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JEL Classification: E3, E52, E58

Keywords: Monetary policy announcements, Firm expectations, survey data, European Central Bank, information effect

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Monetary Policy Announcements and Expectations: Evidence from German Firms*

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Abstract

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1 Introduction

Do monetary policy announcements impact firm expectations and, if so, how? In this paper, we take up the question empirically as we analyze the effect of policy announcements by the European Central Bank (ECB) on expectations of German firms during the period 2004–2018. We rely on the Ifo Business Survey Industry (IBS) of firm expectations and three distinct measures of monetary policy innovations. First, we focus on the announcements of specific non-conventional policy measures in the period since the global financial crisis. Second, more broadly, we consider monetary policy surprises as captured by high-frequency interest-rate changes around monetary policy events. Third, we employ more structural measures of central bank information and communication shocks. Throughout, we focus on how firm expectations of production and prices change in response to these measures.

The main result of our analysis is twofold: we find a) that monetary policy surprises do indeed impact firm expectations significantly and b) that they do so in a nonlinear way. In the first part of our analysis, we show that the announcements of non-conventional policies by the ECB hardly affected firm expectations and, to the extent that they did, they *lowered* expectations of prices and production—even though these policies were arguably designed to be expansionary. Once we turn to monetary policy surprises more broadly defined, we find that they impact firm expectations significantly. Moreover, the effect is nonlinear in the size of the surprise. A moderate surprise increase of the interest rate reduces firm expectations, while surprise reductions raise them—in line with conventional wisdom. The strength of the effect declines as the size of the surprise rises, both for positive and negative surprises. Very large surprises no longer affect firm expectations significantly. Lastly, we find that central bank information shocks also impact firm expectations. Yet, they cannot account for the nonlinear effect of monetary surprises on expectations, and neither can direct central bank communication during monetary policy events.

Our findings are consistent with the notion that monetary policy announcements induce market participants to update their views about the economy quite generally and not only about monetary policy. Romer and Romer (2000) argue that this is to be expected if the information sets of the central bank and the public are not perfectly aligned. And indeed, they show that the forecasts by the US Federal Reserve, which are not known to market participants in real time, are useful in predicting inflation, given professional forecasts of inflation. More recently, Melosi (2017) puts forward and estimates a model where monetary policy shocks operate via a "signaling channel" as they induce price setters to update their belief about the state of the economy. The analysis of Nakamura and Steinsson (2018) also lends support to an "information effect," according to which market participants update their beliefs about the natural rate in response to monetary surprises. Finally, Jarociński and Karadi (2019) use the stock-market reaction to monetary policy surprises in order to strip monetary surprises of their information content. In this way they are able to measure central bank information shocks on which we rely in our analysis below.

Our results highlight a new margin along which the information effect may operate: the size of the monetary surprise. For according to our estimates, firm expectations adjust to monetary policy surprises in conventional ways to the extent that the surprise is small. The effect becomes weaker as the size of the shock increases—possibly because in this case the information effect becomes stronger. This pattern may emerge because the attention that firms pay to the potential information conveyed by monetary policy announcements is endogenous to the size of the policy surprise: inattentiveness is strong for modest surprises, while firms become more attentive to the information content as the surprise gets bigger. We stress that while we find this explanation of our empirical results compelling, we cannot rule out other explanations on the basis of our analysis.

It may seem that our results are in conflict with recent findings by Kumar et al. (2015) and Coibion et al. (2018a). On the basis of survey data for New Zealand they find that firms tend to be inattentive to monetary policy or, more specifically, that firm expectations about aggregate inflation are not well anchored and widely dispersed across firms. We make three observations to reconcile our findings with this evidence. First, our analysis concerns firm expectations about firms' own prices rather than about aggregate inflation. Second, we focus on the impact of interest-rate changes, which are likely more relevant for firms' profits than aggregate inflation. It may hence be more worthwhile for firms to pay closer attention to them. Last, Coibion et al. (2018a) find that inflation errors are less pervasive in the manufacturing sector and in the case when firms face many competitors. It is therefore noteworthy that our results are based on data from the highly competitive manufacturing sector in Germany.

Specifically, our analysis is based on survey data for a large panel of German firms. Firms are surveyed on a monthly basis and asked about their expectations of future production and prices. Our sample runs from July 2004 to June 2018. Crucial for our identification strategy is the information about the specific day on which firms submit their responses online. This allows us to distinguish between firms whose response has been submitted before a specific policy measure was announced, and those firms that have responded afterwards. In a nutshell, the difference in expectations across the two groups of firms provides a measure of the effect of the policy announcement. Moreover, our data set allows us to control for a large set of firm characteristics.

Given our sample of German firms, we focus on the policy announcements of the ECB. First, we consider announcements of non-conventional policies, starting with the one-year long-term refinancing operations (LTRO), announced in June 2009. The last announcement in our sample is the termination of the expanded asset purchasing program (APP) in June 2018. These announcements of non-conventional policies are often discussed in the context of "forward guidance" since they pertain mostly to future policies, even though this holds to some extent for conventional policy announcements as well (Gürkaynak et al. 2005). Still, this policy dimension has become even more pertinent during the last decade as policy rates were constrained by the zero lower

bound. Under these circumstances, central banks relied heavily on announcements in order to communicate unconventional policy measures and to manage the expectations of the public.[1]

According to our estimates the effect of the ECB's non-conventional policy announcements on firm expectations is limited. Moreover, if there is an effect at all, it tends to be negative. That is, the announcements of policies which are arguably meant to be expansionary tend to reduce expectations of production and prices. Such a reduction may be surprising in light of conventional wisdom but can be rationalized through information effects. Similar effects have been observed for the US and have brought to the fore the potentially "Delphic" nature of forward guidance (Campbell et al. 2012).[2] In this case—rather than being perceived as a commitment to a future policy as "Odyssean" forward guidance would have it—market participants update their belief about the state of the economy. In light of the information implicitly conveyed by the policy announcements, the outlook appears less benign to market participants and they revise expectations accordingly.

The non-conventional policies that were announced during our sample period were quite exceptional, both in terms of their specifics and their scope. Hence, we turn to monetary policy surprises more broadly defined. In particular, we study the effect of interest-rate innovations around monetary policy events. We obtain these innovations from the Euro Area Monetary Policy Event-Study Database (Altavilla et al. 2019). A plain-vanilla regression of firm expectations on interest-rate surprises yields a counterintuitive effect: it is weak but positive, even as we limit our analysis to firms which respond to the ifo survey in a narrow window around the monetary policy event. We conjecture that this result may be due to information effects that differ in strength depending on the size of the surprise. And indeed, once we slice the data accordingly, we find a highly nonlinear relationship between monetary policy surprises and firm expectations. Moderate surprises move expectations significantly in the expected direction, large surprises—both positive and negative—do much less so.

To explore further the role of information effects, we turn, in a third step, to more detailed measures of central bank information and communication. Specifically, we rely on a measure of central bank information shocks by Jarociński and Karadi (2019). Positive central bank information shocks capture favorable news about the economy—revealed through monetary policy announcements. As we assess the effect of these shocks on firm expectations, we indeed find that they raise price expectations, and significantly so. The effect on output expectations is insignificant. However, we find that once we control for these shocks in our baseline regression, monetary policy surprises continue to have a nonlinear effect on expectations. As we dissect our results further, we find that they are driven by the news conveyed in the press releases of

[1] At a theoretical level, the effectiveness of such announcements is still a subject of considerable controversy. The canonical New Keynesian model predicts that "forward guidance" generates implausibly large effects (Carlstrom et al. 2015; Del Negro et al. 2015; McKay et al. 2016).

[2] Policy announcements related to non-conventional policy measures have lowered yields significantly (Altavilla and Giannone 2017; Krishnamurthy and Vissing-Jorgensen 2011), but failed to raise expectations of inflation and output growth (Del Negro et al. 2015).

the ECB, rather than in the communication during the press conference. This suggests that the (nonlinear) information effect operates directly through the policy measure, rather than through the communication thereof.

In our view, our paper makes two contributions. First, our results suggest that the potential information conveyed by a monetary policy announcement may be endogenous to the size of the policy change. Second, our paper provides evidence that monetary policy announcements impact the expectations of individual firms. In this way we address a certain shortcoming of existing work that has focused on the effect of monetary policy announcements on professional forecasters (Campbell et al. 2012; Del Negro et al. 2015). According to theory, monetary policy operates through the expectations of price setters. Hence, it is of particular interest to assess whether firms, rather than professional forecasters, respond to monetary policy announcements. Our results show a) that they do and b) nonlinearly so.

More generally, our paper relates to a number of recent contributions that provide new evidence on expectation formation. Coibion and Gorodnichenko (2012, 2015) show that professional forecasters adjust forecasts only sluggishly to shocks. As for evidence on price setters, Boneva et al. (2018) use a panel of expectations of UK firms to estimate a version of the New Keynesian Phillips curve. Coibion et al. (2018b) use a survey of Italian firms to estimate the causal effect of firm expectations on firm decisions. Coibion et al. (2019) instead focus on inflation expectations of households.

There is also work on expectation formation based on the ifo survey. An early study by Nerlove (1983) finds evidence in support of an adaptive expectations model. More recently, Bachmann and Elstner (2015) show that at most one third of the firms in the ifo survey systematically over- or underpredict their production growth one-quarter ahead. Massenot and Pettinicchi (2018), in turn, identify various factors which account for forecasting errors of firms in the ifo sample. Buchheim and Link (2017) analyze to what extent the expectation formation of firms depends on aggregate rather than on firm-specific information. Enders et al. (2019) investigate the role of firm expectations on price setting and production. In a similar vein, a number of recent papers investigate the effects of uncertainty on production- and price-setting decisions on the basis of the ifo survey. Bachmann et al. (2013) show that surprise movements in uncertainty lead to significant reductions in production, while Bachmann et al. (2019) find that the frequency of price adjustment increases in idiosyncratic business volatility.

The remainder of this paper is structured as follows. The next section introduces our data set. In Section 3 we study the effect of the ECB's announcements of non-conventional policies on firm expectations. Section 4 presents results for how monetary policy surprises, more broadly measured, impact firm expectations. Section 5 analyzes the role of central bank information and communication in more detail. A final section offers conclusions.

2 Data

In what follows, we briefly describe our data set. First, we provide some details on the survey of German firms from which we obtain a measure of firm expectations. Second, we turn to the monetary policy announcements of the ECB, both the non-conventional policy measures announced since 2009 and a broader set of monetary policy surprises.

2.1 Firm expectations

Our analysis is based on the Ifo Business Survey Industry (IBS), maintained at the LMU-ifo Economics & Business Data Center (EBDC) in Munich (IBS-IND 2018a). The survey contains monthly observations for several thousand German firms from the manufacturing sector. In each month, firms report expectations regarding their production and their prices for the next 3 months. The answers are qualitative: production and prices may increase, not change, or decrease. In addition, the survey includes qualitative questions about realized production and price changes in the previous month. The survey has broad coverage in terms of German industry. It is also used to construct the ifo business climate index, a widely observed leading indicator for current and future economic activity in Germany (Becker and Wohlrabe 2008).

The unit of observation in the IBS is either a product or a plant, depending on the firm. As a result, some firms provide several responses per month. We conduct our analysis at the product/plant level and do not explicitly account for whether a product/plant is part of a multi-product firm. In our analysis below, we refer to the individual observation as a "firm" in order to simplify the exposition.

The IBS starts in 1980. However, only since 2004 can firms respond online to the survey. By now the majority of firms use this option, as shown in panel (a) of Figure 1. Whenever firms answer online, the time and date of their response is recorded. The majority of firms respond in the first 10 days of the month. Panel (b) of Figure 1 displays the distribution of answers across the days of the month. We rely on the response date in our econometric strategy as explained below. For this reason we limit our analysis to those firms for which the response date was recorded. Our sample runs from July 2004 to June 2018. During this period, some 2300 firms fill out the survey in each month on average. Unfortunately, for a few months during our sample period no response time has been recorded in the database. As a result, we have to drop eight months from our analysis below.[3]

In our analysis, we focus on expectations regarding the change in production and prices. The questions are as follows (our translation):

Q1 Expectations for the next 3 months: Taking changes of terms and conditions into account, our domestic sales prices (net) for product XY will probably increase [1], not change [0], or decrease [-1].

[3]Specifically, we omit the following months: 06-2009, 12-2009, 08-2014, 11-2015, 03-2016, 05-2016, 06-2016, and 12-2016.

Q2 Expectations for the next 3 months: Our domestic production activity regarding good XY will probably increase [1], not change [0], or decrease [-1].

Note that these questions ask for qualitative answers and permit three realizations only: prices and production may increase, decrease, or remain unchanged. As a consequence, whenever a firm reported to expect an increase in the previous period, the change in expectations cannot be larger than zero, and conversely for pessimistic firms. When estimating how expectations change in response to monetary policy announcements, we therefore control for the lags of expectations. Last, note that the IBS does not provide fixed-event forecasts (for instance, expectations regarding June 2009) but fixed-horizon forecast (for instance, expectations for the next 3 months going forward). The change in expectations is thus not a forecast revision in a strict sense, as the two forecasts do not pertain to the exact same period.

Panel (c) of Figure 1 displays the average responses to these questions for the months in our sample. The average expectation across firms fluctuates considerably over time, both for prices and production. The two time series tend to co-move, with some exceptions. For example, the pronounced downturn during the financial crisis was larger for production expectations than for price expectations, reflecting the "missing disinflation" (Hall 2011). More generally, we also observe that over time production expectations are more volatile than price expectations.

Panel (d) shows the dispersion of price and production expectations within each month.[4] The dispersion is generally larger for production expectations. During the crisis, the dispersion in both variables increased. After the crisis, however, it remained at a higher level for production expectations only. Finally, dispersion is more volatile over time for price expectations compared to production expectations.

