Monetary Policy, Firms' Inflation Expectations and Prices: Causal Evidence from Firm-Level Data.

Marco Bottone[‡] and Alfonso Rosolia[‡]

Abstract

We empirically explore the direct and immediate response of firms' inflation expectations to monetary policy shocks. We use the Bank of Italy's quarterly Survey of Inflation and Growth Expectations, in operations since 2000, and compare average point inflation expectations of firms interviewed in the days following scheduled ECB Governing Council meetings with those of firms interviewed just before them; we then relate their difference to the change in nominal market interest rates recorded on Governing Council meeting days, a gauge of the unanticipated component of monetary policy communications. We find that unanticipated changes in market rates are negatively correlated in a statistically significant way with the difference in inflation expectations between the two groups of firms and that this effect becomes stronger since 2009. We do not find evidence that firms' pricing plans are affected by these monetary policy shocks nor that firms perceive significant changes in the main determinants of their pricing choices.

[‡]Bank of Italy - DG Economics, Research and Statistics - Statistical Analysis Directorate. The views expressed are not necessarily shared by the Bank of Italy. We thank Andrea Brandolini, Federico Cingano, Giuseppe Ferrero, Fabrizio Ferriani, Giuseppe Ilardi, Marcello Pericoli, Marco Taboga, Giovanni Veronese for comments and help with the data. We also thank Stefano Iezzi who participated to the project in its early stages.

1 Introduction

Monetary policy actions are transmitted to the economy through several channels that initially involve the response of financial markets and, subsequently, that of households and firms to financial market conditions[1]. The inflation expectations of the agents involved in this chain of events shape their perceived real rates and are therefore central in determining the real effects of central banks' actions. Recently, scholars and policy makers have extensively considered also the possibility that these expectations respond *directly* to monetary policy decisions. For example, Bernanke (2007) suggests that "If the public's long-term inflation expectations are influenced directly by Fed actions [...] the output costs of disinflation may be lower than those suggested by reduced-form-type Phillips curves. Intuitively, if the Fed attempts to disinflate by raising the federal funds rate, the disinflationary effect will be felt not only through the usual output gap channel but also through a direct restraint on long-term inflation expectations.". Against this backdrop, research has focussed on measures of expected inflation reported by professional forecasters or implied by financial market prices; we still lack a thorough empirical assessment of the effects of monetary policy actions on inflation expectations of households and firms.

In this paper we quantify the direct effects of monetary policy shocks on firms' inflation expectations and on firms' decisions about future own selling prices exploiting the timing of data collection of an Italian firm survey relative to scheduled ECB Governing Council meetings. We

[1]This chain of events is well described by prominent policy makers. For example, "The most direct and immediate effects of monetary policy actions, such as changes in the federal funds rate, are on the financial markets; by affecting asset prices and returns, policymakers try to modify economic behavior in ways that will help to achieve their ultimate objectives." (Bernanke and Kuttner (2005)); "In particular, while the first step in the transmission process of monetary policy is typically related to very short-term inter-bank interest rates, the wider transmission requires that these effects spread more widely to medium- and longer-term rates. In the next step, the monetary policy impulse spreads to the pricing of assets that are relevant for the financing conditions of households and corporations, their consumption, production and investment decisions and, finally, inflation." (Constâncio (2014); "I will subdivide the transmission mechanism into two parts - one linking monetary policy actions to financial market conditions and the other linking financial market conditions to spending decisions of households and firms" (Praet (2016)). See Boivin, Kiley and Mishkin (2010) for an overview of the literature.

base our inference on data reported by the middle and top management of a large sample of manufacturing and service firms within the quarterly Survey of Inflation and Growth Expectations run by the Bank of Italy for almost 20 years. Among other things, firms report the consumer price inflation they expect over several horizons and the change in own selling prices they expect to implement in the coming year. Importantly, fields operations last only between 15 and 35 days each quarter and nearly all waves include a scheduled monetary policy meeting of the ECB Governing Council. This allows us to compare replies of firms interviewed just after a given meeting to those of firms interviewed just before it and to relate their difference to high frequency changes in market interest rates recorded around scheduled GC meetings. The latter is a now popular gauge of unanticipated monetary policy news disclosed by monetary policy authorities in their communications plausibly unaffected by other, lower frequency, concurring determinants of interest rate movements (Cook and Hahn (1989), Kuttner (2001), Cochrane and Piazzesi (2002), Bernanke and Kuttner (2005)). Our research design provides a credible identification strategy for the direct effects of monetary policy on firms' inflation expectations and pricing decisions: intuitively, the very short time span between the monetary policy shock and the revision of expected inflation and own prices ensures the revisions are not a response to other transmission channels of the monetary policy impulse.

We find that firms' inflation expectations are significantly related to these gauges of monetary policy shocks: over the entire period under scrutiny, an unanticipated increase of 1 percentage point in the 3-months Overnight Indexed Swap rate on GC meeting days is associated with 0.5 percentage points lower expected 1 year ahead inflation of firms interviewed in the immediate aftermath with respect to those interviewed just before. When we restrict our attention to the period following the global financial crisis, we find even stronger effects, both economically and statistically. Over this period, unanticipated changes in both short spot and long forward rates turn out to be negatively related to expected inflation one year ahead and beyond; the link between inflation expectations at various horizons and long forward rates becomes stronger after 2012, when forward guidance became more explicit and the ECB growingly resorted to unconventional monetary policy tools.

These findings show that firms quickly become aware of monetary policy shocks and update their information set and inflation expectations accordingly. It is obviously highly unlikely that firms themselves closely follow financial market developments on Governing Council days. More likely, the importance of the various ECB communications is conveyed through the media. The results therefore suggest that firms know which events and sources to pay attention to, and have the ability to extract relevant information to update their expectations. In this sense, they imply that informational frictions - at least as concerns the stance of monetary policy - are limited, in terms of both information availability and processing capacity[2].

We then turn to the response of future own selling prices and find that they are not associated in a statistically significant way to unanticipated interest rate changes on GC meeting days. This is surprising only at first. In fact, we show that a weaker statistical significance of monetary policy shocks in a regression of own price future developments than in one of expected consumer inflation is to be expected. The muted response of own future prices might also be partly traceable to the workings of offsetting monetary policy transmission mechanisms, as demand and cost channels. To assess their relevance we turn to the firms' qualitative assessments of the role played by several factors in shaping own price dynamics. Specifically, firms are asked to coarsely report how relevant the demand for own products and the cost of labour and raw materials are for the expected developments in own prices. If absence of an effect of monetary policy shocks also reflected short-run counteracting (standard and non-standard) effects we should detect at least some signal that after observing an unexpected monetary policy easing

[2]This result may help better frame the relevant assumptions for a new generation of models of the behaviour of firms subject to informational as well as operational constraints in setting their prices (for example, Sims (2003), Maćkowiak and Wiederholt (2009), Alvarez, Lippi and Paciello (2018)).

firms anticipate stronger demand and possibly lower costs over the coming months. However, the firms' direct qualitative assessment of the role of demand for own products in putting upward pressures on selling prices turns out to be largely unaffected by monetary policy surprises; similarly, no clearcut effect is detectable as concerns the importance of cost push factors.

All in all, our results show that in the aftermath of unanticipated monetary policy shocks identified from high frequency movements in interest rates firms significantly and consistently revise their consumer price inflation expectations; we do not find strong statistical evidence of other effects on firms' pricing strategies and on their views of the broader short-run economic outlook, a fact that may be traced to the low statistical power of the monetary policy shocks combined with the greater cross-sectional heterogeneity in individual circumstances. It is however worth stressing that failure to detect these effects does not question the broader effectiveness of monetary policy in steering economic activity. Because our identification strategy is based on the nearly contemporaneous response of the outcome variables to monetary policy shocks, it does not capture the standard indirect effects of monetary policy on firms' decisions.

Our paper stands at the junction between two strands of research. On one hand, it is related to the literature that uses survey or experimental data to study agents' expectations. Because of the greater data availability this literature has largely focussed on the inflation expectations of households, mostly tackling issues related to their formation and their effects on households' choices (for example, Carroll (2003), Souleles (2004), Armantier, Nelson, Topa, van der Klaauw and Zafar (2016), Christelis, Georgarakos, Jappelli and van Rooij (2016), Binder (2017), Cavallo, Cruces and Perez-Truglia (2017), Ehrmann, Pfajfar and Santoro (2017)). Inflation expectations of firms, the ultimate price setters, have received substantially less empirical attention due to the lack of suitable data (Bernanke (2007)); existing studies mostly explore how expectations form and evolve with incoming information and how they correlate with firm choices (Bartiloro, Bottone and Rosolia (2017), Conflitti and Zizza (2018), Coibion, Gorodnichenko and Kumar (2018b), Coibion, Gorodnichenko and Ropele (2018a), Ropele (2017), Grasso and Ropele (2017)). Moreover, the low frequency of survey data significantly limits the possibility of studying agents' responses to well identified high frequency shocks. On the other, we speak to a well established empirical macroeconomic literature that studies the aggregate effects of monetary policy shocks by means of high frequency identification strategies. As concerns the response of inflation expectations, this literature has focussed only on those of professional forecasters or implicit in financial market prices, for which data exist at frequencies not too different from those underlying the identification of monetary innovations (for example, Romer and Romer (2000), Canova and Gambetti (2010)), Andrade, Breckenfelder, De Fiore, Karadi and Tristani (2016), Karadi (2016), Gambetti and Musso (2017), Delle Monache and Bulligan (2017), Bulligan (2018), Nakamura and Steinsson (2018)). Our contribution complements and bridges these two lines of investigation: we focus on price-setters and combine survey data with carefully identified high frequency monetary policy shocks to study the direct response of inflation expectations and pricing decisions.

The paper is organized as follows. In the next section we briefly describe the research design and the basic identification strategy. We then document that unanticipated rate changes on GC meeting days do carry additional informational content. Next, we illustrate our main empirical exercises and findings. Finally, we conclude.

2 The research design

Firms' inflation expectations evolve with the underlying information set. Therefore, a reliable assessment of the direct effect of monetary policy innovations on expectations requires that the information set is manipulated so that the estimation is based on comparisons of firms with identical information sets except for the monetary policy innovation.

We make this intuition operational by exploiting the Bank of Italy's quarterly Survey on Inflation and Growth Expectation (SIGE). Since 1999, a broad sample of manufacturing, non financial services and construction firms with at least 50 employees is asked to report, among other things, their point expectations on Italian consumer price inflation one year ahead and their own selling price expected developments over the same horizon; more recently, also inflation expectations over longer horizons have been collected[3]. Bartiloro, Bottone and Rosolia (2019) extensively document how firms' inflation expectations collected with the survey evolve with the broader available information set and, among other things, show that they behave very much like Consensus inflation forecasts (see figure (1)).

Importantly, the SIGE is administered quarterly and within a generally very short time frame, between 15 and 35 calendar days. Knowledge of the day of the interview allows us to compare expectations of firms interviewed before specific ECB Governing Council monetary policy meetings with those of firms interviewed just after them. Figure (2) plots, for each wave, the share of firms that have been interviewed after the relevant GC meeting and the share of days of fieldwork taking place after GC days. In general, between 60 and 80 percent of the interviews are returned after the GC meeting, largely reflecting the fact that the meeting itself tends to fall in the first half of the field period; only few fieldworks do not contain a GC meeting. Figure (3) displays the predicted probability of answering after GC day against the actual event; predicted probabilities are estimated by a probit model for the event of returning the questionnaire after GC day on the log of employees and on dummies for industry, area and size class. The two distributions are basically identical, with perhaps only about one percentage point higher median likelihood of a late interview among late interviewees, suggesting that the observable characteristics under scrutiny do not help predict when the questionnaire will be

[3]The survey also collects qualitative sentiment information on a variety of aspects of the economy at large and of real and financial aspects of own business. See Bartiloro et al. (2017) for further details and a descriptive analysis of the information content of the survey.

completed with respect to the relevant GC day.

