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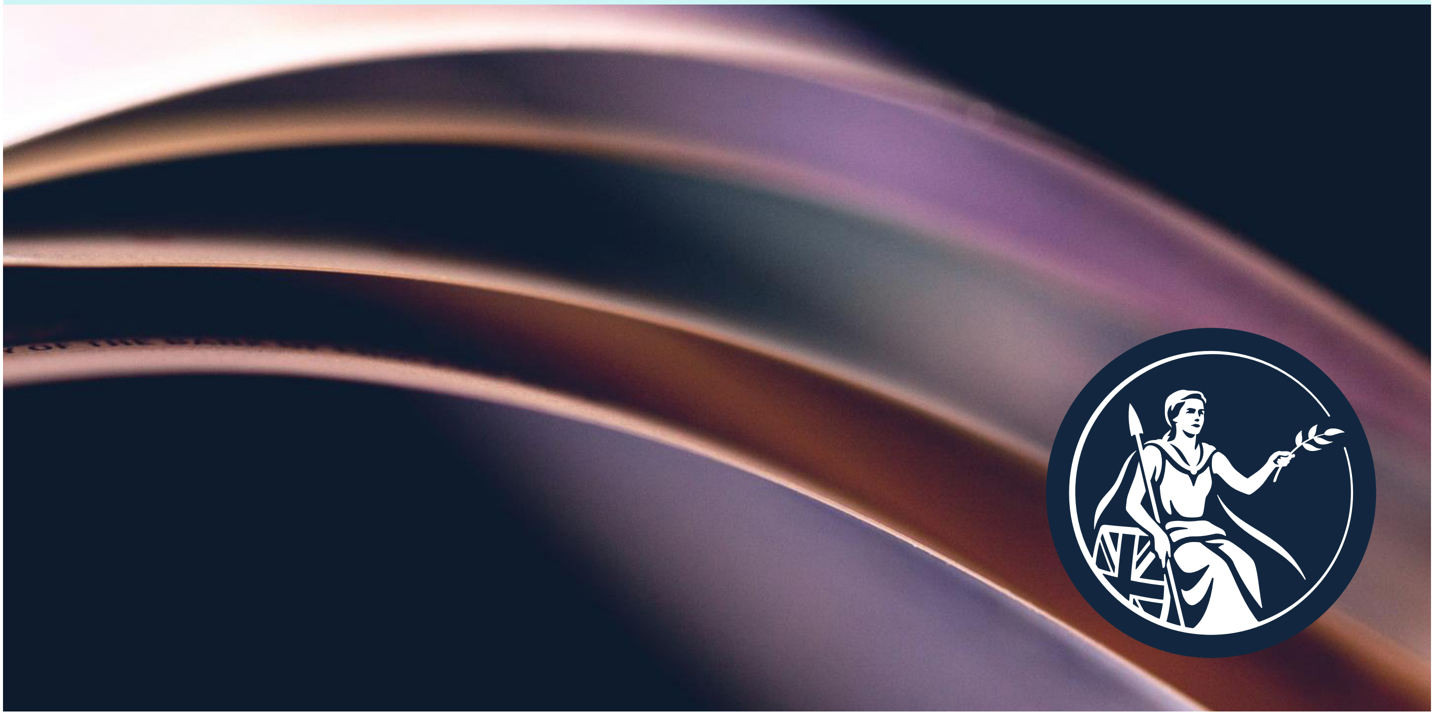

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Do firm expectations respond to monetary policy announcements?

Federico Di Pace,[1] Giacomo Mangiante[2] and Riccardo Masolo[3]

Abstract

This paper studies whether the distribution of firm expected price changes reacts to Bank of England monetary policy announcements by comparing the responses to the Decision Maker Panel Survey filed immediately before and after a Monetary Policy Committee meeting. We find that firm price expectations respond to changes in the monetary policy rate in line with economic theory. The degree to which firms respond to monetary policy announcements varies over time and is more pronounced for the left tail of their expected price distribution. Finally, we show that the response of aggregate prices is consistent with firms acting on the pricing plans they report in their survey responses.

Key words: Monetary policy announcements, firm expectations, monetary policy shocks, survey data.

JEL classification: D84, E52, E58.

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1 Introduction

In recent years the study of expectation formation has put greater emphasis on the difference in household, firm, and financial market participant expectations (Coibion, Gorodnichenko, and Kumar, 2018; Reis, 2021). The way financial markets respond to monetary policy announcements and how they react to monetary shocks has been well documented by Kuttner (2001) and the vast literature that ensued (e.g. Blinder et al., 2008). However, partially due to the limited availability of firm survey data, the extent to which firm expectations are influenced by monetary announcements is still open to debate. As it is firms that set prices and ultimately determine inflation, casting light on the impact of monetary policy announcements on firm expectations is central to our understanding of the propagation of monetary policy interventions.

In this paper, we study whether U.K. firm expectations respond to Bank of England (BoE) monetary policy announcements and, if so, how. We find that firms adjust their expectations in line with theoretical predictions in response to monetary policy shocks, measured as *changes* in the monetary policy rate, possibly purged of endogenous components (Romer and Romer, 2004). We also uncover significant time-variation in the responsiveness of firm expectations, in line with recent findings by Coibion, Gorodnichenko, Kumar, and Pedemonte (2020) and Weber et al. (2023). On the other hand, monetary policy *surprises*, derived from high-frequency variations in asset prices around monetary policy announcements, do not appear to impact firm expectations.

For our empirical analysis, we use the U.K. Decision Maker Panel (DMP) survey. The DMP elicits the entire distribution of expected price changes of each respondent, which we refer to as pricing plan for short. This enables us to study different moments of firm pricing plans, i.e. mean, median and tails. To isolate the effects of the monetary announcements, we exploit the date on which different firms filed their answers. By comparing the responses of those firms that responded immediately before to those that responded after an MPC meeting of the Bank of England, we can test whether the expectations are influenced by monetary policy announcements.

The first contribution of our paper is to assess how firms respond to announced changes in the monetary policy rate. In response to an increase in the bank rate firms tend to revise down their pricing plans. If we do not clean for the information content of monetary policy shocks, the response estimate is rather muted and imprecisely estimated. This is in line with the so-called information or signaling effect of monetary policy (Nakamura and Steinsson, 2018a; Melosi, 2017) playing an important role and biasing our estimates towards zero. However, when we control for the information content of interest rate changes, along the lines of Romer and Romer (2004), we find that the estimate of the impact of a (contractionary) monetary policy announcement on the median of firm pricing plans is negative, larger (in absolute value), and more precisely estimated.

The nature of the DMP data enables us to go one step further. We find that it is the left tail of firm pricing plans that is most responsive to monetary policy announcements. Firms react to monetary policy primarily by re-assessing the low-price states of their pricing plan. This is consistent with the observation that firms are more sensitive to low-price scenarios as their profit function is asymmetric (e.g. Fernández-Villaverde et al., 2015; Masolo and Monti, 2021).

Our second contribution documents the observed time variation in firm responsiveness. It appears that announcements during the Covid period and the initial phase of the current monetary policy tightening cycle were met by sharp responses by firms. As the recent series of rate increases took hold, firms have started to react less to monetary policy announcements. This finding reinforces those by Coibion, Gorodnichenko, Kumar, and Pedemonte (2020) and Weber et al. (2023) which show that the level of attention to inflation and monetary policy is subject to variations across space and time.

Our third contribution shows that the response of aggregate prices is overall consistent with the way firms adjust their pricing plans in the wake of a monetary policy announcement. This is an indirect way of verifying if firms act on their pricing plans. We estimate the impact of information-cleaned changes in the policy rate on aggregate prices by extending to 2023 the analysis of Cloyne and Hürtgen (2016), which estimated a SVAR using U.K. data over the 1975-2007 sample. Our SVAR is estimated with Bayesian techniques and employs the Pandemic Priors proposed by Cascaldi-Garcia (2022) to deal with exceptional data variation recorded during the Covid pandemic. We find that aggregate prices fall in response to the measure of monetary policy shocks that impact firm pricing plans. Relative to Cloyne and Hürtgen (2016), we estimate the response of aggregate prices to be quicker and overall larger in magnitude.

Our results show that firm expectations, unlike financial markets, are sensitive to bank rate changes rather than high-frequency surprises. It is thus of pivotal importance that policy makers consider how their announcements might be perceived and affect different agent expectations and design their communication strategy accordingly (Coibion, Gorodnichenko, Kumar, and Pedemonte, 2020).

Related Literature. This paper contributes to two strands of the literature. First, the results complement the body of empirical evidence on the effects of monetary policy announcements on expectations that rely on event studies. Lamla and Vinogradov (2019), Rast (2022), De Fiore, Lombardi, and Schuffels (2022) and Binder, Campbell, and Ryngaert (2022) focus on the response of the households' expectations. Lamla and Vinogradov (2019) run their own survey around Federal Open Market Committee (FOMC) meetings and document that the announcements have no measurable effect on average beliefs but make people more likely to receive news about the central bank's policy. Rast (2022) uses the GfK survey and finds that policy rate announcements lead to significant adjustments in household inflation expectations, unlike those about forward guidance and quantitative easing. De Fiore, Lombardi, and Schuffels (2022) rely on the responses from the New York Fed's Survey of Consumer Expectations before and after FOMC meetings and find that only the expectations about interest rates are affected. Binder, Campbell, and Ryngaert (2022) use the same survey to evaluate how household inflation expectations respond to FOMC announcements, macroeconomic data releases, and news related to politics and the Covid pandemic.

Similarly, Lewis, Makridis, and Mertens (2020) use daily survey data from Gallup to assess how household beliefs about economic conditions are influenced by monetary policy: changes in the federal funds target rate have a significant and instantaneous effect on economic confidence. Claus and Nguyen (2020) apply a latent factor model to consumer survey data from the Australian CASiE survey to document that expectations about economic conditions, unemployment, and readiness to spend adjust in the direction predicted by standard models following a monetary policy shock.

More closely related to our paper, Enders, Huennekes, and Müller (2019) study whether firm expectations respond to policy surprises and find that many of the ECB's announcements of non-conventional policies did not shift expectations significantly. Bottone and Rosolia (2019) use the Bank of Italy's quarterly Survey of Inflation and Growth Expectations and show that firms' pricing plans are not affected by monetary policy shocks. Pinter and Kočenda (2023) show that French firms' and households' expectations react to central bank announcements only once the media response to the announcement is taken into account. Ferrando and Grazzini (2023) document that firms' bank loan expectations, measured from the ECB Survey on the Access to Finance of Enterprises, react to monetary shocks. We extend this literature by showing how the distribution of firms' expected price growth is affected by changes in interest rate, both raw and cleaned from their information component, as well as by studying how firm responsiveness is subject to changes over time.

We also contribute to the empirical literature on the propagation of monetary policy shocks. The large number of alternative approaches to identifying monetary policy shocks (Ramey, 2016; Nakamura and Steinsson, 2018b) can be grouped into two main categories. The first measures monetary policy shocks by changes in the policy rate, net of endogenous variations. Cleansing from endogenous components can be attained by simply including the policy rate in a Structural Vector Autoregression (SVAR) model (e.g. Sims, 1992; Christiano, Eichenbaum, and Evans, 1996; Uhlig, 2005) or can explicitly account for the information advantage (Romer and Romer, 2000) of policymakers. Romer and Romer (2004) and Coibion (2012) apply this latter approach to the U.S. economy to assess the impact of information-cleaned policy rate changes on aggregate price. Cloyne and Hürtgen (2016) carries out a similar exercise for the U.K.

Alternatively, researchers have used variations of liquid asset-market prices over a few minutes around policy announcements to proxy for monetary policy shocks.[1]. Pioneered by Kuttner (2001), this approach has been popularized by Gürkaynak, Sack, and Swanson (2005), Gertler and Karadi (2015), Nakamura and Steinsson (2018a), Jarociński and Karadi (2020), and Miranda-Agrippino and Ricco (2021) among others, with Gerko and Rey (2017), Cesa-Bianchi, Thwaites, and Vicondoa (2020), and Braun, Miranda-Agrippino, and Saha (2023) applying it to U.K. data. Recently, Bauer and Swanson (2022) extended it to include events such as Fed Chair speeches and Mumtaz, Saleheen, and Spitznagel (2023) following a similar strategy for the U.K.

We contribute by showing that firms revise their pricing plans only in response to the first type of monetary policy disturbance measure, but not to the second. Our finding highlights the importance of studying the expectation formation processes for each economic agent separately. Firms' expectations are found not to be sensitive to asset-price surprises which are commonly used to study the propagation of monetary policy decisions to the financial markets.