In addition, we use answers to further survey questions as control variables. These include questions on past production, prices, and demand, as well as current orders and current capacity utilization. All questions, except for the one on capacity utilization, ask for qualitative answers with a similar answer structure as the price and production expectations questions. In each case there are three possible answers: positive, neutral, and negative. Accordingly, we code the answers in a similar fashion as the price and production expectations. Details on all questions are listed in Table A.1 in the online appendix.

Finally, our econometric strategy requires information about the day the firm responded to the survey. As discussed above, this date is available only for a subset of firms. We know that responses of the full sample of the IBS are useful indicators for the German economy. Therefore, we want to make sure that our subset of firms is not too different from the full sample. For this purpose, we compare the mean and standard deviation of all variables used. We find that firms responding online do not differ much from the full sample regarding their average responses. This is despite the fact that the sub-sample includes a larger share of firms from more recent years,

[4] Dispersion of expectations based on qualitative survey data is measured as $\sqrt{\text{frac}^+ + \text{frac}^- - \left(\text{frac}^+ - \text{frac}^-\right)^2}$, where frac^+ and frac^- are the fraction of positive and negative responses in each month, respectively. This measure is also used by Bachmann et al. (2013).

since the share of firms with a response date increased over time. However, firms in our subset are slightly larger: the average number of employees in the full sample is 489 with a standard deviation of 3560, compared to 548 employees on average in our subset of firms, with a standard deviation of 3770. Details on the descriptive statistics in both samples are listed in Table A.2, also in the online appendix.

2.2 Monetary policy announcements

Our analysis is based on three distinct measures of monetary policy surprises which are due to monetary policy announcements. First, we consider directly the announcements of unconventional policies by the ECB in the wake of the financial crisis. Second, we employ high-frequency changes in overnight-index-swap (OIS) interest rates around monetary policy events. Last, we rely on a decomposition of monetary policy surprises due to Jarociński and Karadi (2019). We briefly discuss these measures in what follows.

First, we identify 16 announcements of non-conventional policies by the ECB between May 2009 and June 2018, such as the announcement of the first long-term refinancing operations (LTROs), the different asset purchase programs, and the first forward guidance announcements. Our list of events largely follows Dedola et al. (2018).[5] Table A.3 in the appendix provides an overview. These policy measures differ along a number of dimensions and we allow for different effects of each announcement in our analysis below. An aspect common to most measures is—with the notable exception of the OMT—that they brought about an expansion of the ECB's balance sheet. The ECB engaged, in other words, in "quantitative easing."

Additionally, we obtain a broader measure of monetary policy surprises from the Euro Area Monetary Policy Event-Study Database (EA-MPD) compiled by Altavilla et al. (2019). It records high-frequency changes of interest rates in a small window around monetary policy events. Given the small window size, these changes are likely to capture the surprise component of the monetary policy announcement relative to what market participants had expected prior to the event. The EA-MPD is a rich resource in that it provides data on changes of various interest rates and exchange rates for monetary policy events in the euro area. For each event there are three event windows:

W1 Press-Release Window: change in the median quote during the interval from 13:25-13:35 before the press release to the median quote during the interval 14:00-14:15 after it.

W2 Press-Conference Window: change in the median quote during the interval from 14:15-14:25 before the press conference to the median quote for the interval from 15:40-15:50 after it.

W3 Monetary-Event Window: change in the median quote during the interval from 13:25-13:35 before the press release to the median quote for the interval 15:40-15:50 after it.

[5]Dedola et al. (2018) analyze the impact of quantitative easing measures and hence consider only policies that affect the ECB's balance sheet. Our focus is broader, such that we include additional announcements like the first forward guidance communication or the announcement of the Outright Monetary Transactions (OMT).

In our baseline analysis, we rely on the full Monetary-Event Window (W3) in order to capture the joint effect of the press release and the press conference. In Section 5, we consider the monetary policy surprise for each window in isolation. In the EA-MPD, interest-rate surprises are measured by the change in the OIS rate for different maturities. In our analysis we employ 1-month OIS rates.

In our sample period around 90% of the observed changes are smaller than 3 basis points in absolute terms, while 50% lie within -0.55 and 0.3 basis points. All observed changes are plotted in Figure A.1 in the online appendix. For what follows we stress that a surprise by 1 basis point is a relatively large surprise. The largest surprises are close to 20 basis points. We use dashed lines to indicate the surprises on the announcement dates of non-conventional policies. Roughly speaking, only half of them bring about a reduction of interest rates, the other half induces the OIS rate to rise. In terms of size, some of the surprises associated with the announcements of non-conventional policies are particularly large, but we also note that some of the announcements brought about almost no change in OIS rates.

As discussed in the introduction, interest-rate surprises are not necessarily pure monetary policy shocks. Monetary policy events may also induce a change in interest rates to the extent that central bank announcements relate news about the state of the economy to market participants. In our analysis below we seek to account for this possibility in various ways. One strategy that we pursue is to rely on a decomposition of monetary policy surprises by Jarociński and Karadi (2019). They disentangle pure monetary policy shocks from unexpected information contained in the ECB's communication during the policy announcements based on high-frequency data and sign restrictions. First, they use high-frequency data to measure monetary policy surprises around monetary policy events, similar to those recorded in the EA-MPD. They also include 9 speeches of the ECB's president in their analysis. Based on this data set, the authors measure the reaction of stock prices (Euro Stoxx 50) and interest rates (3-month Eonia interest swaps) in a window from 10 minutes before to 20 minutes after the announcement. Next, they use sign restrictions to distinguish central bank information shocks from monetary policy shocks. They classify the shocks that move interest rates and stock prices in opposite directions as monetary policy shocks, in line with the received wisdom. Shocks that move both variables in the same direction are classified as central bank information shocks. The intuition is straightforward: because pure monetary policy shocks should push interest rates and stock prices in opposite directions, any positive comovement due to monetary policy surprises reflects new information about the economy released during the monetary policy event in question.

In what follows we proceed in three steps. First, we investigate the effects of the specific non-conventional policy announcements of the ECB on firm expectations. We then consider how monetary policy surprises more broadly defined impact firm expectations. Last, we assess the role of monetary policy and central bank information shocks identified by Jarociński and Karadi (2019) as well as possible differences between the surprises measured during the press-release window (W1) and the press-conference window (W2).

3 Non-conventional monetary policy announcements

We now assess the response of firm expectations to the announcements of non-conventional monetary policies by the ECB. For this purpose we compute the change in expectations in the month of the announcement relative to the previous month. To isolate the effect of an announcement, we consider a four-working-day window centered around the announcement and compare firms that reply within two working days after an announcement to firms that reply two days prior to the announcement.[6]

Our empirical strategy largely follows Del Negro et al. (2015). In contrast to their analysis, however, we focus directly on firms rather than on professional forecasters. Moreover, we are better able to capture the effect of an announcement because we have information about the timing of a firm's response. This allows us to focus our analysis on the expectations of those firms that respond within a narrow window around the announcement and, as a result, it is less likely that expectations change due to macroeconomic developments other than the monetary policy announcement. We assume throughout that the timing of a firm's response is unrelated to the announcement.

We pool the observations of firm responses between January 2009 and June 2018 and estimate the following model:

$$\Delta f(y)_{i,t} = \alpha + \sum_m \beta_m D_{i,m} + \delta_1 f(y)_{i,t-1} + \delta_2 Z_{i,t-1} + u_{i,t}. \tag{1}$$

Here, $f(y)_{i,t}$ are expectations of firm i regarding variable y in the next 3 months reported in month t (production or prices), and $\Delta f(y)_{i,t} = f(y)_{i,t} - f(y)_{i,t-1}$ is the change of the expectation between the current and the previous month. $Z_{i,t-1}$ is a vector of control variables. It includes lagged realizations of expectations and, in addition, several variables which capture economic activity at the firm level, such as the state of orders or capacity utilization.

We use the index m to refer to the announcements of the ECB. $D_{i,m}$ is a dummy variable that indicates whether expectations of firm i have potentially been affected by announcement m. We set $D_{i,m} = 1$ for those firms that respond within two working days after announcement m. Correspondingly, we set $D_{i,m} = 0$ for firms which respond two working days before the announcement. For example, the dummy variable for the introduction of 12-months LTROs, which was announced on May 7, 2009, is 1 for firms responding between May 8 and May 11, and zero for all other observations. We drop all firm observations on the day of the event as well as those outside the four-working-day window of an announcement in the month of the announcement, but include firm-month observations for those months without an announcement in order to enlarge the "control group." In this case, we set the dummy variable to zero. Our sample includes 16 announcements of non-conventional policies by the ECB. In what follows,

[6]Since all ECB announcements occur on Thursday and almost no firm responds on the weekend, we consider all firms which answer between Friday and Monday following the announcement as being subjected to the announcement "shock".

we focus on 12 of these events, since 4 announcements occur either too early or too late in the month. In this case there are too few observations in the four-working-day window around the announcement, see Panel (b) of Figure 1.

Table 1 reports our estimates. Columns (1) to (3) display results for price expectations, columns (4) to (6) for production expectations. Consider first the results without time fixed effects, shown in columns (1), (2), (4), and (5). Here, we find that several announcements alter firm expectations significantly. When including the full set of controls (columns (2) and (5)), three announcements significantly affect price and production expectations. The announcement of 12-month LTROs in May 2009, one of the first measures with a large impact on the ECB's balance sheet (Dedola et al. 2018), *lowered* expectations regarding prices. Similarly, the announcement of 12/13-month LTROs in October 2011 *reduced* both price and production expectations. The announcement of the details of the OMT program also lowered production expectations, but there is no effect on price expectations. The 36-month LTROs announcement in December 2012 is an exception in that it raised price expectations.

In the specification with time fixed effects, shown in columns (3) and (6), we can no longer study the effect of four specific events since the announcement happened so early in each month that there are no observations in the first part of the event window. The remaining announcements are insignificant for price expectations, see column (3), but some announcements continue to have a significant negative effect on production expectations, see column (6).

These results are broadly consistent with earlier findings based on US data (Campbell et al. 2012; Del Negro et al. 2015). However, these studies assess the effect of announcements of non-conventional policies in the US based on the predictions of professional forecasters, rather than on the expectations of price setters. For the sake of comparability, we also turn briefly to professional forecasters' expectations in the euro area. Specifically, we focus on the revisions of forecasts for the HICP inflation and for real GDP growth in the Survey of Professional Forecasters (SPF) run by the ECB. The survey is conducted only at quarterly frequency during a number of specific days. The ECB publishes the time at which the participants receive the questionnaire as well as the deadline for handing it in. We use this information to create a dummy variable for each event. Specifically, only responses from the survey round directly following the announcement are allowed to be affected by the announcement.[7] Otherwise, our econometric specification follows Del Negro et al. (2015): to ensure that we do not capture other macroeconomic news revealed between two surveys, we control for a large set of macroeconomic surprises.[8] Overall, we find that professional forecasters in the euro area, just like firms in the German manufacturing sector, often reduced their forecasts in response to the announcements of non-conventional policies by the ECB. We report results in the online appendix, see Table A.4.

[7]For example, for the first 12-month LTROs announcement on May 07, 2009 the associated survey round is 2009Q3 which was conducted between July 15, 2009 and July 17, 2009. We provide a full list of the SPF rounds associated with each announcement in the online appendix, see Table A.3.

[8]Macroeconomic surprises are measured as the difference between a macroeconomic release and the respective Reuters poll forecast before the release. Here our data source is Thomson Reuters Datastream.

In sum, there is little evidence that announcements of non-conventional monetary policies by the ECB raised firm expectations of production and prices, and similarly for professional forecasters. Remarkably, however, there are some instances where the announcements reduced expectations. To account for this observation, we note that some of the announcements of the ECB may have revealed bad news about non-monetary fundamentals. As discussed above, Campbell et al. (2012) obtain similar results for the US and rationalize these results on the basis of the notion of "Delphic" forward guidance: Delphic forward guidance, as opposed to "Odyssean" forward guidance, does not involve a commitment about future policies but rather reveals information about the likely path of future policies given the policy maker's estimate of current and future non-monetary fundamentals.[9] Hence, the central idea that underlies Delphic forward guidance is the information effect of monetary policy surprises discussed in the introduction.

In concluding this section, we stress that the findings above have to be taken with a grain of salt. This is because of two caveats. First, the announcements of the ECB may have been to some extent anticipated. As a result, the actual announcements of specific non-conventional measures may have fallen short of the expectations about their scope and strength entertained by market participants prior to the announcements. And indeed, in line with this conjecture, we observe positive interest-rate surprises around some of the announcements, see Figure A.1 in the appendix. In order to address this concern, we directly study the impact of interest-rate surprises on firm expectations in our analysis below.

As a second caveat, note that we seek to capture the effect of a single monetary announcement on firm expectations within a four-working-day window. Our data set is unique in that it allows us to capture the effect of macroeconomic policy announcements on firm expectations in such a narrow window. And yet, it is nevertheless possible that expectations are also subject to other shocks within this window. As such, our estimates are potentially contaminated by noise. We run some placebo regressions to assess this hypothesis and find indeed some significant announcement effects for days where no announcements have been made.[10] In the next section, we will address this shortcoming, as we estimate the effect not of individual policy announcements but of a generic interest-rate surprise of which there are many in our sample. This will allow us to estimate the effect of monetary policy announcements more precisely.

[9] Just like us, Campbell et al. (2012) consider non-conventional policy announcements that have a flavor of forward guidance. The non-conventional policy measures which have been announced by the ECB do not qualify as forward guidance in a narrow sense (Eggertsson and Woodford 2003). Still, to the extent that quantitative easing operates through a signaling channel, it contains an element of forward guidance (Bauer and Rudebusch 2014).

[10] Results are available on request.

4 Monetary policy surprises

We now take a broader perspective on how monetary policy announcements impact firm expectations. We no longer focus on the effect of specific non-conventional policy measures, but assess how firm expectations respond to monetary policy surprises in general. For this purpose, we rely on the Euro Area Monetary Policy Database (EA-MPD). As explained in Section 2.2, it provides measures of monetary policy surprises that are constructed on the basis of high-frequency data. In our baseline specification, we measure monetary policy surprises as the change of the 1-month OIS rate in the window that spans both the press release and the press conference.