We postulate the following general model for the inflation expectations formulated by survey respondents:

$$\pi^e_{idt} = \beta I_{idt}(d > m_t) S_{m_t} + \Phi_t + \epsilon_{idt} \qquad (1)$$

where π^e_{idt} are inflation expectations of firm i collected on day d of survey field t, S_{m_t} is the monetary policy news disclosed by the GC meeting held on day m of survey field t and $I_{idt}(d > m_t)$ is a dummy equal to one if, within survey field t, the firm has been interviewed after the GC meeting held on day m; Φ_t is a survey field dummy that collects all information common to survey respondents within a given field, among which the initial stance of monetary policy; ϵ_{idt} is a residual.

An estimate of β from equation (1) represents an assessment of the direct casual effect of monetary policy news on firms' inflation expectations provided S_{m_t} is a reliable measure of unanticipated monetary policy news. Under this assumption, it is possible to rule out that the news is correlated with unobserved determinants of firms' inflation expectations ϵ_{idt}, thus biasing inference about β. Note this is true even if firms endogenously choose when to report their expectations during the survey field because it is unlikely that S_{m_t}, the unanticipated news, belong to the information set governing the choice when to answer[4].

[4] Formally, equation (1) implies that $E(\pi^e_{idt}|I_{idt} = 1) = \beta S_{m_t} + \Phi_t + E(\epsilon_{idt}|I_{idt} = 1)$ and $E(\pi^e_{idt}|I_{idt} = 0) = \Phi_t + E(\epsilon_{idt}|I_{idt} = 0)$. Therefore, at a given t the difference between average expectations of firms interviewed after and before the GC meeting is $E(\pi^e_{idt}|I_{idt} = 1) - E(\pi^e_{idt}|I_{idt} = 0) = \beta S_{m_t} + E(\epsilon_{idt}|I_{idt} = 1) - E(\epsilon_{idt}|I_{idt} = 0)$ and $E(\hat{\beta}) = \beta + \frac{cov(S_{m_t}, \Delta e_t)}{Var(S_{m_t})}$, where Δe_t is the difference in the average unobserved determinants of expected inflation between firms interviewed before and after a given GC meeting. The above expression shows that β is correctly identified even if firms do select themselves across the GC meeting provided the choice to do so is unrelated to S_{m_t}.

3 Monetary policy shocks

Central banks' announcements set the overall stance of monetary policy, both by setting target interest rates and through communication (Blinder, Ehrmann, Fratzscher, De Haan and Jansen (2008)); agents and markets react however to the unexpected component of such announcements. A measure of this surprise component is thus necessary to study the causal response of variables of interest to monetary policy. A popular strategy, based on the increasing availability of high frequency data, relies on measuring the difference between the newly announced reference rate and the corresponding market expectation implicit in specific financial instruments, typically futures (Kuttner (2001)) or high frequency changes in financial markets recorded on days of specific events (Cochrane and Piazzesi (2002)). This event study approach has been further developed, mostly to account for the fact that central bank announcements provide information beyond the actual rate change that may be missed by the measured surprise at the short-end of the yield curve, for the fact that when monetary policy turns to unconventional tools because the zero lower bound bites the reference rate is no longer an exhaustive measure of the stance of monetary policy and to account for the fact that measured surprises may reflect both unexpected changes in the policy stance and the underlying information the central bank is endogenously responding to (for example, Gürkaynak, Sack and Swanson (2005a), Rogers, Scotti and Wright (2014), Matheson and Stavrev (2014), Hanson and Stein (2015), Pericoli and Veronese (2017), Jarociński and Karadi (2018)).

In the following, our main measure of unexpected monetary policy news disclosed by ECB announcements is the daily change in select spot and forward interest rate swaps at various maturities recorded on days of scheduled monetary policy meetings of the ECB Governing Council[5].

[5]Empirical studies based on this event-study methodology generally include also other prominent public events involving policy makers (e.g. speeches, hearings, lectures). We instead focus only on scheduled official meetings of the Governing Council that are more widely reported in the general press and thus more visible to

We start out documenting that scheduled GC days are associated with significant excess volatility of market rates, that is with larger daily changes, all along the term structure plausibly reflecting unexpected news disclosed by ECB communications. Specifically, we focus on 1-, 3-, 6- and 12-months Overnight Indexed Swap (OIS) rates, on the 1 year forward 1 year OIS rate, and on the 5 years forward 5 year interest rate swap with the 6-month Euribor rate and model the rate-specific absolute value of the daily change (ΔR_t) as:

$$|\Delta R_t| = \alpha + \sum_{x=-z}^{x=+z} \delta_x M_{t+x} + \beta_1 |\Delta R_{t-1}| + \beta_2 |\Delta R_{t-2}| + d_t + w_t + q_t + \epsilon_t \tag{2}$$

where d_t, w_t, q_t are day-of-week, week-of-year and time (in quarters) dummies and M_{t+x} is a dummy equal to one if a monetary policy meeting took place x days away from t. We focus on a window of $\{-2, +2\}$ days around monetary policy announcements, thus the coefficients δ_x measure the differential average size of daily changes on GC days and within 2 days around them with respect to days farther away.

In table (1) we report estimates of equation (2) based on the overall period since 1999 or slightly later, depending on data availability. The table report estimates and p-values for the δ_x coefficients estimates on rates of various maturities; for ease of comparison, we also report the corresponding constant α, an estimate of the average absolute change conditional on the control set. At all maturities, absolute daily rate changes on GC days are on average larger by an additional 1-3 basis points. This is a sizeable effect: compared with the mean change, for nearly all short rates under examination it implies a doubling of volatility on GC days; for longer rates, while still sizeable, it represents a smaller fraction of the underlying volatility. Yet, just around GC days no such excess volatility is detectable meaning, in particular, that unanticipated changes are on average permanent and are not undone by market activity in the days following GC meetings. The excess volatility detectable also on long term forward

the general public and not subject to the possibility that they are selected in the sample precisely because the markets reacted substantially.

rates is in line with evidence provided, for example, by Gürkaynak, Sack and Swanson (2005b) and Nakamura and Steinsson (2018) that show that in the US monetary policy surprises are correlated with long-term forward rates in a statistically significant way, in contrast with what standard macroeconomic monetary models would predict[6].

A reasonable concern about this measure of monetary policy news is that in the vicinity of the effective lower bound for interest rates it cannot detect further monetary policy easings. In table (4) we have replicated the above estimates for the period since June 2012 to explore whether, with the adoption of unconventional monetary policy tools, the excess volatility detected on GC days has vanished especially at the short-end of the curve. Also, the change in communication and the stronger reliance on forward guidance may have dampened volatility by increasing policy predictability (e.g. Ferrero and Secchi (2009)). While lower than that detectable on average over the past 20 years, excess volatility is still significant on GC meeting days. Consistently with the adoption of unconventional policies, such excess volatility appears to have become stronger at the long end of the curve. Importantly, results (not reported) for the complementary period of "conventional" monetary policies still show excess volatility throughout the term structure, suggesting that the response of long term forward rates to monetary policy surprises detected in table (1) above is not driven by the more recent period of unconventional policies aimed at that portion of the curve.

A further concern is that the excess volatility detectable on GC days is not only the reaction to unanticipated news on the monetary policy stance given the fundamentals but that it also reflects new information about the fundamentals disclosed by central bank communications.

[6] More realistic models able to replicate these empirical patterns imply a more complex interplay between monetary policy actions and interest rate developments along the term structure. For example, Gürkaynak et al. (2005b) augment an otherwise standard model to allow for the possibility that agents' expectations are not well anchored reflecting imperfect information about the (time-varying) central bank inflation target; Hanson and Stein (2015) introduce yield-oriented investors to explain the role of term premia in causing even longer lasting effects of monetary policy shocks on forward real rates; Nakamura and Steinsson (2018) consider the possibility that monetary policy news also affect beliefs about developments in the natural rate of interest to explain the fact that monetary policy shocks move forward real rates far in the future.

The seminal paper of Romer and Romer (2000) shows that commercial forecasters adapt their forecasts extracting signals on the FOMC's information set from FOMC actions; more recently, Jarociński and Karadi (2018) combine high frequency movements in short rates and stock market indexes to show that changes in swap rates in a half-hour window around ECB GC meetings and FOMC are partly traceable to the new information on the economic outlook disclosed by central bank communication and to which the central bank reacts; Nakamura and Steinsson (2018) document that unexpected increases in real rates around FOMC meetings are associated with higher expected output growth rates, suggesting that the public learns about other fundamentals beyond the path of policy rates.

In an attempt to quantify the role of newly disclosed information in our setting, we replicate the previous analysis augmenting the empirical model so as to allow for a differential excess volatility on GC meetings likely to be associated with novel information on fundamentals. We do that in two ways. First, similarly to Nakamura and Steinsson (2018), we exploit the fact that some GC meetings are accompanied by broad updates of the macroeconomic scenario. Specifically, four times a year (March, June, September, December) the ECB and the ESCB undertake in-depth revisions of their macroeconomic projections which are routinely referred to in those months' communications of monetary policy decisions. Therefore, if the response of market rates reflected both unexpected changes in monetary policy stance and the underlying new information on the economic outlook triggering it we would expect that excess volatility be different on GC days accompanied with broader updates of the macroeconomic scenario. However, results in table (2) detect no statistically significant difference and (statistically not significant) point estimates of the differential effect are also generally very small. Second, we borrow from Jarociński and Karadi (2018)'s intuition and allow for a differential volatility on GC meeting days when interest rates and stock prices moved in the same direction, suggesting monetary policy reacted to information on fundamentals previously unknown to the general public[7]. Again, results in table (3) do not show statistically significant evidence of differential volatility when the central bank is more likely perceived by markets to be reacting to novel information on fundamentals.

To further delve into whether excess volatility is likely to capture the disclosure of relevant macroeconomic information other than that related to the stance of monetary policy, we compare the additional movements recorded on monetary policy announcements days with those recorded on days of major data releases. We thus estimate a version of equation (2) in which the dummies single out days around data releases of both consumer price inflation and GDP. Results, reported in table (5), do not show any excess volatility around or on days of data dissemination, suggesting that financial markets broadly anticipate the disclosed information.

A final concern with our high-frequency identification strategy is that focussing on a 1-day window may still pose a risk that rate changes reflect shocks other than those related to communications from the central bank. Indeed, researchers typically focus on intraday rate changes recorded over very narrow time windows (30 to 90 minutes) around the events of interest using tick-by-tick financial market data, so that the likelihood of contemporaneous shocks is significantly reduced. However, as shown in Appendix A, the visual comparison of the distribution of intraday 3-month OIS changes from figure 7 in Jarociński and Karadi (2018) with that of daily changes of the same rate as used in our paper suggests that the occurrence of major contemporaneous shocks is rather unlikely over the sample window.

All in all, the evidence presented in this section suggests that the excess volatility detected on GC days is neither systematically related to the disclosure of new information nor significantly dampened by the adoption of unconventional policies around the zero lower bound nor affected

[7]This is operationally similar to Jarociński and Karadi (2018)'s 'poor man"s sign restriction. They show that simply proxying the monetary policy shock with observed short interest rate changes when rates and stock prices moved in opposite directions and the information shock with the stock price change when the two moved in the same direction produces impulse responses very similar to those obtained from a VAR identified with proper sign restrictions.

by sizeable concurring shocks. Therefore, rate changes on GC days are a promising proxy of unanticipated monetary policy news to be contrasted with the change in inflation expectations of firms interviewed around GC meetings.