The rest of the paper is organized as follows. Section 2 introduces a simple theoretical framework that illustrates how our empirical identification strategy can be understood in the context of a simple dispersed information model in the spirit of Woodford (2003). In Section 3 we describe our data and validate them. Section 4 presents our estimation strategy and identification scheme. Section 5 illustrates our main empirical findings. In Section 5.3 we perform a battery of robustness checks. Section 6 presents our SVAR evidence. Section 7 concludes.

2 An organizing framework

We present a minimal set of assumptions under which i) our survey data identifies the impact of monetary policy announcements on firm pricing plans; ii) our empirical strategy identifies an impulse response of the aggregate price index.

It amounts to a small variation on the dispersed-information firm pricing model first proposed by Woodford (2003). The economy comprises a continuum of firms $h \in [0, 1]$ that compete monopolistically, so that their pricing decision is subject to a form of strategic complementarity, and are subject to information frictions. Prices are otherwise flexible. We consider linearized equilibrium conditions and assume Gaussian shocks.

To first order, the pricing decision of a firm can be described as $p_{h,t} = \mathbb{E}_{h,t} p_t + \alpha \mathbb{E}_{h,t} y_t$, where $p_{h,t}$ is the price set by firm h in period t, p_t is the aggregate price level and y_t the level of aggregate demand. $0 < \alpha < 1$ measures the degree of strategic complementarity, and $\mathbb{E}_{h,t} p_t = \mathbb{E}\left[p_t | s_{h,0}, ..., s_{h,t}\right]$ is the mathematical expectation operator given the firm information set, defined

[1]While a "second stage" regression maps these high-frequency surprises into variations of interest rates at a monthly frequency, it remains the case that only the portion of the monthly variation that covaries with the high-frequency surprise is considered a valid proxy for a monetary policy disturbance.

as the infinite history of idiosyncratic noisy signals about the underlying state of the economy.

Typically these models are closed by positing an exogenous process for aggregate nominal demand (Woodford, 2003) so as to maintain tractability. We amend this slightly to highlight the impact of the monetary policy rate on aggregate demand. We posit a standard quantity theory of money equation and maintain an inverse relationship between the level of money m_t and the level of the policy rates i_t. Aggregate nominal demand (in log-linear terms and duly detrended) is thus pinned down as $-\eta i_t + v_t = p_t + y_t$, where η is the elasticity of money to interest rates and v_t an exogenous process for velocity. We do not need to specify the policy rule, except to assume that it can ultimately be written out as a linear function of the shocks we are considering, the monetary policy shock and the velocity shock.[2] The end result is a pricing equation in which the only endogenous variable is the aggregate price index:[3]

$$p_{h,t} \quad = \quad (1-\alpha)\,\mathbb{E}_{h,t} p_t - \alpha \mathbb{E}_{h,t}\left(\eta i_t - v_t\right) = \gamma \mathbb{E}_{h,t} \underline{x}_t, \tag{1}$$

where $\gamma \equiv \begin{bmatrix} -\eta\alpha & \alpha & (1-\alpha) \end{bmatrix}$ is a vector of structural parameters and $\underline{x}_t \equiv \begin{bmatrix} i_t & v_t & p_t \end{bmatrix}'$ the state vector of this economy. If v_t is AR(1), it will be possible to describe the law of motion for the state as $\underline{x}_t = M\underline{x}_{t-1} + \mu\underline{u}_t$, where $\underline{u}_t$ contains the monetary policy shocks and the innovation to the process for money velocity.

Each period, firms receive a noisy signal containing information about monetary policy, $s_{h,t}$ and set their price after having observed it. We are deliberately generic regarding the nature of this signal because it will not affect directly our identification scheme.[4] We only restrict the shock to be a linear combination of the variables in the state of the economy plus an idiosyncratic white noise component $\varepsilon_{h,t}$:[5] $s_{h,t} = \phi\underline{x}_t + \varepsilon_{h,t}$. The noise in the signal captures both any inaccuracy in the report firm executives may read, as well as any degree of inattention on their part.

Our empirical assumption exploits the fact that different firms will file the responses at different points in time during the course of monthly "survey wave". We group the firms that respond prior to receiving the current period's signal in set $\mathcal{C}$, for *control* group. Firms in the *treatment* group, $\mathcal{T}$, will respond after the release of the signal $s_{h,t}$. Key to our analysis is that firms are assigned randomly to the two groups or that the distribution of firms in the two groups is the same: $f(h|h \in \mathcal{C}) = f(h|h \in \mathcal{T}) = f(h)$, where $f(\cdot)$ is the probability density function of the

[2]For instance a rule of the form $i_t = \frac{\mathbb{E}_{cb,t} v_t}{\eta} + u_{m,t}$ stabilizes the expected value of aggregate demand (given the information set of the central bank), up to the monetary policy disturbance $u_{m,t}$.

[3]The aggregate price index can be easily solved by undetermined coefficients or, equivalently, resorting to the higher-order expectations constructs in Woodford (2003).

[4]Our empirical identification strategy only requires that the groups of firms differ by whether they have received the most recent monetary-policy-related signal. Other than that it would be easy to extend the model to have additional signals about the state of the economy.

[5]Idiosyncratic means that $\int \varepsilon_{h,t} f(h)\ dh = 0,\ \forall t$, where $f(h)$ is the probability density function of the cross-section of firms.

cross-section of firms. The survey answers we use to elicit the distribution of future prices firm h expects to be charging over the next year. We define the model counterpart to the survey answer as the mean/median expected price change, in keeping with the Linear-Gaussian nature of the model economy we consider:

$$a_{h,t} \quad = \quad \mathbb{E}_{h,t} p_{h,t+j} - p_{h,t-1}. \tag{2}$$

Firm responses amount to their expected price change over a j-period horizon. Key to computing this statistic is their expectation-updating equation: $\mathbb{E}_{h,t}\underline{x}_t = \mathbb{E}_{h,t-1}\underline{x}_t + K\left[s_{h,t} - \mathbb{E}_{h,t-1}s_{h,t}\right]$. It represents the extent to which firms update their expectations based on the surprise, the term in brackets. If firms update their expectations in a fully Bayesian way, K is the Kalman gain matrix.[6] However, this formulation also accommodates other expectation-formation processes, e.g. adaptive expectations, by simply defining the surprise and K accordingly.

Integrating across all firms in the treatment group, we obtain the average response of a firm in the treatment group in period t:

$$a_{\mathcal{T},t} \quad = \quad \int_{h\in\mathcal{T}} a_{h,t} f\left(h|h\in\mathcal{T}\right)\, dh = \gamma M^j \left(\mathbb{E}_{t-1}\underline{x}_t + KF_t\right) - p_{t-1}, \tag{3}$$

where $\mathbb{E}_{t-1}$ is the average expectation across firms and $F_t = \phi\left(\underline{x}_t - \mathbb{E}_{t-1}\underline{x}_t\right)$ is the average surprise, or forecast error in the signal.

The average answer of firms in the control group will differ by the fact that they respond before receiving the period-t signal, i.e. based on their information set from $t-1$. So:

$$a_{C,t} \quad = \quad \int_{h\in C} a_{h,t} f\left(h|h\in C\right)\, dh = \gamma M^j \mathbb{E}_{t-1}\underline{x}_t - p_{t-1}. \tag{4}$$

Then, the difference between the responses of the two groups we will estimate represents:

$$a_{\mathcal{T},t} - a_{C,t} \quad = \quad \gamma M^j K F_t. \tag{5}$$

The difference in the responses of the two groups is a function of the average surprise F_t. Because our empirical analysis focuses on firms respond within a few days of a monetary policy announcement, the empirical counterpart to F_t will represent a proxy to a monetary policy shock. Finally note that given the definition in equation (2), it is also the case that $a_{\mathcal{T},t} - a_{C,t} = \mathbb{E}_t p_{t+j} - \mathbb{E}_{t-1}p_{t+j}$, i.e. the j-period impulse response of the aggregate price index to the shock driving F_t.

[6] We assume that the economy has been ongoing for a sufficiently long time so that we can consider the Kalman gain to be constant.

3 Data

3.1 Decision Maker Panel

The Decision Maker Panel (DMP) is a monthly survey of U.K. firms, launched in August 2016 by the Bank of England, the University of Nottingham, and Stanford University. It is now one of the largest regular business surveys, with a panel of 8,000 firms and around 3,000 responding in any given month. It is designed to be representative of the population of U.K. businesses. Respondents are the Financial Officers of small, medium, and large U.K. companies, operating in a broad range of sectors.[7] DMP survey data has been used in a handful of recent papers: Altig et al. (2020), Bloom et al. (2023) and Yotzov et al. (2023). Ours is the first that tests the extent to which price expectations reported in the survey respond to monetary policy announcements.

The key questions for our analysis are:

i. *Looking ahead, from now to 12 months from now, what approximate % change in your AVERAGE PRICE would you assign to each of the following scenarios? (with five scenarios: lowest, low, middle, high, and highest provided).*

ii. *Please assign a percentage likelihood (probability) to the % changes in your AVERAGE PRICES you entered.*

These questions give us the subjective discrete probability density function (pdf) of the average expected price changes for each firm h in our sample, between time t and $t+12$, if we define our model at a monthly frequency. We will refer to the subjective probability mass that firm h, in period t, assigns to scenario j in period $t+12$ with $\phi_{h,t+12,j},\ j=1,\ldots 5$. We denote the corresponding support points with $\Delta p_{h,t+12,j},\ j=1,\ldots 5$, the reported price changes in each of the five scenarios. By pricing plan or expected price distribution of firm distribution of firm h at time t, we refer formally to the collection $\left\{\left\{\phi_{h,t+12,1}, \Delta p_{h,t+12,1}\right\}, \ldots, \left\{\phi_{h,t+12,5}, \Delta p_{h,t+12,5}\right\}\right\}$. The corresponding cumulative density function (cdf) is defined as $F_{h,t+12,j}(x) \sum_{j=1}^{5} \phi_{h,t+12,j} I\left(\Delta p_{h,t+12,j} \leq x\right)$, with $I(\cdot)$ being the indicator function.

We can then define the individual distribution moments we use in our analysis as:

- $\text{Mean}_{h,t} = \sum_{j=1}^{5} \Delta p_{h,t+12,j} \phi_{h,t+12,j}$,
- $\text{Median}_{h,t} = \Delta p_{h,t+12,k}$ with k such that $\sum_{j=1}^{k-1} \phi_{h,t+12,j} \leq 0.5$ and $\sum_{j=k+1}^{5} \phi_{h,t+12,j} \leq 0.5$,
- $\text{Left Tail}_{h,t} = \frac{\sum_{j=1}^{k} \Delta p_{h,t+12,j} \phi_{h,t+12,j}}{\sum_{j=1}^{k} \phi_{h,t+12,j}}$ with k such that $\sum_{j=1}^{k} \phi_{h,t+12,j} \leq 0.5$,

[7] More information about the representativeness of the data and the structure of the survey can be found here.

- Right $\text{Tail}_{h,t} = \frac{\sum_{j=k}^{5} \Delta p_{h,t+12,j} \phi_{h,t+12,j}}{\sum_{j=k}^{5} \phi_{h,t+12,j}}$ with k such that $\sum_{j=k}^{5} \phi_{h,t+12,j} \leq 0.5$,

where $\Delta p_{h,t+12,j}$ is the expected annual price change by firm h in scenario j, and $\phi_{h,t+12,j}$ is the subjective probability that firm h, in period t, assigns to scenario j in period $t + 12$. In Table 1 we report summary statistics for the different moments of firm pricing plans.

Table 1: Descriptive statistics

Variable	Mean	Std. Dev.	P1	P5	P95	P99
Mean exp. price gr.	3.62	5.03	-8.25	-1.5	11.85	21
Median exp. price gr.	3.39	5.05	-10	-1	10	20
Left tail exp. price gr.	2.31	4.86	-12.72	-3.33	9.3	19.6
Right tail exp. price gr.	4.93	5.66	-4.8	0	14.37	25.83

Notes: The table reports descriptive statistics from the DMP survey on British firms that responded within 5 days of an MPC meeting for the period 2016m8 to 2023m9. The data are at monthly frequency for the 12-month ahead mean, median, left tail, and right tail own price growth expectations.

The DMP panel also provides some firm-level characteristics that we use as controls. As summary description of the data, Table 2 reports the results of a series of regressions in which the four data moments defined above are regressed against each firm's reported past price growth, a set of sectoral fixed effects, a categorical variable for the firms' size[8] and a dummy for exporter status.[9] In line with findings by Coibion, Gorodnichenko, Kumar, and Pedemonte (2020) and Boneva et al. (2020), price growth is an excellent predictor of the distribution of future expected price changes. The exporter status, on the other hand, is largely inconsequential. An increase in size (the baseline is the small-firm category) associates with a leftward shift of the entire pricing distribution. Larger firms report, on average, the lowest average price growth expectations.