4.1 Linear effects

Our sample runs from 2004:M7 to 2018:M6. Within this period there are 155 monetary events, that is, meetings of the governing council of the ECB, followed by a press release and press conference. For 136 events there are sufficiently many firms that submit their survey response in the four-working-day window around the event. Other events are taking place during the first days or the last days of the month. In this case we lack a sufficient number of firm responses within the four-working-day window around the event.[11] Furthermore, there are some months in which no response dates were recorded for any firm, as discussed in Section 2.1. As before, in order to measure their effect on firm expectations, we contrast the responses of firms which responded in the two working days after the event to those which answered in the two working days preceding it.

We again use $\Delta f(y)_{i,t}$ to denote the change in expectations regarding either prices or production reported by firm i at time t. Time is measured in months and there may be several monetary events within a month.[12] We use ε_m to denote the monetary surprise, measured by the change of the 1-month OIS rate at the event date. $D_{i,m}$ is a dummy variable which assumes a value of 1 if firm i responded in the two working days after the monetary event m and 0 if it responded during the two working days prior to the event. We do not consider firms outside the windows. We pool observations across monetary surprises and estimate the following model:

$$\Delta f(y)_{i,t} = \alpha + \beta D_{i,m}\varepsilon_m + \delta_1 f(y)_{i,t-1} + \delta_2 Z_{i,t-1} + u_{i,t}. \tag{2}$$

Vector $Z_{i,t-1}$ includes additional control variables, such as the lagged dependent variable and the average state of business across all firms in the previous month to capture the state of the business cycle. Furthermore, we include additional variables to control for the firm's current situation. These are changes in prices or production and demand in the previous two months, the state of domestic and foreign orders in the previous month, as well as the capacity utilization in the previous month. All variables are coded on an ordinal scale with three outcomes, with the exception of capacity utilization, which is reported in percent. A detailed list of questions is provided in Table A.1 in the online appendix.

[11] See again panel (b) of Figure 1 for the average distribution of responses over the month.

[12] In our sample this happens only twice. In this case, we consider two windows per month.

Table 2 reports the results for price expectations in columns (1) and (2) and for production expectations in columns (3) and (4). The columns refer to alternative specifications in terms of control variables. The effect of monetary surprises on expectations is positive, but weak in the sense that the effect is marginally significant only. Still, taken at face value, this result implies that a surprise increase of interest rates raises price and production expectations, while a surprise reduction lowers expectations. This result conflicts with the received wisdom about the monetary transmission mechanism, but is in line with what we have established in the previous section regarding the effect of announcements of expansionary, non-conventional policies.

4.2 Nonlinear effects

The announcements of non-conventional policies had a relatively large effect on the 1-month OIS rate. On average, the changes of the OIS rate have been twice as large than for conventional monetary policy events.[13] More generally, the size of the surprise varies considerably across monetary events. Against this background, it appears possible that the linear estimate of the response of expectations to monetary surprises masks some non-trivial heterogeneity. Specifically, large monetary policy surprises may induce a larger "information effect" that offsets the conventional effects of monetary surprises. Smaller monetary surprises may instead induce more conventional effects.

To assess this hypothesis formally, we rely on a modified version of model (2). Specifically, we now sort monetary surprises prior to estimation according to their size. Next, we discretize the space of monetary surprises based on the distribution of interest-rate changes over our sample. In particular, we estimate the following model on 7 bins, $b = 1, ..., 7$:

$$\Delta f(y)_{i,t} = \alpha + \sum_{b=1}^{7} \beta_b D_{i,m} \varepsilon_{m,b} + \delta_1 f(y)_{i,t-1} + \delta_2 Z_{i,t-1} + u_{i,t}. \tag{3}$$

Here, $\varepsilon_{m,b}$ assumes the value of the monetary surprise ε_m in case it falls into bin b. Otherwise it is zero.

Figure 2 shows the results. In the top row, we display the effect of monetary policy surprises on expectations conditional on the size of the surprise. In panel (a) we consider the effect on price expectations, in panel (b) the effect on production expectations. In each panel, the horizonal axis indicates the bins (in basis points of interest-rate changes) for which the estimates of β_b are displayed along the vertical axis. Each bin contains at least 5 different events, and several thousand firm observations. Recall that at high frequency, monetary policy surprises appear as somewhat moderate changes in the interest rate, with few changes exceeding $\pm$ 2 basis points (around 15%, see Section 2.2). In both panels, the horizontal line indicates the estimate that we obtain if we do not condition on the size of monetary surprises, reported in columns (2) and (4) of Table 2, with shaded area indicating 90% confidence bounds.

[13] To see this please refer to Figure A.1 in the online appendix.

Our main result is that the effect of monetary policy surprises on firm expectations is now in line with the received wisdom, provided that the surprise is moderate. The estimated coefficients display a U-shaped pattern. A small surprise increase of the short-term interest rate lowers price expectations significantly. This may be because fewer firms expect price increases or because more firms expect price declines, or both. Below, we disentangle the effect on the basis of a binarized outcome variable. Note also that a small surprise reduction of short-term interest rates increases price expectations, according to our estimates. Importantly, however, we find that for *large surprises*, both negative and positive, the effect on expectations is no longer significantly negative and, at times, even positive. A very similar pattern emerges for production expectations, shown in panel (b) of Figure 2. They respond significantly only to small monetary surprises.

In sum, we find that monetary policy impacts firm expectations as conventional wisdom suggests: interest-rate increases (reductions) lower (raise) price and production expectations—but only for as long as the surprise is moderate. Larger surprises fail to impact firm expectations. This pattern is consistent with the notion that larger monetary policy surprises tend to trigger larger information effects. Consider a large surprise reduction of the monetary policy rate. While such a surprise should raise price and production expectations in the absence of information frictions, it may fail to do so if it induces firms to revise their assessment of the economy downward, because they realize that the central bank holds a more pessimistic view about the prospects of the economy than they did prior to the monetary announcement. Likewise, a large surprise increase of interest rates may convey a benign assessment of the economy by the central bank. As a result, it may not lower production and price expectations as a full information rational expectations model would predict.

Earlier work highlights the importance of information effects in accounting for monetary policy transmission (Jarociński and Karadi 2019; Melosi 2017; Nakamura and Steinsson 2018). Our results suggest a new margin along which the information effect may operate: the attention that firms pay to the potential information content of monetary policy announcements might be endogenous to the size of the policy change. Firms may pay little attention to the information content of a monetary announcement if the surprise is moderate. In a sense, firms operate in a business-as-usual regime, as a result of which they simply incorporate the direct effect of the interest-rate change in their forecasts. As the surprise becomes bigger, however, firms might gradually pay more attention and reassess their views about non-monetary fundamentals in light of the monetary policy announcement.[14] In fact, our estimates suggest that the information effect can completely offset the conventional interest rate effect if the surprise is sufficiently large.

To further investigate the nonlinear relationship between interest-rate surprises and firm expectations, we also rely on a non-parametric approach. Specifically, in a first step, to control for

[14]This notion is closely related to rational inattention as formalized by Sims (1998) and Maćkowiak and Wiederholt (2009, 2015). It is, however, distinct from these models as the attention is split between the "routine" monetary-policy part and the information content of interest-rate changes. The former is more or less constantly monitored, the latter only during unusual episodes, see Nimark (2014) for a related setup.

factors other than monetary policy surprises, we estimate model (2), except that we no longer include the interest-rate surprise. We compute the residuals from this regression and estimate a kernel, which relates these residuals to the monetary policy surprises in a fully nonlinear way. In doing so we employ an Epanechnikov kernel.

Figure 2 shows the results for price and production expectations in the bottom panels. Note that the kernel estimates in panels (c) and (d) provide a direct measure of the *effect* of monetary policy surprises on expectations, rather than the *coefficient* estimates shown in panels (a) and (b). That is, panels (c) and (d) account for the fact that the monetary impulse increases as we move from the middle of the spectrum to the outer region in terms of the size of the monetary surprise. In the middle of the spectrum, the effect of monetary policy surprises is in line with conventional wisdom: positive interest-rate surprises lower expectations and, conversely, rate reductions raise expectations. However, once we consider large surprises, the effect becomes weaker and even starts to reverse its sign for very large surprises. Again, this pattern is consistent with the notion that large monetary policy innovations trigger an information effect which counteracts the direct interest effect.

In order to obtain a comprehensive measure of the nonlinear relationship that characterizes the data, we estimate yet another model. For this purpose we include a cubic term in model (2). In this way, we can test for the significance of the nonlinearity while economizing on the degrees of freedom. Specifically, we estimate the following model:

$$\Delta f(y)_{i,t} = \alpha + \beta D_{i,m}\varepsilon_m + \gamma D_{i,m}\varepsilon_m^3 + \delta_1 f(y)_{i,t-1} + \delta_2 Z_{i,t-1} + u_{i,t}. \tag{4}$$

Table 3 reports the estimates for this model, for price expectations in columns (1) to (3) and for output expectations in columns (4) to (6). For the specifications with the full set of control variables (columns (2) and (4)), we obtain a significant effect of the cubic term. For production we now also obtain a significant estimate of the coefficient β, which captures the linear effect. The opposite sign of the linear and the cubic term imply that, as before, small positive interest-rate surprises reduce expectations. For larger surprises, instead, the cubic term dominates and counteracts the conventional effect.

We also make sure that our results are not driven by outliers: we report in columns (3) and (6) results based on a sample which excludes the four largest surprises in our sample (which exceed 10 basis points in absolute value). We find that the coefficients on the cubic terms are larger and in the case of prices also more significant.

Figure 3 visualizes the results reported in Table 3. We plot a straight line that represents the linear effect, based on our estimate of β, see model (4). In addition, we plot the total effect of monetary surprises, that is, the sum of the linear and the cubic terms, based on the estimate of β and γ, respectively. The shaded area indicates the 90% confidence intervals regarding our estimate γ. In this way, we can easily assess for which size a monetary surprise induces an effect that is significantly different from a linear response. We find this to be the case for monetary surprises larger than 4 basis points in absolute value for production expectations. For price expectations, the difference is only marginally significant.

In order to interpret the quantitative effect of monetary surprises on firm expectations, it is important to note that our dependent variable is measured on an ordinal scale with more than two possible answers. Hence, expectations may decline because fewer firms expect an increase or because more firms expect price declines, or both. To disentangle these effects, we proceed as follows. We create two new binary variables which separately measure whether there was an upward or downward revision of expectations. In each case the variable takes a value of 1 if there was a revision of expectations and 0 otherwise. We then estimate model (4) again for both binary variables separately. The new models are linear probability models and the estimated coefficients correspond to the increase of the probability of an upward/downward revision in expectations following a monetary policy surprise by 1 basis point.

Table 4 shows the results for prices in columns (1) and (2), and for production in columns (3) and (4). It turns out that the change in expectations is driven more by changes in downward revisions than upward revisions. Accounting for both the linear and cubic term, a monetary policy surprise of +1 basis point (bp) raises the probability by 0.08 percentage points (pp) that a given firm lowers its price expectations. For a surprise of +5bp the corresponding number is 0.27pp, while for a surprise of +10bp, it is -0.22pp. For production expectations the effects are larger: a surprise of +1bp yields a 0.22pp increase in the probability of a downward revision, a surprise of +5bp a 0.93pp increase, and a surprise of +10bp an increase of merely 0.66pp.

So far we have been concerned with the response of firm expectations to monetary policy announcements. This response is of particular interest to the extent that firm expectations matter for firm actions. We take up the issue in related work as we investigate systematically the effect of firm expectations on firm actions as well as on aggregate outcomes (Enders et al. 2019). The analysis is based on the same data set as the present paper and we establish evidence that expectations do indeed matter strongly, both for firm actions and aggregate outcomes.[15] However, in Enders et al. (2019) we do not condition on monetary policy surprises. Therefore we briefly take up the issue in the context of the present paper. Specifically, we use the survey questions regarding realized changes in prices and production.[16] We replace the dependent variable in our baseline regression (4) with the actual change of prices and production between the period of the monetary event and the following one. We find the same pattern as for expectations: positive (negative) interest-rate changes lead to significantly lower (higher) prices and production, but in a nonlinear way. The cubic term turns out to be positive and significant.[17]

[15] In a related study, Balleer and Zorn (2019) investigate the effect of monetary policy on price-setting behavior of firms in the ifo panel. They also use the shocks identified by Jarociński and Karadi (2019). The authors furthermore analyze whether firm heterogeneity, for example regarding credit constraints, matters for the price-setting response.

[16] These questions are listed in Table A.1 as Q3 and Q4 in the online appendix. They are also qualitative in nature.

[17] We report results in the online appendix, see Table A.6. Note that monetary events affect all firms, independently of whether they answer before or after the event, because all firms may adjust production and prices afterwards.

In a last experiment, we assess whether monetary policy announcements also affect firms' views on current business conditions. This may be expected if information effects play a major role. For this purpose we focus on the current state of business as a dependent variable (Question Q9 in Table A.1). We find no significant effect of the interest-rate surprises, neither linear nor non-linear. This suggests that the effect of monetary policy actions is delayed and that the information revealed by monetary policy announcements pertains to future realizations of non-monetary fundamentals rather than current ones. We do find, however, that firms' assessment of the current stock of inventories (Question Q12 in Table A.1) changes in response to monetary announcements in line with the response of expectations, although the effect of the cubic term is only marginally significant. We report results in the online appendix, see Table A.5.

4.3 Robustness checks

Our results are robust across a variety of alternative specifications. Table 5 reports estimates for a number of sensitivity analyses. It displays the results for prices in the upper panel, and those for production in the bottom panel. In order to streamline the exposition, we omit the estimated coefficients of the additional control variables in the table.

In a first check, we increase the window around the monetary policy event from two working days before and after the event to four working days before and after. Column (1) of Table 5 shows that this does not change our results much. Also, once we employ the "full window" and consider the responses of all firms that have been submitted after an event (prior to the next event), we still find a highly significant effect of the cubic term and all linear terms are highly significant as well. Results are shown in Column (2) of Table 5.

