State-Dependent Effects of Monetary Policy: The Central Bank Information Channel

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ABSTRACT

When the central bank and private agents do not share the same information, private agents may not be able to appreciate whether monetary policy responds to changes in the macroeconomic outlook or to changes in policy preferences. In this context, this paper investigates whether the publication of the central bank macroeconomic information set modifies private agents' interpretation of policy decisions. We find that the sign and magnitude of the effects of monetary policy depend on the publication of policymakers' macroeconomic views. Contractionary monetary policy has negative effects on inflation expectations and stock prices only if associated with inflationary news.

KEY WORDS

Monetary policy, information processing, signal extraction, market-based inflation expectations, central bank projections, real-time forecasts.

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E52, E58.

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"Pound and gilts await Bank of England view on inflation", Financial Times, 10 May 2017

1. Introduction

There are at least two reasons why the private sector may not correctly anticipate monetary policy changes - and eventually be *surprised* by such a change. One reason is that the central bank and the private sector may not share the same information about the economic outlook. The other reason is that the private sector may not perfectly understand the objectives of the central bank. It follows that, when facing a monetary policy surprise, private agents will adjust their beliefs about either the macroeconomic outlook or the central bank's objectives or both. The very responses of the private sector will depend on which interpretation dominates. As a consequence, the publication by a central bank of its own assessment of the macroeconomic outlook may modify private agents' interpretation of policy decisions. In this context, this paper investigates whether the effect of monetary policy depends on the macroeconomic information released by the central bank.

The fact that policy decisions may reveal information about the central bank's view of macroeconomic developments, influencing in turn private beliefs, has been quite extensively documented in the literature. Romer and Romer (2000) find evidence of this signaling effect of monetary policy and the revelation of the Federal Reserve's private information about the future state of the economy through its decisions. Ellingson and Söderström (2001, 2005) establish that the private response to policy decisions may reflect a mix of the responses to the pure monetary innovation and to the macroeconomic information conveyed by the policy instrument. Campbell et al. (2012), Tang (2015), Melosi (2017) and Nakamura and Steinsson (2018) complement the analysis of this signaling channel of monetary policy.[1] When the central bank and private agents do not share the same information set, private agents cannot infer whether the observed policy decision stems from a change in policymakers' assessment of the macroeconomic outlook (the endogenous policy response) or from an exogenous policy innovation.

When the central bank reveals its macroeconomic information set, private agents are able to appreciate the endogenous policy response to economic developments. So the publication of the central bank macroeconomic information set may help reduce the dimensionality of private agents' signal extraction issue. Because private agents' interpretation of policy changes is crucial in determining the sign and magnitude of the effect of monetary policy decisions, central bank communication policies that align private agents' and policymakers' information sets may take on a key importance for determining the transmission of policy.

This paper contributes to the existing literature in two ways. So far the attention has focused on the effect of central bank communication on different macroeconomic and financial variables. In contrast, this paper bridges the central bank information literature with the literature about the non-linear effects of monetary policy. It provides original empirical evidence about whether the publication of central bank information matters for the transmission of monetary policy.[2] Second, this paper examines which channels can explain private agents' interpretation of changes in monetary policy.

[1] The signaling issue has also received attention from a theoretical perspective. See Angeletos et al. (2006), Walsh (2007), Baeriswyl and Cornand (2010) and Kohlhas (2014).

[2] It is worth stressing that this paper focuses on the influence of the release of central bank *macroeconomic* information, not on policy announcements, communication about the future likely path of policy or the relative hawkishness/dovishness of communication (see e.g. Rosa and Verga, 2007; or Lucca and Trebbi, 2011).

To empirically estimate the private responses to monetary policy, we make use of three features of the United Kingdom (UK) data. First, a necessary requirement for identification is that the information set revealed by the central bank (such as its projections) is not a function of the current policy decision, so both monetary surprises and central bank information surprises can be separately identified. We exploit the fact that the Bank of England (BoE) publishes macroeconomic projections that are conditioned on the path for the policy instrument implied by financial market interest rates prior to the policy meeting.[3] As these projections are not conditioned on the BoE's policy decision, it enables us to identify separately projection surprises and monetary innovations. Second, the fact that policy decisions and the Inflation Report (IR) containing the BoE's macroeconomic projections were released on different days until August 2015 enables us to carefully measure the surprise components of the two events using high-frequency data.[4] Third, policy decisions happen every month whereas the IR is published quarterly, so that private agents observe up-to-date central bank information for only one over three policy decisions.[5]

This paper investigates whether and how asset prices respond to BoE's policy surprises conditionally on the insight of central bank information surprises. We test the hypothesis that private agents' revise their beliefs about policy when the IR is published. The release of the central bank macroeconomic information, by facilitating information processing, would help private agents solve their signal extraction issue when observing a policy decision.

We use a high-frequency event-study analysis to provide a causal inference of the state-dependent effect of monetary policy decisions conditional on the publication of central bank information on the term structure of market-based measures of inflation expectations and stock prices.[6] As regularly used in the literature, the surprise component of Monetary Policy Committee (MPC) announcements and the surprise component of the IR publication are computed as the daily change in one-year nominal gilt yields.[7] We measure whether and how monetary surprises associated with IR surprises impact changes in inflation swaps at different maturities from 1-year to 5-year and FTSE returns.[8] Our sample period starts in October 2004 when inflation swap data become available with sufficient liquidity and ends in July 2015 when the BoE decided to release MPC decisions and the IR simultaneously.

Whereas a positive (i.e. restrictive) 25 basis points (bp) monetary surprise increases inflation expectations 3-year ahead by 9 bp during non-IR months or in the days before the IR is published, the same positive 25 bp monetary surprise decreases inflation expectations 3-year ahead by 34 bp if complemented by a positive 5 bp IR surprise (i.e. inflationary news). We find evidence for this non-linearity of monetary policy on inflation swaps at 2, 3 and 4-year maturities and on stock prices. The opposite signs of the two responses suggest a clear pattern in the way economic agents process monetary surprises if the central bank

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[3] For comparison, FOMC projections are conditioned on FOMC members' views of "appropriate monetary policy" which corresponds to the future interest rate path that best satisfies the Federal Reserve's mandate.

[4] After August 2015, both are released simultaneously at 12:00 so even intraday data would not enable to do so.

[5] Until September 2016, the BoE's Monetary Policy Committee held policy meetings every month, with 12 per year. After that point, the number of meetings has been lowered to 8 per year.

[6] An event-study approach enables us to abstract from quantifying qualitative communication like statements (see Hubert, 2017, and Detmers et al., 2018). Market surprises capture both quantitative and qualitative dimensions.

[7] Because the policy rate is at its effective lower bound during a significant part of the sample period and monetary policy has taken many different dimensions over the last years, using changes in 1-year gilt yields enables to capture all dimensions of monetary policy into a single variable of the monetary stance. The drawback of such a specification is that we cannot decompose the effects of specific policies on asset prices.

[8] The use of inflation swaps to measure inflation expectations calls for correcting for term, liquidity and inflation risk premia. We use a regression-based approach following Gürkaynak et al. (2010a, 2010b) and Soderlind (2011).

information set has been revealed to them. We find that the publication of the central bank's own assessment of the macroeconomic outlook does modify the effect of monetary policy. This state-dependent effect of monetary policy holds when we consider a more specific piece of information published - BoE's inflation projection surprises - as the contingent variable.[9]

A potential concern is that the effect of IR surprises that modifies the impact of monetary surprises could be unrelated to the central bank information set and could instead reflect other macroeconomic news published in between the policy decision and the IR. If so, our estimates would suffer from an omitted variable bias.[10] To address this concern, we modify our baseline model and control for the news surprises in nine of the most important macroeconomic data releases, such as inflation, PMI, industrial production and earnings. We obtain similar estimates to our baseline results.

We also assess the impact of monetary surprises and central bank information surprises at a lower frequency. The state-dependent effect of monetary policy is confirmed using a standard model of inflation expectation formation derived from the information friction literature. In addition, we estimate monetary shocks using Romer and Romer (2004)'s identification method augmented with private forecasts. Using local projections, we find evidence of a persistent state-dependent effect of monetary policy on different maturities of inflation expectations and on stock prices, inflation and industrial production.

The main result of this paper is at odds with standard information theory and a simple Kalman filtering framework, in which the effect of a tightening monetary policy surprise is the same after a positive or negative information surprise. A least two competing hypotheses may illustrate private agents' interpretation of these policy and information signals. In a first case, the published macroeconomic information may signal the rationale for the policy decision within the central bank reaction function and policymakers' commitment to stabilize objective variables around their target. So the information surprise is interpreted as a means to *confirm* the policy surprise. In such a case, the negative effect of a contractionary monetary surprise on private inflation expectations is reinforced (muted) when the central bank publishes an inflationary (deflationary) surprise. In a second case, the published macroeconomic information may signal the endogenous policy response, so private agents can infer, by deduction, that the policy surprise is driven by an exogenous policy innovation. The information surprise is interpreted as a means to *deduct* the policy surprise. In such a case, the negative effect of a tightening monetary surprise on private inflation expectations is amplified (muted) when the central bank publishes a deflationary (inflationary) surprise.

The sign of private agents' responses suggests that private agents process central bank information according to the *confirmation* hypothesis. This finding can be illustrated with the BoE's announcement on 7 August 2014. On that date, the MPC kept its policy rate and the stock of asset purchases constant which materialized as an expansionary policy surprise, but resulted in a decrease in inflation swaps and stock prices. On 13 August 2014, the BoE published its IR which materialized as a deflationary information surprise, but inflation swaps and stock prices went up. In both days, the response of asset prices goes in the counterintuitive direction. However, when the two events are considered together, they may be rationalized according to the *confirmation* interpretation: a deflationary news confirms the rationale for an expansionary policy.

[9] The same is not true of output projection surprises, although that might be consistent with the remit of an inflation targeting central bank such as the Bank of England.

[10] The minutes of MPC meetings were published on average two weeks after the given meeting, so after the IR.

As a key result, we show that monetary policy alone has no effect, or even the opposite effect to what is usually expected, such as a positive response of inflation expectations and stock prices after a tightening policy surprise. This happens most certainly because of the signaling channel of monetary policy. However, when the underlying macroeconomic reasons for the observed policy decision are provided to the public, monetary policy has standard effects.

One policy implication is that the release of central bank macroeconomic information and its coordination with policy announcements appear crucial for the transmission and effectiveness of monetary policy. This result also suggests that providing guidance about the future state of the economy rather than about the future likely path of policy – such as the Forward Guidance (FG) policy – may actually enhance the effectiveness of monetary policy by allowing private agents to understand the underlying rationale for the policy setting. In addition, publishing macroeconomic forecasts could reduce the adverse effects of FG through the signaling of a weak future expected economic outlook (see Andrade et al., 2015 and Michelacci and Paciello, 2017). Finally, this finding suggests that the release of central bank macroeconomic information may be able to reduce the contractionary effects of the Zero-Lower Bound (ZLB) constraint. The ZLB has been modelled as news about a sequence of contractionary shocks (Campbell et al., 2012, 2017). So the publication of deflationary surprises at the ZLB may mitigate the contractionary effect of these monetary shocks.