Finally, we validate the survey by comparing the time series for expected price changes, averaged across firms,[10] against realized inflation. Figure 1 reports average mean expected price changes (red line) and realized annual CPI inflation (green line), alongside the time series for the Bank of England bank rate for reference. First, the average mean expected price change series displays less variation than actual inflation. This is to be expected of an expectational series, as outturns naturally tend to be more volatile. Second, and more importantly, the average mean

[8]We classify a firm as small if it has less than 50 employees, medium if between 50 and 250, and large if it employs more than 250 people.

[9]It should be noted that these regressions include the same set of firms that we will include in our baseline regression with monetary policy shocks. This means that we restrict the attention to those firms that responded in a five-day window around each monetary policy announcement.

[10]A question inquiring about inflation expectations, as opposed to own price expectations, has been added only at a later date, which results in a much shorter and not overlapping sample - as firms providing inflation expectations do not report price expectations and vice versa.

Table 2: Key moments of the individual expected price change distribution

	(1) Mean price	(2) Median price	(3) Left tail price	(4) Right tail price
Past price growth	0.235***	0.217***	0.191***	0.270***
	(0.0201)	(0.0205)	(0.0204)	(0.0221)
Medium (50-250)	-0.848***	-0.618***	-0.515***	-1.120***
	(0.145)	(0.148)	(0.143)	(0.163)
Large (above 250)	-1.285***	-0.961***	-0.709***	-1.780***
	(0.153)	(0.156)	(0.154)	(0.171)
Exporter	-0.130	-0.152	-0.262**	-0.00687
	(0.125)	(0.128)	(0.124)	(0.140)
Constant	3.520***	3.187***	2.159***	4.849***
	(0.161)	(0.168)	(0.158)	(0.187)
Observations	6951	6951	6951	6951
R^2	0.133	0.108	0.091	0.144
Sector FE	YES	YES	YES	YES

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

expected price change series appears to lead the series for actual inflation. This is particularly evident around turning points and suggests that, on average, firms act on their reported pricing plans, thus impacting actual inflation over the following year.

3.2 Monetary Policy Surprises

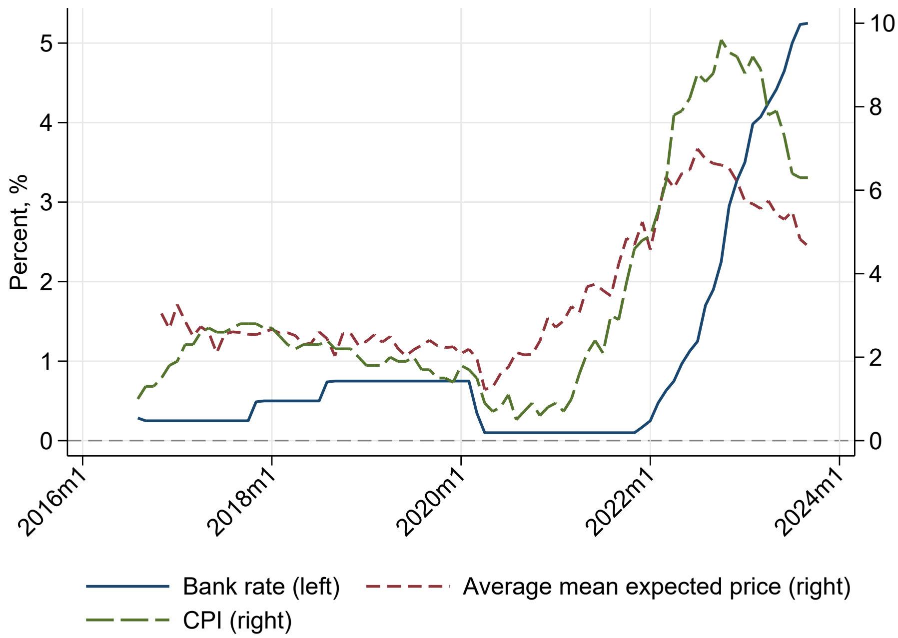
To evaluate whether firm expectations respond to monetary policy we rely on different monetary policy measures. Central banks engage in several forms of communication and firms might not pay attention to and understand them in the same way.

As a baseline measure of high-frequency monetary policy surprises, we use the surprises computed by Cesa-Bianchi, Thwaites, and Vicondoa (2020), based on the identification approach developed by Gürkaynak, Sack, and Swanson (2005). The surprises are the changes in the price of 3-month Sterling futures contracts expiring 2 quarters ahead in a 30-minute window around the announcements of the Monetary Policy Committee of the Bank of England.[11]

In the left panel of Figure 2 we plot the time series of the BoE bank rate. Despite the DMP survey only starting in 2016, we can capture important monetary events. Since 2016 the bank rate has been adjusted several times to respond to different events related to the Brexit referendum, Covid, and the recent increase in the inflation rate. This is reflected in the evolution over time of the monetary policy shocks, reported in the right panel of Figure 2. From 2016 onward the magnitude and the volatility of the surprises in the bank rate have correspondingly increased,

[11] From 2021 onward the Libor-based futures are not available anymore, so Sonia-based futures are used instead.

Figure 1: Time series of the BoE bank rate, the CPI, and the average mean price

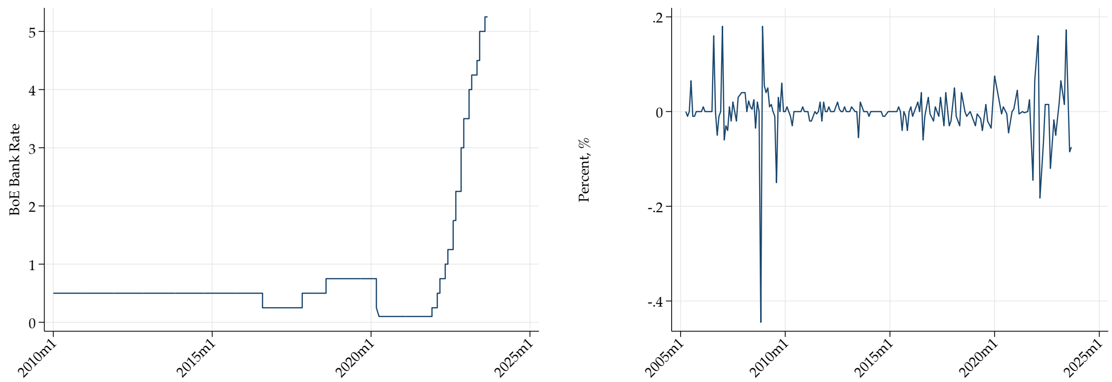


Notes: The plot reports the evolution over time of the Bank of England Bank rate (blue, left axis), CPI inflation (green, right axis), and the average of the cross-sectional mean expected price growth at firm-level (red, right axis).

relative to the early 2010s.

As a robustness check, we extend the analysis by considering several alternative measures of monetary policy surprises. First of all, in line with Swanson (2021), we decompose the surprises into a Target Factor, a Forward Guidance (FG) Factor, and a Quantitative Easing (QE) Factor which measure surprises at very short maturities, intermediate maturities, and longer maturities respectively and we use the first component as monetary shocks. Second, as shown by Miranda-Agrippino and Ricco (2021), monetary surprises can be a combination of a true shock and information about the state of the economy inferred by the agents through the actions of the central bank. Following the authors' approach we clean the surprises by this information component. Similarly to Cloyne and Hürtgen (2016), the same approach is applied to the bank rate changes to obtain an exogenous measure of the policy response as proposed by Romer and Romer (2004). Third, monetary surprises have been found to correlate with public economic and financial data therefore not being completely exogenous. As in Bauer and Swanson (2022), we purge the surprises by this so-called news component. Fourth, we extract the pure monetary policy component of the announcements by adopting the "poor man" approach proposed by Jarociński and Karadi

Figure 2: Bank of England Base Rate and Monetary Policy Surprises



Notes: The left panel plots the Bank of England Base Rate over time. The vertical axis is in annual percentage points. The right panel reports monetary policy surprises, computed as the changes in the second front contract of the 3-month Sterling future, the 3-to-6 month ahead expectation about the 3-month Libor, in a 30-minute window around monetary policy events.

(2020). Therefore, we consider only the surprises that negatively move with the FTSE All Share index. More details about these alternative measures can be found in Appendix A, where we also validate our measures of monetary policy surprises by showing how the inflation expectations of financial markets respond to these shocks.

4 Estimation Strategy and Identification

We estimate the treatment effect of monetary policy announcements by comparing the survey responses filed right before the MPC announcement with those right after, along the lines of Lamla and Vinogradov (2019), Rast (2022), De Fiore, Lombardi, and Schuffels (2022) and Binder, Campbell, and Ryngaert (2022).

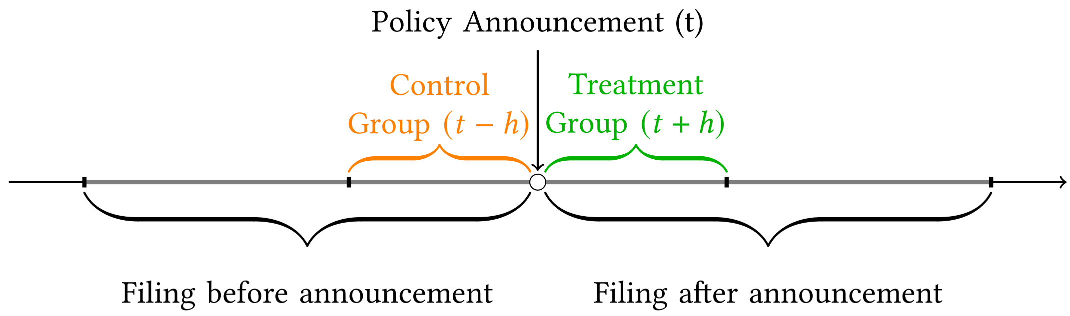
DMP surveys are conducted monthly over a period of 2 to 3 weeks. Firms can respond at any time during that period. Figure 3 depicts the timeline of a typical monthly survey wave. We focus on the monetary policy announcements that take place during the time window in which the DMP survey is administered and contrast the responses of firms that submitted their responses right before the announcement to those that did in the aftermath.[12]

We estimate the following regression specification:

$$y_{h,t} = \alpha + \gamma D_{h,t} + \beta D_{h,t}\mathbf{s}_t + X_{h,t} + \epsilon_{h,t}, \tag{6}$$

[12]We exclude the responses that have been filed on the days of an announcement as we do not observe the exact time of the submission.

Figure 3: Estimation strategy



Notes: Timeline of a typical DMP survey wave in which the monetary policy announcement is made while survey answers are being collected. We restrict our attention to firms responding within h days of the announcement.

where $D_{h,t}$ is a dummy equal to 1 if the firm responds after the announcement (as a baseline we use a symmetric time window around the MPC announcements of 5 days), s_t represents our measures of monetary policy shocks, and $X_{h,t}$ is the matrix of control variables, which includes a size categorical variable, exporter status, past price growth and sector and wave fixed effects. By wave, we refer to the monthly administering of the survey. A wave is completed within a month, so we could equivalently label it as monthly fixed effect. Robust standard errors are adopted.[13]

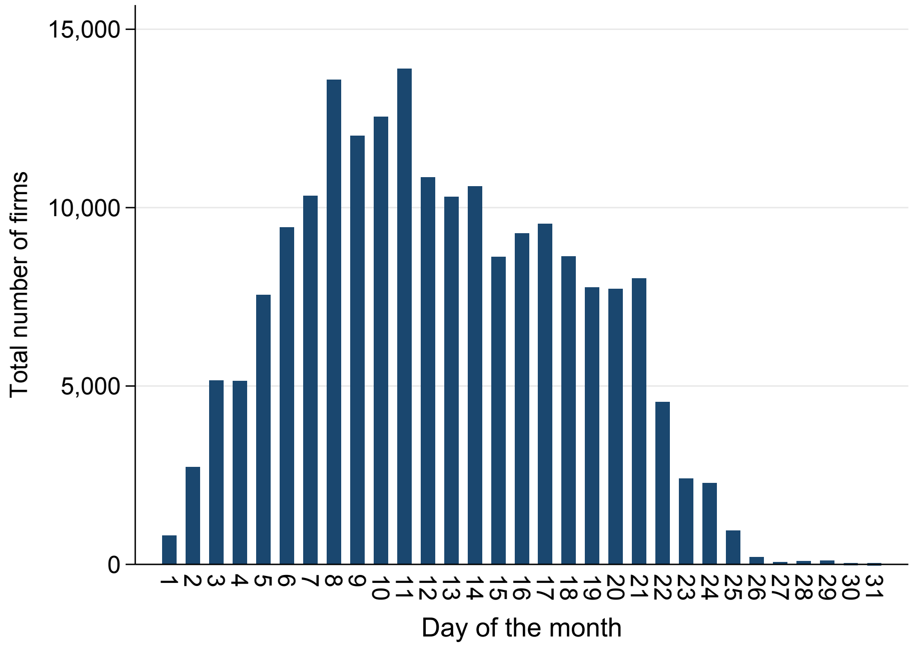
In Appendix A we show that financial markets' inflation expectations strongly respond to releases from the Office for National Statistics (ONS). This finding is in line with Yotzov et al. (2023) that show that firms in the DMP survey change their price expectations following ONS inflation releases. Therefore, we also include a dummy equal to one if firms responded after an ONS release regarding inflation, wages and unemployment and zero otherwise, as well as the interaction between these ONS dummies and the surprises of these variables (defined as the difference between the market median expectations for that release from Refinitiv Datastream and the actual value released by the ONS).[14]

In Figure 4, we report the total number of respondents for each day of the month. The majority of firms submit their responses in the second week of the month, while only a few file their answers during the last week. So if an announcement is made towards the end of the month, we may not be able to include it in our analysis as no firm's observations fall within the 5-day window around the announcement. The time series of the bank rate changes and surprises for the MPC meetings used in the empirical analysis are shown in the Appendix (Figure B.1).