4 Results

4.1 Inflation expectations

A first insight on the relationship between unanticipated monetary policy news and firms' inflation expectations can be obtained noticing that equation (1) implies:

$$E(\pi^e_{idt}|I_{idt}=1) - E(\pi^e_{idt}|I_{idt}=0) = \beta S_{m_t} + E(\epsilon_{idt}|I_{idt}=1) - E(\epsilon_{idt}|I_{idt}=0) \tag{3}$$

Therefore, under the assumption that $\Delta e_t = E(\epsilon_{idt}|I_{idt} = 1) - E(\epsilon_{idt}|I_{idt} = 0) = 0$, the wave-specific ratios between $\Delta\pi^e_t = E(\pi^e_{idt}|I_{idt} = 1) - E(\pi^e_{idt}|I_{idt} = 0)$ and S_{m_t} represent a set of univariate estimates for β. We focus on surveys from 2002 onwards, when the physical introduction of the Euro made the ECB and its decisions more visible to the general public. Our sample is thus composed of manufacturing and services firms interviewed in the 59 waves of the survey (out of the 63 run between 2002 and 2017) that include a meeting of the Governing Council. Following the previous discussion, we proxy S_{m_t} with daily changes of specific short and long, spot and forward market rates.

Figure (4) provides a preliminary visual summary of the data. Each panel corresponds to a specific interest rate; the y-axis reports the difference between one-year ahead expected inflation of firms interviewed just after and just before a GC meeting and the x-axis reports the change in the relevant interest rate recorded on the corresponding GC day. Broadly speaking, the data are consistent with a negative relationship between unexpected rate changes due to ECB communications and changes in expected inflation. For all rates, not only the cloud of data points is downward sloping, it also systematically goes through the origin thus implying that the sign of the rate change is generally the opposite of that recorded by expected inflation.

Table (6) presents a more quantitative analysis of the wave-specific ratios between rate changes and differences in expected inflation. Panel A reports the shares of negative ratios along with median and mean ratios between $\Delta\pi_t^e$ and S_{m_t} measured by the change on GC meeting days of the spot and forward rates introduced above. As suggested by figure (4) and consistently with theoretical predictions, the ratios are generally negative and their median values, less affected by extreme values, suggest sizeable revisions of inflation expectations in the immediate aftermath of unanticipated monetary policy news. The interpretation of this preliminary evidence rests on the assumption that $\Delta e_t = 0$. This assumption would be violated if determinants of when firms choose to return the questionnaire during the field are correlated with unobserved determinants of their inflation expectations. For example, firms that are more optimistic about the economic outlook, thus expecting all else equal stronger inflation, may be busier with their business and therefore delay their response. While this would not imply a correlation with the unanticipated monetary policy news S_{m_t}, and consequently a bias in OLS estimates of β from equation (1) above, it would lead to inconsistency of the simple univariate ratio estimates summarised in table (6). Therefore, in panel B of table (6) we also report univariate OLS estimates of equation (3) augmented with a constant term. The results are not too far from the corresponding median ratios and consistently show a negative relationship between firms' inflation expectations and unanticipated changes at the shorter end of the term structure on GC meeting days, while the effect of changes of longer spot and forward rates is far from reaching conventional thresholds for statistical significance. These simple estimates assign equal weight to all waves and do not account for the fact that wave-specific mean differences are computed on varying numbers of observations; besides, they make inefficient use of the available information on firms. In panel C we thus estimate equation (1) extended to account for firms' observed heterogeneity. Specifically, all regressions include the log of employees, dummies for the interaction of sector, area and size class, dummies for day-of-week and dummies for survey waves; to further control for the possibility that firms select themselves across the GC meeting day based on observables, we also include a cubic in the probability that the firm is interviewed after the relevant GC meeting estimated by the auxiliary model underlying figure (3). Point estimates are broadly in line with those of panel B, consistently showing a negative relationship, stronger at the shorter end of the curve, between firms' inflation expectations and unanticipated rate changes. However, particularly at the longer end of the curve, the statistical significance of these estimates remains rather low.

These simple regressions implicitly assume that the daily change of the specific rate fully describes the monetary policy shock. However, this is unlikely to be he case. For example, Gürkaynak et al. (2005a) show that the effects of FOMC announcements on daily changes in asset prices reflect two factors, a "target" factor capturing surprises in the current federal funds rate target, and a "policy-path" factor describing changes in future rates that are independent of those in the current funds rate target. These considerations suggest that a more detailed description of the response of the term structure to monetary policy surprises provides more information on the nature of the surprise thus allowing for a cleaner assessment of the links with firms' inflation expectations. Therefore, we estimate a broader version of the empirical model of panel C of table (6) that simultaneously includes changes on GC meeting days of interest rates for 3-month, 1 year-forward 1 year and 5 year-forward 5 year maturities[8]:

$$\pi^e_{it} = \alpha + \beta \Delta R^{3m}_{GC} + \gamma \Delta R^{1f1y}_{GC} + \theta \Delta R^{5f5y}_{GC} + \delta X_{it} + d(i) + \Phi_t + \epsilon_{it} \tag{4}$$

where X_{it} includes the log of employees, dummies for the interaction of sector, area and size class, and a cubic in the probability that the firm is interviewed after the relevant GC meeting; $d(i)$ are dummies for day-of-week when the i's interview takes place and Φ_t are dummies for survey waves.

Column (1) in table (7) reports estimates based on all waves that include a GC meeting between 2002:1 and 2017:3. Results show that an unanticipated increase of 1 percentage point in the 3-month rate on the day of a GC meeting is associated with half percentage point lower 1-year ahead inflation expectations; the estimated coefficient has a p-value of about 8 percent. Changes of forward rates, unaffected by movements at the short end of the curve, still turn out to be not statistically significant in explaining inflation expectations over the entire period under examination.

One possibility for the weak overall response is that rate changes capture both new information and the endogenous policy reaction. Intuitively, an effective monetary policy would imply that inflation expectations remain nearly unchanged as policy action is able to offset economic shocks. In columns (2) and (3) we explore this possibility and try to disentangle the response to unanticipated changes in the stance of monetary policy from the reaction to macroeconomic news information disclosed by central bank communication. We proceed in a spirit similar to Matheson and Stavrev (2014) and Jarociński and Karadi (2018) and split the sample based on

[8] We select these three rates to balance the goal of retaining a sufficiently broad description with the risk of saturating the empirical model with (highly correlated) sources of identifying variation of the parameter of interest. Note that this approach differs from most macroeconometric studies of the effects of monetary policy news in that we do not use factor analysis techniques to extract a synthetic policy indicator from observed daily changes in certain financial instruments (for example, Gürkaynak et al. (2005a), Pericoli and Veronese (2017), Nakamura and Steinsson (2018)) but rather directly relate changes along the term structure of interest rates to expected inflation. In particular, this implies that rate-specific coefficients are identified out of orthogonal variation across interest rates, rather than out of variation in the common component.

the sign of the comovement between 3-months OIS rate and stock prices on GC meeting days. Column (2) reports results for waves in which the two variables moved in opposite directions on GC day, suggesting that rate and stock price developments were driven primarily by unanticipated changes in the stance of monetary policy; column (3) reports results for the remaining waves in which the two variables moved in the same direction on GC meeting days, suggesting that the change in monetary policy stance was accompanied (and driven) by substantive news on the economic outlook. This sample selection rule splits the overall sample in about half. Firms' inflation expectations respond in a statistically significant way to interest rate changes only in the former subsample: an increase of 1 percentage point in 3-month rates cuts 1-year ahead inflation expectations by more than 1 percentage point; the statistical significance is now much higher, with a p-value below 2 percent. In this subsample, inflation expectations are also mildly and positively associated to changes in 1 year forward 1 year rates; longer rates, while still negatively associated, do not turn out to be statistically significant. The lack of response in the subsample of positive comovements of stock prices and short rates is consistent with the effectiveness of monetary policy in hedging demand shocks; on the contrary, the mildly positive correlation with 1-year forward 1 year rate in the subsample of negative comovements is somewhat of a puzzle to which we return later on.

In columns (4) to (7) we explore whether the relationship between firms' inflation expectations and monetary policy surprises has changed with the adoption of unconventional policies and the stronger reliance on forward guidance to overcome the limitations posed by reaching the zero lower bound for policy rates. Specifically, we analyze separately the pre-2009 period (column (4)) and then focus on the periods from 2009 (column (5)), after the global financial crisis, from 2012 (column (6)), when reliance on forward guidance became more explicit, and from 2014 (column (7)), a period prominently featuring the Asset Purchase Programme. Since 2009:2 the Survey also collects point expectations on 2 years ahead consumer price inflation; therefore, in columns (8) to (11) we explore the relationship between rate changes on GC meeting days and longer term inflation expectations for the same three subperiods since the global financial crisis.

Several results are worth pointing out. First, 1-year ahead inflation expectations between 2002 and 2008 are not significantly affected by rate movements on GC meeting days, while the relationship turns out to be stronger and statistically significant in the subsequent period. Overall, this result is consistent with the behaviour of rationally inattentive economic agents who pay less attention to policy making in relatively less volatile times[9]. Between 2002 and the first half of 2008 the average absolute deviation of Italian harmonized inflation from the goal of price stability was less than half a percentage point with a standard deviation of about 0.4; between the second half of 2008 and the third quarter of 2017, the end of our sample, the absolute gap went up to 1.2 percentage points with a standard deviation of about 0.7.

Second, over the period since the global financial crisis the effect of changes in short rates is rather stable and tends to be stronger on longer term inflation expectation, for whom it becomes increasingly more statistically significant. A one percentage point unanticipated increase in 3-month OIS causes a drop of similar size in 1-year inflation expectations, a somewhat larger one 2 years ahead and an almost double one in average inflation expected between 3 and 5 years ahead (col. (11)). This effect is amplified by changes in long term forward rates, detectable since 2012 on 1-year ahead expectations and somewhat earlier for longer term ones. A drop in 5-year forward 5 year rates causes 1-year ahead inflation expectations to drop by about half percentage point since 2012 and a bit more for 2-year ahead inflation expectations and almost twice as much for average inflation expected 3 to 5 years ahead[10]. The puzzling positive

[9] Coibion and Gorodnichenko (2015) show this is the case both in models with information rigidities arising from fixed costs that induce only infrequent updating of the information set (e.g. Mankiw and Reis (2002)) and in models with continuous updating based on noisy information on fundamentals (e.g. Sims (2010)).

[10] The drop of longer term inflation expectations after an unexpected monetary tightening is consistent with results in, for example, Gürkaynak, Levin and Swanson (2010) and Nakamura and Steinsson (2018).

effect on inflation expectations of changes in the 1-year forward 1 year OIS rate is statistically significant only in the last part of the sample.

Identification of the effects of interest substantially hinges on variation of interest rate changes across the 59 GC meetings included in the fieldwork of the Bank of Italy's survey. To assess their robustness to specific episodes we have run a jackknife estimate of the parameters of interest. Specifically, we have re-estimated the model above for all the samples obtainable leaving out all possible combinations of 3 waves (about 5 percent of the sample) underlying estimates in column (1) of table (7); this makes a total of over 32,000 estimates for each of the three parameters of interest. Figure (5) plots the empirical density and cumulative distribution functions of these parameters. Each panel correspond to the distribution of one parameter jackknife estimate. The coefficient on the 3-month OIS change is never positive and, at -0.28, the largest point estimate is well below zero; similarly the coefficient estimated on the 5 years forward 5-year rate is negative in 99 percent of the cases. Their mean values are, respectively, -0.5 and -0.1. On the contrary, estimates of the coefficient on the change of 1 year forward 1 year OIS are clustered just below zero, with mean and median values on opposite sides. Overall, this exercise suggests that the negative relationships detected between short and longer term forward rates detected in table (7) are rather robust to major sample changes and therefore do not hinge on few specific episodes, contrary to what one can conclude about the link between 1 year forward 1 year rates and inflation expectations.

4.2 Other effects of monetary policy shocks

We have shown that unanticipated changes in certain spot and forward market interest rates on days of scheduled GC meetings are associated in a theoretically consistent way to firms' expected consumer price inflation. The very short time span over which these effects materialize suggests that this empirical association reflects a direct effect of monetary policy news on expected inflation. We now turn to exploring whether the same unanticipated rate changes also have direct effects on firms' expectations other than developments of the general price level.