This paper lies at the intersection of two distinct strands of the literature. A large literature studies the substantial changes over the last two decades in the way central banks communicate to the public. Gürkaynak et al. (2005) is one of the first papers to show that FOMC statements contain information beyond the current policy decision about the future policy path, while Kohn and Sack (2003) show that FOMC statements provide information about the outlook for the economy.[11] Recently there has been a burgeoning literature about the identification and the importance of the so-called central bank information channel. Hanson and Stein (2015), Andrade and Ferroni (2018), Campbell et al. (2017), Jarocinski and Karadi (2018), Cieslak and Schrimpf (2018), Hansen et al. (2018) or Lakdawala and Schaffer (2018) establish the presence of such non-monetary news in central bank communication, quantify the importance and nature of this information content (about the macroeconomic outlook or the term premium, for instance) and provide evidence of the importance of central bank information shocks.

In the meantime, despite a considerable empirical literature, there is still uncertainty about the effects of monetary policy. The sign and magnitude of the responses of private beliefs and economic variables to monetary policy may depend on the identification strategy, the model specification, and as described above, the relative information sets of policymakers and private agents.[12] Another strand of the literature focuses on the state-dependent effect of monetary policy. Weise (1999), Garcia (2002), Lo and Piger (2005), Angrist et al. (2013), Santoro et al. (2014), Barnichon and Matthes (2015) and Tenreyro and Thwaites (2016) analyze its dependence to the state of the economy or to the sign of monetary shocks. Hubrich and Tetlow (2015), Aikman et al. (2017), Alpanda and Zubairy (2018), Ottonello and Winberry (2017), Beraja et al. (2017), Cloyne et al. (2018) assess the effects of monetary policy conditional on financial and credit conditions, and debt or collateral values.

[11] There is an ample literature on the role of central bank communication (see Woodford, 2005; Ehrmann and Fratzscher, 2007; Reis, 2013), its effects on expectations (see Swanson, 2006; Ehrmann et al., 2012; Hubert, 2014, 2015), or for the predictability of policy decisions (see Jansen and De Haan, 2009; Hayo and Neuenkirch, 2010; Sturm and De Haan, 2011). Blinder et al. (2008) provide a comprehensive survey of this literature.
[12] See Sims (1972), Bernanke and Blinder (1992), Romer and Romer (2004), Coibion (2012), Gertler and Karadi (2015), Miranda-Agrippino (2016), Ramey (2016) and Miranda-Agrippino and Ricco (2017).

The rest of the paper is organized as follows. Section 2 describes the framework. Section 3 investigates the role of IR surprises, and section 4 the one of inflation projection surprises. Section 5 examines these state-dependent effects at a lower frequency. Section 6 concludes.

2. Monetary Policy Decisions with or without Communication

This section aims to motivate and frame the research question. First, we discuss why and how central bank communication may matter according to the central bank's and private agents' information sets. Second, we present the BoE's operating procedure and how policy decisions and the IR are communicated to the public.

2.1. The value of publishing central bank macroeconomic information

In a standard macroeconomic framework such as a New-Keynesian model, when the central bank and private agents have the same information, private agents know the macroeconomic outlook to which the policy instrument responds to. In other words, private agents know the values of the variables entering the Taylor (2003) rule. So contractionary monetary shocks have a negative effect on private expectations through the usual transmission channels, irrespective of whether the central bank publishes its information set. Private agents are able to infer the exogenous innovation from the policy rule, and there is no room for central bank macroeconomic communication to modify the effect of policy decisions.

In a framework allowing for information frictions [13] and more precisely non-nested information sets, when observing the policy decision, private agents cannot disentangle whether it comes from a change in central bank assessment of the economic outlook (the endogenous policy response) or whether it comes from an exogenous policy innovation (a pure policy shock or a change in the policy preferences).[14] In this framework, when the central bank does *not* publish its information set, private agents face a signal processing issue as the unexpected policy decision can be due to, at least, two factors. Policy decisions may therefore convey to private agents signals about future macroeconomic developments and/or signals about the policy stance, so the effect of the policy decision would be a mix of private agents' responses to both signals, which may give rise to the signaling channel evidenced by Ellingsen and Söderström (2005) or Melosi (2017).[15]

Alternatively, when the central bank *publishes* its macroeconomic information set, private agents may be able to infer the true driving force of the observed policy decision, i.e. whether it was driven by the endogenous response to the economy or an exogenous policy innovation. The publication of the central bank information set reduces the dimensionality of private agents' signal extraction. In this situation, the publication of the central bank information set can be interpreted in two different ways, which would lead to opposite

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[13] See Coibion and Gorodnichenko (2015) and Andrade and Le Bihan (2013) for empirical evidence about information frictions and Woodford (2001), Mankiw and Reis (2002), and Sims (2003) for theoretical evidence about how departing from the full information assumption can account for empirical patterns of expectations.

[14] The exogenous policy shock could either come from unexpected changes in policymakers' preferences (the parameters of the reaction function) or from a pure exogenous innovation. For the simplicity of the demonstration, we do not distinguish between both. Ultimately, this does not change the issue that without knowing the central bank information set, private agents cannot infer the exogenous policy shock.

[15] The signalling channel of monetary policy might then be one explanation for the positive response of inflation to monetary shocks documented in the VAR literature as the "price puzzle" (Sims 1992) and would be consistent with Castelnuovo and Surico (2010) that including the omitted information set in VARs solves this price puzzle.

effects of the policy decision. As a consequence, the sign of the information surprise relative to the sign of the surprise related to the policy decision may play a role.

On one hand, one may expect that the negative effect of a contractionary monetary surprise on private inflation expectations is amplified when there is an inflationary surprise (a positive IR or inflation projection surprise), because both the policy decision and the macroeconomic surprise are consistent within the central bank reaction function. The rationale for such a policy decision is clear, so can be its effect on future inflation. At the opposite, one may expect a contractionary monetary surprise to have a more muted effect on private inflation expectations when associated with a deflationary surprise, since the policy decision taken is not consistent with the macroeconomic surprise, so the decision-making process appears unclear so the policy decision is less effective. This prediction builds on whether the central bank information confirms the unexpected observed policy decision. It relies on the view that the central bank private information that is published is pivotal in determining the policy decision taken. So the publication of the central bank information set signals the rationale for the policy decision within the central bank reaction function and policymakers' commitment to stabilize objective variables around their target. We refer to this mechanism as the "confirmation" hypothesis. One example of such a set-up is the communication of Mark Carney after the rate hike on 2 august 2018 that he justified because "*employment is at a record high, there is very limited spare capacity, (and) real wages are picking up*".

Another mechanism that would produce similar responses builds on the idea that IR or inflation projection surprises are signals about the future policy path, so an inflationary surprise would raise private agents' expectations of future policy rates. A contractionary policy surprise would therefore be magnified (mitigated) by an inflationary (deflationary) macroeconomic surprise since both signals would add up (offset each other). An anecdotal example of conflicting signals is the ECB policy announcement of 10 March 2016 in the euro area. While Mario Draghi announced extremely expansionary measures[16] and asset prices reacted accordingly at the moment, he later announced during the press conference that "*the ECB will no longer reduce interest rates*", which was interpreted by investors as a signal for the end of the loosening cycle. This change in investors' expectations of future policy offset the initial response of asset prices to the expansionary policy decision.

On another hand, an unexpected increase in the policy rate with a deflationary macroeconomic surprise (negative IR or inflation projection surprises) may signal to private agents an exogenous contractionary policy innovation, which would lower private inflation expectations. Yet, the same unexpected increase in the policy rate with an inflationary surprise may be interpreted as the endogenous policy response to macroeconomic developments, so would not affect private inflation expectations. This prediction builds on the view that the central bank private information that is published is marginal in determining the policy decision taken. The publication of the central bank information set signals the endogenous policy response, so private agents could infer, by deduction, that the policy surprise was driven by the exogenous policy innovation. We refer to this mechanism as the "deduction" hypothesis. The sign of private responses to central bank macroeconomic information signals would therefore shed light on these two competing hypotheses.

[16] An increase in asset purchases from € 60bn to € 80bn per month, extension of the types of securities eligible for purchases, and the implementation of the new Targeted Longer-Term Refinancing Operations (TLTRO) program at negative rates.

2.2. The Bank of England's operating procedure

The Monetary Policy Committee (MPC) of the Bank of England is made up of nine members: five internal members – the Governor, the three Deputy Governors for Monetary Policy, Financial Stability and Markets and Banking, and the Chief Economist - and four external members. The latter are appointed by the Chancellor of the Exchequer (subject to approval from the Treasury Select Committee) from outside the Bank. The governors serve five year terms while other members serve three year terms, after which they may be either replaced or reappointed. MPC meetings are chaired by the Governor and take place monthly since June 1997. Decisions concern the value for the Bank of England's official interest rate – and sometimes other measures, asset purchases for instance – in order to reach a target rate of inflation. These decisions are made by simple-majority rule on a one-person, one-vote basis. Every member receives BoE staff briefings related to monetary policy and attends the monthly meetings. They happen during the first full week of each month on average.

Since February 1993, the Bank of England publishes the Inflation Report (IR) once a quarter, which provides an analysis of the UK economy and the factors influencing the policy decisions.[17] It includes the MPC's central projections for inflation. Since February 1996, the Bank's inflation forecast has been published in the form of a probability distribution known as "the fan chart" capturing the uncertainty and skewness of the forecasts.[18] The IR includes projections for output growth since November 1997. They are available for each quarter up to three years ahead. They are released in February, May, August and November.

One compelling feature of the Bank of England's set-up is that MPC decisions and the IR were not published on the same day until May 2015. The IR was published on average 4 business days after the MPC meeting, with a minimum of 2 days on May 2005, May 2010 and May 2015 and a maximum of 5 days in February 2015. From August 2015 and following Warsh (2014)'s report, the IR started to be published at the same time as policy decisions. Another interesting feature of the BoE's set-up is that policy decisions happen every month whereas the BoE's projections are published quarterly.[19] That means that private agents do not observe up-to-date central bank macroeconomic projections for each decision, but only for one over three policy meetings. And when they observe it, they observe it with a delay, as shown in Figure 1. So it is possible to identify and quantify the influence of the publication of the BoE macroeconomic information set on the effect of monetary policy.

The IR projections capture the judgement of the MPC of the prospects of inflation and growth, conditioned on specific assumptions, including interest and exchange rates and some exogenous variables, as well as on general judgements about the future. Each IR specify that they "represent the MPC's best collective judgement about the most likely paths for inflation and output, and the uncertainties surrounding those central projections". Two sets of forecasts are published: one set is conditioned on a constant interest rate path which ex-post includes the effect of the Monetary Policy Committee's (MPC) most recent Bank Rate decision. The other set is conditioned on the path for Bank Rate implied by market interest

[17] While there is variation in the content and style of central bank publications such as Monetary Policy Reports, a number of central banks, including the Federal Reserve, European Central Bank, Riksbank, Norges Bank and Reserve Bank of New Zealand, release such information on a regular basis.

[18] Analysing whether the uncertainty and skewness matter for the responses of inflation expectations is beyond the scope of this paper and left for future research about the balance of risks. In any case, the variance of these measures is actually small on our sample.

[19] Until September 2016, the Bank's Monetary Policy Committee held policy meetings every month, with 12 per year. After that point, the number of meetings has been lowered to 8 per year.

rates just prior to the policy meeting. We use this second set since a crucial assumption to ensure identification of information surprises is that the central bank macroeconomic projections do not already contain the effect of the policy decision.