[13]In Section 5.3 we interact the term $D_{h,t}s_t$ with firm-level characteristics that may influence the reaction to monetary policy shocks, to isolate elements of heterogeneity in firm responses.

[14]The days of the releases are excluded if they fall in the window of the MPC announcements as it would not be possible to distinguish firms that responded to the survey before from those that responded after the release.

Figure 4: Distribution of survey respondents by day of the month



Notes: The histogram reports the number of firms that filed their survey responses by day of the month.

More important for our identification strategy is that the date on which firms file their responses does not depend systematically on firm characteristics or on the timing of the policy announcement. In Section 5.3 we test this assumption and find that the probability of answering the survey before or after the MPC announcements is unrelated to firms' observable characteristics.

5 Empirical Results

In this section, we report the main results of our empirical analysis. We start by analyzing which proxy for monetary policy shocks firms respond to. We find that firms tend to respond primarily to interest rate changes rather than high-frequency surprises. They do so in line with economic theory: a monetary policy tightening leads to a leftward shift in firm distributions of expected price changes.

Monetary policy announcements have a larger effect on the left tail of firm pricing plans.[15] Moreover, the responsiveness of firms to monetary policy announcements displays a degree of

[15] As per our definition, a shift in the left tail captures a combination of the reassessment of the likelihood of low-price scenarios as well as any change in the prices firms expect to charge in those scenarios.

variation over time, with firms appearing to become less responsive when a rate increase becomes "the norm", as during the current monetary policy tightening cycle.

5.1 What monetary policy shocks do firms respond to?

As discussed in the Introduction, we can divide the empirical proxies for monetary policy shock into two broad categories. One measures the impact of monetary policy using the reaction of financial markets around the time of announcements. The other, relies on the actual change in policy rates, duly corrected for any endogenous component.

Our baseline series for U.K. market-based monetary policy surprises is that computed by Cesa-Bianchi, Thwaites, and Vicondoa (2020). We assess the impact of this series of surprises on the mean, median, left and right tail of firms' 12-month ahead expected price growth. We estimate equation (6) and include wave and sector fixed effects, alongside controls for reported past price growth, firm size, exporter status and ONS releases.

Table 3: MPC announcements and firms' expectations, high-frequency surprises

	(1) Mean price	(2) Median price	(3) Left tail price	(4) Right tail price
Surprise x Dummy MPC	1.936	1.785	1.306	2.321
	(1.271)	(1.272)	(1.217)	(1.419)
Dummy MPC	-0.563*	-0.515	-0.478	-0.669*
	(0.330)	(0.347)	(0.313)	(0.389)
Past price growth	0.181***	0.161***	0.139***	0.212***
	(0.0215)	(0.0218)	(0.0220)	(0.0236)
Medium (50-250)	-0.617***	-0.395**	-0.311**	-0.873***
	(0.155)	(0.157)	(0.153)	(0.173)
Large (above 250)	-1.033***	-0.713***	-0.491***	-1.497***
	(0.162)	(0.164)	(0.164)	(0.181)
Exporter	-0.186	-0.210	-0.310**	-0.0712
	(0.133)	(0.135)	(0.132)	(0.147)
Constant	4.155***	3.805***	2.706***	5.589***
	(0.286)	(0.300)	(0.269)	(0.340)
Observations	5979	5979	5979	5979
R^2	0.187	0.164	0.139	0.200
Wave FE	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES
Number of meetings	45	45	45	45

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3 reports our estimates[16]. The coefficient of interest is that on the interaction between

[16]In the interest of space the coefficients relative to the ONS dummies and their interaction with the surprises are excluded.

the surprise and the Dummy MPC. It measures to which extent the distribution of expected price changes by firms responding after the release of the policy communication differs from that of firms that filed their responses beforehand. The surprise series is normalized so that the coefficient corresponds to the response to a 25 basis point surprise. None of the coefficients is significant. In the Appendix (Table B.1) we confirm this result using a battery of alternative measures of high-frequency monetary surprises, described in Appendix A. The lack of firm responsiveness to monetary policy surprises is in line with findings by Bottone and Rosolia (2019) and Enders, Huennekes, and Müller (2019).

Table 4: MPC announcements and firms' expectations, bank rate changes

	(1) Mean price	(2) Median price	(3) Left tail price	(4) Right tail price
BR change x Dummy MPC	-0.337	-0.394	-0.439*	-0.284
	(0.233)	(0.242)	(0.226)	(0.266)
Dummy MPC	-0.382	-0.279	-0.243	-0.494
	(0.294)	(0.309)	(0.281)	(0.344)
Past price growth	0.182***	0.163***	0.142***	0.212***
	(0.0214)	(0.0218)	(0.0220)	(0.0235)
Medium (50-250)	-0.545***	-0.316**	-0.236	-0.796***
	(0.152)	(0.156)	(0.151)	(0.170)
Large (above 250)	-0.963***	-0.630***	-0.423***	-1.417***
	(0.159)	(0.164)	(0.163)	(0.178)
Exporter	-0.148	-0.177	-0.278**	-0.0291
	(0.129)	(0.131)	(0.129)	(0.143)
Constant	3.949***	3.579***	2.516***	5.353***
	(0.295)	(0.313)	(0.282)	(0.348)
Observations	6356	6356	6356	6356
R^2	0.183	0.160	0.138	0.193
Wave FE	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES
Number of meetings	46	46	46	46
BR change meetings	13	13	13	13

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Things change when we measure monetary policy shocks by bank rate changes. Table 4 reports our estimates of the change in firm pricing plans in the wake of raw changes in BoE's monetary policy rates. Coefficients are for the most part not significant, with the notable exception of the left tail that appears to move further to the left in the aftermath of a rate increase.

Importantly, all coefficients are negative, in line with macroeconomic theory. Moreover, the fact that coefficients are not significant masks important time variation, in that firms actually appear to respond to rate changes significantly albeit only at times - we present an in-depth analysis of this finding in the next section.

Since seminal work by Romer and Romer (2004), it has been recognized that policy rate changes reflect, at least in part, the information advantage of policymakers (Romer and Romer, 2000). The so-called information or signaling effects (Melosi, 2017) of monetary policy can push prices in the opposite direction relative to standard monetary policy shocks. In terms of our simple model, suppose that the surprise F_t reflects both the monetary policy shock and the superior information about the state of the economy (e.g. about the level of money velocity) on the part of the central bank. If F_t was positive because of a contractionary monetary policy shock, pricing plans should be revised down. If, instead, F_t was positive due to the central bank reacting to a stronger-than-expected aggregate demand, then prices should be increased. An imperfectly informed firm will weigh the two effects, based on their likelihood. The end result is that our estimate of the response of the price distribution would be biased upwards. In other words, we would expect the effect to be more negative if we netted out the information effect.

Table 5: MPC announcements and firms' expectations, information cleaned bank rate changes

	(1) Mean price	(2) Median price	(3) Left tail price	(4) Right tail price
BR change (Info clean) x Dummy MPC	-0.597*	-0.715**	-0.689**	-0.585
	(0.349)	(0.355)	(0.337)	(0.400)
Dummy MPC	-0.722*	-0.690*	-0.615*	-0.845*
	(0.398)	(0.410)	(0.370)	(0.466)
Past price growth	0.182***	0.163***	0.142***	0.212***
	(0.0214)	(0.0218)	(0.0219)	(0.0235)
Medium (50-250)	-0.542***	-0.313**	-0.232	-0.793***
	(0.152)	(0.156)	(0.151)	(0.170)
Large (above 250)	-0.962***	-0.629***	-0.422***	-1.416***
	(0.159)	(0.164)	(0.163)	(0.178)
Exporter	-0.146	-0.174	-0.275**	-0.0264
	(0.129)	(0.131)	(0.129)	(0.143)
Constant	4.074***	3.734***	2.628***	5.504***
	(0.326)	(0.338)	(0.305)	(0.383)
Observations	6356	6356	6356	6356
R^2	0.183	0.161	0.138	0.193
Wave FE	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES
Number of meetings	46	46	46	46
BR change meetings	43	43	43	43

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Following Romer and Romer (2004) and Cloyne and Hürtgen (2016) we purge the rate change for any plausibly endogenous component. When we run our regression using this information-cleaned version of rate changes we find that firms respond in a statistically significant manner, as shown in Table 5. Once information effects are accounted for, the response of pricing plans to a contractionary monetary policy shock of 25 basis points is larger (in absolute value) and more precisely estimated. The mean and median fall by about .6 to .7 percent, driven primarily by a shift in the left tail of the distribution.

The downward revision in the left tail of firm pricing plans means that firms read the monetary policy communication of a rate hike as increasing the likelihood of low-price scenarios or commanding lower prices in those scenarios. This is suggestive of the fact that firms are particularly wary of low-price scenarios, due to the well-known asymmetry in the profit function in models with monopolistic competition (e.g. Fernández-Villaverde et al., 2015; Masolo and Monti, 2021) and thus they respond to monetary policy shocks first and foremost by revising their assessment of low-price scenarios for the upcoming future.[17]

5.2 Time-variation

Recent work by Weber et al. (2023) shows that the effectiveness of providing information about the current inflation rate on inflation expectations has remarkably increased in the current high inflation period. We believe that this phenomenon may be at work in the context of monetary policy communication too. While fairly short, our sample period includes significant changes in the emphasis on monetary policy in the wider U.K. economic debate. The first part of the sample saw rates near or at their effective lower bound and the focus primarily on Brexit (Broadbent et al., 2023). Just as policy rates started to rise, the Covid pandemic kicked in, and rate cuts in March 2020 were one of the first forms of policy stimulus. Finally, with the start of 2022, the current monetary policy tightening cycle began, with the expectation of rate hikes becoming more entrenched as they became the norm rather than the exception over the course of the last year or so.

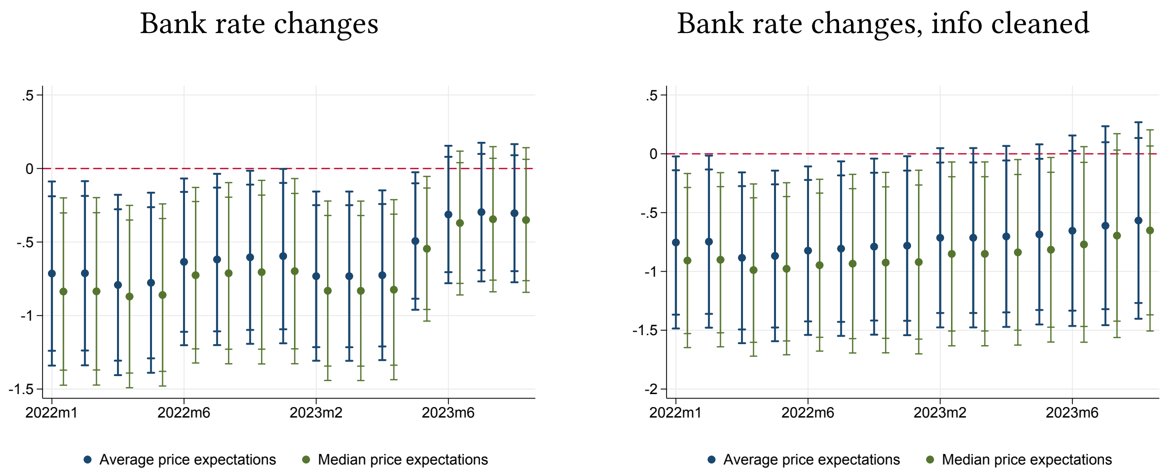
Our identification procedure, which takes advantage of cross-sectional variation, enables us to attempt a rolling-window estimation albeit at the cost of a loss in the precision of our estimates. In light of our short sample, we started our time-varying estimation exercise at the start of 2022, when the recent series of rate hikes started.