Columns (1) to (4) of table (8) focus on firms' qualitative assessment of developments in the macroeconomic and own business outlook over the recent past and the next three months. Specifically, firms are asked to assess developments over the past three months in macroeconomic conditions (col. 1) and in own investment opportunities (col. 2), and to judge developments over the next three months in the overall (col. 3) and own business (col. 4) outlook. We transform their replies in dummies equal to one if an improvement is reported[11].

Panel A reports results for the entire sample period. It shows that unanticipated monetary policy news do not cause significant revisions of the ex-post assessment of developments over the past 3 months (cols. 1, 2). Notice that point estimates not only have large standard errors but are basically nil for all rate changes and in both columns. While these results should not come as a surprise as they refer to developments over the past 3 months, they are also consistent with the fact that monetary policy news do not disclose news about the recent past. Also expectations about own general business conditions and about macroeconomic developments over the coming quarter are largely unaffected by unanticipated monetary policy news; only changes in long term forward long rates appear to be mildly and positively associated to the likelihood of an economic upturn in the very short-run (cols. 3, 4). The results are largely unchanged if we only focus on survey waves in which short rates and the stock market moved in opposite directions on GC days, plausibly reflecting only unanticipated changes in the monetary stance (Panel B) and when we limit attention to the post-2009 period, over which unanticipated changes in interest rates on GC meeting days displayed a stronger correlation with expected inflation (Panel C)

[11]Appendix B provides further details on the questions originating these variables and on the transformations applied to the replies provided by firms.

We then turn to the relationship between firms' expected own selling price changes, Δ_i^p, and monetary policy shocks using again the specification in equation (4). Estimates in column (5) of Panel A do not show any statistically significant association. In Appendix C we show that conventional macro models embedding meaningful price formation processes imply that standard errors in this regression are expected to be larger than those obtained from regressions of expected inflation on the same shocks, thus leading to weaker statistical significance of the estimated coefficients. Intuitively, in those models expected inflation is the cross-sectional average of own firms' expected price changes[12] (see for example, Galí (2015)). Therefore, when formulating their expectations firms filter out the cross-sectional heterogeneity of own price changes uncorrelated with the unanticipated shock[13].

Point estimates signal a (statistically not significant) positive relationship between price developments and rate changes which is consistent with the existence of offsetting effects of monetary policy, at least in the short run. For example, the so-called "cost channel", by which a monetary tightening increases marginal costs and thus selling prices, would temporarily offset the standard "demand channel", by which a monetary tightening curbs demand thus reducing selling prices, leading to a more muted (or even *wrong*) response of own prices to monetary policy actions[14]. To this end, the survey also provides qualitative information of the perceived

[12]Empirically, this is unlikely to strictly be the case, for example because firms' are asked to report off-the-shelf consumer price expected inflation whereas their own prices mostly refer to domestic producer prices. For example, Vermeulen, Dias, Dossche, Gautier, Hernando, Sabbatini and Stahl (2012) show that in the Euro area the average size of producer price adjustments is much smaller than that of consumer prices, although their frequency adjustment is somewhat higher, while in the US Nakamura and Steinsson (2008) find that the two adjustment sizes are roughly equivalent. Yet, lack of sufficiently detailed firm-level information prevents us from developing a careful research design able to account for the mechanical correlation between expected own and average price changes implied by theory and to allow us to focus on meaningful economic relationships.

[13]Note also that this consideration also implies that a regression of firm-specific price changes on inflation in principle amounts to estimating the effect of the group average of a variable on the individual level of the same variable, an estimate that always yields a unit coefficient (see Angrist and Pischke (2009)).

[14]For example, Christiano, Eichenbaum and Evans (2005) and Ravenna and Walsh (2006). For Italy, Gaiotti and Secchi (2006) analyse the pricing behaviour of a panel of Italian manufacturing firm and show that the cost channel is pervasive and economically relevant. Incidentally, note that the existence of offsetting transmission channels makes an IV estimation of the causal effect of expected inflation on own prices using monetary policy shocks as instruments not credible as the exclusion restriction that monetary policy shocks affect pricing choices

main drivers of own price expected developments. In columns (6) to (8) the dependent variable is a dummy equal to one if, respectively, demand, wages or prices of materials are expected to exert an upward pressure on own prices over the coming 12 months; unfortunately, there is little else to assess the perceived response of financial conditions and costs. In all three cases, the estimated effects of unanticipated rate changes are statistically not significant, signalling that firms' perceptions of price determinants are largely unaffected by our measures of monetary policy actions.

The lack of effects, apparently inconsistent with the presence of offsetting effects of monetary policy, may also reflect the possibility that, as for inflation expectations, the measures of monetary policy shocks embed the central bank endogenous reaction to macroeconomic shocks. Therefore, in panel B we focus only on survey waves when short term rates and stock prices moved in opposite directions on GC meeting day, ideally a cleaner measure of an unanticipated monetary policy tightening/easing. However, also limiting attention to episodes in which this aspect can be plausibly be excluded, firms' expected pricing decisions remain largely unaffected by monetary policy shocks (Panel B). We only detect a statistically significant positive association between perceived upward demand pressures on prices and changes in long term long forward rates and a statistically significant negative one between perceived upward pressures of intermediates costs on own prices and changes in short rates. The latter result could be reconciled with movements of the exchange rate, whose appreciation in response to a monetary tightening curbs the cost of imported intermediates; yet, the former association remains hard to reconcile with standard economic theory if one believes that focussing on periods of negative comovements between short rates and stock market surprises isolates episodes prevalently characterised by unanticipated changes of the monetary stance. We fail to detect statistically significant associations even when focussing on the post-2009 period, characterised by a stronger effect of monetary policy shocks on expected inflation (Panel C).

only through inflation expectations is naturally violated.

5 Conclusions

Agents' inflation expectations play a fundamental role in modern macroeconomics. Understanding how they form, evolve and affect agents' decisions is therefore crucial. This paper contributes to this task by providing empirical evidence on the direct causal relationship between monetary policy shocks and firms' inflation expectations. We combine the standard macroeconometric approach of measuring monetary policy surprises through high frequency financial market movements around central bank communications with the inflation expectations of firms interviewed in the Bank of Italy's Quarterly Survey of Inflation and Growth Expectations since 2000 exploiting dates of interviews.

Results show that inflation expectations are surprisingly sensitive to these measures of monetary policy shocks. On average, the expected inflation one year ahead reported by firms interviewed just after a given GC meeting are half a percentage points lower for each unexpected percentage point increase in the 3-months OIS on GC meeting day; the effect is substantially stronger during the period between 2012 and 2017, when also long forward rates are negatively correlated with inflation expectations. Longer term inflation expectations also respond as expected, and somewhat more strongly, to these monetary policy shocks.

Against this theoretically consistent empirical evidence, we fail to detect a statistically significant effect of the monetary policy shocks underlying our identification strategy on the expected change in own prices over the following year. This finding is consistent both with the coexistence of the standard demand channel of monetary policy with offsetting ones as, for example, the cost channel as well as with the presence of menu costs that prevent continuous price adjustments against incoming information, especially when this involves small shocks. However, when studying the reasons underlying own price pressures reported by the firms, we again fail to detect any systematic relationship of demand or cost channels with monetary policy shocks.

In sum, our results show that central bank communication does significantly and directly affects agents' short- and long-term inflation expectations, even when standard monetary policy tools have limited room of manoeuvre.

References

Alvarez, Fernando, Francesco Lippi, and Luigi Paciello, "Monetary Shocks in Models with Observation and Menu Costs," *Journal of the European Economic Association*, 2018, *16* (2).

Andrade, Philippe, Johannes Breckenfelder, Fiorella De Fiore, Peter Karadi, and Oreste Tristani, "The ECB's Asset Purchase Programme: an Early Assessment," 2016. European Central Bank, Working Paper Series, n. 1956.

Angrist, Joshua D. and Jörn-Steffen Pischke, *Mostly Harmless Econometrics: an Empiricist's Companion*, Princeton University Press, 2009.

Armantier, Olivier, Scott Nelson, Giorgio Topa, Wilbert van der Klaauw, and Basit Zafar, "The Price Is Right: Updating Inflation Expectations in a Randomized Price Information Experiment," *Review of Economic and Statistics*, 2016, *98* (3), 503–523.

Bartiloro, Laura, Marco Bottone, and Alfonso Rosolia, "What does the heterogeneity of the inflation expectations of the Italian firms tell us?," 2017. Bank of Italy, Occasional paper n. 414.

– , – , and – , "The Heterogeneity of the Inflation Expectations of Italian Firms along the Business Cycle," *International Journal of Central Banking*, 2019.

Bernanke, Ben S., "Inflation Expectations and Inflation Forecasting," 2007. Speech at the Monetary Economics Workshop of the National Bureau of Economic Research Summer Institute, Cambridge, Massachusetts.

– and Kenneth N. Kuttner, "What Explains the Stock Market's Reaction to Federal Reserve Policy?," *Journal of Finance*, 2005, *60* (3).

Binder, Carola, "Fed Speak on Main Street: Central Bank Communication and Household Expectations," *Journal of Macroeconomics*, 2017, *52.*

Blinder, Alan S., Michael Ehrmann, Marcel Fratzscher, Jakob De Haan, and David-Jan Jansen, "Central Bank Communication and Monetary Policy: a Survey of Theory and Evidence," *Journal of Economic Literature*, 2008, *46* (4).

Boivin, Jean, Michael T. Kiley, and Frederic S. Mishkin, "How Has the Monetary Transmission Mechanism Evolved Over Time?," in Benjamin M. Friedman and Michael Woodford, eds., *Handbook of Monetary Economics*, Vol. 3 of Handbook of Monetary Economics, Amsterdam: Elsevier, 2010, chapter 8, pp. 369 – 422.

Bulligan, Guido, "The Effect of the Eurosystem Expanded Asset Purchase Programme on Inflation Expectations: Evidence from the ECB Survey of Professioanl Forecasters," 2018. Bank of Italy, mimeo.

Canova, Fabio and Luca Gambetti, "Do Expectations Matter? The Great Moderation Revisited," *American Economic Journal: Macroeconomics*, 2010, *2* (3).

Carroll, Christopher D., "Macroeconomic Expectations of Households and Professional Forecasters," *Quarterly Journal of Economics*, 2003, *118* (1), 269–298.

Cavallo, Alberto, Guillermo Cruces, and Ricardo Perez-Truglia, "Inflation Expectations, Learning and Supermarket Prices - Evidence from Survey Experiments," *American Economic Journal: Macroeconomics*, 2017, *9* (3).

Christelis, Dimitris, Dimitris Georgarakos, Tullio Jappelli, and Maarten van Rooij, “Trust in the Central Bank and Inflation Expectations,” 2016. CSEF Working Papers n. 458.

Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans, “Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy,” *Journal of Political Economy*, 2005, *113* (1), 1–45.

Cochrane, John H. and Monika Piazzesi, “The Fed and Interest Rates: A High Frequency Identification,” *American Economic Review*, 2002, *92* (2).

Coibion, Olivier and Yuriy Gorodnichenko, “Information Rigidity and the Expectations Formation Process: A Simple Framework and New Facts,” *American Economic Review*, 2015, *105* (8).

– , Yurij Gorodnichenko, and Tiziano Ropele, “Inflation Expectations and Firm Decisions: New Causal Evidence,” December 2018. NBER WP n. 25412.

– , Yuriy Gorodnichenko, and Saten Kumar, “How do Firms Form Their Expectations? New Survey Evidence,” *American Economic Review*, 2018, *108.*

Conflitti, Cristina and Roberta Zizza, “What’s behind firms’ inflation forecasts?,” 2018. Bank of Italy, Occasional Papers n. 465.

Constâncio, Vítor, “Understanding the Yield Curve,” 2014. Opening address at the ECB Workshop ”Understanding the yield curve: what has changed with the crisis?”, Frankfurt.