3. The Effect of Monetary Surprises conditional on IR Surprises

Our analysis of whether private agents process monetary policy decisions differently when they receive central bank information uses standard high-frequency monetary surprises that have been extensively used in the existing literature. We apply the same high-frequency methodology to measure surprises related to the publication of the IR. To assess the effects of unexpected policy decisions on asset prices, the literature relies on the following regression:

$$\Delta y_t = \alpha + \beta_1 \Delta x_t + \varepsilon_t \quad (1)$$

where Δx_t denotes the surprise component of the policy decision announced by the MPC, Δy_t denotes the change in the asset price considered over an interval that brackets the monetary policy announcement, and ε_t is a stochastic error term that captures the effects of other factors that influence the asset price in question.

The literature commonly uses a high-frequency event-study analysis to estimate equation (1). Equation (1) cannot be estimated with monthly or quarterly data due to reverse causality and omitted variables bias. The measured effect of monetary policy on asset prices could easily capture the response of monetary policy to earlier changes in asset prices in the month or quarter. In addition, changes in monetary policy and asset prices could respond to macroeconomic news released earlier in the month or quarter. Using higher-frequency data and a tight window around the policy decision enables to address these two issues. The key assumption is that the reaction of asset prices that are continually affected by various factors can be specifically attributed to monetary news on the day of the policy announcement. Since asset prices adjust in real-time to macroeconomic news, their movements during the window of a policy announcement only reflect the effect of news about monetary policy. This is crucial for identification since it strips out the endogenous variation in asset prices associated with other shocks than monetary news. Using daily data, Cook and Hahn (1989), Kuttner (2001), Cochrane and Piazzesi (2002) or Faust et al. (2004) have initiated this approach.

3.1. The empirical model

Since this paper aims to test the hypothesis that the effect of monetary surprises varies with the publication of the IR, we augment equation (1) with a variable, Δz_t, capturing the surprise component of the macroeconomic information published in the IR and an interaction term, $\Delta x_t \cdot \Delta z_t$, which is the product of the surprise components of the policy decision and of the publication of the IR:

$$\Delta y_t = \alpha + \beta_1 \Delta x_t + \beta_2 \Delta z_t + \beta_3 \Delta x_t \cdot \Delta z_t + \varepsilon_t \quad (2)$$

When estimating equation (2), the parameter associated to the interaction term, β_3, indicates the marginal effect of monetary surprises conditional on the publication of the IR; so how much the effect of monetary surprises on the given asset price is modified by the publication of the IR. If β_3 equals zero, the effect of monetary surprises does not depend on IR surprises. Otherwise, it means that the publication of the IR modifies the effect of monetary surprises on the given asset price y_t.

A large consensus has formed about the content of monetary policy news: the main piece of information on central bank announcement days relates to changes in the future likely policy path. Following Gürkaynak et al. (2005), Campbell et al. (2012) and Hanson and Stein (2015), our identification strategy is based on the idea that a primary share of the news contained in MPC announcements is about the expected path of future policy (whether it is the policy rate during a period of conventional monetary policy or asset purchases in the most recent period) over the next several quarters as opposed to surprise changes in the current policy stance. A simple and transparent way to capture revisions to the expected path of policy over a given horizon is to use the daily change in the nominal Gilt yield at this horizon on MPC announcement dates as our proxy for monetary policy news. We follow Gürkaynak et al. (2005) that use a 1-year maturity while Hanson and Stein (2015) uses 2-year. However, as described in our robustness tests in the Appendix, we obtain similar results with different maturities.[20] The key point is that this measure captures news about the expected medium-term policy path as opposed to news only about the contemporaneous policy decision, meaning that they encompass the so-called "target" and "path" factors (Gürkaynak et al, 2005) of monetary news. Since there is no single measure of the overall stance of monetary policy during unconventional times, another advantage of this simple measure is that it allows encompassing in one single variable the multidimensional aspects of monetary policy such as extended liquidity provisions, forward guidance or asset purchases.[21]

We consider the surprise component of the IR publication as a reasonable proxy for surprises to central bank inflation and output projections that would enter in the central bank reaction function in standard macroeconomic models. We use the same measure as monetary news to capture IR news and compute the daily change in the one-year nominal Gilt yield on IR publication dates. Figure 2 plots the MPC and IR surprises over our sample. A simple visual inspection confirms the effect of the 2008-2009 financial crisis on the policy and macroeconomic outlook with large negative surprises in both series around these dates.

Since the remit of the Bank of England's MPC is to target a 2% inflation rate, a natural candidate to investigate the effect of monetary policy is to measure their impact on inflation expectations. At the daily frequency, inflation swaps are a standard proxy for measuring compensation for expected inflation and inflation risk (Beechey et al., 2011).[22] These instruments are financial market contracts to transfer inflation risk from one counterparty to another. Most of the liquidity is driven by corporate firms at shorter maturities and pension, insurance and retirement funds at longer maturities for hedging inflation exposures. We consider instantaneous forwards at different maturities, from 1 to 5-year ahead, that provide

[20] Cesa-Bianchi et al. (2016) use intraday data from 10 minutes before to 20 minutes after the policy announcement to measure monetary policy surprises. We use their data series in the robustness analysis in section A1 in the Appendix and find similar results. See Table A3 for estimates with alternative monetary and IR surprises.

[21] Bean and Jenkinson (2001) suggest that the BoE is more likely to change policy in IR months – what would affect policy expectations. Our sample includes 7 interest rate changes in IR months and 8 in non-IR months.

[22] One advantage of these financial instruments are that they are available at a high frequency and are directly related to payoff decisions in contrast with survey expectations. One drawback however is that they may be affected by term, liquidity and inflation risk premia. Inflation swaps tend to be a better market measure for deriving inflation expectations than inflation-indexed gilts (which we use for robustness later however) because they are generally less sensitive to term and liquidity premia. As described in our robustness tests below, we correct inflation compensation, the raw measure extracted from inflation swaps, for term, liquidity and inflation risk premia using a regression based approach following the methodology used by Gürkaynak et al. (2010a, 2010b) and Soderlind (2011). This procedure is detailed in section A2 in the Appendix.

a proxy measure for expected inflation at the date of the maturity of the contract.[23] These are available since October 2004, which determines the starting date of our sample.[24]

3.2. The issue of interacting events on different days

One advantage (until May 2015) of the BoE's institutional set-up for disentangling the information contents of MPC news and IR news – the fact that they happen on different days – raises an empirical challenge to assess their interaction. Indeed, MPC announcements and the publication of the IR do not happen in the same period, so the interaction we included in equation (2) would be null in all cases. In order to assess the impact of the publication of the IR on the effect of monetary surprises, we interact the news component of the IR publication identified in t+i with the news component of the MPC decision identified in t. Equation (2) is therefore modified as following:

$$\Delta_w y_t = \alpha + \beta_1 \Delta x_t + \beta_2 \Delta z_{t+i} + \beta_3 \Delta x_t \cdot \Delta z_{t+i} + \varepsilon_t \quad (3)$$

The product of two variables, the MPC (Δx_t) and IR news (Δz_{t+i}), at two different dates raises the question of the window w to consider to measure the response of the dependent variable ($\Delta_w y_t$). Figure 3 shows the different options considered and detailed below.

For a MPC meeting on day t during non-IR months, we follow the baseline specification of Hanson and Stein (2015) and compute the change in inflation swaps over a 2-day window from t–1 to t+1 to capture the full market response to the MPC announcement. The implicit assumption is that the full reaction to an MPC announcement might not be instantaneous, particularly for longer term horizons. This could be because investors are uncertain about the implications of incoming news and update their beliefs as others' interpretations are revealed via trading volumes, price dynamics, and the financial media. Thus, it could take some time for private agents to digest the information content of a policy decision, a policy statement or an economic report.[25]

For a MPC meeting at date t during IR months, computing the change in inflation swaps over a window from t–1 to t+1 does not make sense with respect to our research question. The IR has not yet been published so by construction it cannot influence the effect of the MPC policy news. A first option is to consider a window that encompasses the full central bank announcement period, from the MPC announcement to the IR publication, so from t–1 to t+i+1. The main advantage is that all relevant information is observed, but this means that the windows considered have different sizes in IR and non-IR months. A second option is to consider the sum of *(i)* the change in inflation swaps around the MPC announcement, so over the window from t–1 to t+1, and *(ii)* the change in inflation swaps around the IR publication, so from t+i–1 to t+i+1. The advantage here is to abstract from the days in between the MPC announcement and the IR publication in case that other data are released. A third option, the most conservative, is to consider only the change in inflation swaps around the date of the IR publication, so from t+i–1 to t+i+1. It has the benefit of measuring the response of inflation swaps over a window of the same size between IR and non-IR months. However, such a window would miss the initial response of inflation swaps to the

[23] In the UK, they are linked to the Retail Price Index (RPI) measure of inflation, rather than CPI, which is the measure the Bank's inflation target is currently based on.
[24] Table A1 in the Appendix provides data sources and description while Table A2 some descriptive statistics.
[25] However, we obtain similar results with a 1-day window (from t-1 to t) as shown in Table A4 in the Appendix.

MPC monetary surprises and would focus only on the window around the publication of the IR when private agents may revise their beliefs about policy.[26]

3.3. The effect of monetary surprises conditional on IR surprises

We now empirically assess whether private agents give monetary surprises a different interpretation when the IR is published. We test the null hypothesis that the publication of the central bank information set, the IR news surprises, modifies private agents' responses to monetary surprises. In equation (3), this would translate into β_3 being significantly different from zero. In the case that $\beta_3 \neq 0$, the sign of β_3 would document which interpretation of the central bank macroeconomic information surprises (the "confirmation" vs. "deduction" hypotheses) is favored by private agents.

Table 1 presents our results for equation (3) estimated by OLS using daily data. We compute heteroskedasticity robust standard errors. Our sample period goes from October 2004 to July 2015 and covers 130 MPC announcements. The independent variables are the surprise component of MPC announcements and the surprise component of the IR publication, both computed as the daily change in one-year gilt nominal yields, and their interaction. The dependent variable is the change in inflation swaps at different maturities from 1-year to 5-year over the three different windows described above.[27]

The first result is that the parameter associated to the interaction term, β_3, is significant at the 2, 3 and 4-year horizons in all three specifications of window sizes for changes in inflation swaps. This means that central bank information surprises do convey useful information to private agents to interpret monetary surprises such that it modifies their effects. The second result is related to the negative sign of β_3 which suggests that the direction to which the publication of the IR modifies the effect of monetary surprises follows the "confirmation" hypothesis. Thus, whereas a positive 25 bp monetary surprise increases inflation swaps 3-year ahead by 9 bp during non-IR months or in the days before the IR is published, the same positive 25 bp monetary surprise decreases (increases) inflation swaps 3-year ahead by 34 (53) bp if complemented by a positive (negative) 5 bp IR surprise. The opposite sign of the two responses suggests a clear pattern in the way private agents process monetary surprises when the IR is published. The key result is that monetary policy alone has no effect, or even the opposite effect to what is usually expected. However, when interacted with central bank information surprises, the impact of monetary policy has its standard expected effect on inflation expectations.

The fact that *(i)* the state-dependent effect materializes at horizons (2 to 4 years) consistent with the policy horizons of central banks and the transmission lags of monetary policy, and *(ii)* the magnitude of the effect gradually decreases with the horizon consistent with the transmission of monetary policy suggests that the main result is economically grounded. In all specifications, a tightening monetary surprise decreases inflation swaps when "*confirmed*"

[26] As a placebo test, we also run an exercise where we compare changes in inflation swaps 4 days after the MPC announcement during IR-months (so on the day of the IR publication) to similar changes during non IR-months, when no event happens on that fourth day after the MPC. Excess trading and volatility on MPC days could bias the comparison. We obtain a similar result when doing so. Estimates are available from the author upon request.