Figure 5 reports our estimation results - in each successive MPC meeting we remove one meeting at the start of the sample and include one more at the end. The blue dots refer to the regressions using the mean of the price expectation distribution as dependent variable and the green ones to specifications using the median.

At the start of our estimation window, significant responses reflected primarily the impact of the monetary policy expansion during Covid. Firms also appeared to respond strongly to the first few rate hikes, in a context of high inflation and rapid monetary policy tightening that had little

[17] The mechanism works in reverse in the case of a rate cut. Firms would first and foremost assess their low-price scenarios and revise down their likelihood or increase the prices they would set in those states of the world.

Figure 5: Time-varying effects of monetary policy announcements



Notes: The figure plots the coefficients of the interaction between the post-MPC dummy and different monetary policy shocks for the mean (blue) and median (green) price expectations alongside the 90% and 95% confidence intervals.

precedent in the last few decades. As rate increases became normal firms started to react less. This is true both when we consider raw rate changes as a proxy for monetary policy shocks as well as when we consider their information-cleaned counterpart.[18] In other words, even controlling for the signaling content of policy announcements, it looks like firms got used to the new economic landscape and budgeted accordingly in advance.

In Figure B.3, we perform the same exercise using alternative high-frequency surprises as a measure of monetary shocks. The responses over time are never significant throughout the time period considered therefore confirming that firms' expectations do not respond to monetary announcements measured using this kind of shocks.

We see this finding as complementing that of Weber et al. (2023). Notice that a simple modification to our model would be able to account for this finding too. Our rolling-window estimation results amount to suggesting that the Kalman gain matrix could be time-varying. This follows if one assumes a variation in the noise-to-signal ratio, a proxy for changes in the degree of attention and predictability of the signal.

[18]We read periods in which the two measures produce similar effects as periods in which the information effect of monetary policy is small relative to genuine monetary policy shocks.

5.3 Robustness checks

The identification strategy we adopt crucially relies on firms responding to the survey at random points in time within the month. As in Bottone and Rosolia (2019), we test this assumption by plotting the predicted probability of answering before or after the MPC announcement in Figure B.2. The predicted probabilities are estimated with a probit model for the event of returning the questionnaire after the monetary event on past price growth, a categorical variables identifying firms' class size, and dummies for industry and exporter status. The two distributions are essentially identical. This suggests that the decision to submit the survey responses before or after the announcements is unrelated to the observable characteristics considered.

We investigate whether firms heterogeneously respond to monetary policy shocks based on their observable characteristics. We focus on the firms' size, i.e., the number of employees, their sector, and their exporter status. We classify a firm as small if it has less than 50 employees, medium if between 50 and 250, and large if it employs more than 250 people. We then estimate equation (6) interacting the post-announcement dummy and the bank rate changes with the categorical variable of the firm size, the exporter status, or a dummy identifying firms in the financial sector.

The results are reported in Table B.2 using as dependent variable the median price expectations. While there are systematic differences in the level of expectations across groups, there are no significant differences in the responses of price expectations. The response of firm expectations is largely independent of their size, exporter status and sector. Overall, this section documents that the observable characteristics considered, i.e., size, sector, and exporter status, play a negligible role in explaining the responsiveness of firm expectations to monetary shocks.

Our empirical strategy also rests on the window size around the announcement. The smaller the window, the less likely economic news other than monetary policy announcements can pollute our estimates. At the same time, a shorter window reduces the number of respondents and increases noise. In our baseline, the treatment group is represented by firms filing survey responses up to 5 days after the announcements. Correspondingly, firms in the control group will have filed their responses 5 days before the announcement.

As robustness checks, we consider a 3-day and a 7-day window. Increasing the size of the window from 5 days to 7 days includes 3 more events that now fall inside the interval considered. However, as it can be seen in Table B.3, changing the size of the window has only a marginal effect on the estimated coefficients.

6 Macroeconomic effects

From a macroeconomic perspective, studying firm expectations is important insofar as firms act on them and changes in their pricing plans ultimately produce aggregate effects. The nature and time-coverage of the DMP survey mean we can only verify this indirectly, using a time-series model.

Having established that firm pricing plans respond to a Romer and Romer (2004) measure of monetary policy shocks, it remains to be seen what impact this shock series has on aggregate U.K. prices. Cloyne and Hürtgen (2016) carried out this exercise on U.K. data but their sample stopped in 2007. We follow their approach but extend our analysis to 2023. For us, it is essential to include the most recent period in our analysis to maximize the overlap with the DMP sample. To do so we take advantage of recent developments on the estimation of Bayesian VARs over the Covid period (Lenza and Primiceri, 2022; Cascaldi-Garcia, 2022).

We estimate a 12-lag monthly Bayesian SVAR using the Pandemic Minnesota Priors proposed by Cascaldi-Garcia (2022). Our baseline specification includes four macro covariates: the unemployment rate, the log of the Retail Price Index excluding Mortgage payments (RPIxMort), a measure of Commodity prices, and the cumulated sum of our information-cleaned measure of monetary policy shocks. We estimate a 12-lag monthly VAR over the sample from February 1999 to June 2023.[19] These are the same variables as Cloyne and Hürtgen (2016) except for unemployment replacing industrial production.[20] RPI excluding Mortgage payments is commonly used in VARs estimated on U.K. data (see also Gerko and Rey, 2017). Given the prevalence of flexible-rate mortgages in the U.K., it is important to ensure that our reference price index excludes the mechanical impact on aggregate prices from an increase in mortgage rates, which follows a different logic relative to that captured in the DMP survey.

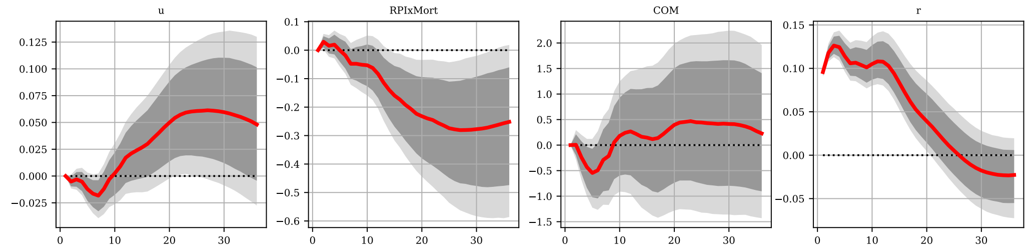
Figure 6 reports our baseline estimates. A contractionary monetary policy shock has significant disinflationary effects. The commodity price series, being primarily driven by international factors is hardly affected. Relative to Cloyne and Hürtgen (2016), who focus on the 1975-2007 sample, we find prices to respond more rapidly. The 12-month horizon median estimate implies a reduction in aggregate prices of the order of .22 percent in response to a 25bp shock.[21] This is

[19]We use the forecasts published in the Inflation Report (later Monetary Policy Report) by the Bank of England to clean the rate changes from information effects. This explains why our series starts in the late 1990s.

[20]We find unemployment to be a better business cycle indicator than industrial production over our sample but in Appendix D we show that our finding with regards to the impact on prices is robust to including industrial production instead of unemployment in our specification. Also, for what concerns the commodity price index, we use the one provided by Cloyne and Hürtgen (2016) for the first part of the sample and we extend it splicing it to the corresponding series available in FRED. Finally, in the Appendix we show that our results do not depend on prior setting, in particular with regards to the number of periods we want to apply the pandemic correction to.

[21]This results from rescaling the 12-month IRF response of about .083 percent in response to a one-standard-deviation shock of about 9.6bp size.

Figure 6: Bayesian SVAR impulse responses



Notes: Responses of unemployment, aggregate prices, commodity prices, and the interest rate (with 68 and 84 percent credible sets), to a one-standard-deviation monetary policy shock, from a 12-lag monthly Bayesian SVAR estimated over the Feb 1999 to June 2023 sample with Minnesota Pandemic priors (Cascaldi-Garcia, 2022).

well within the confidence interval of our estimates in Table 5 though overall smaller.

We have shown above that the responsiveness of firms to monetary policy shocks varies over time. Our SVAR sample extends over a relatively tranquil period, up to until about 2007. If we pushed the envelope and estimated our SVAR starting in 2007, our median estimate of the response of prices to a 25bp shock would more than double, to .49 percent, much closer to our DMP estimates.[22] This is consistent with our finding of quicker responses of prices to monetary policy shocks relative to Cloyne and Hürtgen (2016), who stop in 2007 and with evidence of time variation in the degree to which firms respond.

All and all, the analysis of the response of aggregate prices to the measure of monetary policy shocks that most affect firm price responsive reinforces our working assumption that firms set prices based on their expectations and it is thus important to study their expectations.

7 Conclusion

The extent to which central bank announcements affect expectations is critical to the transmission of monetary policy to inflation. The ability to influence expectations, and ultimately decisions, is considered one of the most important policy tools available to monetary authorities (Coibion, Gorodnichenko, Kumar, and Pedemonte, 2020).

In this paper, we provide more evidence in this regard, by studying how U.K. firm expectations respond to monetary policy announcements from Bank of England. We do so by comparing the responses to the DMP survey filed before with those after an MPC meeting. We establish that firms revise their pricing plans, in response to monetary policy announcements, measured as

[22]We report the estimation of this VAR specification in Appendix D.

changes in the monetary policy rate. However, high-frequency surprises do not appear to affect firm expected price growth. Firms react primarily by revising the left tails of the reported pricing plan. We also identify a noticeable degree of time variation in the sensitivity to which firms respond to monetary policy announcements. Finally, we show that the response of aggregate prices to the same set of shocks is consistent with that of firm pricing plans.

Our findings suggest that central bank announcements can indeed influence firm expectations. As firms set prices, it is important for central banks to be aware of how firms respond to their input and to be mindful of the differences in firm responses relative to financial markets (Reis, 2021).

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A Information and news cleaning

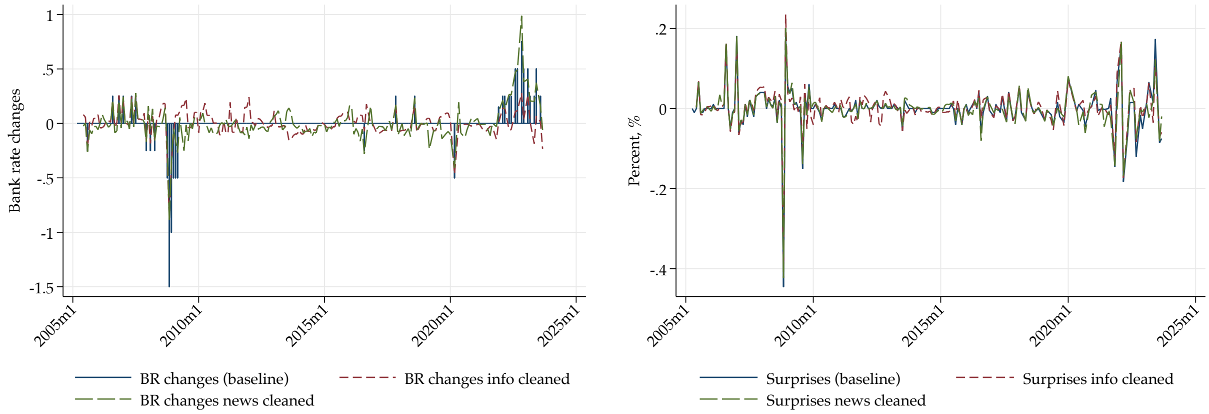
Monetary policy surprises computed from high-frequency data have been extensively used in the literature as an exogenous measure of the central banks' activities. However, recently two critiques have been raised against these surprises. The first one is that the surprises are the combination of a true shock and information about the state of the economy inferred by the agents through the monetary policy actions as documented by Miranda-Agrippino and Ricco (2021). The second is that monetary surprises are not purely exogenous as they correlate with economic and financial data publicly available as shown by Bauer and Swanson (2020). Therefore, in line with the existing literature, we clean the surprises by the information as well as the news component to isolate the pure exogenous monetary shocks.