Columns (3) to (5) report the estimates once we control for distinct features of the macroeconomic environment. First, we exclude from our sample the period where monetary policy in the euro area was close to the zero lower bound on interest rates. That is, we estimate our model on observations for the period from 2004 to 2011 only. We find that the effects for production are larger and more significant in this case, while the effects for prices are roughly unchanged but turn insignificant. In column (4) we show results based on a specification which features a dummy variable to account for the financial crisis in 2008 and 2009. Again we find that results for prices are weaker than in the baseline, while effects for production are strong, both in terms of size and significance. Finally, we also control for economic uncertainty as measured by a stock market volatility index (VSTOXX). Specifically, we capture periods of high uncertainty by a dummy variable which we set to one whenever the volatility index exceeds the sample mean plus one standard deviation. We interact the linear change in the OIS with this dummy variable. We find that our results regarding the cubic term are robust to accounting for economic uncertainty and conclude that the nonlinear effect of our baseline specification is not merely capturing increased uncertainty or other features of the macroeconomic environment.

In the last three columns of Table 5, we provide results for additional robustness checks. First, we include firm fixed effects and report results in column (6). We find our estimates largely unchanged relative to the baseline, but the cubic term for prices becomes insignificant. Still, results for production remain highly significant. Column (7) shows results for a specification where we cluster standard errors at the firm level in order to account for potential correlation within firms over time. It turns out that this is not consequential for the precision of our estimates. Finally, we want to make sure that the qualitative nature of our dependent variables does not drive the results. One issue in this regard is that the responses of firms which expect an increase (or decrease) in the previous period are constrained in that they cannot report an even more optimistic (or pessimistic) outlook. Therefore, we estimate a specification in which we only include firms that expected no change in the previous month. The results in column (8) are fairly close to the baseline.

We further explore the relevance of working with qualitative variables as we turn to an additional variable. The ifo survey also features a question on the expected state of business of the responding firm. This question is answered twice using different measures. Once, firms simply choose from the qualitative answers as for the other questions (improve/stay the same/worsen). The second time, firms choose a scalar value between 0 and 100 by moving a slider, but without seeing the full scale. Instead, they only see marks at 0, 50, and 100, as well as that these values indicate "worsen", "stay the same", and "improve", respectively. We estimate a version of our model on the basis of this variable and find that results for expectations regarding the expected state of business expectations are very similar to production expectations. We provide details in Table A.5 in the online appendix. We conclude that the qualitative nature of the data does drive our results for the baseline.

5 Central bank information and communication

The analysis in the previous section shows that firm expectations respond to monetary policy surprises. Moreover, the response depends on the size of the surprise. Building on earlier work that has established the information effect of monetary policy surprises, we put forward the following hypothesis to account for our finding: the extent of attention that firms pay to the potential information content of monetary policy announcements increases in the size of the policy change. As a result, the direct effect of a monetary surprise may be partially offset by the information effect, or even completely, provided that the surprise is very large. In what follows, we shed further light on the relationship between monetary policy surprises and firm expectations and assess whether it can be accounted for by available measures of central bank information and communication. In a first step, we rely on the series of central bank information shocks by Jarociński and Karadi (2019). In a second step, we use the information in the EA-MPD about the timing of information releases by the central bank to disentangle effects of monetary policy decisions as such and central bank communication.

5.1 Central bank information shocks

Under our maintained hypothesis, central bank information is crucial to account for our findings. We thus investigate whether a more direct measure of central bank information has a bearing on the expectation formation of the firms in our sample. Jarociński and Karadi (2019) propose such a measure by decomposing monetary policy surprises into monetary policy shocks and central bank information shocks, as explained in Section 2.2 above. We use these measures rather than overall monetary policy surprises and estimate the following variant of model (2):

$$\Delta f(y)_{i,t} = \alpha + \beta D_{i,m}\varepsilon_m^{MP} + \gamma D_{i,m}\varepsilon_m^{CBI} + \delta_1 f(y)_{i,t-1} + \delta_2 Z_{i,t-1} + u_{i,t}. \tag{5}$$

Here, ε_m^{MP} and ε_m^{CBI} denote monetary policy and central bank information shocks, as identified by Jarociński and Karadi (2019). These shocks are generated regressors. Still, as pointed out by Coibion and Gorodnichenko (2015), the standard errors on the generated regressors are asymptotically valid under the null hypothesis that the coefficient is zero (Pagan 1984). The dummy variable $D_{i,m}$ is specified as in the previous section: it captures whether a firm has filed response to the survey two working days before or after the monetary event.

Our sample runs from June 2004 to November 2016. For this period Jarociński and Karadi (2019) identify 182 shocks. We keep these shocks in our sample to the extent that we are able to define a four-working-day window around each shock.[18] As we estimate model (5), we use, as before, the change in expectations regarding future prices and production as the dependent variable. We find that monetary policy shocks do not impact price and production expectations significantly. Central bank information shocks, instead, raise price and production expectations. Table A.7 in the online appendix shows the results.

Against this background, we explore whether central bank information shocks can explain the nonlinear effect of monetary policy surprises on expectations, documented in Section 4 above. To this end, we include the identified shocks of Jarociński and Karadi (2019) as additional regressors in model (4). Table 6 reports the results. We find that, while the central bank information shock has a significant and positive effect on price expectations, the cubic term capturing the monetary surprise as such remains nevertheless highly significant. To further illustrate this result we again plot the nonlinear effects as already in Figure 3. The effects are very similar to the baseline case, as can also be seen in Figure A.2 in the online appendix.

In light of this result we conclude that, while central bank information shocks play an important role for firm expectations, they cannot explain why the effect of monetary policy surprises on firm expectations depends on the size of the surprise. This might be a result of the identifying assumption maintained by Jarociński and Karadi (2019). Recall that their decomposition

[18] There are more events in total despite the shorter sample period compared to the EA-MPD because Jarociński and Karadi (2019) also include speeches in addition to governing council meetings. For 159 of these events, we have sufficiently many firms responding in the four-working-days window around the event. For 127 events we have both OIS surprises from the EA-MPD as well as the shocks provided by Jarociński and Karadi (2019).

assumes that monetary policy shocks and central bank information shocks are orthogonal. Our results, instead, suggest that the amount of attention that firms pay to new information depends on the size of the monetary surprise. Under this hypothesis, we would expect a systematic link between monetary policy shocks and central bank information shocks. Such a link is ruled out by Jarociński and Karadi (2019).[19]

5.2 Central bank communication shocks

The Euro Area Monetary Policy Event Study Database provides distinct measures for interest-rate surprises for each monetary policy event: one for a window around the press release and one for a window around the press conference of the ECB. The press release contains little more than the monetary policy decision as such. The market reaction in response to the press release thus provides a natural measure of the monetary policy surprise. Instead, the surprise captured by the interest-rate change within the press conference window should more directly reflect the effect of central bank communication, net of the effect of the pure interest-rate change (since this has been released earlier).

In principle, a systematically different communication in the press conferences after large surprises in central bank rates could explain the nonlinear effects of monetary policy surprises on firm expectations. To give an example, if the ECB regularly justified large reductions in interest rates with a gloomy view on the economy, this would counteract the stimulating effects of the rate cuts. To explore this hypothesis systematically, we run regression (4) twice. The first regression includes the change (linear and cubic term) in the 1-month OIS rate that occurs during the time window around the press release, while the second regression features the change in the same variable in the window around the press conference.

Table 7 shows the results for price and production expectations. Columns (1) and (3) report results for the press release, columns (2) and (4) for the press conference. The cubic term remains significantly positive in all specifications, except for production expectations in the case of the conference window. We also provide a graphical illustration in the online appendix, see Figure A.3. The responses to the press release exhibit a very similar pattern than in our baseline findings, shown in Figure 3 above. In contrast, the information released during the press conference seems to trigger quite distinct reactions.[20] These results suggest that the information effect of monetary policy surprises is not confined to the press conference. Instead, it appears that monetary surprises as such may induce an information effect to the extent that they are large.

[19] In fact, we find that while monetary policy and central bank information shocks are uncorrelated by construction, they turn out to be correlated in a nonlinear way: the correlation between the monetary policy shock cubed and the central bank information shock cubed is 0.68 and significant at the 1% level.

[20] Conrad and Lamla (2010) show that for a given monetary policy tightening or easing, financial-market reactions, as measured by the exchange-rate response, depend on the specific topic of communication during the ECB press conference. This might explain why we do not find a clear pattern for the conference window.

6 Conclusion

We have asked whether monetary policy announcements impact firm expectations and, if so, how. This issue is of particular importance because for policy announcements to be effective, theory requires them to impact expectations of price setters, that is, firms. Yet, most evidence regarding the effect of monetary policy on expectations is confined to professional forecasters. In this paper we focus directly on firm expectations on the basis of a uniquely suited data set. It contains survey responses of several thousand firms in the German manufacturing sector. Our sample runs from 2004 to 2018. Observations are monthly, but we also know the calender date at which firms file their responses. Our empirical strategy relies on this specific feature of the data set.

In a first step we conduct an event study: we estimate the effects of the announcements of non-conventional policies by the ECB since the crisis. We compare the responses of firms in a four-working-day window around the announcement and find no significant effects on firms' price and production expectations, except for a few instances where expectations are revised *downwards*. Taken at face value, this result is surprising. However, similar findings for professional forecasters in the US have been rationalized on the ground that monetary policy announcements by the Federal Reserve may have revealed bad news about the economy. In the context of non-conventional policy announcements this phenomenon has given rise to the notion of "Delphic forward guidance," as opposed to "Odyssean forward guidance." Delphic forward guidance, in turn, is related to the broader concept of "information effects," which may at times offset the conventional effect of monetary policy measures.

In a second step we explore this issue further, as we rely on a broader measure of monetary policy surprises, compiled on the basis of high-frequency data and available in the Euro Area Monetary Policy Event-Study Database. We estimate the responses of firms' expectations to monetary policy surprises and find that they impact firm expectations significantly. A second important finding is that the effect of policy surprises depends on their size. Moderate surprises impact firm expectations in line with standard theory: interest-rate increases lower price and production expectations, while interest-rate reductions raise them. Large changes, however, have no significant effect. This finding is consistent with information effects, provided that such effects operate along a specific margin, namely the size of the monetary policy surprise.

In the last part of our analysis, we shed more light on this possibility and investigate the effect of central bank information and communication on firm expectations. First, we consider the time series of central bank information shocks computed by Jarociński and Karadi (2019). We find that firms revise their price expectations upward in response to positive shocks, even if they appear in the context of surprise tightenings of the policy rate. However, once we include central bank information shocks in our baseline model as an additional control variable, the nonlinear relationship between the size of a monetary policy surprise and its effect on firm expectations remains intact. Second, we distinguish between monetary surprises due to the ECB's press releases and the ECB's press conferences. We find that our main result continues to hold once we consider only monetary policy surprises around the press release window.

Our results are likely to have a bearing on actual policy design. First, they suggest that it may be beneficial to separate interest-rate decisions from central bank communication about the state of the economy as much as possible. Wiederholt (2015) provides a recent analysis of the effectiveness of central bank communication in an environment where information is dispersed and conventional monetary policy is constrained by the zero lower bound. Second, our results also underscore the specific challenges for the conduct of monetary policy in the presence of information frictions. Jia (2019) performs a model-based analysis and finds that stabilizing the economy becomes more difficult for monetary policy if private agents extract information about non-monetary fundamentals from policy decisions. Our results point in the same direction. Central banks may face a specific dilemma in the presence of information frictions: there might simply be no way to justify drastic policy measures without generating attention for the non-monetary fundamentals which motivate the policy, rendering large policy changes ineffective. However, we stress that at this point our results are based on a purely empirical analysis and call for a further, model-based analysis before they can inform actual policy making in a reliable manner.

References

Altavilla, Carlo and Domenico Giannone (2017). "The effectiveness of non-standard monetary policy measures: evidence from survey data". *Journal of Applied Econometrics 32* (5), 952–964.

Altavilla, Carlo, Luca Brugnolini, Refet S. Gürkaynak, Roberto Motto, and Guiseppe Ragusa (2019). "Measuring euro area monetary policy". ECB Working Paper Series No 2281.

Bachmann, R., Steffen Elstner, and Eric R. Sims (2013). "Uncertainty and Economic Activity: Evidence from Business Survey Data". *American Economic Journal: Macroeconomics 5* (2), 217–249.

Bachmann, Rüdiger and Steffen Elstner (2015). "Firm optimism and pessimism". *European Economic Review 79*, 297 –325.

Bachmann, Rüdiger, Benjamin Born, Steffen Elstner, and Christian Grimme (2019). "Time-varying business volatility and the price setting of firms". *Journal of Monetary Economics 101*, 82–99.

Balleer, Almut and Peter Zorn (2019). "Monetary policy, price setting, and credit constraints". mimeo.

Bauer, Michael D. and Glenn D. Rudebusch (2014). "The Signaling Channel for Federal Reserve Bond Purchases". *International Journal of Central Banking 10* (3), 233–289.

Becker, Sasha. O. and Klaus Wohlrabe (2008). "Micro Data at the Ifo Institute for Economic Research - The 'Ifo Business Survey' Usage and Access". *Schmollers Jahrbuch-Zeitschrift für Wirtschafts- und Sozialwissenschaften 182* (2), 307–319.

Boneva, Lena, James CLoyne, Martin Weale, and Tomasz Wieladek (2018). "Firms' Expectations of New Orders, Employment, Costs and Prices: Evidence from Micro Data". CEPR Discussion Paper 12722.

Buchheim, Lukas and Sebastian Link (2017). "The effect of disaggregate information on the expectation formation of firms". CESifo Working Paper 6768.

Campbell, Jeffrey, Charles L. Evans, Jonas Fisher, and Alejandro Justiniano (2012). "Macroeconomic effects of federal reserve forward guidance". *Brookings Papers on Economic Activity 43* (1 (Spring)), 1–80.