[27] Estimating equation (3) along the term structure of inflation swaps allows us to assess whether surprises have different effects at different horizons. This could happen for a number of reasons. One relates to the transmission lags of policy. The term structure could be split into three groups: (i) the short term (i.e. 1 year ahead), which should be barely affected by policy decisions given the transmission lags of monetary policy, (ii) the medium term (i.e. 2-4 years ahead), when monetary policy instruments are generally thought to affect the economy, and (iii) the longer term (i.e. 5 years ahead), when the impact of any monetary decisions should have died out.

by a positive IR surprise and decreases inflation swaps when "*contradicted*" by a negative IR surprise. One explanation of the sign of this non-linearity is that private agents think of central bank information as a signal about the rationale for the policy decision which reinforces their interpretation of the monetary surprise: the publication by the central bank of an inflationary news confirms the policy tightening observed some days before.

A limitation of this specification is that since the interaction term is equal to zero by construction two times every three observations, this may bias the estimation of the non-linear effect. Economically, zeros in non-IR months are different from zeros in IR months. The former relates to the absence of macroeconomic information published by the central bank whereas the latter relates to IR news which informational content was expected. However, zeros in non-IR months can be seen as measurement errors since there may be policymakers' speeches in these months that may reveal part of the central bank information set. As described in our robustness tests in the Appendix (see Table A5), we obtain similar results when equation (3) is estimated separately for non-IR and IR months.

For comparability with the literature on the central bank information shocks, and in order to widen the scope of the main result, we also estimate equation (3) with FTSE returns and 10-year sovereign yields as the dependent variables. As described in the robustness analysis (see Table A6 in the Appendix), we obtain a similar result for stock returns. Contractionary monetary surprises alone have a positive effect on stock prices consistent with the signaling channel, but have a negative effect when interacted with an inflationary IR news surprise. At the opposite, 10-year sovereign yields react to monetary surprises with the standard expected sign and there is no non-linear marginal effect. This suggests that the expectations hypothesis of the term structure of interest rates dominates the information effect.

3.4. Controlling for macroeconomic news releases

A potential concern with the specification of equation (3) is that the effect of IR surprises that modifies the impact of monetary surprises could be unrelated to the central bank information set and could instead reflect other macroeconomic news published in between the policy decision and the IR. To address this concern, we augment equation (3) with additional controls. More specifically, we include the news surprises in nine of the most important macroeconomic data releases: employment change, ILO unemployment rate, industrial production, PMI Services, PMI Manufacturing, GDP, average weekly earnings, producer price index (PPI) for output, and Consumer Price Index (CPI) inflation. These surprises are computed as the difference between actual releases and Bloomberg surveys on the days before the release. Table 2 shows that while some series were never released on, or between, MPC and IR dates such as GDP, some other series have been and regularly. For instance, industrial production has been released 30 times on MPC dates over our sample. Earnings and unemployment have been published 27 times each on IR dates. In addition, PPI inflation figures have been 32 times during the days between the MPC and IR dates.

Table 3 presents our results for equation (3) estimated by OLS using daily data, when equation (3) is augmented with the news surprises of the nine macroeconomic data releases. We obtain similar estimates to our baseline results, such that β_3 is significantly different from zero and negative at similar horizons. Although the releases of macroeconomic news certainly play a role in the revisions of private beliefs about policy, the publication of the central bank macroeconomic information set has its own influence on private agents' changes in their interpretation of policy decisions.

3.5. The timeline of private beliefs' revisions

This subsection investigates the dynamic effect of monetary surprises after the MPC announcement, and in particular, how the IR publication modifies the response of inflation swaps some days later. Our preferred approach is to use local projections as proposed by Jordà (2005) with our externally identified instruments for monetary and IR surprises. This method has become a very popular tool to compute impulse responses because of its robustness to model misspecification. In comparison, impulse response functions obtained from VARs may be imposing excessive restrictions on the endogenous dynamics, while the local projection method is more flexible and can easily account for non-linearities in the transmission of monetary policy. The Jordà (2005) method requires estimating a series of k regressions for each horizon, with the estimated coefficient representing the response of the dependent variable at the horizon k to a given exogenous shock at time t. Equation (3) is therefore estimated k times as follows:

$$\Delta_w y_{t+k} = \alpha_k + \beta_{1k}\,\Delta x_t + \beta_{2k}\,\Delta z_{t+i} + \beta_{3k}\,\Delta x_t \cdot \Delta z_{t+i} + \varepsilon_{t+k} \qquad (4)$$

From t (the date of the MPC policy announcement) to t+i-1 (the day before the IR publication), equation (4) only comprises the MPC surprises variable (Δx_t) measured similarly for IR and non-IR months. From the day of the IR publication (t+i) and after, equation (4) is fully specified as shown above. The dependent variable, the change in inflation swaps, is considered on a similar window for both IR and non-IR months, what corresponds to the third specification described in section 3.2 with the smallest window.

Figure 4 plots the sequence of the overall effect of monetary surprises on inflation swaps across 6 days. This overall effect corresponds to the β_{1k} coefficient for k = 0 to i-1 when the effect of monetary policy is linear. The overall effect corresponds to the sum of the average effect and the marginal effect when the interaction term is introduced. After the publication of the IR so for k = i to i+2, the effect of monetary surprises is a combination of β_{1k} and β_{3k}. In contrast with estimates of equation (3) that represent the static state-dependent effect of monetary surprises, this timeline of the effect of MPC news is meant to represent in a dynamic fashion how private agents form and revise their beliefs about policy before and after the IR is published. In particular, it is interesting to observe whether the state-dependent effect builds up in the days before the publication of the IR. Such a case would mean that either the IR surprises are not well identified, or that the state-dependent effect captures other pieces of information that are released before the IR publication (in the spirit of the omitted variable bias discussed in section 3.4).

Figure 4 shows that the effects of monetary surprises in IR and non-IR months are similar until the day before the IR is published. Then, the effects of both monetary surprises diverge. A tightening monetary surprise during IR months, that has a no significant effect before the publication of the IR, has a pronounced negative effect on inflation swaps when complemented with an inflationary IR surprise once the IR is published. This dynamic evidence provides additional support for this state-dependent effect of monetary policy.

3.6. Discussion

Table 4 shows the distribution of inflationary and deflationary IR surprises with respect to restrictive and expansionary monetary surprises. Across the sample considered, there have been as many consistent cases (expansionary policy with a deflationary outlook and restrictive policy with an inflationary outlook, in bold in the table) as inconsistent ones (expansionary policy with an inflationary outlook and restrictive policy with a deflationary outlook) – 51% versus 49% respectively. The estimated result therefore relies on a rather uniform distribution of the policy-information surprises and does not seem driven by a skewed distribution of surprise pairs.

It is also worth stressing that the state-dependent effect of monetary surprises documented so far does not depend on the most recent communication developments or on the specificity of macroeconomic dynamics at the ZLB. We estimate equation (3) on two different subsamples ending in March 2009, before the policy rate reached its lower bound, and in July 2013, when the forward guidance policy was introduced.[28] We find that the state-dependent result is robust to a subsample of conventional monetary policy when the short-term interest rate is the policy instrument and to a subsample when the central bank did not commit to a future policy path.

Overall, these findings suggest first that the IR publication pushes private agents to revise their beliefs about policy. Second, their interpretation of the central bank macroeconomic information suggests that they take the information surprise as a signal confirming the direction of the policy surprise. The information surprise seems to be seen as a way to gauge the rationale for the policy decision within the central bank reaction function and policymakers' commitment to stabilize objective variables around their target.

The "confirmation" interpretation suggests that when contractionary monetary surprises are not corroborated by an inflationary surprise, the inference of the rationale for such a tightening is more difficult so the negative effect of monetary surprises is muted. Similarly, when contractionary monetary surprises are contradicted by a deflationary surprise, the rationale for the policy tightening appears unclear, so private agents only focus on the signaling channel of policy (they give a zero weight to central bank communication deflationary signals and places all weight on the inflationary signal conveyed by the policy decision, possibly because actions speak louder than words) such that inflation swaps respond positively to contractionary monetary surprises.

This finding is consistent with Melosi (2017) who finds that inflation expectations may respond positively to contractionary monetary shocks under certain scenarios. When the quality of private information is poor relative to that of central bank information (private agents' signal-to-noise ratio is low), and/or if the policy rate is more informative about non-monetary shocks than about monetary shocks (the variance of monetary shocks is low or the central bank's estimates of inflation and the output gap are relatively accurate), then the signaling channel may be at work. Similarly, Tang (2015) finds a positive effect of monetary shocks on inflation expectations when prior uncertainty about inflation is high.

This result suggests that providing guidance about the future state of the economy rather than future likely path of policy – such as with the FG policy – may actually enhance the effectiveness of monetary policy by allowing private agents to know the central bank information set and understand the underlying rationale of the policy setting.

[28] Estimates are presented in Table A7 in the Appendix.

4. The Effect of Monetary Surprises conditional on Central Bank Projection Surprises

So far we have analyzed the effect of monetary policy when interacted with the surprise component of the publication of the central bank's overall assessment of the macroeconomic outlook. However, the mechanism described in section 2.1 driving the non-linearity of monetary policy effects may rely more formally on the central bank macroeconomic projections that enter a forward-looking reaction function. This section aims to identify surprises to central bank inflation and output projections specifically.

4.1. The identification of central bank projection surprises

Central bank inflation and output projection surprises are identified as the unpredictable component of these projections, conditional on the information available to private agents at the date when these projections are published. Effectively, this comes back to estimate the best in-sample prediction of these variables such that the residuals would be the surprises. This is similar in spirit to the approach of Romer and Romer (2004) for the policy instrument and applied to UK data by Cloyne and Huertgen (2016).[29]

A crucial assumption to ensure identification of the effect of central bank projection surprises is that they do not already contain the effect of the contemporaneous policy decision. We therefore exploit the fact that the BoE publishes macroeconomic projections that are conditioned on the path for the policy instrument implied by financial market interest rates prior to the policy meeting. We estimate these surprises using the following equation (for inflation projections at the horizon h, $\pi_{t,h}^{CB}$, as an example):

$$\pi_{t,h}^{CB} = \phi_0 + \phi_1 i_{t-1}^{CB} + \sum_{h=1}^{3} \phi_{2,h} \pi_{t-1,h}^{CB} + \sum_{h=1}^{3} \phi_{3,h} x_{t-1,h}^{CB} + \phi_4 mc_{t,h} + \phi_5 \Psi_{t-1} + \varepsilon_{t,h}^{\pi_{CB}} \quad (5)$$

where the level of the previous central bank inflation ($\pi_{t-1,h}^{CB}$) and output ($x_{t-1,h}^{CB}$) projections at horizons h = 4, 8 and 12 quarters ahead is included together with the market interest rate curve, $mc_{t,h}$, used as conditioning path for BoE's macroeconomic projections at the same three horizons and a lag of the policy instrument, i_{t-1}^{CB}. The vector Ψ_{t-1} includes a lag of the first principal components of private inflation and output expectations at various maturities and a lag of various macro variables likely to determine future inflation: CPI inflation, industrial production, oil prices, the sterling effective exchange rate, net lending, and housing prices (included as annual growth rates).[30] The timing of the variables in equation (5) is driven by the assumption that projection surprises can affect private expectations and macro and

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[29] The main advantage of this approach over a VAR estimation is that the identification of innovations does not rely on a full set of short-run timing restrictions in a recursive set-up. Only one restriction is required: projections are not a function of the current policy rate and cannot react contemporaneously to it whereas the opposite is true. Moreover, estimating a VAR might also raise the issue of the number of degrees of freedom. Because there is no obvious instrument for these variables, an instrumental variable strategy does not appear relevant.