To remove the information content of the monetary policy surprises we follow the approach of Miranda-Agrippino and Ricco (2021). The authors regress the U.S. monetary surprises on a series of variables whose aim is to control for the central bank's superior information of the economy and take the residuals as cleaned monetary policy surprises. The control variables included are the forecasts and forecast revisions for real output growth, inflation, and the unemployment rate from the Greenbook forecasts. In particular, the variables considered are the 1-quarter backcast, the nowcast, and up to 2-quarter ahead forecast as well as the revision of the backcast, nowcast and 1-quarter ahead forecast. As in Cloyne and Hürtgen (2016), for the U.K. we use the forecasts for the same variables published in the Inflation Report (IR) of the Bank of England since 1993. Since the forecasts are available at the quarterly frequency, we assign the latest available forecast to the MPC meetings without an IR. Moreover, we control for economic developments between the last forecast and the policy decision by including the 7-day lags of the policy rate.

To address the second critique and remove the component of the monetary policy surprises that are correlated with economic and financial data, we follow Bauer and Swanson (2022). The monetary surprises are regressed on the latest available surprises on inflation, wage and unemployment (defined as the difference between the market median expectations for that release from Refinitiv Datastream and the actual value released by the Office for National Statistics). Moreover, we control for financial and economic conditions by including the log change in nonfarm payroll employment from one year earlier to the most recent release before the MPC meeting, the log change in the FTSE500, the Bloomberg Commodity Spot Price index, the slope of the yield curve and the effective exchange rate from three months (65 trading days) before the MPC meeting to the day before the meeting. The residuals are then used as monetary surprise cleaned from the news component.

Moreover, we also further clean the surprises and the Target factor by adopting the "poor man" approach proposed by Jarociński and Karadi (2020). We do so by considering only the shocks that

Figure A.1: Bank of England Base Rate changes and monetary policy surprises, raw and cleaned



Notes: The left panel plots the Bank of England Base Rate changes over time alongside the measures cleaned from the information and news components. The vertical axis is in annual percentage points. The right panel reports the raw as well as cleaned measures of the high-frequency monetary policy surprises.

negatively move with the FTSE All Share index as a measure of the financial markets' response.

The same cleaning procedures are applied to the bank rate changes to obtain an exogenous measure of the policy response. The approach we adopt to remove the information component is analogous to that used by Cloyne and Hürtgen (2016) close in spirit to the narrative approach pioneered by Romer and Romer (2004). The raw and cleaned time series of the bank rate changes and monetary surprises are reported in Figure A.1.

We validate our measures of monetary policy surprises by studying the responses of financial markets to these shocks. We adopt the same empirical specification described in Section 4 using as dependent variable the daily Inflation Linked Swaps (ILS) 1-year, 2-year and 5- to 2-year ahead. The dependent variable is regressed over a dummy equal to 1 for the data 5 days after the MPC announcement and 0 for 5 days before, the interaction between the dummy and the monetary surprise and a set of controls. Financial markets have been found to significantly respond to macro releases[23]. Therefore, we control for whether there has been a release from the ONS regarding the U.K. inflation, wage and unemployment by including a dummy equal to 1 for the days after the releases and 0 otherwise as well as the interaction between these dummies and the surprises on inflation, wage and unemployment as previously defined.

We report in Table A.1 the results using as monetary shocks the bank rate changes as well as the baseline surprises from Cesa-Bianchi, Thwaites, and Vicondoa (2020). As it can be noticed, markets' short- and medium-term inflation expectations significantly respond to inflation sur-

[23]See Ivan, FED guy

prises. Focusing on the interaction between the MPC dummy and the monetary surprises, we see that the only significant coefficient is the one relative to the medium-term ILS.

Table A.1: Monetary policy shocks and financial market's inflation expectations, BR changes and monetary surprises

	(1) Infl. swaps 1y	(2) Infl. swaps 1y	(3) Infl. swaps 2y	(4) Infl. swaps 2y	(5) Infl. swaps 5-2y	(6) Infl. swaps 5-2y
Dummy MPC	0.0276	0.0310	0.0364***	0.0463***	-0.00525	-0.00197
	(0.0170)	(0.0192)	(0.00846)	(0.00925)	(0.00480)	(0.00510)
BR change x Dummy MPC	-0.00886		0.0171		0.00797	
	(0.0298)		(0.0144)		(0.00752)	
Surprise x Dummy MPC		-0.1000		-0.0741*		-0.0104
		(0.0922)		(0.0383)		(0.0246)
Dummy ONS Infl.	0.00935	-0.00445	-0.0199	-0.0254**	-0.00135	-0.00285
	(0.0258)	(0.0240)	(0.0136)	(0.0128)	(0.00980)	(0.00967)
CPI surprise x Dummy ONS	0.973***	1.025***	0.391***	0.446***	-0.0233	-0.0113
	(0.131)	(0.144)	(0.0588)	(0.0635)	(0.0412)	(0.0436)
Dummy ONS Empl.	-0.0143	0.00611	-0.0849***	-0.0805***	-0.0356***	-0.0332***
	(0.0338)	(0.0237)	(0.0147)	(0.0123)	(0.00971)	(0.0101)
Unemp. surprise x Dummy ONS Empl.	0.519***	0.599***	-0.0491	0.00145	-0.192***	-0.171***
	(0.188)	(0.142)	(0.0788)	(0.0660)	(0.0559)	(0.0566)
Wage surprise x Dummy ONS Empl.	-0.0438	-0.0864	0.0289	0.00344	0.00189	-0.00664
	(0.105)	(0.0902)	(0.0393)	(0.0355)	(0.0327)	(0.0333)
Constant	3.992***	4.022***	3.792***	3.810***	3.701***	3.705***
	(0.0109)	(0.0107)	(0.00507)	(0.00490)	(0.00286)	(0.00289)
Observations	522	513	522	513	522	513
Wave FE	YES	YES	YES	YES	YES	YES
Number of meetings	57	57	57	57	57	57
BR change meetings	18		18		18	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.2 reports the same analysis using the cleaned monetary policy surprises as shocks[24]. The coefficients of the 1- and 2-year ahead ILS are negative and significant. These results are in line with Braun, Miranda-Agrippino, and Saha (2023). However, using the cleaned bank rate changes the coefficients are still not significant (not reported in the interest of space). Overall, this suggests that financial markets do not respond to monetary announcements measured as bank rate changes, raw or cleaned, but they adjust their expectations following monetary surprises especially once cleaned by their information and news components.

[24] Similar results are found using the raw and cleaned Target factors.

Table A.2: Monetary policy shocks and financial market's inflation expectations, cleaned monetary surprises

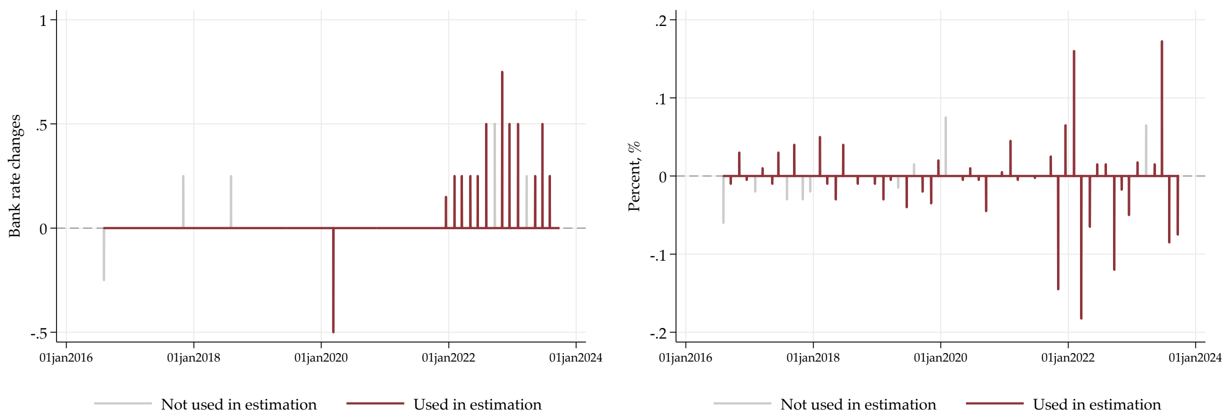
	(1) Infl. swaps 1y	(2) Infl. swaps 1y	(3) Infl. swaps 2y	(4) Infl. swaps 2y	(5) Infl. swaps 5-2y	(6) Infl. swaps 5-2y
Dummy MPC	0.0323*	0.0289	0.0475***	0.0456***	-0.00187	-0.00261
	(0.0185)	(0.0191)	(0.00917)	(0.00921)	(0.00534)	(0.00516)
Surprise (Info clean) x Dummy MPC	-0.172*		-0.109***		-0.0226	
	(0.102)		(0.0395)		(0.0235)	
Surprise (News clean) x Dummy MPC		-0.168*		-0.0973***		-0.0325
		(0.0934)		(0.0370)		(0.0209)
Dummy ONS Infl.	-0.000773	-0.000249	-0.0235*	-0.0236*	-0.00226	-0.00168
	(0.0241)	(0.0241)	(0.0127)	(0.0129)	(0.00965)	(0.00972)
CPI surprise x Dummy ONS	1.050***	0.969***	0.456***	0.404***	-0.00637	-0.0170
	(0.138)	(0.130)	(0.0608)	(0.0560)	(0.0422)	(0.0405)
Dummy ONS Empl.	0.00451	0.00565	-0.0810***	-0.0801***	-0.0335***	-0.0337***
	(0.0239)	(0.0238)	(0.0120)	(0.0122)	(0.00993)	(0.00988)
Unemp. surprise x Dummy ONS Empl.	0.609***	0.645***	0.00918	0.0302	-0.170***	-0.163***
	(0.147)	(0.151)	(0.0649)	(0.0677)	(0.0558)	(0.0560)
Wage surprise x Dummy ONS Empl.	-0.0929	-0.0973	-0.000196	-0.00218	-0.00763	-0.00918
	(0.0938)	(0.0917)	(0.0347)	(0.0354)	(0.0329)	(0.0328)
Constant	4.022***	4.022***	3.810***	3.810***	3.705***	3.705***
	(0.0107)	(0.0107)	(0.00488)	(0.00489)	(0.00288)	(0.00288)
Observations	513	513	513	513	513	513
Wave FE	YES	YES	YES	YES	YES	YES
Number of meetings	57	57	57	57	57	57

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

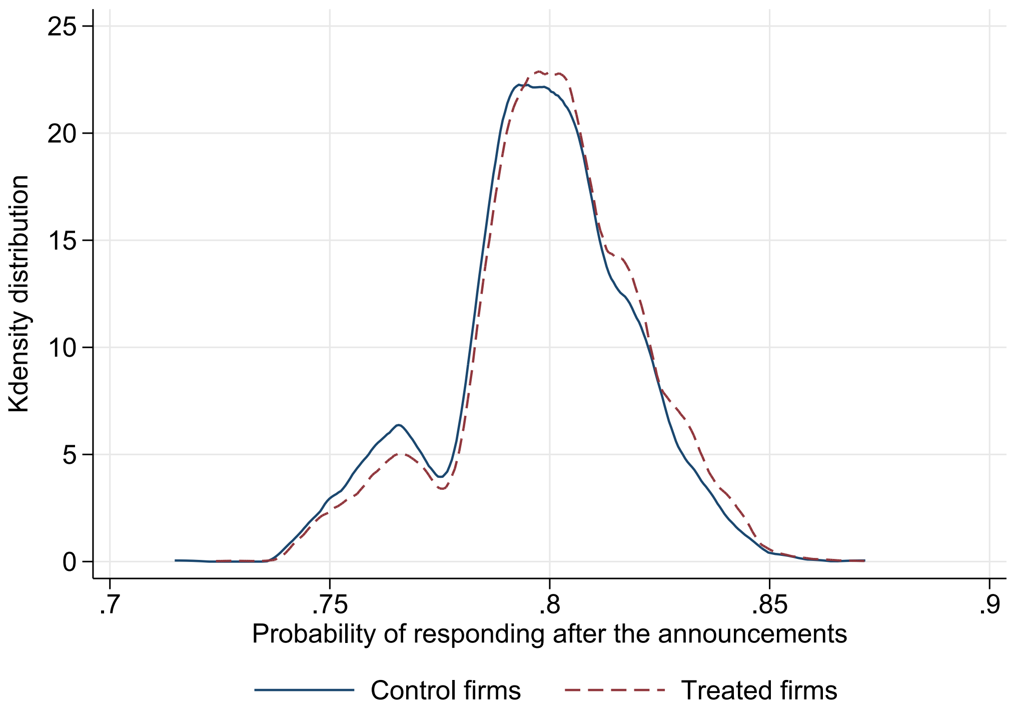
B Robustness checks

Figure B.1: Time series of the MPC meetings used in the empirical analysis



Notes: The left panel plots the time series of bank rate changes for the MPC meetings that are part of the empirical analysis as they happen around the days the DMP is conducted. The right panel reports the same series but for the monetary surprises.