Cook, Timothy and Thomas Hahn, “The Effect of Changes in the Federal Funds Rate Target on Market Interest Rates in the 1970s,” *Journal of Monetary Economics*, 1989, *24* (3), 331 – 351.

Delle Monache, Davide and Guido Bulligan, “Financial Market Effects of ECB Unconventioanl Monetary Policy Announcements,” 2017. Bank of Italy, mimeo.

Ehrmann, Michael, Damjan Pfajfar, and Emiliano Santoro, “Consumers’ Attitudes and Their Inflation Expectations,” *International Journal of Central Banking*, June 2017.

Ferrero, Giuseppe and Alessandro Secchi, “The Announcement of Monetary Policy Intentions,” 2009. Bank of Italy, Discussion Papers, n. 720.

Gaiotti, Eugenio and Alessandro Secchi, “Is There a Cost Channel of Monetary Policy Transmission? An Investigation into the Pricing Behavior of 2,000 Firms,” *Journal of Money, Credit and Banking*, 2006, *38* (8).

Galí, Jordi, *Monetary Policy, Inflation and the Business Cycle: An Introduction to the New Keynesian Framework*, Princeton, NJ: Princeton University Press, 2015.

Gambetti, Luca and Alberto Musso, “The macroeconomic impact of the ECB’s expanded asset purchase programme (APP),” 2017. European Central Bank, Working Paper Series, n. 2075.

Grasso, Adriana and Tiziano Ropele, “Business Investment Plans and Inflation Expectations,” 2017. mimeo, Bank of Italy.

Gürkaynak, Refet S., Andrew Levin, and Eric T. Swanson, “Does Inflation Targeting Anchor Long-Run Inflation Expectations? Evidence from the U.S., UK, and Sweden,” *Journal of the European Economic Association*, 2010, *8* (6), 1208–1242.

– **, Brian Sack, and Eric T. Swanson**, "Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements," *International Journal of Central Banking*, 2005.

– **, – , and –** , "The Sensitivity of Long-Term Interest Rates to Economic News: Evidence and Implications for Macroeconomic Models," *American Economic Review*, 2005, *95* (1).

Hanson, Samuel G. and Jeremy C. Stein, "Monetary Policy and Long-Term Real Rates," *Journal of Financial Economics*, 2015, *115.*

Jarociński, Marek and Peter Karadi, "Deconstructing monetary policy surprises: the role of information shocks," 2018. ECB, Working paper n. 2133.

Karadi, Peter, "The ECB's announcements of non-standard measures and longer-term inflation expectations," 2016. European Centra Bank, Research Bullettin n. 33.

Kuttner, Kenneth N., "Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market," *Journal of Monetary Economics*, 2001, *47* (3).

Maćkowiak, Bartosz and Mirko Wiederholt, "Optimal Sticky Prices under Rational Inattention," *American Economic Review*, 2009, *99* (3).

Mankiw, Gregory N and Ricardo Reis, "Sticky Information vs Sticky Prices: a Proposal to Replace the New Keynesian Phillips Curve," *Quarterly Journal of Economics*, 2002, *117* (4).

Matheson, Troy and Emil Stavrev, "News and Monetary Shocks at a High Frequency: A Simple Approach," 2014. IMF, Working Paper, n. 167.

Nakamura, Emi and Jón Steinsson, "Five Facts about Prices: A Reevaluation of Menu Cost Models," *Quarterly Journal of Economics*, 2008, *123* (4), 1415–1464.

– **and** – , "High Frequency Identification of Monetary Non-Neutrality: The Information Effect," *Quarterly Journal of Economics*, 2018, *133* (3).

Pericoli, Marcello and Giovanni Veronese, "Monetary Policy Surprises over Time," 2017. Bank of Italy, Discussion Paper n. 1102.

Praet, Peter, "Transmission Channels of Monetary Policy in the Current Environment," 2016. Speech at the Financial Times Festival of Finance, London.

Ravenna, Federico and Carl E. Walsh, "Optimal Monetary Policy with the Cost Channel," *Journal of Monetary Economics*, 2006, *53* (2).

Rogers, John H., Chiara Scotti, and Jonathan H. Wright, "Evaluating Asset-Market Effects of Unconventional Monetary Policy: A Multi-Country Review," *Economic Policy*, 2014, *29* (80).

Romer, Christina D. and David H. Romer, "Federal Reserve Information and the Behavior of Interest Rates," *American Economic Review*, 2000, *90* (3).

Ropele, Tiziano, "Inflation expectations and price setting behavior: evidence from business survey data," 2017. mimeo, Bank of Italy.

Sims, Christopher A., "Implications of Rational Inattention," *Journal of Monetary Economics*, 2003, *50* (3), 665 – 690.

– , "Rational Inattention and Monetary Economics," in B.M. Friedman and M. Woodford, eds., *Handbook of Monetary Economics*, Vol. 3, London, UK: North Holland, 2010, chapter 4.

Souleles, Nicholas, "Expectations, Heterogeneous Forecast Errors, And Consumption: Micro Evidence Form The Michigan Consumer Sentiment Surveys," *Journal of Money, Credit and Banking*, 2004, *36* (1).

Vermeulen, Philip, Daniel A. Dias, Maarten Dossche, Erwan Gautier, Ignacio Hernando, Roberto Sabbatini, and Harald Stahl, "Price Setting in the Euro Area: Some Stylized Facts from Individual Producer Price Data," *Journal of Money, Credit and Banking*, 2012, *44* (8), 1631–1650.

Table 1: Interest rates around GC meetings

	(1) 1 month	(2) 3 month	(3) 6 month	(4) 1 year	(5) 1-yf 1 year	(6) 5-yf 5 year
$t+2$	0.07	0.08	0.07	0.59	-0.62	-0.13
	(0.692)	(0.574)	(0.697)	(0.282)	(0.119)	(0.579)
$t+1$	0.18	-0.13	-0.17	0.30	0.49	0.25
	(0.374)	(0.284)	(0.214)	(0.409)	(0.625)	(0.419)
t	1.09***	1.15***	1.45***	1.64***	2.78***	0.86***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
$t-1$	-0.15	-0.29*	-0.15	0.15	0.79	0.67**
	(0.401)	(0.079)	(0.353)	(0.642)	(0.142)	(0.024)
$t-2$	0.03	-0.13	-0.19	-0.31	-0.29	-0.00
	(0.854)	(0.370)	(0.231)	(0.168)	(0.475)	(0.985)
Mean	1.19	1.25	1.49	1.35	2.50	5.08
Obs.	5004	5004	5004	5004	4473	5008

P-values of $H_0 : \beta = 0$ in parentheses (*** p<0.01, ** p<0.05, * p<0.1).
Dependent variable: absolute daily change (basis points) of rate in column heading between January 5th, 1999 and March 15th, 2018 (cols. 1-4), January 17th, 2001 and March 15th, 2018 (col. 5), January 2nd, 1998 and March 15th, 2018 (col. 6). Table reports estimated coefficients on dummies for number of days x between rate change and closest GC meeting: $x < 0$ GC meeting took place x days earlier; $x > 0$ GC meeting will take place in x days. All regressions include also two lags of the dependent variable, and day-of-week, week-of-year and time (in quarters) dummies. "Mean" is value of constant from regression.

Table 2: Interest rates around GC meetings with and without updated information

	(1) 1 month	(2) 3 month	(3) 6 month	(4) 1 year	(5) 1-yf 1 year	(6) 5-yf 5 year
$t+2$	0.07	0.08	0.07	0.59	-0.61	-0.13
	(0.691)	(0.574)	(0.698)	(0.283)	(0.125)	(0.604)
$t+1$	0.18	-0.13	-0.17	0.30	0.50	0.24
	(0.373)	(0.285)	(0.213)	(0.410)	(0.620)	(0.431)
t	1.06***	1.16***	1.47***	1.76***	2.23***	0.79**
	(0.003)	(0.001)	(0.000)	(0.000)	(0.000)	(0.014)
t X Forecasts	0.11	-0.03	-0.04	-0.35	1.61	0.26
	(0.858)	(0.956)	(0.944)	(0.605)	(0.342)	(0.658)
$t-1$	-0.15	-0.29*	-0.15	0.14	0.82	0.64**
	(0.404)	(0.079)	(0.352)	(0.650)	(0.125)	(0.029)
$t-2$	0.03	-0.13	-0.19	-0.32	-0.27	-0.04
	(0.850)	(0.370)	(0.229)	(0.160)	(0.503)	(0.885)
Mean	1.19	1.25	1.49	1.35	2.47	3.22
Obs.	5004	5004	5004	5004	4473	5266

P-values of $H_0 : \beta = 0$ in parentheses (*** p<0.01, ** p<0.05, * p<0.1).
Dependent variable: absolute daily change (basis points) of rate in column heading between January 5th, 1999 and March 15th, 2018 (cols. 1-4), January 17th, 2001 and March 15th, 2018 (col. 5), January 2nd, 1998 and March 15th, 2018 (col. 6). Table reports estimated coefficients on dummies for number of days x between rate change and closest GC meeting: $x < 0$ GC meeting took place x days earlier; $x > 0$ GC meeting will take place in x days. 'Forecast' equals 1 if GC meeting accompanied by broad revisions of macroeconomic forecasts; zero otherwise. All regressions include also two lags of the dependent variable, and day-of-week, week-of-year and time (in quarters) dummies. "Mean" is value of constant from regression.

Table 3: Interest rates around GC meetings and stock market developments

	(1) 1 month	(2) 3 month	(3) 6 month	(4) 1 year	(5) 1-yf 1 year	(6) 5-yf 5 year
$t+2$	0.07	0.08	0.07	0.60	-0.62	-0.13
	(0.692)	(0.574)	(0.697)	(0.282)	(0.117)	(0.603)
$t+1$	0.18	-0.13	-0.17	0.30	0.49	0.24
	(0.375)	(0.284)	(0.215)	(0.407)	(0.625)	(0.433)
t	1.30***	1.14**	1.25***	1.06**	2.07***	0.87**
	(0.008)	(0.012)	(0.003)	(0.024)	(0.000)	(0.023)
t X Comov.	-0.40	0.03	0.37	1.09*	1.34	0.01
	(0.473)	(0.961)	(0.469)	(0.064)	(0.243)	(0.991)
$t-1$	-0.15	-0.29*	-0.15	0.15	0.80	0.64**
	(0.398)	(0.080)	(0.356)	(0.639)	(0.139)	(0.030)
$t-2$	0.03	-0.13	-0.19	-0.31	-0.29	-0.04
	(0.862)	(0.371)	(0.233)	(0.172)	(0.481)	(0.878)
Mean	1.19	1.25	1.49	1.35	2.46	3.22
Obs.	5004	5004	5004	5004	4473	5266

P-values of $H_0 : \beta = 0$ in parentheses (*** p<0.01, ** p<0.05, * p<0.1).
Dependent variable: absolute daily change (basis points) of rate in column heading between January 5th, 1999 and March 15th, 2018 (cols. 1-4), January 17th, 2001 and March 15th, 2018 (col. 5), January 2nd, 1998 and March 15th, 2018 (col. 6). Table reports estimated coefficients on dummies for number of days x between rate change and closest GC meeting: $x < 0$ GC meeting took place x days earlier; $x > 0$ GC meeting will take place in x days. 'Comov.' equals 1 if on GC meeting day stock prices and 3-months interest rates moved in same direction; zero otherwise. All regressions include also two lags of the dependent variable, and day-of-week, week-of-year and time (in quarters) dummies. "Mean" is value of constant from regression.