[30] Private inflation and output expectations are included through their respective first principal components (from a Principal Component Analysis, PCA) using five inflation expectation series from 1 to 5 years ahead, and five output expectation series from 1-quarter to 2 years ahead. Private output expectations are obtained from Consensus Forecasts for 1 to 6 quarters ahead and from the Survey of External Forecasters for 2 years ahead. We use first principal components so as not to include all horizons in the estimated model and then avoid multi-collinearity or losing too many degrees of freedom. First principal components intend to capture the information set of forecasters for all horizons together. The first principal component of inflation forecasts captures 76% of the variance of the underlying series, while the first principal component of output forecasts captures 85%. For robustness purposes, we estimate equation (5) with all individual forecast series together as described later.

financial variables contemporaneously, so these variables enter with a lag in equation (5). Because the formation of the BoE projections precedes the MPC policy decision, the monetary policy instrument enters with a lag in equation (5). The error term $\varepsilon_{t,h}^{\pi_{CB}}$ reflects the inflation projection surprises.

The inclusion of both private and central bank forecasts in the regression model enables us to deal with an important concern. Private agents and policymakers' information sets include a large number of variables. Forecasts encompass rich information sets. Bernanke et al. (2005) show that a data-rich environment approach modifies the identification of monetary shocks. Forecasts work as a FAVAR model as they summarize a large variety of macroeconomic variables as well as their expected evolutions. Identifying these projection surprises requires to control for policymakers' and private agents' forward-looking information set.

Since no projections are released during non-IR months, equation (5) is estimated on IR months only without affecting the lag structure.[31] This means, for instance, that the inflation projections published in early February is regressed on the market curve prior to the February policy decision and on macro variables as of the end of January. The estimated projection surprises therefore have non-zero values during IR months and zeros otherwise, which is consistent with the fact that no re-assessment or releases of the BoE's projections happen during these months.[32]

Figure 5 plots the estimated series of 4-quarter-ahead inflation and output projection surprises. The inflation series shows quite large positive surprises around 2010 and 2011 when inflation in the UK spiked around 4-5%. Table 5 shows the three largest value of inflation projection surprises with media reports on the day of the publication of the IR. This narrative evidence tends to suggest that commentators were actually surprised on these days. In addition, the largest surprises for output projection are on the negative side in 2009 and 2010 consistent with the real effects of the financial crisis. Finally, for these estimated series of exogenous surprises to be relevant, they must be unpredictable from movements in data. The null hypothesis that these estimated series are unpredictable from a set of standard macro variables cannot be rejected, so they can be relevant as externally identified instruments for central bank projection surprises.[33]

4.2. The effect of monetary surprises conditional on central bank projection surprises

Our baseline analysis is performed for BoE's 4-quarter ahead inflation projection surprises.[34] This horizon falls before interest rates are generally estimated to have their peak effect on inflation - around 18-24 months ahead - and hence enables us to minimize the control issue.[35] In the meantime, this forecasting horizon should also convey information about inflation 1-year ahead, the shortest horizon of the term structure of inflation swaps studied here.

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[31] Table A8 in the Appendix shows the estimated parameters of equation (5).

[32] As described in our robustness tests below, a potential alternative is to proceed to a constant-interpolation of the BoE's projection surprises for the following two months during each quarter to fill the missing observation gaps. One may argue that the projections remain available during the following two months. We choose to focus on the most conservative choice and keep zeros for the months during non-IR months.

[33] We assess the predictability of projection surprises with Granger-causality type tests and regress these series on a set of standard macro variables: inflation, industrial production, oil prices, the sterling effective exchange rate and net lending growth. The bottom panel of Table A8 in the Appendix shows the F-stats of this test.

[34] Figure A1 in the Appendix shows the distribution of the absolute value of deviations of inflation projections to the inflation target. The mode is higher for 4-quarter ahead projections than for 8-quarter ahead ones.

[35] Policy instruments give central banks some control over the forecasted variables. This issue is circumvented when the horizon of central bank projections is shorter than the transmission lag of monetary policy.

Equation (3) is estimated as in section 3.3 except that BoE's inflation projection surprises replace IR surprises. We are still primarily interested in the value and sign of the parameter (β_3) associated with the interaction variable. Table 6 shows that the interaction term is negative and mostly significant around the 2, 3 and 4-year horizons. The main result that a tightening monetary surprise has a negative (positive) effect on inflation swaps at medium-term horizons if corroborated (contradicted) by an inflationary (deflationary) projection surprise holds. In the spirit of Table 4, the distribution of consistent and inconsistent policy-information surprises is also uniform when considering projection surprises: consistent and inconsistent configurations each represent 50% of the occurrences.

We also estimate equation (3) with BoE's 8-quarter ahead inflation projection surprises and BoE's 4- and 8-quarter output projection surprises. Whereas the interaction of monetary surprises with 8-quarter ahead inflation projection surprises is significant for inflation expectations 2 to 5-year ahead, it is not the case with output projection surprises.[36] The fact that private forecasters use inflation projections more than output ones to interpret policy decisions appears consistent with a central bank pursing an inflation targeting strategy, like the Bank of England. We then estimate equation (3) with stock prices and confirm the non-linear effect of monetary policy on FTSE returns with projection surprises.[37]

It is worth stressing that central bank inflation projection surprises themselves do not impact much inflation swaps, at least at conventional significance levels. The value added of central bank inflation projections goes through their contribution to the transmission of monetary surprises. This finding is consistent with Hubert and Maule (2017). They find that central bank projections may convey policy signals in the same way as policy decisions may convey signals about the state of the economy. It is also worth stressing that both 4-quarter and 8-quarter ahead output projection surprises have a negative effect on inflation swaps at longer-term horizons. This suggests that private agents do not expect policymakers to fully offset deviations of inflation from the target caused by output shocks such that private agents may believe that the BoE has a higher tolerance for such inflation deviations.

5. Testing for the State-Dependent Effect at a Lower Frequency

Since policy decisions happen every month, an additional way to measure the state-dependent effect of monetary policy conditional on the publication of central bank information is to work at the monthly frequency. This has at least three advantages. First, since policy decisions and the IR (or central bank projections) are released on different days in a given month, working at the monthly frequency enables us to interact monetary and IR (or projection) surprises at the same date – i.e. within the same month. The assumptions about the window size for the dependent variable described in section 3.2 are not required. We thus measure inflation swaps as the average of all working day observations in each month.[38] Second, working at the monthly frequency enables us to use an empirical model derived from the information friction literature, though we continue to benefit from the high-frequency identification of surprises. Third, it is possible at the monthly frequency to estimate monetary shocks – i.e. shocks to the policy instrument – in contrast with high-frequency monetary surprises that are shocks to the information set of private agents.

[36] Table A9 in the Appendix provides the estimated parameters.
[37] Table A10 in the Appendix provides the estimated parameters.
[38] Alternatively, we also consider the last observation of the month. This frequency transformation is more extreme as it discards all data points before the last observation. However, *(i)* it makes sure that all news released during a month are potentially incorporated in the asset price of the last day of the month; and *(ii)* that there is no endogeneity issue between our left-hand side variable and its potential explanatory variables.

5.1. The empirical model

Our empirical setup is motivated by two theoretical models with rational expectations and information frictions. In the sticky information model of Mankiw and Reis (2002) and Carroll (2003), private agents update their information set infrequently as they face costs of absorbing and processing information. When private agents update their information set, they gain perfect information. In the noisy information models of Woodford (2001) and Sims (2003), private agents continuously update their information set but observe only noisy signals about the true state of the economy. Their inertial reaction arises from the inability to pay attention to all the information available. Internalising their information processing capacity constraint, they remain inattentive to a part of the information (Moscarini, 2004).

Under the assumption that private agents have homogeneous inflation expectations,[39] we can bridge these two strands of the literature in a simple and general specification. Private inflation expectations are modelled as a linear combination of a prior belief about future inflation, the past expectations $\pi_{t-1,h}^{PF}$, and new (and potentially noisy) information relevant for future inflation released between t-1 and t, measured by the vector Λ_t.

$$\pi_{t,h}^{PF} = \beta_0 + \beta_L \, \pi_{t-1,h}^{PF} + \beta_\Lambda \, \Lambda_t + \varepsilon_t \qquad (6)$$

This specification allows us to be agnostic about the nature of information frictions.[40] The vector Λ_t could include any variable that is likely to affect inflation and that can be used to predict future inflation. We decompose this vector into three groups of variables.

A first vector MP_t comprises our externally identified instruments for monetary surprises as well as IR surprises or inflation and output projection surprises. It also includes their interaction term. To test our research question, we explicitly assume that these surprises are incorporated in private agents' forecasting function.[41]

A second vector X_t aims to capture news shocks and surprises to macro developments that are contemporaneous to monetary surprises and IR or projection surprises. It includes a news variable π^s which captures the information content of any data released between *t-1* and *t* that may affect inflation. Following Andersen et al. (2003), this inflation surprises variable is defined as the difference between the actual value of CPI inflation in *t* and the private inflation forecast, measured by the Bloomberg Consensus, formed at date *t-1* for the quarter *t* ($\pi^s = \pi_t - E_{t-1}\pi_t$). This is equivalent to an inflation forecast error and captures the news published between the two dates. Bloomberg provides the market average expected one-month ahead CPI inflation at a monthly frequency. We also capture the presence of macro news by using the three indices estimated by Scotti (2016) for the UK: the real activity index, capturing the state of economic conditions, the surprise index, summarizing economic data surprises, and the uncertainty index, measuring uncertainty related to the state of the

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[39] This assumption matches the point forecasts nature of inflation swaps. We acknowledge that point forecasts may suffer an aggregation bias because agents may have heterogeneous beliefs due to differences in their own information sets, but we abstract from this issue in this paper.

[40] The value of β_L, expected to be positive, sheds light on whether the limited adjustment mechanism in which information is only partially absorbed over time is at work in the data. We show in section 6 that including more lags does not alter our main results.

[41] The timing of policy decisions and IR releases - detailed in section 2 - which are made public in the early days of the given months should ensure that their information content is not already contained in private inflation expectations and that inflation expectation dynamics are not responsible for these shocks. We test the robustness of this assumption by considering only the last daily observation of each month for our left-hand side variable so as to remove any potential endogeneity issue.

economy. Finally, we include two high-frequency financial indices, the UK move and the FTSE, that are supposed to react in real-time to information flows.