Figure B.2: Predicted probability of responding after the announcement, control vs treated



Notes: The plot shows the predicted probabilities of responding to the survey before or after a monetary announcement for the control and treated firms, i.e., those that actually filed the survey before and after the announcements. The predicted probabilities are estimated with a probit model for the event of returning the questionnaire after the monetary event on a categorical variable for size class, exporter status, past price growth and industry fixed effects.

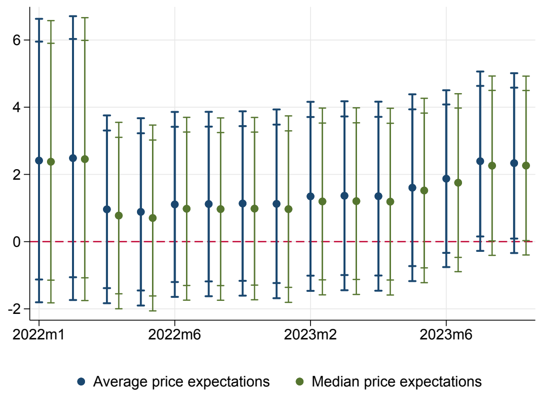
Table B.1: Response of median expected price growth to high-frequency shocks.

	(1) Median price	(2) Median price	(3) Median price	(4) Median price	(5) Median price	(6) Median price	(7) Median price
Dummy MPC	-0.576*	-0.606*	-0.470	-0.573	-0.512	-0.524	-0.525
	(0.350)	(0.353)	(0.355)	(0.350)	(0.346)	(0.346)	(0.345)
Surprise (6-9 m) x Dummy MPC	1.761						
	(1.118)						
Surprise (9-12 m) x Dummy MPC		1.678					
		(1.069)					
Surprise (Info clean) x Dummy MPC			1.293				
			(1.316)				
Surprise (News clean) x Dummy MPC				1.803			
				(1.263)			
Surprise (JK clean) x Dummy MPC					1.339		
					(1.291)		
Target x Dummy MPC						0.749	
						(1.718)	
Target (JK clean) x Dummy MPC							0.897
							(1.756)
Observations	5979	5979	5979	5979	5979	5979	5979
R^2	0.164	0.164	0.164	0.164	0.164	0.163	0.163
Wave FE	YES	YES	YES	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES	YES	YES	YES
Number of meetings	45	45	45	45	45	45	45

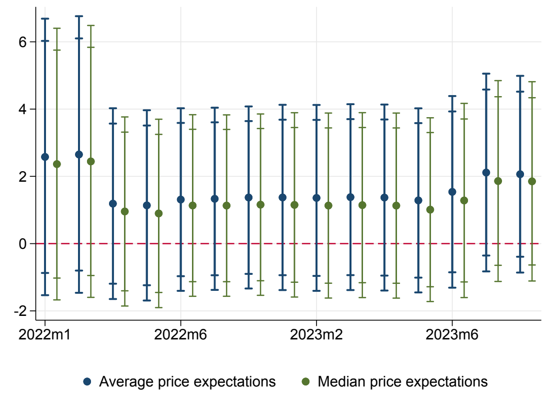
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure B.3: Time-varying estimates of the coefficient on the interaction between the post-MPC dummy and different monetary policy shocks for the mean (blue) and median (green) price expectations.

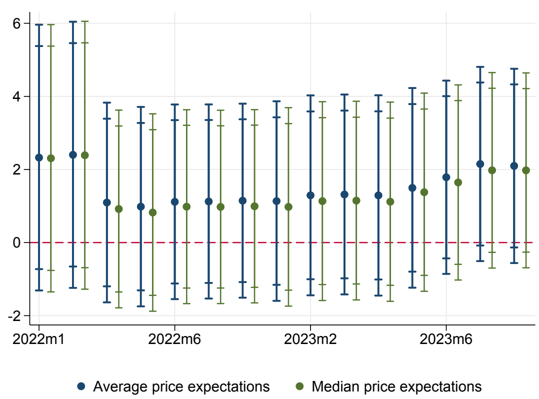
Surprises



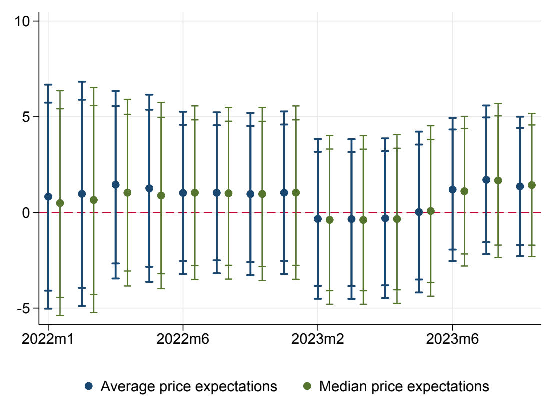
Surprises info cleaned



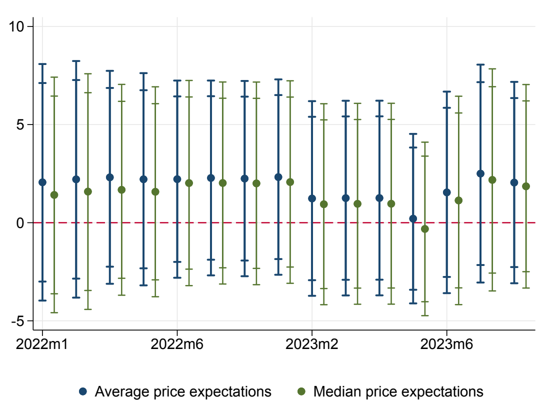
Surprise info cleaned



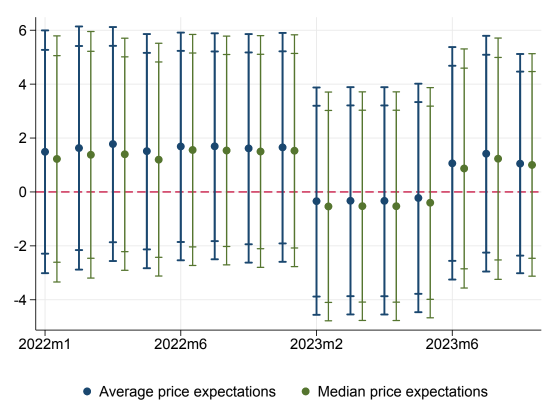
Target



Target factor info cleaned



Target factor news cleaned



Notes: The figure plots the coefficients of the interaction between the post-MPC dummy and different monetary policy shocks for the mean (blue) and median (green) price expectations alongside the 90% and 95% confidence intervals.

Table B.2: MPC announcements and firms' expectations by firms' characteristics

	(1) Median price	(2) Median price	(3) Median price	(4) Median price	(5) Median price	(6) Median price
Dummy MPC	-0.276	-0.279	-0.283	-0.694*	-0.685*	-0.686*
	(0.308)	(0.309)	(0.309)	(0.411)	(0.410)	(0.413)
BR change x Dummy MPC	-0.409	-0.433*	-0.391			
	(0.273)	(0.252)	(0.242)			
Medium (50-250) × BR change x Dummy MPC	-0.0276					
	(0.189)					
Large (above 250) × BR change x Dummy MPC	0.0996					
	(0.180)					
Exporter × BR change x Dummy MPC		0.0879				
		(0.152)				
Finance × BR change x Dummy MPC			-0.0838			
			(0.377)			
BR change (Info clean) x Dummy MPC				-0.766*	-0.830**	-0.714**
				(0.414)	(0.395)	(0.356)
Medium (50-250) × BR change (Info clean) x Dummy MPC				-0.172		
				(0.325)		
Large (above 250) × BR change (Info clean) x Dummy MPC				0.437		
				(0.314)		
Exporter × BR change (Info clean) x Dummy MPC					0.260	
					(0.256)	
Finance × BR change (Info clean) x Dummy MPC						0.142
						(0.561)
Medium (50-250)	-0.309*	-0.318**	-0.334**	-0.312**	-0.314**	-0.331**
	(0.167)	(0.156)	(0.154)	(0.155)	(0.156)	(0.154)
Large (above 250)	-0.666***	-0.634***	-0.583***	-0.636***	-0.633***	-0.584***
	(0.176)	(0.164)	(0.160)	(0.163)	(0.164)	(0.159)
Past price growth	0.163***	0.163***	0.164***	0.163***	0.162***	0.164***
	(0.0218)	(0.0218)	(0.0218)	(0.0218)	(0.0218)	(0.0217)
Exporter	-0.179	-0.214	-0.257**	-0.178	-0.184	-0.255**
	(0.132)	(0.134)	(0.117)	(0.131)	(0.131)	(0.117)
Finance			-0.612**			-0.647**
			(0.281)			(0.261)
Constant	3.585***	3.598***	3.646***	3.742***	3.737***	3.798***
	(0.318)	(0.312)	(0.308)	(0.338)	(0.338)	(0.337)
Observations	6356	6356	6356	6356	6356	6356
R^2	0.160	0.160	0.156	0.161	0.161	0.156
Wave FE	YES	YES	YES	YES	YES	YES
Sector FE	YES	YES	NO	YES	YES	NO
Number of meetings	46	46	46	46	46	46

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.3: MPC announcements and firms' expectations, different window size

	(1) Median price	(2) Median price	(3) Median price	(4) Median price	(5) Median price	(6) Median price	(7) Median price	(8) Median price
Dummy MPC	-0.261	-0.723	-0.487	-0.450	0.106	-0.166	0.00568	0.0235
	(0.359)	(0.445)	(0.375)	(0.382)	(0.188)	(0.227)	(0.205)	(0.208)
BR change x Dummy MPC	-0.409				-0.346			
	(0.316)				(0.215)			
Past price growth	0.153***	0.153***	0.153***	0.153***	0.164***	0.164***	0.162***	0.162***
	(0.0261)	(0.0260)	(0.0259)	(0.0260)	(0.0167)	(0.0167)	(0.0167)	(0.0167)
Small (below 50)	0	0	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Medium (50-250)	-0.471**	-0.467**	-0.596***	-0.597***	-0.250**	-0.248**	-0.285***	-0.286***
	(0.201)	(0.202)	(0.202)	(0.202)	(0.109)	(0.109)	(0.110)	(0.110)
Large (above 250)	-0.756***	-0.754***	-0.811***	-0.812***	-0.559***	-0.558***	-0.591***	-0.591***
	(0.204)	(0.204)	(0.206)	(0.206)	(0.114)	(0.114)	(0.115)	(0.115)
Not exporter	0	0	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Exporter	-0.201	-0.196	-0.214	-0.216	-0.163**	-0.163**	-0.172**	-0.172**
	(0.147)	(0.147)	(0.149)	(0.149)	(0.0826)	(0.0826)	(0.0837)	(0.0837)
Dummy ONS Infl.	0.818*	0.999*	0.756	0.741	-0.112	-0.0559	-0.110	-0.142
	(0.489)	(0.517)	(0.489)	(0.498)	(0.182)	(0.185)	(0.185)	(0.187)
CPI surprise x Dummy ONS	0.454	0.674	-1.709	-0.969	0.179	0.351	-0.645	-0.464
	(1.824)	(1.840)	(1.968)	(1.971)	(0.963)	(0.970)	(1.003)	(1.032)
Dummy ONS Empl.	-0.195	-0.0680	0.0483	-0.0758	-0.0224	-0.0506	-0.0711	-0.0850
	(0.488)	(0.496)	(0.485)	(0.481)	(0.184)	(0.180)	(0.180)	(0.180)
Unemp. surprise x Dummy ONS	0.934	0.511	0.920	0.563	-0.275	-0.730	-0.795	-0.944
	(1.770)	(1.729)	(1.755)	(1.737)	(0.907)	(0.878)	(0.880)	(0.883)
Wage surprise x Dummy ONS	0.118	0.309	0.563	0.484	0.110	0.179	0.340	0.417
	(0.892)	(0.882)	(0.883)	(0.902)	(0.404)	(0.397)	(0.404)	(0.414)
BR change (Info clean) x Dummy MPC		-0.854*				-0.597**		
		(0.476)				(0.279)		
Surprise x Dummy MPC			2.088				1.779*	
			(1.343)				(0.975)	
Surprise (Info clean) x Dummy MPC				1.532				1.510
				(1.414)				(0.948)
Constant	3.670***	3.840***	3.859***	3.800***	3.223***	3.283***	3.295***	3.261***
	(0.337)	(0.355)	(0.317)	(0.318)	(0.171)	(0.173)	(0.160)	(0.161)
Observations	4440	4440	4242	4242	12351	12351	11955	11955
R^2	0.141	0.141	0.145	0.145	0.155	0.155	0.156	0.156
Wave FE	YES	YES	YES	YES	YES	YES	YES	YES
Window	3 days	3 days	3 days	3 days	7 days	7 days	7 days	7 days
Number of meetings	45	45	44	44	48	48	47	47
BR change meetings	13				13			