Carlstrom, Charles T., Timothy S. Fuerst, and Matthias Paustian (2015). "Inflation and output in new keynesian models with a transient interest rate peg". *Journal of Monetary Economics 76*, 230 –243.

Coibion, Olivier and Yuriy Gorodnichenko (2012). "What can survey forecasts tell us about information rigidities?" *Journal of Political Economy 120* (1), 116–159.

——— (2015). "Information rigidity and the expectations formation process: a simple framework and new facts". *American Economic Review 105* (8), 2644–78.

Coibion, Olivier, Yuriy Gorodnichenko, and Saten Kumar (2018a). "How Do Firms Form Their Expectations? New Survey Evidence". *American Economic Review 108* (9), 2671–2713.

Coibion, Olivier, Yuriy Gorodnichenko, and Tiziano Ropele (2018b). "Inflation expectations and firm decisions: new causal evidence". NBER Working Paper 25412.

Coibion, Olivier, Yuriy Gorodnichenko, and Michael Weber (2019). "Monetary policy communications and their effects on household inflation expectations". CESifo Working Paper 7464.

Conrad, Christian and Michael J. Lamla (2010). "The high-frequency response of the eur-usd exchange rate to ecb communication". *Journal of Money, Credit and Banking 42* (7), 1391–1417.

Dedola, Luca, Georgios Georgiadis, Johannes Gräb, and Arnaud Mehl (2018). "Does a big bazooka matter? Central bank balance-sheet policies and exchange rates". Working Paper Series 2197. European Central Bank.

Del Negro, Marco, Marc Giannoni, and Christina Patterson (2015). "The forward guidance puzzle". Staff Reports 574. Federal Reserve Bank of New York.

Eggertsson, Gauti B. and Michael Woodford (2003). "The Zero Bound on Interest Rates and Optimal Monetary Policy". *Brookings Papers on Economic Activity 34* (1), 139–235.

Enders, Zeno, Franziska Hünnekes, and Gernot J. Müller (2019). "Firm expectations and economic activity". CESifo Working Paper 7623.

Gürkaynak, Refet S, Brian Sack, and Eric Swanson (2005). "Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements". *International Journal of Central Banking 1* (1).

Hall, Robert (2011). "The long slump". *American Economic Review 101*, 431–469.

IBS-IND (2018a). "Ifo Business Survey Industry 1/1980 – 6/2018, LMU-ifo Economics & Business Data Center, Munich". *doi: 10.7805/ebdc-ibs-ind-2018a*.

Jarociński, Marek and Peter Karadi (2019). "Deconstructing Monetary Policy Surprises - The Role of Information Shocks". *American Economic Journal: Macroeconomics*, forthcoming.

Jia, Chengcheng (2019). "The informational effect of monetary policy and the case for policy commitment". mimeo.

Krishnamurthy, Arvind and Annette Vissing-Jorgensen (2011). "The effects of quantitative easing on interest rates: channels and implications for policy". *Brookings Papers on Economic Activity 42* (2 (Fall)), 215–287.

Kumar, Saten, Hassan Afrouzi, Olivier Coibion, and Yuriy Gorodnichenko (2015). "Inflation targeting does not anchor inflation expectations: evidence from firms in New Zealand". *Brookings Papers on Economic Activity 2015*, 151–208.

Maćkowiak, Bartosz and Mirko Wiederholt (2009). "Optimal sticky prices under rational inattention". *American Economic Review 99* (3), 769–803.

——— (2015). "Business cycle dynamics under rational inattention". *Review of Economic Studies 82* (4), 1502–1532.

Massenot, Baptiste and Yuri Pettinicchi (2018). "Can firms see into the future? Survey evidence from germany". *Journal of Economic Behavior & Organization 145*, 66 –79.

McKay, Alisdair, Emi Nakamura, and Jón Steinsson (2016). "The power of forward guidance revisited". *American Economic Review 106* (10), 3133–58.

Melosi, Leonardo (2017). "Signalling effects of monetary policy". *The Review of Economic Studies 84* (2), 853–884.

Nakamura, Emi and Jón Steinsson (2018). "High-frequency identification of monetary non-neutrality: the information effect". *The Quarterly Journal of Economics 133* (3), 1283–1330.

Nerlove, Marc (1983). "Expectations, Plans, and Realizations in Theory and Practice". *Econometrica 51* (5), 1251–1279.

Nimark, Kristoffer P. (2014). "Man-Bites-Dog Business Cycles". *American Economic Review 104* (8), 2320–67.

Pagan, Adrian (1984). "Econometric issues in the analysis of regressions with generated regressors". *International Economic Review 25* (1), 221.

Romer, Christina D. and David H. Romer (2000). "Federal reserve information and the behavior of interest rates". *American Economic Review 90* (3), 429–457.

Sims, Christopher A. (1998). "Stickiness". *Carnegie-Rochester Conference Series on Public Policy, 49*, 317–356.

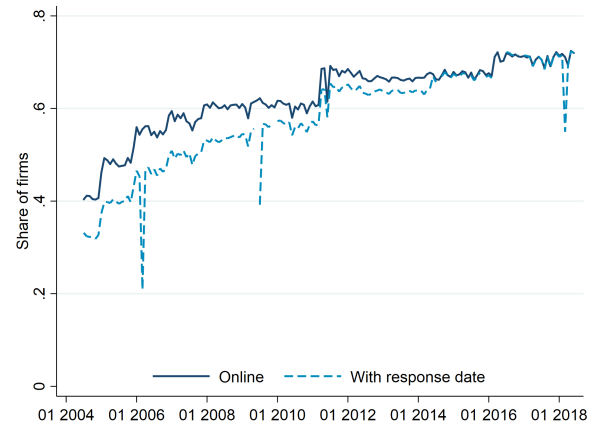
Wiederholt, Mirko (2015). "Empirical properties of inflation expectations and the zero lower bound". mimeo.

Tables and figures in the main body

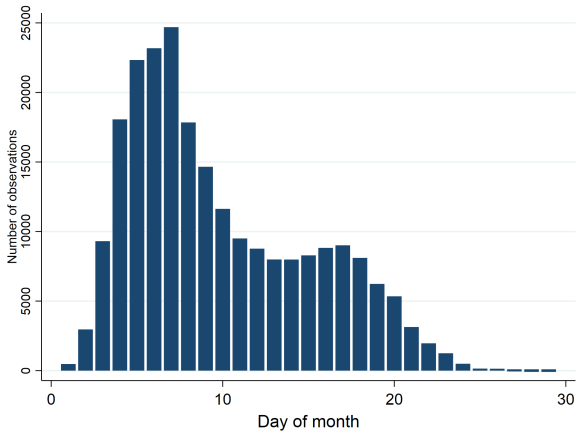
Figure 1: Ifo business survey, descriptive statistics.

Descriptive statistics for our sub-sample of the ifo business survey (IBS). Panel (a) shows share of firms with a response date. Panel (b) reports response days within month. Panel (c) shows average expectations over time. Panel (d) displays dispersion measure suggested by Bachmann et al. (2013). Averages are arithmetic means, no weights used. Response dates are not available in the following months: 06-2009, 12-2009, 08-2014, 11-2015, 03-2016, 05-2016, 06-2016, and 12-2016. Shaded areas mark recession periods as defined by the German Council of Economic Experts.

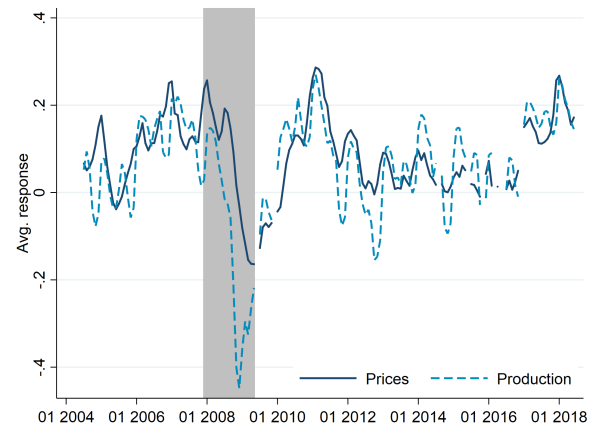
(a) Share of firms responding online



(b) Distribution of responses within months



(c) Average expectations within months



(d) Dispersion of expectations within months

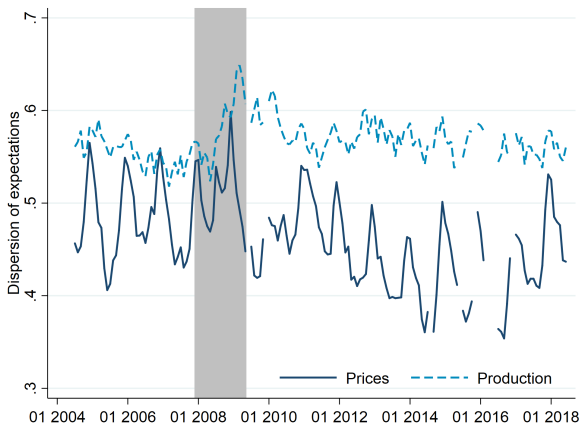
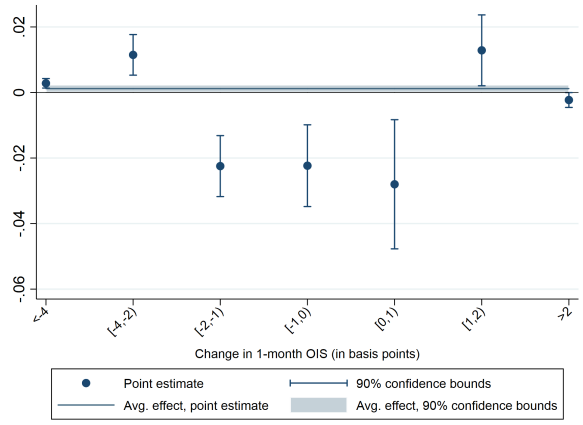


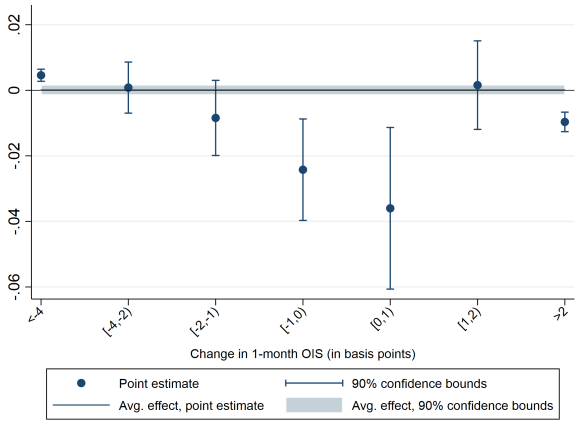
Figure 2: Effect of monetary policy surprises on firm expectations

Effects estimated in four-working-day windows around monetary events. Effects are allowed to vary for different sizes of the surprise. Upper panels display estimates of 7 separate bins of surprise sizes. Horizontal line represents estimate based on linear specification. Bottom panels display kernel estimates, excluding largest/smallest OIS changes. Degree: 3. Firm expectations are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around monetary policy meetings, taken from Altavilla et al. (2019).

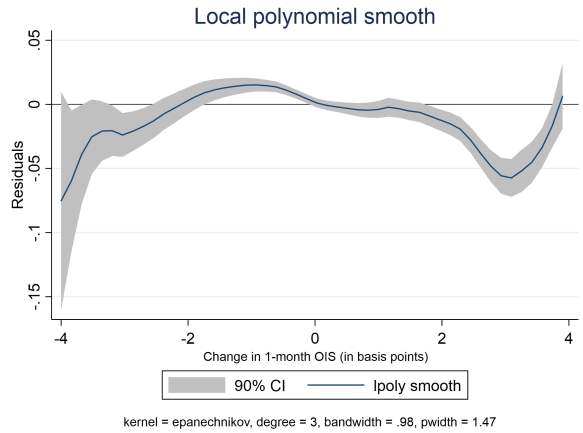
(a) Prices



(b) Production



(c) Prices



(d) Production

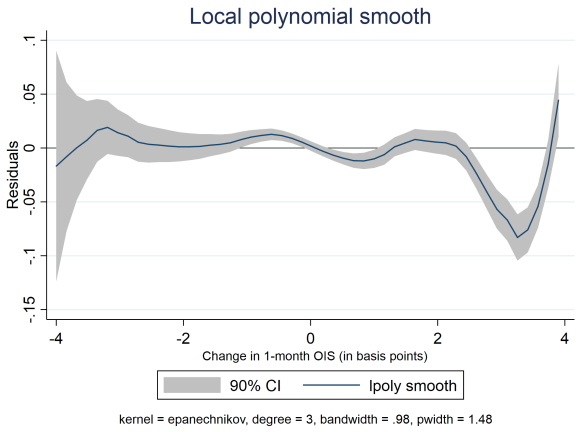
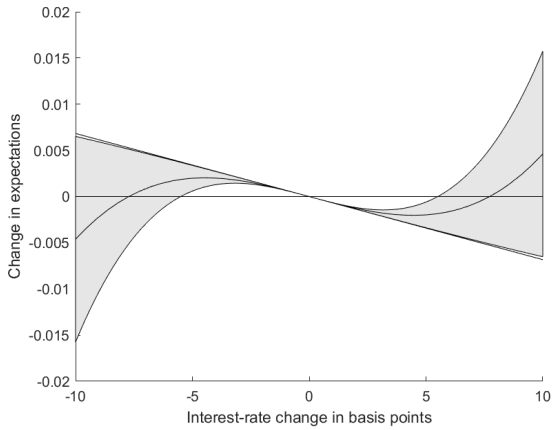


Figure 3: Effect of changes in the 1-month OIS rate, 2004 to 2018, with cubic changes

Graphical representation of results from the regression of changes in expectations on monetary policy surprises and surprises cubed in four-working-day windows around the respective events (Table 3). Straight line represents estimate of linear term. Shaded area indicates 90% confidence interval around the cubic component. Horizontal axis measures interest-rate changes (bp), vertical axis measures change in expectations. Firm expectations are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around monetary policy meetings, taken from Altavilla et al. (2019).