A third vector Z_t includes macroeconomic variables that are likely to affect future inflation dynamics and so inflation expectations. It includes CPI inflation, industrial production, oil prices, net lending, the sterling effective exchange rate, and housing prices (included as annual growth rates).[42]

5.2. The low-frequency effect of monetary surprises

Independently of whether we are interested in the standard effects of monetary policy or in its state-dependent effects, the concern that confounding factors may bias the estimation is more stringent at the monthly frequency. The inclusion of the two vectors X_t and Z_t specifically aims to capture other news and macroeconomic shocks that could occur contemporaneously to the publication of the IR and central bank projections and that would bias the response of inflation swaps. Equation (6) can be written as following:

$$\pi_{t,h}^{PF} = \beta_0 + \beta_L\, \pi_{t-1,h}^{PF} + \beta_{MP}\, MP_t + \beta_X\, X_t + \beta_Z\, Z_t + \varepsilon_t \qquad (7)$$

The dependent variable is the level of monthly-average inflation swaps. The vector MP_t comprises the monetary surprises, the IR or BoE's 4-quarter ahead inflation projection surprises and the interaction of both. Monetary surprises and IR surprises are computed as the daily change in one-year gilt nominal yields. Alternatively, projection surprises are computed based on equation (5). We are primarily interested in the β_{MP} parameters which include the coefficient associated with the interaction term between monetary surprises and IR or projection surprises. We estimate equation (7) by OLS for different horizons of the term structure of inflation swaps.[43] Because our dependent variables is now in levels, we compute heteroskedasticity and autocorrelation robust Newey-West standard errors assuming that the autocorrelation dies out after three lags.[44]

Table 7 presents estimates for equation (7). The upper panel shows the specification with IR surprises while the lower panel shows the one with 4-quarter ahead inflation projection surprises.[45] The main result is that the coefficient associated to the interaction term is significantly different zero and negative from 1- to 5-year horizon inflation swaps, both when the effect of monetary surprises is conditioned on IR surprises and inflation projection surprises. This state-dependent effect is more significant at the monthly frequency than at the daily frequency and spans over the full term structure of inflation swaps. A tightening monetary surprise reduces inflation swaps when associated with positive inflation projection surprises, but increases inflation swaps when associated with negative inflation projection surprises. So the main result evidenced at the daily frequency holds at a lower frequency.

[42] Table A1 in the Appendix provides data sources and description while Table A2 some descriptive statistics.
[43] Introducing an interaction term in equation (7) resembles the smooth transition model of Teräsvirta (1994) but abstract from defining a specific transition function.
[44] This correction also helps circumvent the "generated regressor" bias due to externally identified instruments.
[45] Estimates show that β_L is positive and significant, consistent with inertia in inflation swaps, suggesting that the information frictions framework is likely to be appropriate for this analysis.

5.3. The identification and effects of monetary shocks

We move on to estimating monetary shocks – i.e. shocks to the policy instrument –, in contrast with high-frequency monetary surprises. However, the policy rate is at the ZLB during a significant part of the sample period and monetary policy has taken various dimensions in the meantime. The policy instrument is proxied by a shadow rate that translates unconventional policies into a single variable expressed in the interest rate space and captures the overall stance of monetary policy. Our baseline measure is a BoE in-house shadow rate that we compare to the ones of Wu and Xia (2016) and Krippner (2013, 2014).[46]

We follow the Romer and Romer (2004) approach applied to UK data by Cloyne and Huertgen (2016) to identify monetary shocks. These shock series are estimated as residuals from a regression of the policy instrument on the BoE's information set. Blanchard et al. (2013) and Miranda-Agrippino and Ricco (2017) have shown how information frictions modify the econometric identification problem. In the presence of non-nested information sets, exogenous monetary innovations should also be made orthogonal to private agents' information set. We aim to remove the contribution of lagged private forecasts and macroeconomic variables (so that monetary innovations can have contemporaneous effects on these) and the contribution of *contemporaneous* BoE's inflation and output projections (so as to remove the information set of policymakers). We estimate the following equation:

$$\Delta i_t^{CB} = \alpha_0 + \alpha_1\, i_{t-1} + \sum_{h=1}^{3} \alpha_{2,h}\, \pi_{t,h}^{CB} + \sum_{h=1}^{3} \alpha_{3,h}\, x_{t,h}^{CB} + \sum_{h=1}^{3} \alpha_{4,h}\, \Delta\pi_{t,h}^{CB} + \sum_{h=1}^{3} \alpha_{5,h}\, \Delta x_{t,h}^{CB} + \alpha_6\, \Psi_{t-1} + \alpha_7\, IR_t + \varepsilon_t^{i} \quad (8)$$

We assume that changes in the policy instrument, Δi_t^{CB}, are driven by the policymakers' response to the level and change in their own inflation ($\pi_{t,h}^{CB}$ and $\Delta\pi_{t,h}^{CB}$) and output ($x_{t,h}^{CB}$ and $\Delta x_{t,h}^{CB}$) projections at horizons h = 4, 8 and 12 quarters ahead. We also include the vector Ψ_{t-1} which encompasses the first principal components of lagged private inflation and output expectations described in section 4.1 and macro variables (CPI, industrial production, oil prices, sterling effective exchange rate, net lending, and housing prices). We also include a dummy IR_t that takes the value 1 in months when the BoE publishes the IR. The error term ε_t^{i} reflects monetary shocks.[47] Figure 6 plots the series of estimated monetary shocks. As expected, the largest values happen around 2008 and 2009 with strong negative (expansionary) shocks. We have also tested that these monetary shocks are unpredictable from movements in macroeconomic data.

Equation (7) is estimated with monetary shocks instead of monetary surprises and 4-quarter ahead projection surprises. Table 8 shows that the parameter associated to the interaction term is again significantly different from zero and negative. The state-dependent effect is at work over the full term structure of inflation swaps from the 1 to 5-year horizons. It is worth stressing that the magnitude of the effect gradually decreases with the horizon consistent with the transmission of monetary policy. In this set-up, a 25 bp tightening monetary shock reduces inflation swaps by 0.46 percentage point at the 3-year horizon when associated with a 15 bp positive inflation projection surprises, but increases 3-year horizon inflation swaps by 0.50 percentage point when associated with a 15 bp negative inflation projection

[46] The BoE shadow rate is derived by computing a sequence of unanticipated monetary shocks to match the estimated effect of QE on GDP using estimates from Joyce et al. (2011) – see also Section 8.4 of Burgess et al. (2013). The underlying assumption is that QE is a close substitute as a monetary policy instrument to Bank Rate such that the zero lower bound was not an effective constraint on monetary policy over the period in question.

[47] Table A8 in the Appendix shows the estimated parameters of equation (8).

surprises. Central bank information is therefore processed and interpreted the same way whether we consider monetary surprises or shocks. Central bank information provides a signal about the rationale for the policy decision and reinforces the interpretation of the observed sign of the monetary shock: an inflationary news confirms a policy tightening.

The present result should not be confused with a non-linear effect of monetary policy with the business cycle. Tenreyro and Thwaites (2016) find that monetary policy is less powerful during recessions. Under the assumption that inflation projection surprises are a proxy for the output gap, one may suppose that the amplified effect of monetary shocks with inflationary surprises captures the amplified effect of monetary policy during expansions. However, this assumption relies on the view that business cycles are driven mainly by demand shocks, not other shocks. In addition, the data does not support this assumption: the correlation between inflation projection surprises and a standard HP measure of the output gap is null and non-significant. This suggests that the state-dependent effect of monetary policy evidenced in this paper is specific to central bank macroeconomic information.

5.4. Dynamic macroeconomic effects

This section investigates the dynamic state-dependent effects of monetary shocks conditional on central bank projection surprises using the local projections method of Jordà (2005) described in section 3.5. We modify equation (7) in the following respect:

$$\pi^{PF}_{t+k,h} = \beta_{0,k} + \beta_{L,k}\, \pi^{PF}_{t-1,h} + \beta_{MP,k}\, MP_t + \beta_{X,k}\, X_t + \beta_{Z,k}\, Z_t + \varepsilon_{t+k} \qquad (9)$$

where $\pi^{PF}_{t+k,h}$ is the level of inflation swaps for different maturities h-year ahead at different horizons k, the vector MP_t comprises the monetary shock (ε^i_t), BoE's 4-quarter ahead inflation projection surprises ($\varepsilon^{\pi CB}_t$) and the interaction of both ($\varepsilon^i_t \cdot \varepsilon^{\pi CB}_t$). X_t and Z_t are vectors of news and macroeconomic controls respectively. Equation (9) is estimated with OLS.

Figure 7 plots the impulse response over 3 months of inflation swaps to a contractionary monetary shock interacted with a positive or negative inflation projection surprises. Monetary shocks associated with inflationary or deflationary projection surprises have statistically different effects on inflation swaps during 2 months after the policy decision. This is true for inflation swaps from 1 to 5-year ahead. The positive response of inflation swaps to a contractionary monetary shock when associated with a deflationary projection surprise is consistent with the dynamic findings of Tang (2015) and Melosi (2017). It is worth stressing that the contemporaneous non-linear effect evidenced in Tables 1, 3, 6, 7 and 8 is not reversed afterwards. Both responses to monetary shocks gradually vanish across time, but the difference in the cumulated effects over the following months is not offset. These dynamic estimates show that the state-dependent effect of monetary policy conditional on central bank inflation projections is persistent.

Finally, we estimate equation (9) with FTSE returns, CPI and industrial production as dependent variables. Figure 8 plots the impulse response over 6 months of these three variables to a contractionary monetary shock interacted with a positive or negative inflation projection surprises. The state-dependent effect of monetary policy is confirmed with these financial and macroeconomic variables. Restrictive monetary policy has a negative effect on these three variables when interacted with an inflationary projection surprise. This suggests that the influence of the publication of the central bank macroeconomic information on the monetary policy transmission may have aggregate dynamic effects.

6. Conclusion

This paper investigates the extent to which the effects of monetary policy depend on the macroeconomic information set released by the central bank. We document that monetary policy has different effects on inflation swaps and stock prices when the IR or inflation projections are published in the days following the policy decision. This result is robust to a lower frequency analysis and macroeconomic variables. The publication of the central bank information set may help to reduce the dimensionality of the signal extraction issue of private agents when they observe a policy decision, so they would revise their beliefs and responses to policy decisions.

We find that a tightening monetary surprise has a negative impact on inflation swaps when associated with an inflationary surprise whereas it has a positive effect on inflation swaps when associated with a deflationary surprise. The latter finding is consistent with the literature about the signaling channel of monetary policy that reports increases in inflation expectations following a restrictive monetary shock under certain scenarios. Private agents' interpretation of the central bank information released suggests that they take it as a signal about the macroeconomic rationale for the policy decision such that an inflationary news confirms a policy tightening.

This state-dependent effect of monetary policy, conditional on the publication of central bank information, may have important implications for central bank communication. It suggests that providing guidance about the central bank's view of the state of the economy actually affects the transmission of monetary policy. A regular communication of the rationale for policy decisions may enhance the effectiveness of monetary policy.