Table 4: Interest rates around GC meetings during UMP

	(1) 1 month	(2) 3 month	(3) 6 month	(4) 1 year	(5) 1-yf 1 year	(6) 5-yf 5 year
$t+2$	-0.08	-0.10**	-0.10	-0.18**	-0.32*	-0.59
	(0.287)	(0.038)	(0.105)	(0.030)	(0.098)	(0.149)
$t+1$	-0.04	-0.04	-0.03	-0.08	0.05	0.48
	(0.633)	(0.576)	(0.702)	(0.341)	(0.805)	(0.411)
t	0.61***	0.68***	0.81***	1.06***	1.65***	1.34**
	(0.003)	(0.001)	(0.000)	(0.000)	(0.000)	(0.028)
$t-1$	-0.02	-0.13	-0.14	-0.03	0.17	1.02*
	(0.792)	(0.102)	(0.118)	(0.764)	(0.505)	(0.065)
$t-2$	-0.09	-0.05	0.07	0.12	0.14	-0.27
	(0.214)	(0.461)	(0.446)	(0.333)	(0.545)	(0.448)
Mean	0.71	1.01	1.25	0.87	2.36	4.73
Obs.	1508	1508	1508	1508	1508	1508

P-values of $H_0 : \beta = 0$ in parentheses (*** p<0.01, ** p<0.05, * p<0.1).
Dependent variable: absolute daily change (basis points) of rate in column heading between June 1st, 2012 and March 15th, 2018. Table reports estimated coefficients on dummies for number of days x between rate change and closest GC meeting: $x < 0$ GC meeting took place x days earlier; $x > 0$ GC meeting will take place in x days. All regressions include also two lags of the dependent variable, and day-of-week, week-of-year and time (in quarters) dummies. "Mean" is value of constant from regression.

Table 5: Interest rates around data releases

	(1) 1 month	(2) 3 month	(3) 6 month	(4) 1 year	(5) 1-yf 1 year	(6) 5-yf 5 year
	A. Consumer price index					
$t+2$	0.09	0.07	0.01	-0.06	0.31	-0.02
	(0.412)	(0.466)	(0.896)	(0.722)	(0.357)	(0.927)
$t+1$	0.11	-0.06	0.09	0.09	-0.39	0.26
	(0.287)	(0.566)	(0.390)	(0.563)	(0.250)	(0.134)
t	0.10	-0.05	-0.09	0.06	-0.08	-0.18
	(0.375)	(0.645)	(0.352)	(0.716)	(0.816)	(0.316)
$t-1$	0.07	0.06	0.01	-0.04	-0.14	0.10
	(0.529)	(0.528)	(0.933)	(0.817)	(0.693)	(0.561)
$t-2$	-0.03	-0.04	0.06	0.05	0.33	0.11
	(0.807)	(0.659)	(0.523)	(0.753)	(0.321)	(0.529)
	B. Gross domestic product					
$t+2$	0.05	-0.02	0.03	-0.11	-0.02	-0.05
	(0.803)	(0.909)	(0.893)	(0.724)	(0.972)	(0.879)
$t+1$	0.13	0.02	0.14	0.10	-0.32	-0.23
	(0.542)	(0.924)	(0.461)	(0.751)	(0.611)	(0.505)
t	0.08	-0.06	-0.05	-0.29	-0.27	0.22
	(0.691)	(0.773)	(0.817)	(0.361)	(0.666)	(0.516)
$t-1$	0.19	-0.04	-0.04	-0.36	-0.68	0.18
	(0.366)	(0.838)	(0.845)	(0.258)	(0.281)	(0.592)
$t-2$	0.44**	0.28	0.06	-0.35	-0.21	0.07
	(0.038)	(0.142)	(0.774)	(0.272)	(0.745)	(0.834)
Mean	1.16	1.20	1.43	1.20	2.53	3.08
Obs.	5004	5004	5004	5004	4473	5266

P-values of $H_0 : \beta = 0$ in parentheses (*** p<0.01, ** p<0.05, * p<0.1).
Dependent variable: absolute daily change (basis points) of rate in column heading between January 5th, 1999 and March 15th, 2018 (cols. 1-4), January 17th, 2001 and March 15th, 2018 (col. 5), January 2nd, 1998 and March 15th, 2018 (col. 6). Table reports estimated coefficients on dummies for number of days x between rate change and closest data release on CPI (panel A) or GDP (panel B): $x < 0$ data release took place x days earlier; $x > 0$ data release will take place in x days. All regressions include also two lags of the dependent variable, and day-of-week, week-of-year and time (in quarters) dummies. “Mean” is value of constant from regression.

Table 6: Inflation expectations and interest rate changes

	(1) 1 month	(2) 3-month	(3) 6-month	(4) 1 year	(5) 1yf 1 year	(6) 5yf 5 year
			A. Wave-specific ratio estimates.			
Share < 0	0.63	0.70	0.57	0.54	0.49	0.53
Median	-0.9	-1.9	-0.7	-0.3	0.0	-0.3
Mean	-5.0	-2.2	2.1	-1.2	0.0	-0.3
N. waves	59	59	59	59	59	59
			B. OLS mean estimates.			
$\hat{\beta}$	-0.69	-0.63*	-0.46*	-0.23	-0.01	0.00
	(0.104)	(0.089)	(0.090)	(0.256)	(0.915)	(0.983)
N. waves	59	59	59	59	59	59
			C. OLS micro estimates.			
$\hat{\beta}$	-0.45	-0.50*	-0.25	-0.12	-0.01	-0.09
	(0.155)	(0.072)	(0.206)	(0.453)	(0.608)	(0.546)
N. obs.	29973	29973	29973	29973	29973	29973

P-values of $H_0 : \beta = 0$ in parentheses (*** p<0.01, ** p<0.05, * p<0.1).
Panel A: share of negative ratios between the difference in 1-year ahead inflation expectations of firms interviewed after and before the relevant GC meeting and the daily change of the rate described in column heading on GC meeting day, mean and median of wave-specific ratio estimates; panel B: OLS mean estimate of β from a univariate regression of the change in mean inflation expectations on a constant and the change in rates on the waves from 2002:1 and the associated p-value; panel C: OLS estimates of firms inflation expectations on change of the rate described in column heading on GC meeting day interacted with a dummy equal to 1 for firms interviewed after relevant GC meeting and additional controls (see text for details).

Table 7: Firms' inflation expectations and monetary policy shocks.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Dep. var.	π_{t+12}	π_{t+12}		π_{t+12}				π_{t+24}			π_{long}
ΔR^{3m}_{GC}	-0.5*	-1.2**	-0.3	-0.2	-1.0*	-1.2**	-1.3**	-1.1*	-1.4*	-1.6**	-2.1**
	(0.084)	(0.018)	(0.427)	(0.574)	(0.065)	(0.046)	(0.022)	(0.085)	(0.060)	(0.033)	(0.021)
ΔR^{1f1y}_{GC}	-0.0	0.4*	-0.0	0.0	0.4	0.4	0.8**	0.2	0.5	0.8**	1.0**
	(0.946)	(0.077)	(0.572)	(0.646)	(0.201)	(0.156)	(0.015)	(0.608)	(0.190)	(0.025)	(0.035)
ΔR^{5f5y}_{GC}	-0.1	-0.2	-0.2	0.2	-0.3	-0.5**	-0.5**	-0.4*	-0.7***	-0.6**	-0.9***
	(0.598)	(0.298)	(0.434)	(0.518)	(0.145)	(0.014)	(0.026)	(0.099)	(0.005)	(0.033)	(0.003)
From	2002:1	2002:1	2002:1	2002:1	2009:1	2012:1	2014:1	2009:2	2012:1	2014:1	2014:1
Obs.	29973	15298	14675	11377	18596	12668	8006	18147	12668	8006	8006

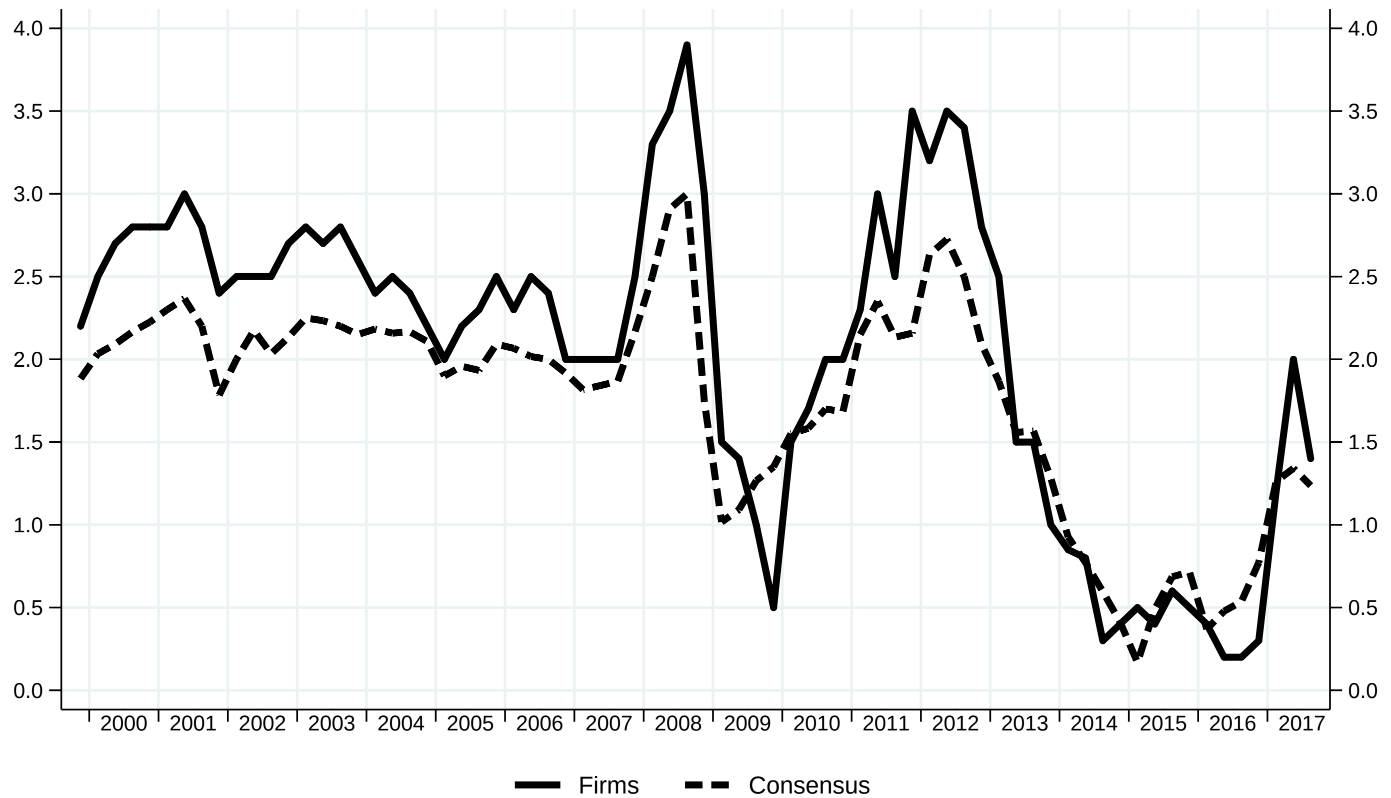
P-values of $H_0 : \beta = 0$ in parentheses (*** p<0.01, ** p<0.05, * p<0.1); Huber-White robust standard errors.
Dependent variable: 1-year ahead expected consumer price inflation (cols. 1-7), available since 2002:1; 2-year ahead expected consumer price inflation (cols. 8-10), available since 2009:2; average expected inflation between 3 and 5 years ahead (col. 11), available since 2014:1. All samples end in 2017:3 except column (4) in 2008:4. ΔR^{H}_{GC} is change of 3-months ($H = 3m$), 1-year forward 1 year ($H = 1f1y$) and 5-year forward 5 year ($H = 5f5y$) rate swaps on Governing Council (GC) days for firms interviewed after relevant GC day and zero for those before. Waves that do not contain a GC meeting are excluded. All regressions include a cubic of the estimated probability of interview after GC, log of employees, dummies for the full interaction of industry, area and size class, dummies for time (in quarters) and day-of-week. Col. (2) only waves in which 3-month rates and EuroStox50 moved in opposite direction on GC days; col. (3) only waves in which 3-month rates and EuroStox50 moved in same direction on GC days.

Table 8: Other effects of monetary policy news.