(a) Price expectations



(b) Production expectations

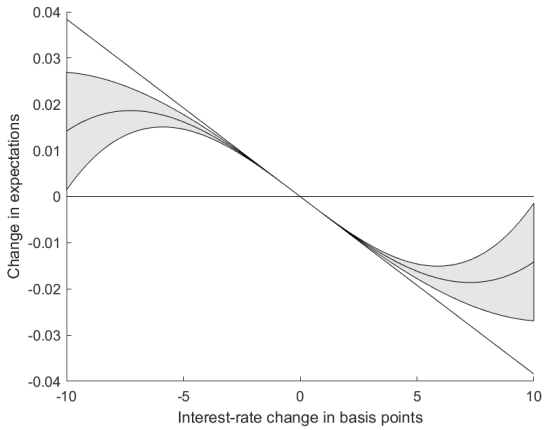


Table 1: Effect of unconventional monetary policy on firm expectations

Results from regression of changes in expectations on dummy variables indicating whether a monetary policy announcement occurred. Only firms responding within a four-working-day window around the respective events are included. Firms from months without events are included as additional control observations. Coefficients show how expectations of firms responding after the announcement differ from those responding before. Firm expectations are obtained from IBS. Robust standard errors displayed in parentheses.
p<0.1, ** p<0.05, *** p<0.01.

	Dependent variable: change in the expectations for prices			production		
	(1)	(2)	(3)	(4)	(5)	(6)
12-month LTROs	-0.1558***	-0.1010***	-0.0052	-0.1401***	-0.0661	-0.0561
	(0.032)	(0.031)	(0.038)	(0.041)	(0.041)	(0.051)
6-month LTROs	-0.0361	-0.0336	-0.0431	-0.0462	-0.0150	-0.0249
	(0.027)	(0.026)	(0.031)	(0.036)	(0.035)	(0.041)
12/13-month LTROs	-0.0292	-0.0639**	-0.0409	-0.1362***	-0.1528***	-0.0798*
	(0.026)	(0.025)	(0.028)	(0.038)	(0.040)	(0.044)
36-month LTROs	0.0699**	0.0859**	0.0562	-0.0027	0.0268	0.0696
	(0.035)	(0.035)	(0.046)	(0.042)	(0.040)	(0.056)
OMT details	-0.0537**	-0.0379	-0.0344	-0.1921***	-0.1345***	-0.1226***
	(0.026)	(0.026)	(0.029)	(0.039)	(0.040)	(0.044)
Forward Guidance	-0.0298**	-0.0187		-0.0047	0.0011	
	(0.013)	(0.012)		(0.019)	(0.018)	
TLTROs	-0.0702	-0.0552	-0.0227	-0.0423	0.0098	0.0482
	(0.052)	(0.052)	(0.056)	(0.067)	(0.069)	(0.074)
ABSPP+CBPP3	-0.0107	-0.0062		-0.0364*	0.0075	
	(0.013)	(0.013)		(0.021)	(0.021)	
APP details	0.0058	-0.0031		0.0279	0.0303	
	(0.020)	(0.020)		(0.026)	(0.027)	
PSPP share limit	-0.0267	-0.0190		0.0641**	0.1010***	
	(0.017)	(0.017)		(0.031)	(0.033)	
APP end	0.0337	0.0279	-0.0060	-0.0134	-0.0106	-0.0552
	(0.028)	(0.033)	(0.048)	(0.043)	(0.045)	(0.067)
Expected prices, t-1	-0.4389***	-0.5763***	-0.5818***			
	(0.002)	(0.003)	(0.003)			
Expected production, t-1				-0.4930***	-0.6072***	-0.6120***
				(0.002)	(0.003)	(0.003)
Prices, t-1		0.2664***	0.2617***			
		(0.004)	(0.004)			
Prices, t-2		0.0028	0.0020			
		(0.003)	(0.003)			
Production, t-1					0.0661***	0.0681***
					(0.003)	(0.003)
Production, t-2					0.0114***	0.0108***
					(0.003)	(0.003)
Demand, t-1		0.0490***	0.0455***		0.2021***	0.1980***
		(0.001)	(0.001)		(0.002)	(0.002)
Demand, t-2		-0.0026*	-0.0058***		-0.0096***	-0.0131***
		(0.001)	(0.002)		(0.002)	(0.002)
Orders, t-1		0.0088***	0.0066***		0.0079***	0.0044
		(0.002)	(0.002)		(0.003)	(0.003)
Foreign orders, t-1		0.0013	-0.0012		0.0244***	0.0212***
		(0.002)	(0.002)		(0.003)	(0.003)
Capacity utilization, t-1		0.0000	-0.0000		-0.0004***	-0.0004***
		(0.000)	(0.000)		(0.000)	(0.000)
Constant	0.0293***	0.0319***	-0.0270**	0.0228***	0.0561***	-0.0085
	(0.001)	(0.005)	(0.011)	(0.001)	(0.006)	(0.014)
Observations	236635	201212	201212	230028	197239	197239
Adjusted R^2	0.22	0.29	0.29	0.25	0.32	0.33
Monthly time FE	No	No	Yes	No	No	Yes

Table 2: Effect of changes in the 1-month OIS rate

Results for regression of changes in expectations on monetary policy surprises in four-working-day windows around the respective events. Firm expectations are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around monetary policy meetings, taken from Altavilla et al. (2019). Robust standard errors displayed in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

	Dependent variable: change in the expectations for prices		Dependent variable: change in the expectations for production	
	(1)	(2)	(3)	(4)
OIS, 1-month	0.000712	0.001180*	0.001737*	0.000109
	(0.00070)	(0.00070)	(0.00093)	(0.00092)
Expected prices, t-1	-0.453926***	-0.577462***		
	(0.00442)	(0.00556)		
Expected production, t-1			-0.494913***	-0.621993***
			(0.00401)	(0.00493)
Average state of business, t-1	0.133941***	0.077335***	0.132691***	0.091695***
	(0.00847)	(0.00873)	(0.01141)	(0.01159)
Prices, t-1		0.255370***		
		(0.00656)		
Prices, t-2		0.012252**		
		(0.00571)		
Production, t-1				0.086247***
				(0.00588)
Production, t-2				0.010418*
				(0.00543)
Demand, t-1		0.049109***		0.220692***
		(0.00270)		(0.00455)
Demand, t-2		-0.004271		-0.013500***
		(0.00281)		(0.00447)
Orders, t-1		0.011549***		0.008696*
		(0.00384)		(0.00512)
Foreign orders, t-1		-0.003217		0.027333***
		(0.00385)		(0.00496)
Capacity utilization, t-1		-0.000096		-0.000619***
		(0.00011)		(0.00014)
Constant	0.019802***	0.036120***	0.004984*	0.066913***
	(0.00189)	(0.00905)	(0.00256)	(0.01227)
Observations	65003	58779	62968	57379
Adjusted R^2	0.23	0.28	0.24	0.33
Observations before	31978	28761	30960	28058
Observations after	33025	30018	32008	29321

Table 3: Effect of changes in the 1-month OIS rate, with cubic changes

Results for regression of changes in expectations on monetary policy surprises and surprises cubed in four-working-day windows around the respective events. Firm expectations are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around monetary policy meetings, taken from Altavilla et al. (2019). In columns (3) and (6) the largest four surprises are excluded (absolute value larger 10 basis points). Robust standard errors displayed in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

	Dependent variable: change in the expectations for					
	prices			production		
	(1)	(2)	(3)	(4)	(5)	(6)
OIS, 1-month	-0.000516	-0.000683	-0.003538**	-0.001756	-0.003842**	-0.003887*
	(0.00116)	(0.00119)	(0.00171)	(0.00154)	(0.00152)	(0.00223)
OIS, 1-month, cubic	0.000007	0.000011*	0.000102***	0.000021***	0.000024***	0.000100***
	(0.00001)	(0.00001)	(0.00003)	(0.00001)	(0.00001)	(0.00004)
Expected prices, t-1	-0.453915***	-0.577454***	-0.575872***			
	(0.00442)	(0.00556)	(0.00565)			
Expected production, t-1				-0.495059***	-0.622135***	-0.622122***
				(0.00401)	(0.00493)	(0.00502)
Average state of business, t-1	0.134514***	0.078224***	0.082531***	0.134375***	0.093574***	0.094782***
	(0.00849)	(0.00875)	(0.00889)	(0.01143)	(0.01161)	(0.01177)
Prices, t-1		0.255362***	0.252039***			
		(0.00656)	(0.00668)			
Prices, t-2		0.012275**	0.012791**			
		(0.00571)	(0.00582)			
Production, t-1					0.086450***	0.084561***
					(0.00588)	(0.00598)
Production, t-2					0.010438*	0.011266**
					(0.00543)	(0.00552)
Demand, t-1		0.049103***	0.048136***		0.220601***	0.216653***
		(0.00270)	(0.00276)		(0.00455)	(0.00464)
Demand, t-2		-0.004357	-0.005429*		-0.013671***	-0.015195***
		(0.00281)	(0.00287)		(0.00447)	(0.00456)
Orders, t-1		0.011548***	0.012220***		0.008706*	0.011403**
		(0.00384)	(0.00391)		(0.00512)	(0.00521)
Foreign orders, t-1		-0.003237	-0.002813		0.027275***	0.026387***
		(0.00385)	(0.00392)		(0.00496)	(0.00505)
Capacity utilization, t-1		-0.000094	-0.000065		-0.000615***	-0.000621***
		(0.00011)	(0.00011)		(0.00014)	(0.00015)
Constant	0.019678***	0.035749***	0.034343***	0.004634*	0.066216***	0.072745***
	(0.00190)	(0.00905)	(0.00918)	(0.00256)	(0.01227)	(0.01247)
Observations	65003	58779	56491	62968	57379	55155
Adjusted R^2	0.23	0.28	0.28	0.24	0.33	0.33
Observations before	31978	28761	27395	30960	28058	26731
Observations after	33025	30018	29096	32008	29321	28424
Excl. largest surprises			X			X

Table 4: Effect of changes in the 1-month OIS rate, binarized dependent variable

Results based on regression of changes in expectations on monetary policy surprises and surprises cubed in four-working-day windows around the respective events. Changes in expectations are binarized, i.e., two new variables separately indicate upward and downward revisions. Firm expectations are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around monetary policy meetings, taken from Altavilla et al. (2019). Robust standard errors displayed in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

	Dependent variable: change in the expectations for			
	Prices		Production	
	(1)	(2)	(3)	(4)
	Upward revision	Downward revision	Upward revision	Downward revision
OIS, 1-month	0.000139	0.000796	-0.001248	0.002247**
	(0.00078)	(0.00086)	(0.00097)	(0.00105)
OIS, 1-month, cubic	0.000002	-0.000010**	0.000007	-0.000016***
	(0.00000)	(0.00000)	(0.00000)	(0.00001)
Expected prices, t-1	-0.233636***	0.320257***		
	(0.00352)	(0.00425)		
Expected production, t-1			-0.262166***	0.305374***
			(0.00295)	(0.00325)
Average state of business, t-1	0.034385***	-0.036316***	0.013427*	-0.075074***
	(0.00623)	(0.00620)	(0.00786)	(0.00758)
Prices, t-1	0.129232***	-0.109666***		
	(0.00420)	(0.00486)		
Prices, t-2	-0.014247***	-0.033737***		
	(0.00377)	(0.00416)		
Production, t-1			0.037697***	-0.045633***
			(0.00377)	(0.00367)
Production, t-2			0.003718	-0.001646
			(0.00344)	(0.00360)
Demand, t-1	0.021587***	-0.026210***	0.095279***	-0.106071***
	(0.00192)	(0.00187)	(0.00292)	(0.00296)
Demand, t-2	-0.005468***	-0.001109	-0.010343***	0.000381
	(0.00201)	(0.00194)	(0.00291)	(0.00296)
Orders, t-1	0.006674**	-0.003678	-0.001640	-0.010240***
	(0.00272)	(0.00268)	(0.00329)	(0.00342)
Foreign orders, t-1	-0.005283*	-0.003187	0.009878***	-0.015610***
	(0.00274)	(0.00267)	(0.00323)	(0.00328)
Capacity utilization, t-1	-0.000185**	-0.000106	-0.000672***	-0.000046
	(0.00008)	(0.00007)	(0.00010)	(0.00009)
Constant	0.117578***	0.083770***	0.208047***	0.146019***
	(0.00656)	(0.00627)	(0.00814)	(0.00787)
Observations	58779	58779	57379	57379
Adjusted R^2	0.12	0.20	0.17	0.21
Observations before	28761	28761	28058	28058
Observations after	30018	30018	29321	29321

Table 5: Robustness checks

Table shows several robustness checks for the non-linear effects of monetary policy surprises on firm expectations. Firm expectations are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around monetary policy meetings, taken from Altavilla et al. (2019). In columns (1) and (2) window size varies. In columns (3) to (8) we use the four-working-day window. "Crisis dummy" is 1 from 2008:M1 to 2009:M4 and 0 otherwise, based on data from the German Council of Economic Experts. "Uncertainty dummy" is 1 if VSTOXX_{t-1} is larger than its sample mean plus one standard deviation, and 0 otherwise. The volatility series is the V2TX series from www.stoxx.com. Full set of additional control variables included (not shown). Robust standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