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Table 1 - The effect of monetary surprises conditional on IR surprises

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
CB-announcement-period window					
Monetary surprises	0.748*	0.603**	0.366*	0.161	-0.011
	[0.45]	[0.28]	[0.21]	[0.17]	[0.16]
IR surprises	1.004	0.575*	0.395	0.319	0.259
	[1.12]	[0.35]	[0.25]	[0.21]	[0.16]
Monetary surprises * IR surprises	5.755	-8.176***	-8.677***	-4.479**	-0.796
	[7.15]	[2.68]	[1.96]	[1.84]	[1.65]
N	130	130	130	130	130
R^2	0.04	0.27	0.33	0.17	0.04
Effect of a positive 25 bp monetary surprise with:					
a 5 bp positive IR surprise	0.475	-0.258	-0.342**	-0.184	-0.042
	[0.40]	[0.18]	[0.14]	[0.12]	[0.11]
a 5 bp negative IR surprise	-0.101	0.560***	0.525***	0.264***	0.037
	[0.35]	[0.12]	[0.08]	[0.08]	[0.07]
Sum of MPC and IR windows					
Monetary surprises	0.662	0.592**	0.398**	0.193	0.022
	[0.44]	[0.27]	[0.20]	[0.14]	[0.14]
IR surprises	-0.619	0.078	0.407	0.365	0.287
	[2.28]	[0.60]	[0.30]	[0.32]	[0.21]
Monetary surprises * IR surprises	7.266	-7.276*	-7.705***	-3.906*	-0.667
	[11.92]	[3.77]	[1.85]	[2.06]	[1.77]
N	130	130	130	130	130
R^2	0.03	0.18	0.35	0.18	0.04
Effect of a positive 25 bp monetary surprise with:					
a 5 bp positive IR surprise	0.529	-0.216	-0.286**	-0.147	-0.028
	[0.64]	[0.22]	[0.13]	[0.12]	[0.11]
a 5 bp negative IR surprise	-0.198	0.512***	0.485***	0.243***	0.039
	[0.57]	[0.17]	[0.07]	[0.09]	[0.08]
Smallest window (on IR day only)					
Monetary surprises	0.556	0.574**	0.387**	0.181	0.006
	[0.40]	[0.28]	[0.19]	[0.14]	[0.14]
IR surprises	0.716	0.512	0.287***	0.118	0.02
	[0.94]	[0.32]	[0.10]	[0.11]	[0.18]
Monetary surprises * IR surprises	7.195	-6.292**	-6.152***	-2.916***	-0.487
	[6.07]	[2.65]	[1.18]	[1.01]	[1.18]
N	130	130	130	130	130
R^2	0.03	0.27	0.30	0.09	0.00
Effect of a positive 25 bp monetary surprise with:					
a 5 bp positive IR surprise	0.499	-0.171	-0.211**	-0.101	-0.023
	[0.34]	[0.18]	[0.10]	[0.08]	[0.09]
a 5 bp negative IR surprise	-0.221	0.458***	0.404***	0.191***	0.026
	[0.30]	[0.11]	[0.03]	[0.03]	[0.04]

Note : Heteroskedasticity robust standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Each column corresponds to equation (3) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. The independent variables are the surprise component of MPC announcements and the surprise component of the IR publication, both computed as the daily change in one-year gilt nominal yields, and their interaction. The dependent variable is the change in inflation swaps at different maturities from 1-year to 5-year over the different windows considered. The constant is around zero and never significant, so has been removed from each panel for the sake of parsimony.

Table 2 - Macro releases and associated surprises

Variable	Obs	Mean	Min	Max
Macro releases and associated surprises on MPC dates				
PPI	2	0.15	0.00	0.30
PMI Services	4	0.18	-1.70	2.10
Ind. Pro.	30	-0.08	-1.40	0.70
Macro releases and associated surprises on IR dates				
Earnings	27	0.02	-0.40	1.90
Ind. Pro.	1	0.30	0.30	0.30
Unemp.	27	0.00	-0.20	0.10
Employment	7	-14000	-103000	64000
Macro releases and associated surprises between MPC and IR dates				
CPI	16	0.01	-0.20	0.30
PPI	32	0.17	-0.50	0.90
Earnings	1	0.60	0.60	0.60
PMI Manuf.	2	-0.65	-3.00	1.70
PMI Services	15	0.11	-2.10	2.40
Ind. Pro.	34	0.04	-1.40	1.70
Unemp.	1	0.20	0.20	0.20

Note : Descriptive statistics for the news surprises in the following nine macroeconomic data series (Employment Change 3M, ILO Unemployment Rate 3M, Industrial Production MoM, PMI Services, PMI Manufacturing, GDP QoQ, Avg Wkly Earnings 3M YoY, PPI Output MoM, CPI MoM) around central bank announcement days.

Table 3 - Controlling for macroeconomic data releases

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
CB-announcement-period window					
Monetary surprises	0.969**	0.663**	0.401*	0.225	0.075
	[0.47]	[0.30]	[0.22]	[0.14]	[0.13]
IR surprises	1.889	0.751**	0.355	0.376*	0.448***
	[1.16]	[0.38]	[0.26]	[0.21]	[0.17]
Monetary surprises * IR surprises	12.904	-8.118*	-9.400***	-3.409	1.938
	[10.67]	[4.15]	[3.00]	[2.31]	[1.87]
Macro data releases	Yes	Yes	Yes	Yes	Yes
N	130	130	130	130	130
R^2	0.18	0.37	0.39	0.25	0.13
Sum of MPC and IR windows					
Monetary surprises	0.737	0.625**	0.399*	0.185	0.014
	[0.45]	[0.28]	[0.20]	[0.15]	[0.14]
IR surprises	-1.027	-0.018	0.46	0.42	0.311
	[2.40]	[0.64]	[0.29]	[0.34]	[0.24]
Monetary surprises * IR surprises	3.888	-8.194**	-7.381***	-3.503*	-0.438
	[11.11]	[3.42]	[1.88]	[2.06]	[1.79]
Macro data releases	Yes	Yes	Yes	Yes	Yes
N	130	130	130	130	130
R^2	0.21	0.30	0.37	0.20	0.06
Smallest window (on IR day only)					
Monetary surprises	0.617	0.596**	0.385*	0.174	0.001
	[0.41]	[0.28]	[0.20]	[0.14]	[0.14]
IR surprises	0.404	0.458	0.338***	0.16	0.034
	[0.96]	[0.33]	[0.09]	[0.12]	[0.20]
Monetary surprises * IR surprises	4.247	-6.993***	-5.856***	-2.658**	-0.44
	[4.69]	[2.23]	[1.21]	[1.02]	[1.20]
Macro data releases	Yes	Yes	Yes	Yes	Yes
N	130	130	130	130	130
R^2	0.36	0.40	0.32	0.11	0.01

Note : Heteroskedasticity robust standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Each column corresponds to equation (3) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. The independent variables are the surprise component of MPC announcements and the surprise component of the IR publication, both computed as the daily change in one-year gilt nominal yields, and their interaction. The dependent variable is the change in inflation swaps at different maturities from 1-year to 5-year over the different windows considered. The constant is around zero and never significant, so has been removed from each panel for the sake of parsimony. Equation (3) also includes surprises to the following nine macro data series (Employment Change 3M, ILO Unemployment Rate 3M, Industrial Production MoM, PMI Services, PMI Manufacturing, GDP QoQ, Avg Wkly Earnings 3M YoY, PPI Output MoM, CPI MoM) as controls. These surprises are included correspondingly with the window considered for the dependent variable. All surprises are considered for the CB-announcement-period window, releases on MPC and IR dates in the second case and finally, releases on MPC dates for the third case. For parsimony, only the key coefficients are reported. Parameter estimates for macro surprises are available from the author upon request.

Table 4 - The matrix of MPC and IR surprises

	IR surprises		
Monetary surprises	Deflationary	Inflationary	Total
Expansionary	**35%**	23%	58%
Restrictive	26%	**16%**	42%
Total	61%	39%	100%

Note : This table categorises, over our sample, the cases when montary surprises and IR surprises are consistent (expansionary policy with a deflationary outlook and restrictive policy with an inflationary outlook, in bold in the table) versus inconsistent (expansionary policy with an inflationary outlook and restrictive policy with a deflationary outlook).

Table 5 - Three largest values of 4Q-ahead inflation projection surprises

IR date	value	commentary
August 2010	0.603	"Bank of England forecasts 'choppy' economic recovery (…) as inflation would stay higher for longer than previously forecasted", BBC News, August 11.
May 2011	0.559	"Inflation could go higher, Mervyn King warns. The rise in the cost of living could become so great that workers rebel against the lack of pay increases." The Telegraph, May 17
November 2013	-0.506	"Inflation had been lower than expected and is on course to fall back to around its target "over the next year or so". Daily Express, November 13.

Note : Media reports at the date corresponding to the three largest Bank of England's 4-quarter ahead inflation projection surprises identified from equation (5).

Table 6 - The effect of monetary surprises conditional on inflation projection surprises

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
CB-announcement-period window					
Monetary surprises	0.743*	0.898***	0.636**	0.309*	0.034
	[0.41]	[0.31]	[0.24]	[0.17]	[0.14]
$E^{BoE}\pi_{t+4}$ surprises	0.149	0.084	0.04	0.042	0.048**
	[0.25]	[0.10]	[0.04]	[0.03]	[0.02]
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	1.348	-4.458	-4.864*	-2.893**	-1.081
	[5.05]	[3.65]	[2.52]	[1.43]	[0.94]
N	130	130	130	130	130
R^2	0.03	0.18	0.20	0.10	0.03
Sum of MPC and IR windows					
Monetary surprises	0.232	0.745***	0.655***	0.345**	0.073
	[0.58]	[0.26]	[0.23]	[0.17]	[0.14]
$E^{BoE}\pi_{t+4}$ surprises	0.28	0.058	-0.031	-0.025	-0.012
	[0.27]	[0.09]	[0.04]	[0.04]	[0.03]
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	0.469	-4.734*	-4.327*	-2.509	-1.058
	[7.23]	[2.73]	[2.52]	[1.61]	[1.03]
N	130	130	130	130	130
R^2	0.03	0.17	0.20	0.08	0.01
Smallest window (on IR day only)					
Monetary surprises	0.493	0.770***	0.537***	0.227*	-0.02
	[0.36]	[0.25]	[0.18]	[0.12]	[0.12]
$E^{BoE}\pi_{t+4}$ surprises	0.191	0.035	-0.005	0.016	0.035*
	[0.20]	[0.08]	[0.02]	[0.02]	[0.02]
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	3.22	-4.900*	-4.889***	-2.922***	-1.440*
	[3.92]	[2.55]	[1.31]	[0.57]	[0.84]
N	130	130	130	130	130
R^2	0.04	0.20	0.24	0.10	0.03

Note : Heteroskedasticity robust standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each column corresponds to equation (3) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. The independent variables are the surprise component of MPC announcements computed as the daily change in one-year gilt nominal yields, inflation projection surprises estimated based on equation (5), and their interaction. The dependent variable is the change in inflation swaps at different maturities from 1-year to 5-year over the different windows considered. The constant is around zero and never significant, so has been removed from each panel for the sake of parsimony.