	(1) Macro outlook	(2) Own inv. outlook	(3) Own op. cond.	(4) Macro outlook	(5) Own price change (%)	(6) Upward price pressures from: demand	(7) wages	(8) mater.
	improved past 3 months		will improve next 3 months		next 12 months			
A. All sample								
ΔR_{GC}^{3m}	0.0	0.2	0.1	0.4	1.0	0.2	-0.1	-0.3
	(0.850)	(0.268)	(0.670)	(0.198)	(0.587)	(0.166)	(0.763)	(0.156)
ΔR_{GC}^{1f1y}	-0.0	-0.0	0.0	-0.1	0.9	0.0	-0.0	0.0*
	(0.669)	(0.866)	(0.979)	(0.415)	(0.221)	(0.545)	(0.161)	(0.051)
ΔR_{GC}^{5f5y}	0.0	0.0	0.0	0.2*	-0.1	0.1	0.0	-0.1
	(0.523)	(0.411)	(0.365)	(0.077)	(0.893)	(0.239)	(0.673)	(0.267)
B. Only negative comovements of rates and stocks								
ΔR_{GC}^{3m}	0.1	0.5	-0.1	-0.2	2.0	0.4	-0.5	-0.8**
	(0.674)	(0.157)	(0.724)	(0.753)	(0.416)	(0.236)	(0.193)	(0.048)
ΔR_{GC}^{1f1y}	-0.0	-0.1	0.1	0.0	-0.6	-0.2	0.1	0.2
	(0.929)	(0.297)	(0.603)	(0.986)	(0.581)	(0.111)	(0.409)	(0.165)
ΔR_{GC}^{5f5y}	0.0	0.1	0.1	0.2	0.6	0.2**	-0.1	-0.2
	(0.706)	(0.170)	(0.459)	(0.171)	(0.463)	(0.032)	(0.390)	(0.101)
C. Since 2009:1								
ΔR_{GC}^{3m}	-0.1	0.1	0.0	0.2	-0.2	0.2	0.0	-0.1
	(0.786)	(0.817)	(0.925)	(0.568)	(0.941)	(0.530)	(0.897)	(0.696)
ΔR_{GC}^{1f1y}	-0.0	0.1	-0.1	0.0	2.8**	-0.0	-0.1	0.1
	(0.946)	(0.201)	(0.514)	(0.856)	(0.015)	(0.811)	(0.464)	(0.496)
ΔR_{GC}^{5f5y}	0.0	-0.0	0.1	0.1	-0.2	0.1	0.0	-0.2
	(0.664)	(0.800)	(0.108)	(0.166)	(0.758)	(0.223)	(0.653)	(0.122)

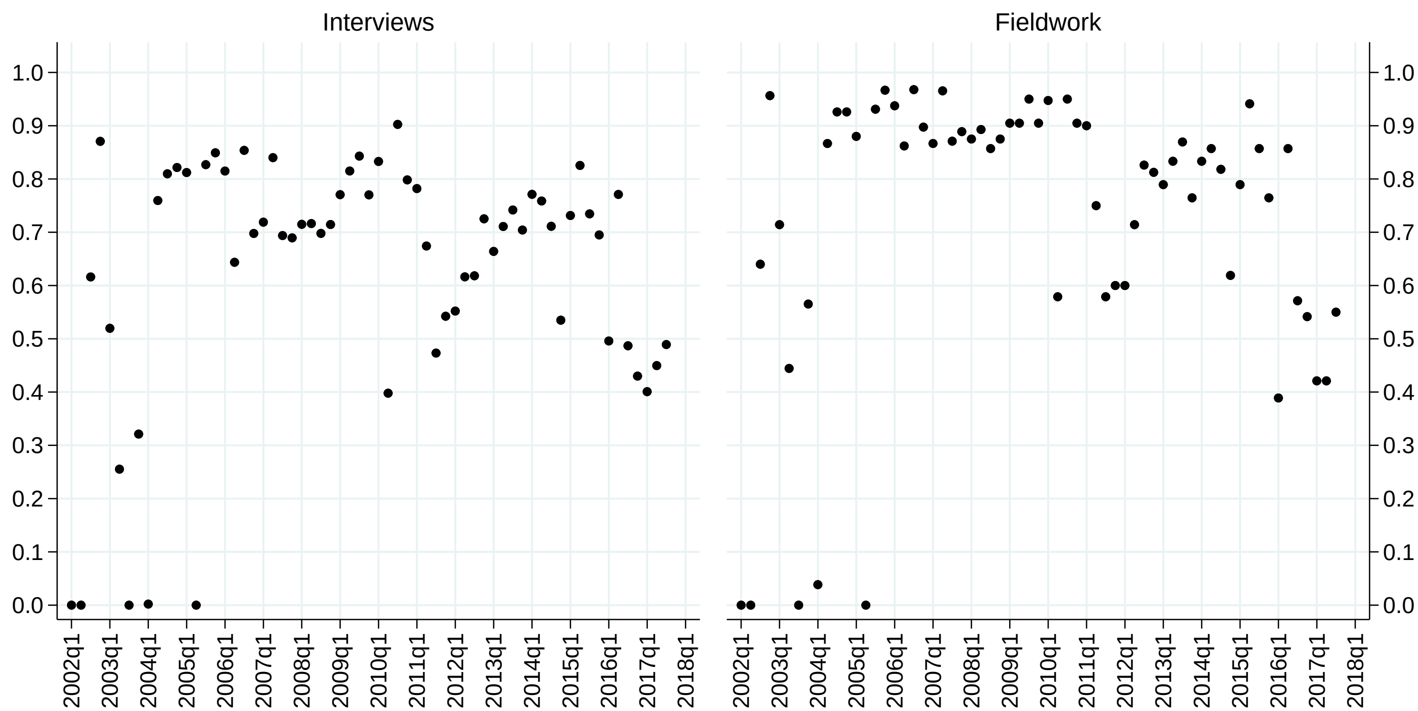
P-values of $H_0 : \beta = 0$ in parentheses (*** p<0.01, ** p<0.05, * p<0.1); Huber-White robust standard errors.
ΔR_{GC}^{H} is change of 3-months ($H = 3m$), 1-year forward 1 year ($H = 1f1y$) and 5-year forward 5 year ($H = 5f5y$) rate swaps on Governing Council (GC) days for firms interviewed after relevant GC day and zero for those before. Waves that do not contain a GC meeting are excluded. All regressions include a cubic of the estimated probability of interview after GC, log of employees, dummies for the full interaction of industry, area and size class, dummies for time (in quarters) and day-of-week. Col. (5) also include percentage change in own prices during past 12 months.

Figure 1: Mean firms' expected one-year inflation and Consensus Forecasts.



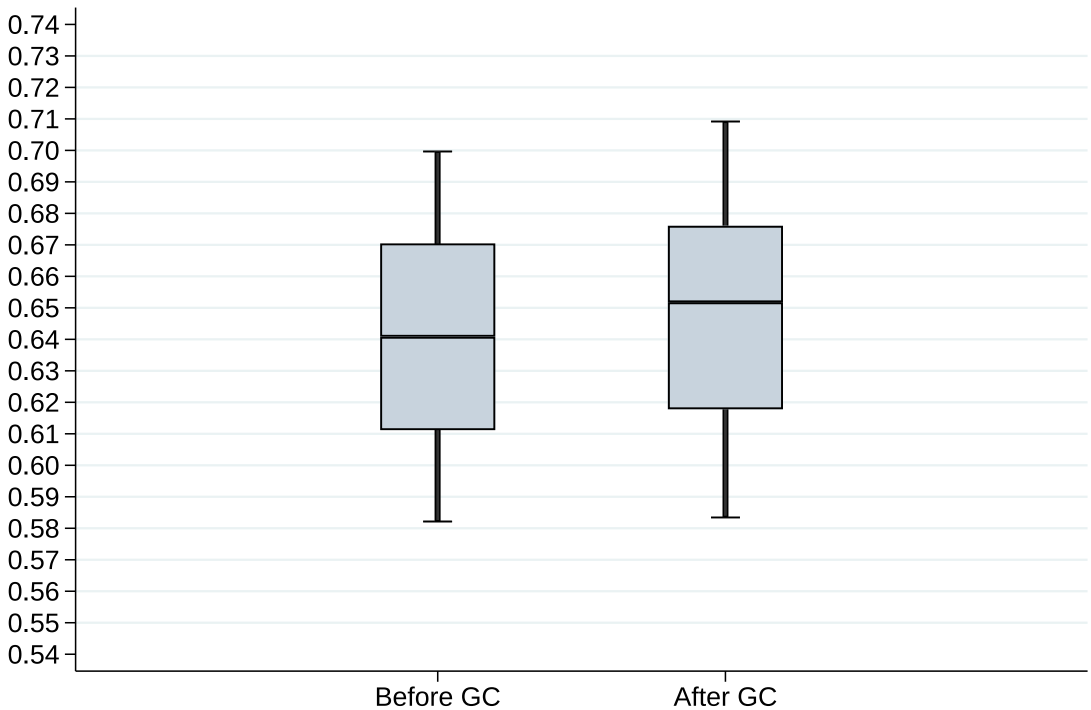
The figure reports average one-year ahead expected inflation reported by firms and contemporaneous Consensus Forecasts over the same horizon. See Bartiloro et al. (2019) for details.

Figure 2: Share of firms interviewed after relevant GC meeting in each wave.



Panel A: share of interviews in each wave of the survey that took place after the GC meeting day. Panel B: share of days of each wave fieldwork taking place after the GC meeting day.

Figure 3: Predicted probability of interview after GC day vs actual timing.



Each box plots the distribution of the estimated probability of returning the questionnaire after the GC meeting for the groups who returned it before and after the meeting. Probabilities are estimated with a probit model for the event of returning the questionnaire after GC day on the log of employees and on dummies for industry, area and size class.

Figure 4: Interest rate changes and differences in expected inflation across GC days.