	8-working-day window	Full window	2004-2011	Crisis dummy	Uncertainty	Firm fixed effects	Std. errors clustered by firm	Only firms expecting no change in t-1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel (a): Dependent variable: change in the expectations for prices							
OIS, 1-month	-0.000847	-0.001619***	-0.000906	-0.000780	0.000004	-0.000633	-0.000683	-0.000937
	(0.00118)	(0.00046)	(0.00180)	(0.00124)	(0.00122)	(0.00120)	(0.00116)	(0.00112)
OIS, 1-month, cubic	0.000014**	0.000008***	0.000012	0.000013	0.000017*	0.000010	0.000011*	0.000017***
	(0.00001)	(0.00000)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
OIS, 1-month × crisis dummy				-0.000603				
				(0.00236)				
OIS, 1-month × uncertainty dummy					-0.002374			
					(0.00194)			
Further Controls	X	X	X	X	X	X	X	X
Observations	72013	188211	24329	58779	58779	58779	58779	45258
Adjusted R^2	0.28	0.29	0.29	0.28	0.28	0.32	0.28	0.10
Observations before	41939		13905	28761	28761	28761	28761	22209
Observations after	30074		10424	30018	30018	30018	30018	23049
	Panel (b): Dependent variable: change in the expectations for production							
OIS, 1-month	-0.003525**	-0.005090***	-0.009882***	-0.005576***	-0.001417	-0.003887**	-0.003842**	-0.001823
	(0.00150)	(0.00060)	(0.00218)	(0.00158)	(0.00164)	(0.00151)	(0.00154)	(0.00165)
OIS, 1-month, cubic	0.000022***	0.000034***	0.000045***	0.000051***	0.000045***	0.000024***	0.000024***	0.000015*
	(0.00001)	(0.00000)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
OIS, 1-month × crisis dummy				-0.010957***				
				(0.00291)				
OIS, 1-month × uncertainty dummy					-0.008346***			
					(0.00253)			
Further Controls	X	X	X	X	X	X	X	X
Observations	70239	184184	23827	57379	57379	57379	57379	37627
Adjusted R^2	0.33	0.33	0.34	0.33	0.33	0.37	0.33	0.12
Observations before	40864		13625	28058	28058	28058	28058	18247
Observations after	29375		10202	29321	29321	29321	29321	19380

Table 6: Effect of changes in the 1-month OIS rate, 2004 to 2018, with Jarociński-Karadi shocks

Results based on regression of changes in expectations on monetary policy surprises and monetary policy shocks (standardized) provided by Jarociński and Karadi (2019). Firm expectations are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around monetary policy meetings, taken from Altavilla et al. (2019). Robust standard errors displayed in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

	Dependent variable: change in the expectations for prices		production	
	(1)	(2)	(3)	(4)
OIS, 1-month	-0.001607	-0.002871*	-0.004620***	-0.002371
	(0.00130)	(0.00164)	(0.00166)	(0.00207)
OIS, 1-month, cubic	0.000014**	0.000016**	0.000026***	0.000023***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Central bank information shock	0.004250*	0.005834**	0.003364	0.000541
	(0.00229)	(0.00267)	(0.00294)	(0.00328)
Monetary policy shock		0.003620		-0.006430*
		(0.00299)		(0.00362)
Expected prices, t-1	-0.577985***	-0.578014***		
	(0.00571)	(0.00571)		
Expected production, t-1			-0.622090***	-0.622083***
			(0.00505)	(0.00505)
Average state of business, t-1	0.078967***	0.078520***	0.091358***	0.092153***
	(0.00915)	(0.00916)	(0.01209)	(0.01209)
Prices, t-1	0.254644***	0.254637***		
	(0.00673)	(0.00673)		
Prices, t-2	0.014408**	0.014392**		
	(0.00588)	(0.00588)		
Production, t-1			0.087733***	0.087714***
			(0.00601)	(0.00601)
Production, t-2			0.011033**	0.011058**
			(0.00556)	(0.00556)
Demand, t-1	0.050929***	0.050972***	0.219238***	0.219172***
	(0.00277)	(0.00277)	(0.00465)	(0.00465)
Demand, t-2	-0.005250*	-0.005253*	-0.014850***	-0.014851***
	(0.00288)	(0.00288)	(0.00457)	(0.00458)
Orders, t-1	0.011596***	0.011589***	0.007719	0.007738
	(0.00396)	(0.00396)	(0.00526)	(0.00526)
Foreign orders, t-1	-0.002459	-0.002447	0.029101***	0.029080***
	(0.00397)	(0.00397)	(0.00510)	(0.00510)
Capacity utilization, t-1	-0.000130	-0.000130	-0.000596***	-0.000595***
	(0.00011)	(0.00011)	(0.00015)	(0.00015)
Constant	0.039176***	0.039209***	0.064532***	0.064498***
	(0.00926)	(0.00926)	(0.01254)	(0.01254)
Observations	56109	56109	54754	54754
Adjusted R^2	0.28	0.28	0.33	0.33
Observations before	26706	26706	26046	26046
Observations after	29403	29403	28708	28708

Table 7: Effect of changes in the 1-month OIS rate, 2004 to 2018, press release and press conference window separately

Results for regression of changes in expectations on monetary policy surprises and surprises cubed in four-working-day windows around the respective events, separately for surprises from windows around ECB press releases and ECB press conferences. Firm expectations are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around ECB press releases and ECB press conference, taken from Altavilla et al. (2019). Robust standard errors displayed in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

	Dependent variable: change in the expectations for prices		Dependent variable: change in the expectations for production	
	(1) Release	(2) Conference	(3) Release	(4) Conference
OIS, 1-month	-0.002156	-0.006632**	-0.007207***	-0.000271
	(0.00154)	(0.00278)	(0.00191)	(0.00350)
OIS, 1-month, cubic	0.000017**	0.000298***	0.000036***	0.000111
	(0.00001)	(0.00009)	(0.00001)	(0.00011)
Expected prices, t-1	-0.577428***	-0.577458***		
	(0.00556)	(0.00556)		
Expected production, t-1			-0.622094***	-0.621948***
			(0.00493)	(0.00493)
Average state of business, t-1	0.077271***	0.082035***	0.089637***	0.092029***
	(0.00874)	(0.00896)	(0.01161)	(0.01181)
Prices, t-1	0.255341***	0.255253***		
	(0.00656)	(0.00656)		
Prices, t-2	0.012268**	0.012191**		
	(0.00571)	(0.00571)		
Production, t-1			0.086461***	0.086208***
			(0.00588)	(0.00588)
Production, t-2			0.010366*	0.010427*
			(0.00543)	(0.00543)
Demand, t-1	0.049070***	0.049115***	0.220432***	0.220665***
	(0.00270)	(0.00270)	(0.00455)	(0.00455)
Demand, t-2	-0.004426	-0.004175	-0.013855***	-0.013532***
	(0.00281)	(0.00281)	(0.00447)	(0.00447)
Orders, t-1	0.011570***	0.011543***	0.008783*	0.008717*
	(0.00384)	(0.00384)	(0.00512)	(0.00512)
Foreign orders, t-1	-0.003247	-0.003259	0.027256***	0.027320***
	(0.00385)	(0.00385)	(0.00496)	(0.00496)
Capacity utilization, t-1	-0.000094	-0.000097	-0.000614***	-0.000619***
	(0.00011)	(0.00011)	(0.00014)	(0.00014)
Constant	0.035939***	0.035265***	0.067156***	0.067040***
	(0.00905)	(0.00906)	(0.01227)	(0.01227)
Observations	58779	58779	57379	57379
Adjusted R^2	0.28	0.28	0.33	0.33
Observations before	28761	28761	28058	28058
Observations after	30018	30018	29321	29321

Appendix

Table A.1: All questions from the IBS used in the estimations

Authors' translation of the most recent formulation of the question in German according to the EBDC Questionnaire manual. We only show those answer possibilities that we consider. Specifically, we exclude "no production" or similar answers which indicate that the question does not apply to the firm.

Label	Name	Question	Possible answers
Q1	expected prices	Expectations for the next 3 months: Taking changes of terms and conditions into account, our domestic sales prices (net) for product XY will probably ...	increase [1] not change [0] decrease [-1]
Q2	expected production	Expectations for the next 3 months: Our domestic production activity regarding good XY will probably ...	increase [1] not change [0] decrease [-1]
Q3	prices	Tendencies in the previous month: Taking changes of terms and conditions into account, our domestic sales prices (net) for product XY have ...	increased [1] not changed [0] decreased [-1]
Q4	production	Tendencies in the previous month: Our domestic production activities with respect to product XY have ...	increased [1] not changed [0] decreased [-1]
Q5	demand	Tendencies in the previous month: The demand situation with respect to product XY is ...	better [1] not changed [0] worse [-1]
Q6	orders	We consider our order backlog to be ...	relatively high [1] sufficient [0] too small [-1]
Q7	foreign orders	We consider our order backlog for exports to be ...	relatively high [1] sufficient [0] too small [-1]
Q8	capacity utilization	The current utilization of our capacities for producing XY (standard utilization = 100%) is currently x%.	x is a value between 30 and 100 divisible by 10 OR if value > 100, firms can write this value down
Q9	state of business (ordinal)	Current situation: We evaluate our state of business for XY to be...	good [1] satisfactory [0] bad [-1]
Q10	expected state of business (ordinal)	Expectations for the next 6 months: Our state of business for XY will ...	improve [1] stay the same [0] worsen [-1]
Q11	expected state of business (scale)	Expectations for the next 6 months: Our state of business for XY will x ...	x is a scalar between 0 and 100 chosen by moving a slider; the following values are labeled: 0–worsen, 50–stay the same, 100–improve
Q12	inventories	Current situation: we assess our stock of unsold amounts of good XY to be ...	too low [1] sufficient (for the season) [0] too large [-1]

Table A.2: Descriptive statistics

Comparison of mean and variance for all variables we consider between the full sample and our sub-sample. Data from the IBS.

	Full sample			Sample with part. date		
	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.
Employees in production	489	3563.26	428790	548	3771.49	232267
Expected production, t	0.04	0.57	414486	0.06	0.58	224473
Expected prices, t	0.08	0.47	426451	0.08	0.47	231031
Production, t-1	-0.00	0.58	413784	0.01	0.58	224232
Prices, t-1	0.03	0.44	426706	0.04	0.43	231021
Demand, t-1	0.02	0.65	428220	0.03	0.66	231851
Orders, t	-0.14	0.65	426175	-0.12	0.66	231498
Foreign orders, t	-0.16	0.58	422043	-0.14	0.60	229778
Capacity utilization, t	81.08	16.57	366987	81.63	16.19	208385
State of business (ordinal), t	0.12	0.68	428291	0.15	0.69	231959
Exp. state of business (ordinal), t	0.02	0.60	427022	0.02	0.60	231297
Exp. state of business (scale), t	52.47	16.46	243925	52.64	16.44	213926
Inventories, t	-0.11	0.48	294251	-0.09	0.48	159477

Table A.3: Important ECB announcements and SPF rounds

Dates are an extended version of the list provided by Dedola et al. (2018). We also show which round of the survey of professional forecasters (SPF) conducted by the ECB is associated with the events.

		Associated SPF survey		
Date	Announcement	Round	Start	End
05/07/2009	12-month Longer-term Refinancing Operations (LTROs) + other measures	2009Q3	07/15/2009	07/17/2009
08/04/2011	6-month LTROs + other measures	2011Q4	10/14/2011	10/18/2011
10/06/2011	12 and 13-month LTROs	2011Q4	10/14/2011	10/18/2011
12/08/2011	36-month LTROs	2012Q1	01/17/2012	01/20/2012
08/02/2012	Announcement of the Outright Monetary Transactions (OMT) program	2012Q4	10/16/2012	10/22/2012
09/06/2012	OMT implementation details	2012Q4	10/16/2012	10/22/2012
07/04/2013	First forward guidance announcement	2013Q3	07/16/2013	07/19/2013
06/05/2014	Targeted Longer-term Refinancing Operations (TLTROs)	2014Q3	07/17/2014	07/24/2014
09/04/2014	Announcement of the Asset-backed Securities Purchase Program (ABSPP) and the new Covered Bonds Purchase Program (CBPP3)	2014Q4	10/16/2014	10/23/2014
01/22/2015	Announcement of the expanded Asset Purchase Program (APP)	2015Q2	03/31/2015	04/07/2015
03/05/2015	APP implementation details	2015Q2	03/31/2015	04/07/2015
09/03/2015	Increase in public sector purchase program (PSPP) share limit	2015Q4	09/30/2015	10/06/2015
03/10/2016	Announcement of Corporate Sector Purchase Program (CSPP)	2016Q2	03/31/2016	04/06/2016
12/08/2016	First extension of the APP	2017Q1	01/04/2017	01/10/2017
10/26/2017	Second extension of the APP	2018Q1	01/08/2018	01/11/2018
06/14/2018	Announcement of the end of the APP	2018Q3	07/02/2018	07/06/2018

Table A.4: Effect of unconventional monetary policy on SPF expectations

Results from regression of changes in the forecasts in the Survey of Professional Forecasters (SPF) conducted by the ECB on dummy variables indicating different monetary policy announcements. Forecasts are made for the current year and the next year. HICP inflation is measured as the year-on-year change in the HICP price index. GDP growth is measured as the annual real GDP growth rate. The timing of the announcements and the survey rounds is shown in Table A.3. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