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

C Dispersed Information Model

Given a law of motion for the exogenous velocity process and a proposed monetary policy rule (note that we could also assume the interest rate to be exogenous) the law of motion for the state of the economy can be written out as:

$$\begin{bmatrix} i_t \\ v_t \\ p_t \end{bmatrix} = \begin{bmatrix} 0 & \frac{\rho_v}{\eta} & 0 \\ 0 & \rho_v & 0 \\ a & b & c \end{bmatrix} \begin{bmatrix} i_{t-1} \\ v_{t-1} \\ p_{t-1} \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ f & g \end{bmatrix} \begin{bmatrix} u_{m,t} \\ u_{v,t} \end{bmatrix}, \tag{C.1}$$

$$\underline{x}_t = M\underline{x}_{t-1} + \mu u_t, \tag{C.2}$$

where the second equation is simply a compact way to write the first, the underlying monetary policy rule is one in which $i_t = \frac{\rho_v}{\eta} + u_{m,t}$, which corresponds to the policy rule of a central bank that aims at stabilizing aggregate demand and has full but delayed (by one period) information about the state of the economy. Solving the model amounts to solving for the undetermined coefficients a, b, c, f, g, i.e. for the law of motion of the endogenous state variable p_t.

This amounts to combining the state equation above with the observation equation $s_{h,t} = \phi\underline{x}_t + \varepsilon_{h,t}$, the Kalman update equation, and finally aggregating to obtain:

$$p_t = \gamma (I - K\phi) M\underline{x}_{t-1|t-1} + \gamma K\phi M\underline{x}_{t-1} + \gamma K\phi\mu u_t. \tag{C.3}$$

For a given level of K, which is easy to compute numerically, it is then a matter of matching coefficients. To do so we have to specify the process for the signal, i.e. ϕ, the level of noise in the signal, as well as the policy rule. We are not interested in this because we do not need to impose these extra assumptions to derive the identification scheme we bring to the data.

Nonetheless, it is possible to verify that, given the policy rule proposed just above, if $\phi = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$, the surprise F_t will reflect an information effect. In this case, the signal is a noisy measure of the policy rate. As such it will reflect the response of the bank to v_{t-1} for which it has superior information relative to firms. Firms will take that into account when observing the signal. If instead $\phi = \begin{bmatrix} 1 & -\frac{\rho_v}{\eta}v_{t-1} & 0 \end{bmatrix}$, the information firms receive is cleaned of any endogenous response of the central bank to the information advantage it has. As a result, F_t will not reflect any information effect. Clearly, in the real world, this "cleansing" effect is achieved by some combination of central bank communication (e.g. publication of forecasts), news coverage of the policy announcement, and other signal about the state of the economy firms gather. Yet, the end result of the cleaning is that the surprising component of the monetary policy announcement will be driven primarily if not exclusively by the monetary policy shock.

D SVAR robustness checks

Figure D.1 reports impulse response for our baseline SVAR specification estimated over a shorter sample starting in 2007. The most notable difference is that the response of prices gets larger as discussed in the main text.

Implementing the Pandemic Priors proposed by Cascaldi-Garcia (2022) requires taking a stand on the number of periods that should be considered part of the pandemic period. Our baseline results are derived assuming that the pandemic period comprises three months, determined by the number of months it took industrial production to return to its pre-pandemic value in Britain. If instead we measure the duration of the pandemic by the number of months it took unemployment to return to its pre-Covid level we end up extending the pandemic period out to 19 months. We believe this is way too long and reflects other macroeconomic factors. Nevertheless, we report, in Figures fig: VAR robust D.2 estimation results under both scenarios. Our key takeaway is robust to this assumption.

The key parameter to this prior setting governs how much information from the pandemic period should be used for estimation purposes. In our baseline, we set it optimally according to the routine proposed by Cascaldi-Garcia (2022). Here we report estimation results when we set it so that the pandemic periods are all but discarded from the estimation, i.e. they are uninformative.

We also experiment with the tightness of Minnesota prior referred to as λ, i.e. the hyper-parameter that governs how tight the random walk hypothesis underlying Minnesota prior is imposed. Cascaldi-Garcia (2022) sets it to .2 in his baseline estimation. For our baseline, we use a looser prior, by setting $\lambda = 1$. Here, we report IRFs estimating setting the tightness parameter to $\lambda = .2$. As expected, the IRFs tend to get smoother as loadings on lags beyond the first will tend to be smaller. Other than that, nothing of substance changes.

For a good measure, Figure D.3 reports an OLS version of our SVAR with bootstrap confidence bands estimated using Ambrogio Cesa-Bianchi's toolkit.

Finally, Figure D.4 shows IRFs estimates for specifications in which we replace unemployment with industrial production, in line with Cloyne and Hürtgen, 2016. We find that industrial production is not as good a business cycle indicator as unemployment. Our findings regarding the response of the RPI price index are largely unaffected though.[25]

[25] The extreme assumption of 19 pandemic-affected months only applies to specifications including unemployment, not to those featuring industrial production.

Figure D.1: Impulse responses to a monetary policy shocks given our baseline specification estimated over the 2007m1-2023m6 sample.

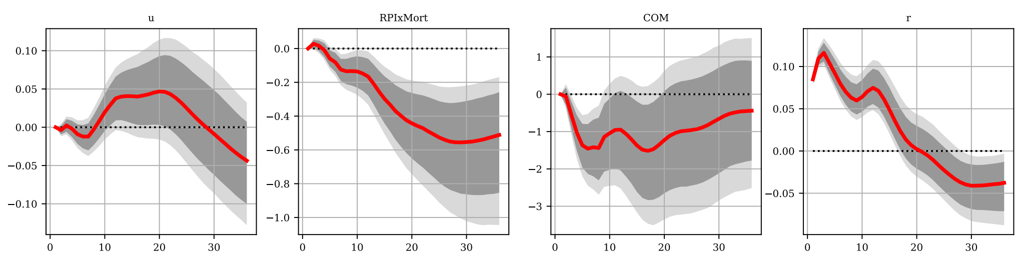


Figure D.2: Impulse responses to a monetary policy shock under various model specifications. First row: $\lambda = 1$, pandemic periods equal to 3, Pandemic Priors set so that the pandemic periods are uninformative. Second row: $\lambda = 1$, pandemic periods equal to 3, Pandemic Priors set optimally. Third row: $\lambda = 1$, pandemic periods equal to 19, Pandemic Priors set optimally. Fourth row: $\lambda = .2$, pandemic periods equal to 3, Pandemic Priors set optimally. Fifth row: $\lambda = .2$, pandemic periods equal to 19, Pandemic Priors set optimally.

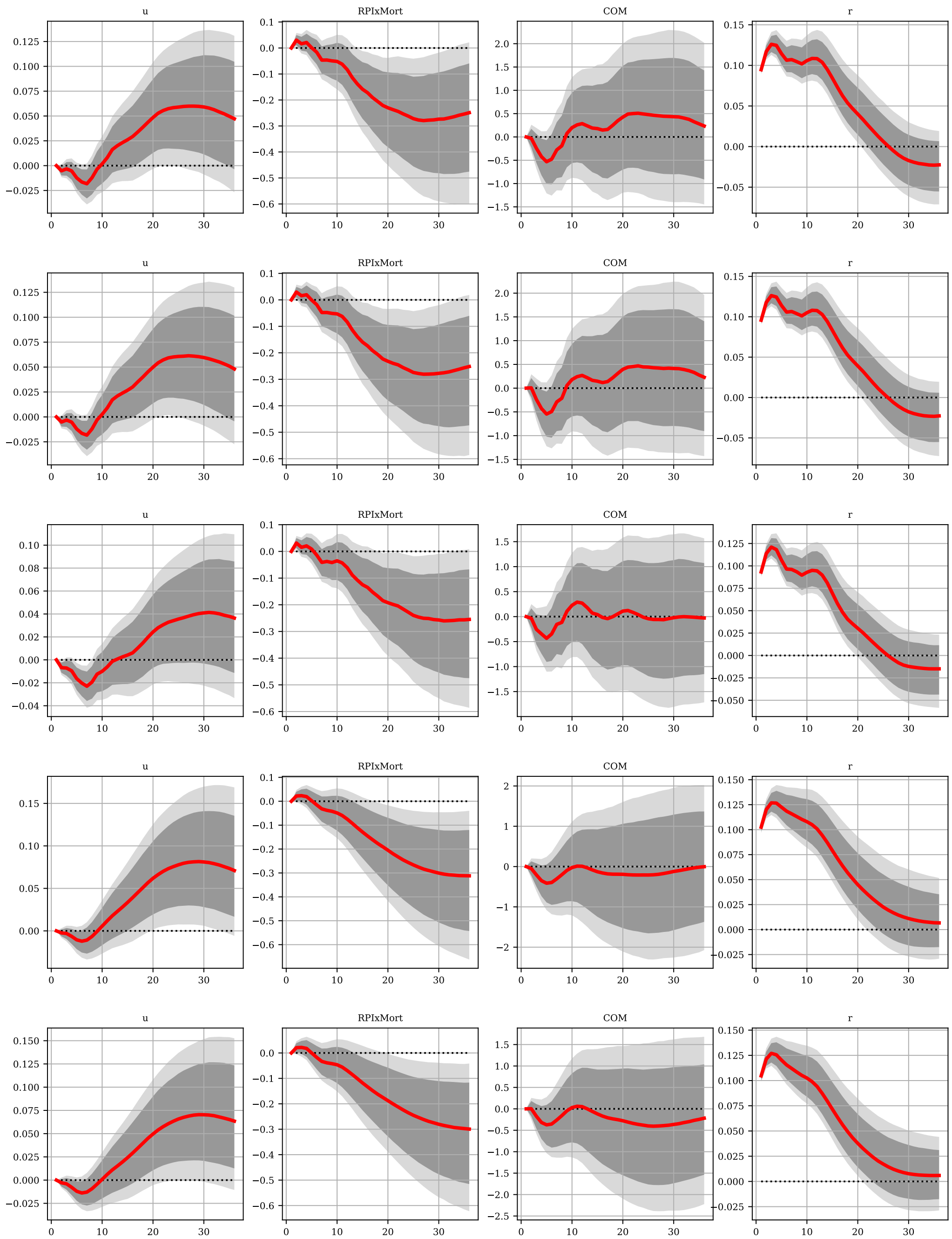


Figure D.3: Responses of unemployment, aggregate prices, commodity prices, and the interest rate (with 68 and 84 percent wild-bootstrap confidence bands), to a one-standard-deviation monetary policy shock, from a 12-lag monthly VAR estimated with OLS.

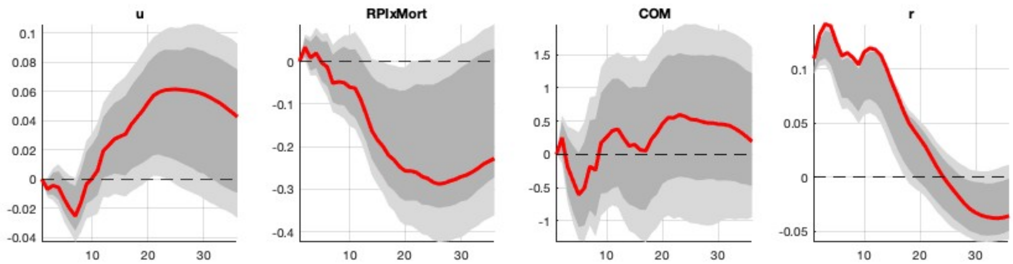


Figure D.4: Impulse responds to a monetary policy shock under various model specifications which include industrial production instead of unemployment. First row: $\lambda = 1$, pandemic periods equal to 3, Pandemic Priors set so that the pandemic periods are uninformative. Second row: $\lambda = 1$, pandemic periods equal to 3, Pandemic Priors set optimally. Third row: $\lambda = .2$, pandemic periods equal to 3, Pandemic Priors set optimally.