5110.000

Table 13: Relevance of Press Conference for News Heard

	(1)	(2)	(3)
		before Announcement	After Announcement
		Share of People that heard News	
Press Conference	0.33	0.28	0.37
NO Press Conference	0.25	0.25	0.25
Total	0.32	0.28	0.36
N	15172	7620	7549

Table 14: Regional Distribution

	(1)	(2)	(3)
	est1	with controls	with controls
	b/se	b/se	b/se
NewsFed			
Announcement (d)	0.078***	0.095***	0.103***
	(0.01)	(0.01)	(0.01)
nopress (d)	-0.072***	-0.102***	-0.061***
	(0.01)	(0.01)	(0.02)
Anopress (d)			-0.083***
			(0.03)
Survey	No	Yes	Yes
Demographics			
Regional			
N	15169.000	12523.000	12523.000

Note: Marginal Effects reported