	Current year		Next year	
	GDP growth	HICP inflation	GDP growth	HICP inflation
	(1)	(2)	(3)	(4)
12-month SLTROs	-1.4795***	-0.5590***	-0.4456***	-0.2903**
	(0.12)	(0.10)	(0.10)	(0.12)
12/13-month SLTROs	0.0005	0.1564***	-0.6040***	0.0589
	(0.05)	(0.05)	(0.09)	(0.05)
36-month SLTROs	0.2275**	0.1927**	-0.0812	-0.0195
	(0.10)	(0.08)	(0.09)	(0.08)
OMT	-0.1390***	0.0950*	-0.4834***	0.1906***
	(0.04)	(0.05)	(0.07)	(0.04)
Forward Guidance	0.0868	0.0051	-0.0054	-0.2196***
	(0.10)	(0.07)	(0.09)	(0.07)
ABSPP+CBPP3	-0.1606***	-0.0061	-0.3764***	-0.2639***
	(0.04)	(0.05)	(0.05)	(0.05)
APP announcement+details	0.5741***	-0.2066**	0.3985***	-0.0956
	(0.06)	(0.10)	(0.06)	(0.06)
PSPP share limit	-0.0246	0.2727***	-0.2805***	-0.2714***
	(0.07)	(0.05)	(0.07)	(0.06)
CSPP	0.0708	-0.4221***	0.0271	-0.1864***
	(0.05)	(0.06)	(0.03)	(0.06)
First APP extension	-0.0256	0.1893***	-0.0960*	0.0272
	(0.04)	(0.06)	(0.05)	(0.04)
Second APP extension	0.2579***	-0.0494	0.2859***	0.0624
	(0.05)	(0.06)	(0.07)	(0.05)
APP end	-0.3658***	-0.0622*	0.1254***	0.0810**
	(0.03)	(0.04)	(0.04)	(0.03)
Previous SPF forecast for GDP growth, t	-0.0154*			
	(0.01)			
Previous SPF forecast for HICP inflation, t		-0.0188		
		(0.01)		
Previous SPF forecast for GDP growth, t+1			-0.1730***	
			(0.03)	
Previous SPF forecast for HICP inflation, t+1				-0.2300***
				(0.04)
Revision of expected oil price, average next 4 quarters (SPF)	0.0028***	0.0142***	0.0024**	0.0043***
	(0.00)	(0.00)	(0.00)	(0.00)
Revision of expected USD/EUR exchange rate, average next 4 quarters (SPF)	0.4114**	-0.2342	0.5644***	-0.1602
	(0.18)	(0.17)	(0.15)	(0.11)
Revision of expected main refinancing rate, average next 4 quarters (SPF)	0.1195*	0.1599***	0.0702	0.1196*
	(0.07)	(0.05)	(0.05)	(0.07)
Survey in first quarter	-0.2136***	0.0649*	-0.1855***	-0.0464
	(0.03)	(0.03)	(0.04)	(0.03)
Survey in second quarter	-0.1168***	0.1629***	-0.0995***	0.0093
	(0.03)	(0.02)	(0.03)	(0.03)
Survey in third quarter	-0.0272	0.1220***	-0.1663***	0.0011
	(0.02)	(0.02)	(0.03)	(0.03)
Constant	0.0337	-0.0352	0.2928***	0.3528***
	(0.02)	(0.02)	(0.05)	(0.07)
Observations	1217	1211	1170	1166
Within R^2	0.77	0.58	0.49	0.26
No. forecasters	50	50	49	49
Avg. obs/forecaster	24.3	24.2	23.9	23.8
Min. obs/forecaster	10	10	10	10
Incl. Reuters surprises	Yes	Yes	Yes	Yes

Table A.5: Robustness checks, different dependent variables

Results for regression of changes in different dependent variables on monetary policy surprises and surprises cubed in four-working-day windows around the respective events. Answers in column (4) are measured on a scale from 0-100. Firm responses are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around monetary policy meetings, taken from Altavilla et al. (2019). Full set of additional control variables included (not shown). Robust standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

	Dependent variable: change in			
	state of business	inventories	exp. state of business, ordinal measure	exp. state of business, scale measure
	(1)	(2)	(3)	(4)
OIS, 1-month	0.000358	-0.001707	-0.004467***	-0.080802**
	(0.00120)	(0.00139)	(0.00155)	(0.03264)
OIS, 1-month, cubic	-0.000002	0.000016*	0.000040***	0.000404**
	(0.00001)	(0.00001)	(0.00001)	(0.00019)
Further Controls	X	X	X	X
Observations	55327	36617	56989	52905
Adjusted R^2	0.32	0.52	0.31	0.17
Observations before	27102	17907	27916	27139
Observations after	28225	18710	29073	25766

Table A.6: Effect on realized prices and production

Results for regression of realized changes in prices and production on monetary policy surprises and surprises cubed for firms which responded in four-working-day windows around monetary events. Interactions with a dummy indicating whether response was recorded after an event are included. Firm responses are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around monetary policy meetings, taken from Altavilla et al. (2019). Full set of additional control variables included (not shown). Robust standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

	Dependent variable:			
	Prices, t	Prices, t+1	Production, t	Production, t+1
	(1)	(2)	(3)	(4)
OIS, 1-month	-0.004228***	-0.006543***	-0.013134***	-0.012782***
	(0.00107)	(0.00122)	(0.00168)	(0.00184)
OIS, 1-month, cubic	0.000009*	0.000024***	0.000028***	0.000040***
	(0.00000)	(0.00001)	(0.00001)	(0.00001)
OIS, 1-month × after event	0.001812	0.002651	0.004510*	0.002126
	(0.00151)	(0.00169)	(0.00234)	(0.00250)
OIS, 1-month, cubic × after event	-0.000000	-0.000002	0.000005	0.000018
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Further Controls	X	X	X	X
Observations	55666	55199	54241	53820
Adjusted R^2	0.35	0.24	0.27	0.18
Observations before	27252	27004	26516	26304
Observations after	28414	28195	27725	27516

Table A.7: Effect of Jarociński-Karadi monetary policy shocks

Results based on regression of changes in expectations on monetary policy shocks provided by Jarociński and Karadi (2019) in four-working-day windows around monetary events. Monetary policy shocks are standardized. Firm expectations are obtained from IBS. Robust standard errors in parentheses. * p<0.1, ** p<0.5, *** p<0.01.

	Dependent variable: change in the expectations for			
	Prices		Production	
	(1)	(2)	(3)	(4)
Monetary policy shock	0.0003	0.0010	-0.0003	-0.0015
	(0.002)	(0.002)	(0.003)	(0.002)
Central bank information shock	0.0068***	0.0061***	0.0072***	-0.0014
	(0.002)	(0.002)	(0.002)	(0.002)
Expected prices, t-1	-0.4531***	-0.5801***		
	(0.004)	(0.005)		
Expected production, t-1			-0.4936***	-0.6207***
			(0.004)	(0.005)
Average state of business, t-1	0.1447***	0.0838***	0.1449***	0.0936***
	(0.008)	(0.008)	(0.011)	(0.011)
Prices, t-1		0.2573***		
		(0.006)		
Prices, t-2		0.0159***		
		(0.006)		
Production, t-1				0.0868***
				(0.006)
Production, t-2				0.0097*
				(0.005)
Demand, t-1		0.0507***		0.2198***
		(0.003)		(0.004)
Demand, t-2		-0.0046*		-0.0129***
		(0.003)		(0.004)
Orders, t-1		0.0117***		0.0084*
		(0.004)		(0.005)
Foreign orders, t-1		-0.0021		0.0276***
		(0.004)		(0.005)
Capacity, t-1		-0.0001		-0.0006***
		(0.000)		(0.000)
Constant	0.0176***	0.0361***	-0.0017	0.0654***
	(0.002)	(0.009)	(0.002)	(0.012)
Observations	69121	62641	66931	61150
Adjusted R^2	0.23	0.29	0.24	0.33
Observations before	32571	29465	31535	28767
Observations after	36550	33176	35396	32383

Figure A.1: Monetary policy surprises, 2004-2018

Changes in the 1-month OIS rate around ECB meetings, as provided by Altavilla et al. (2019). Days with unconventional announcements are indicated by dashed lines.

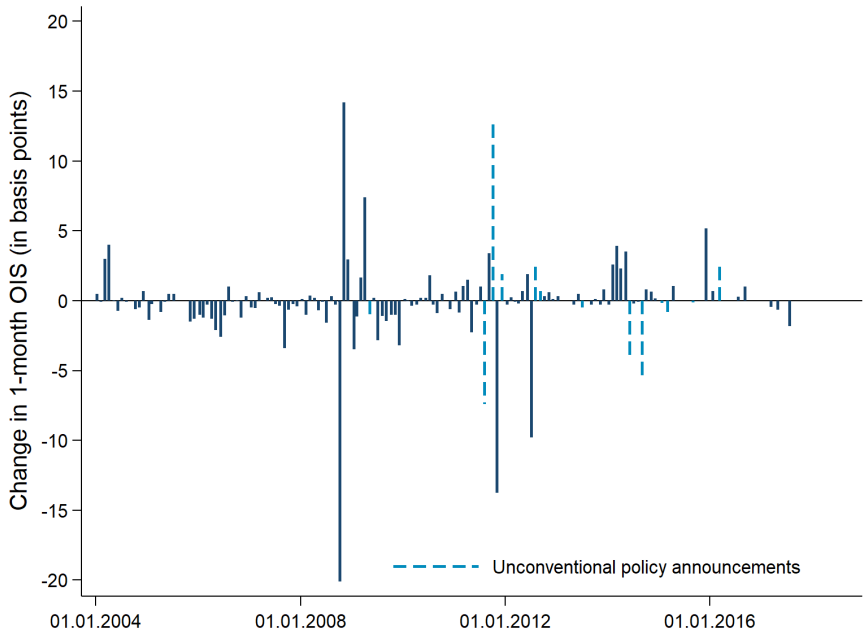
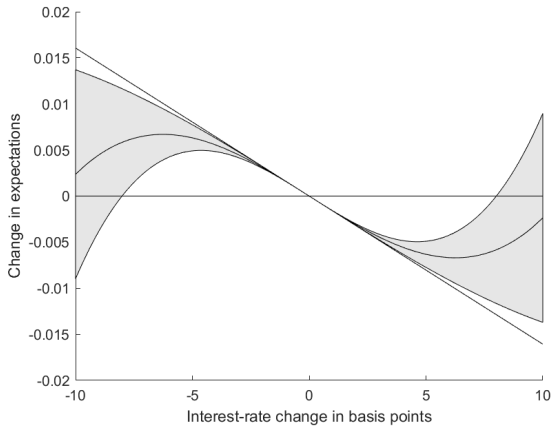


Figure A.2: Effect of changes in the 1-month OIS rate, with Jarociński-Karadi shocks

Graphical representation of results from the regression of changes in expectations on monetary policy surprises, surprises cubed, and the central bank information shock provided by Jarociński and Karadi (2019) in four-working-day windows around monetary events (see Table 6). Straight line represents estimate of linear term for changes in the 1-month OIS rate. Shaded area indicates 90% confidence interval around the cubic component. Firm expectations are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around monetary policy meetings, taken from Altavilla et al. (2019).

(a) Price expectations



(b) Production expectations

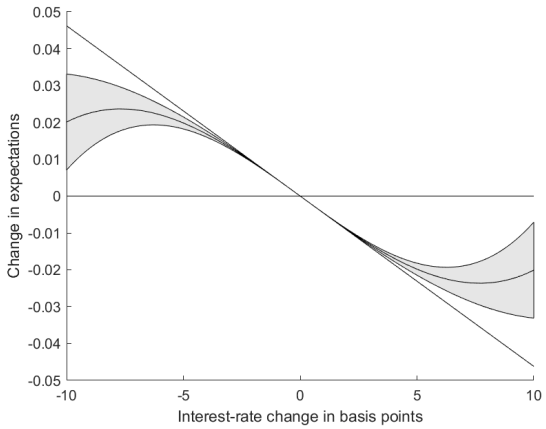
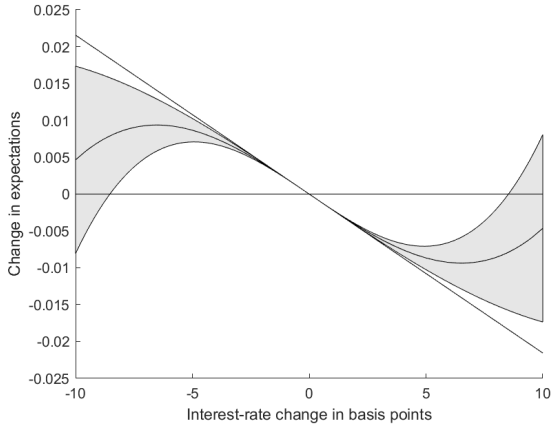


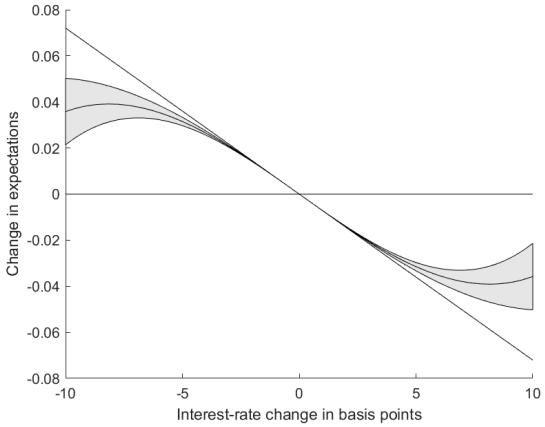
Figure A.3: Effect of changes in the 1-month OIS rate, press release vs. press conference window

Graphical representation of results from the regression of changes in expectations on monetary policy surprises and surprises cubed in four-working-day windows around the events, separately for the press release and the press conference window (see Table 7). Straight line represents estimate of linear term. Shaded area indicates 90% confidence interval around the cubic component. Firm expectations are obtained from IBS. Monetary policy surprises are measured using high-frequency interest-rate changes in a tight window around monetary policy meetings, taken from Altavilla et al. (2019).

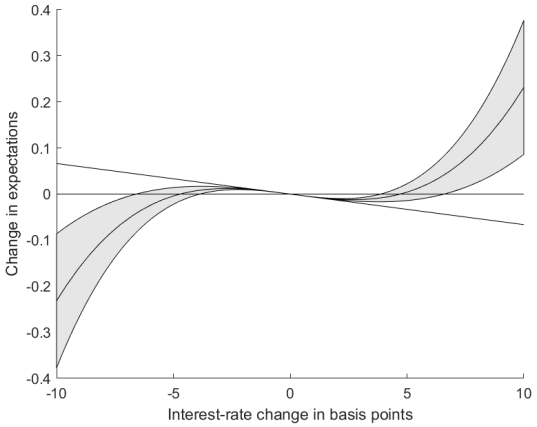
(a) Price expectations, Press Release



(b) Production expectations, Press Release



(c) Price expectations, Press Conference



(d) Production expectations, Press Conference