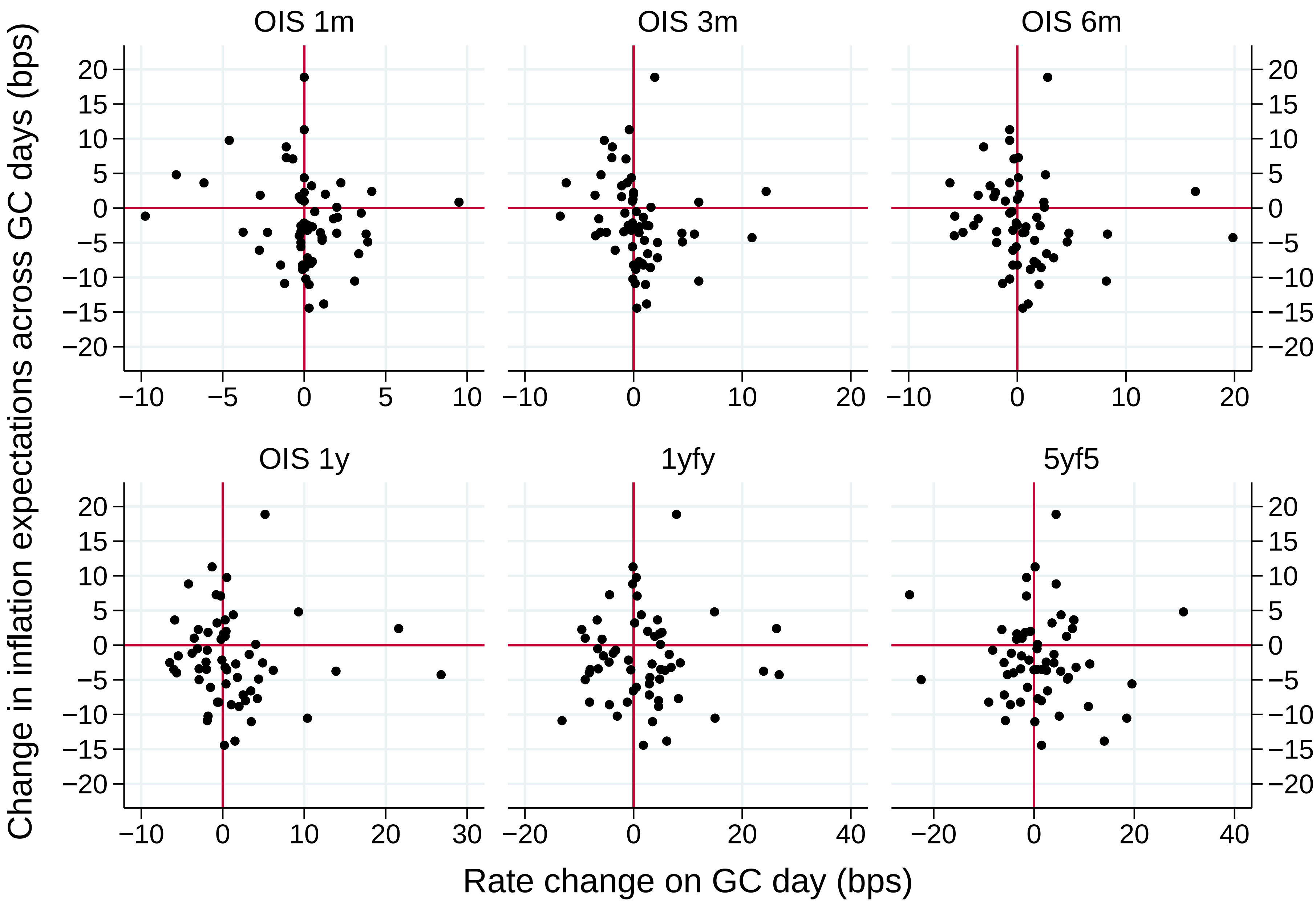
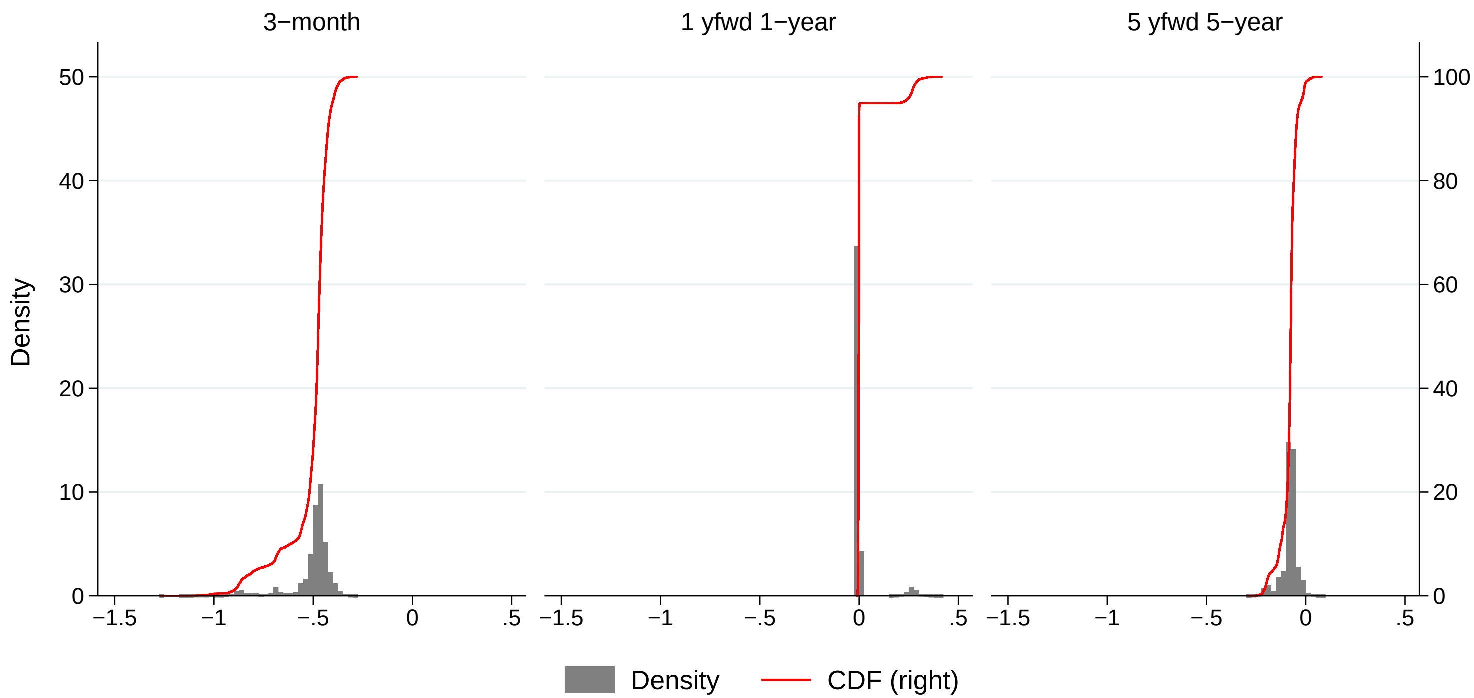


Figure 5: Distribution of jackknife estimates of main equation

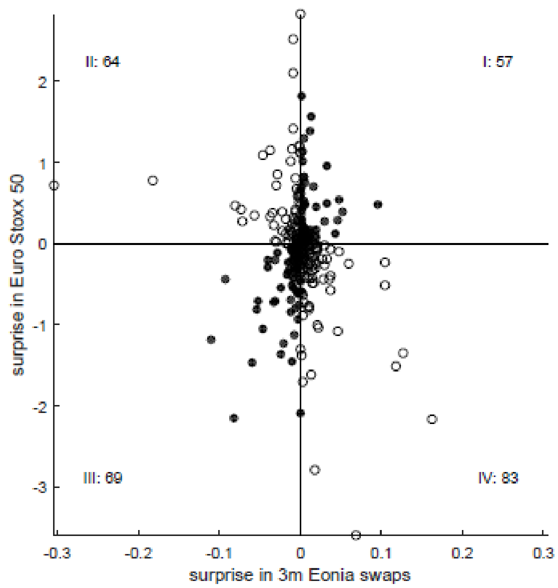


The three panels correspond to the three parameters of table (7). Each panel reports the empirical density function and CDF of the corresponding parameter estimate (x-axis) obtained estimating the main equation on all possible samples obtained dropping all combinations of three waves between 2002:1 and 2017:3.

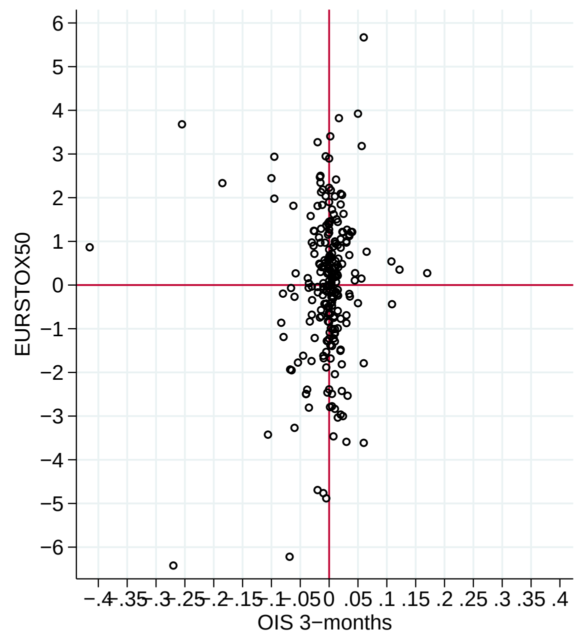
A Daily vs intraday rate changes

We compare figure 7 from Jarociński and Karadi (2018), which refers to intra-day rate and stock price index changes around ECB statements (including also statements outside of scheduled GC monetary policy meetings) with daily changes of the same variables recorded only on scheduled GC monetary policy meetings. Both figures report changes in percentage points.

Jarociński and Karadi (2018)



This paper



B Main variables from SIGE

We describe the main survey questions originating the variables used in the analysis. We report their wording, possible replies and, when relevant, how replies have been recoded into the final dependent variables. More details are available at
`https://www.bancaditalia.it/pubblicazioni/indagine-inflazione`.

Expected inflation

Dependent variable in tables (6) and (7).

In [month of most recent inflation release] consumer price inflation, measured by the 12-month change in the HARMONIZED INDEX OF CONSUMER PRICES was [xx] per cent in Italy and [yy] per cent in the euro area. What do you think it will be in Italy...[in six months], [in one year], [in 2 years], [on average between 3 and 5 years] ?

An alternative wording of the question, not including the information of recent inflation developments, was introduced in 2012:3 for a random subsample of firms. We exclude those replies from opur analysis. See Bartiloro et al. (2019) for details.

Replies are percentage values, constrained to be in the $[-10, +10]$ percent range. However, there is no evidence of bunching at the extremes of the interval: throughout the sample period only 24 observations take extreme values.

Assessment of recent macroeconomic developments

Dependent variable in table (8), column (1).

Compared with 3 months ago, do you consider Italy's general economic situation is ...?
Worse, Same, Better.

Answers recoded as dummy variable equal to one if firm report improved general economic situation.

Assessment of recent conditions for investments

Dependent variable in table (8), column (2).

Compared with 3 month ago, do you think conditions for investment are ... ?
Worse, Same, Better

Answers recoded as dummy variable equal to one if firm reports improved conditions for investment.

Assessment of future overall business conditions

Dependent variable in table (8), column (3).

How do you think business conditions for your company will be in the next 3 months?
Worse, Same, Better.

Answers recoded as dummy variable equal to one if firm reports improving business conditions over the next 3 months.

Assessment of expected macroeconomic outlook

Dependent variable in table (8), column (4).

What do you think is the probability of an improvement of Italy's general economic situation in the next 3 months?
Zero, [1-25] per cent, (25-50] per cent, (50-75] per cent, (75-99] per cent, 100 per cent.

Answers recoded as dummy equal to one if firms reports positive probability of improvement.

Own expected selling prices

Dependent variable in table(8), column (5).

Over the next 12 months, what do you expect will be the average change in your firm's selling prices?

Replies are percentage values. No constraint is imposed.

Factors affecting expected own selling prices

Dependent variables in table (8), columns (6, 7, 8).

Please indicate direction and intensity of the following factors as they will affect your firm's selling prices in the next 12 months:
Total demand, Labour costs, Raw materials prices.

Replies are Direction (downward, neutral, upward) and, if not neutral, Intensity (moderate, average, high).

Answers recoded as dummy variables equal to one if firm reports upward pressures from specific factor, irrespective of intensity.

C Own prices and average prices in a simple model

Conventional processess of time-dependent price adjustments allow for substantial price dispersion at each point in time. Rational agents hold the same model-consistent beliefs about future average prices, $E(p_{t+1}|I_{it}) = E(p_{t+1}) \quad \forall i$. Also, in the typical model the process of individual price adjustment is such that $E(p^i_{t+1}|I_{it}) = E(p_{t+1}) \quad \forall i$, that is each agent expects her future price to be at the average aggregate level. This implies that expected inflation $\pi^e_{i,t+1} = E(p_{t+1}) - p_t \quad \forall i$ and that expected change in own price is $\Delta^p_{i,t+1} = E(p_{t+1}) - p^i_t$ so that $\Delta^p_{i,t+1} = \pi^e_{i,t+1} + (p_t - p^i_t)$.

Therefore a regression $\pi^e_{i,t+1} = \alpha_0 + \beta_0 Z_i + \epsilon_i$ and a regression $\Delta^p_{i,t+1} = \alpha_1 + \beta_1 Z_i + u_i$ where Z_i is an exogenous determinant of $E(p_{t+1})$ (in our case the unanticipated monetary shock) should return the same coefficient estimates but with higher standard errors for $\{\alpha_1, \beta_1\}$ because of the additional variability stemming from individual price dispersion, $(p_t - p^i_t)$, assumed to be orthogonal to Z_i.