Table 7 - A low frequency model of inflation expectations updating

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Monetary surprises * IR surprises					
Monetary surprises	0.020	0.042*	0.039**	0.027	0.013
	[0.03]	[0.02]	[0.02]	[0.02]	[0.01]
IR surprises	-0.079	-0.035	-0.014	-0.005	0.001
	[0.07]	[0.05]	[0.04]	[0.03]	[0.03]
Monetary surprises * IR surprises	-0.061***	-0.041***	-0.030***	-0.022**	-0.016*
	[0.02]	[0.01]	[0.01]	[0.01]	[0.01]
Lag dep var	0.694***	0.683***	0.742***	0.814***	0.875***
	[0.10]	[0.09]	[0.08]	[0.08]	[0.07]
Constant	1.161**	1.139***	0.903***	0.661**	0.468**
	[0.44]	[0.36]	[0.31]	[0.27]	[0.23]
Controls: X_t & Z_t	Yes	Yes	Yes	Yes	Yes
N	125	125	125	125	125
R^2	0.83	0.78	0.77	0.79	0.84
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises					
Monetary surprises	0.022	0.044*	0.041**	0.027*	0.013
	[0.04]	[0.02]	[0.02]	[0.02]	[0.01]
$E^{BoE}\pi_{t+4}$ surprises	0.316*	0.201*	0.146	0.113	0.087
	[0.18]	[0.12]	[0.10]	[0.08]	[0.07]
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-0.912***	-0.660***	-0.522***	-0.411***	-0.312***
	[0.29]	[0.19]	[0.14]	[0.12]	[0.10]
Lag dep var	0.704***	0.697***	0.751***	0.816***	0.872***
	[0.09]	[0.08]	[0.07]	[0.06]	[0.06]
Constant	1.101***	1.092***	0.887***	0.667***	0.488**
	[0.37]	[0.31]	[0.25]	[0.22]	[0.19]
Controls: X_t & Z_t	Yes	Yes	Yes	Yes	Yes
N	125	125	125	125	125
R^2	0.84	0.80	0.78	0.80	0.85

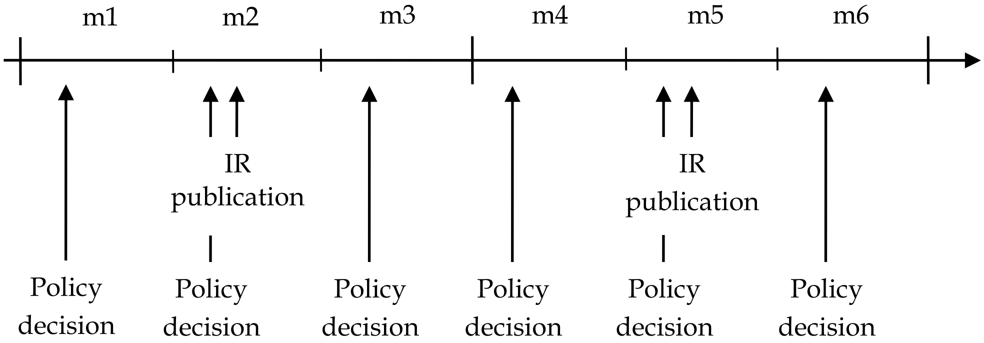
Note : Heteroskedasticity and autocorrelation robust Newey-West standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Each column corresponds to equation (7) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. The surprise component of MPC announcements and the surprise component of the IR publication are both computed as the daily change in one-year gilt nominal yields. Inflation projection surprises are estimated based on equation (5). The dependent variable is the level of monthly averaged inflation swaps at different maturities from 1-year to 5-year. For parsimony, only the key coefficients are reported. Complete tables are available from the authors upon request. X_t includes a news variable capturing the information flow between *t-1* and *t* of macro data releases related to inflation, the real activity, uncertainty and news indices of Scotti (2016), the changes in the FTSE and UK move indices. Z_t includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Table 8 - The state-dependent effect of monetary shocks

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises					
Monetary shocks	-0.003	0.004	0.005	0.001	-0.003
	[0.03]	[0.02]	[0.02]	[0.01]	[0.01]
$E^{BoE}\pi_{t+4}$ surprises	0.111	0.07	0.056	0.041	0.026
	[0.15]	[0.10]	[0.09]	[0.07]	[0.06]
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.992***	-0.675***	-0.481***	-0.372***	-0.288***
	[0.34]	[0.22]	[0.16]	[0.13]	[0.10]
Lag dep var	0.685***	0.679***	0.737***	0.809***	0.869***
	[0.10]	[0.10]	[0.10]	[0.09]	[0.07]
Constant	1.219***	1.201***	0.970***	0.719**	0.520**
	[0.43]	[0.40]	[0.35]	[0.29]	[0.24]
Controls: X_t & Z_t	Yes	Yes	Yes	Yes	Yes
N	125	125	125	125	125
R^2	0.83	0.77	0.74	0.77	0.84
Effect of a positive 25 bp monetary shock with:					
a 15 bp positive $E^{BoE}\pi_{t+4}$ surprise	-1.002***	-0.661***	-0.462***	-0.369***	-0.301***
	[0.39]	[0.24]	[0.17]	[0.14]	[0.12]
a 15 bp negative $E^{BoE}\pi_{t+4}$ surprise	0.982***	0.689***	0.499***	0.375***	0.276***
	[0.33]	[0.23]	[0.18]	[0.14]	[0.10]

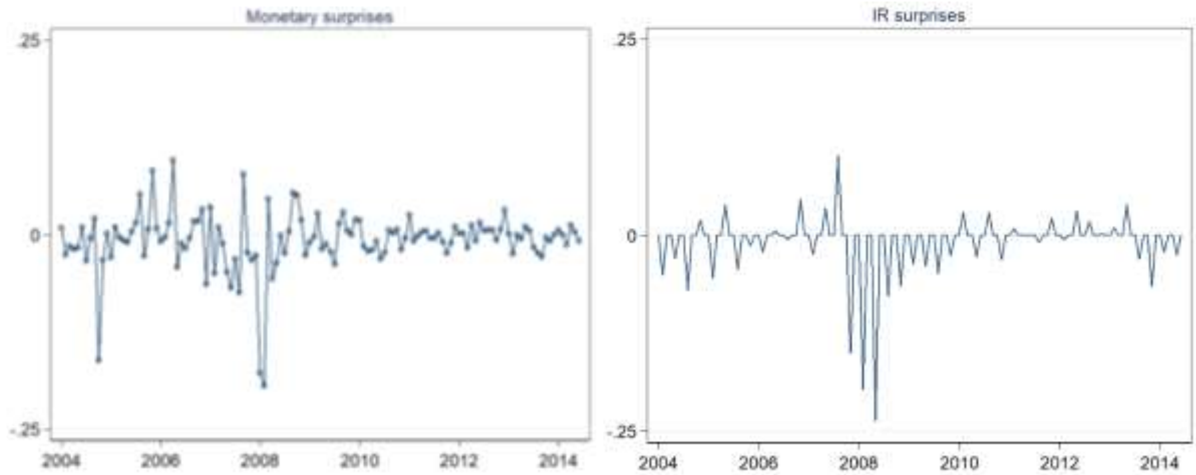
Note : Heteroskedasticity and autocorrelation robust Newey-West standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Each column corresponds to equation (7) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. Inflation projection surprises are estimated based on equation (5). Monetary shocks are estimated based on equation (8). The dependent variable is the level of monthly averaged inflation swaps at different maturities from 1-year to 5-year. For parsimony, only the key coefficients are reported. Complete tables are available from the authors upon request. X_t incluc a news variable capturing the information flow between *t-1* and *t* of macro data releases related to inflation, the real activity, uncertainty and news indices of Scotti (2016), the changes in the FTSE and UK move indices. Z_t includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Figure 1 – Timeline of central bank announcements



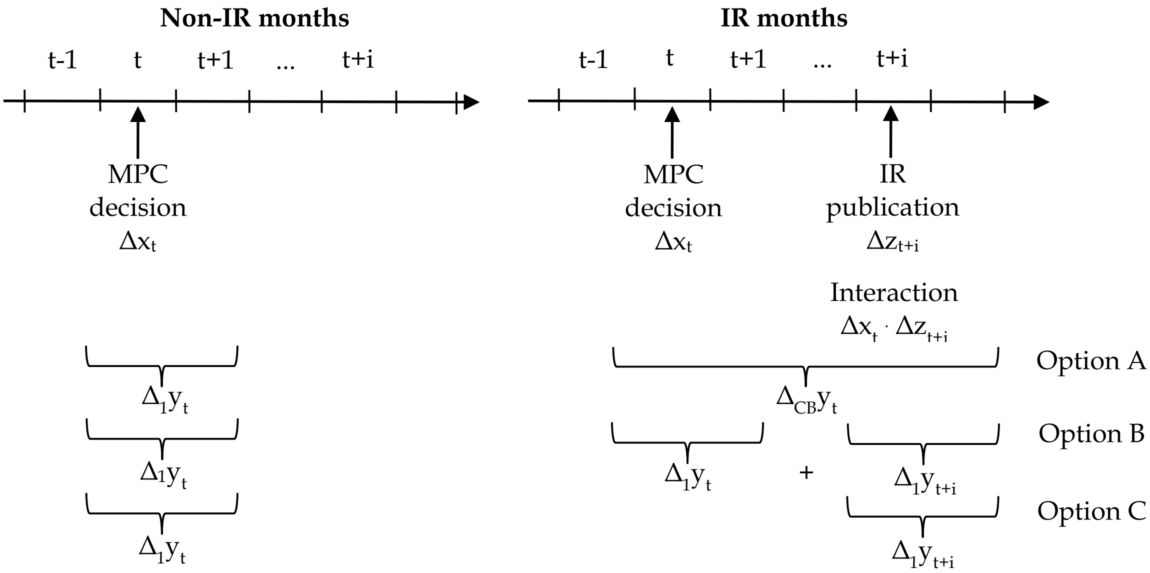
Note: This timeline represents two quarters during which six policy decisions are taken by the Bank of England and two Inflation Reports are published. The MPC policy announcement and the publication of the IR are separated by 4 days on average.

Figure 2 – Monetary and IR surprises



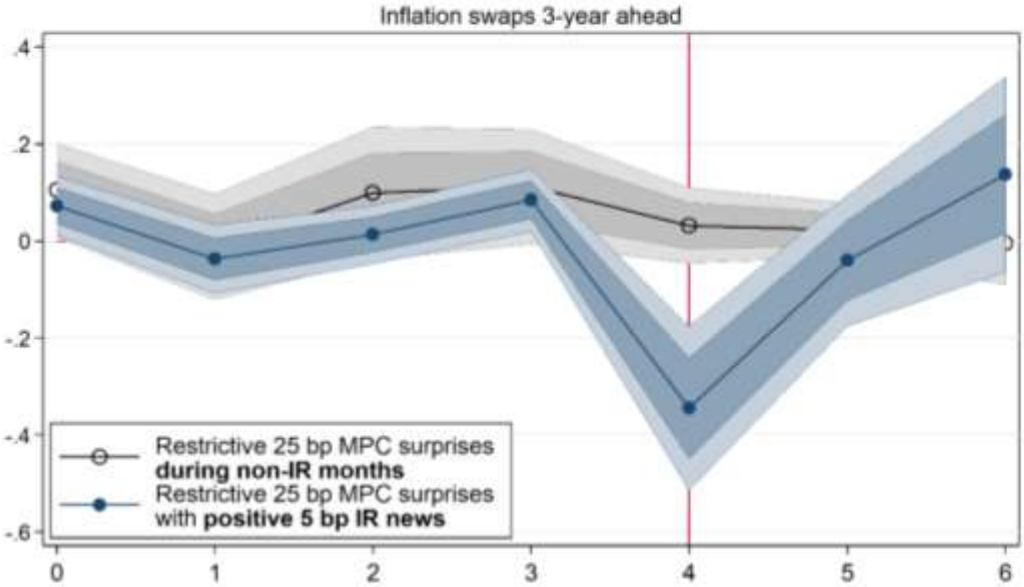
Note: The monetary surprises and the IR publication surprises are computed as the daily change in one-year gilt nominal yields on the day of policy decision announcements and the publication of the Inflation Report.

Figure 3 – The interaction term and windows for the response of inflation swaps



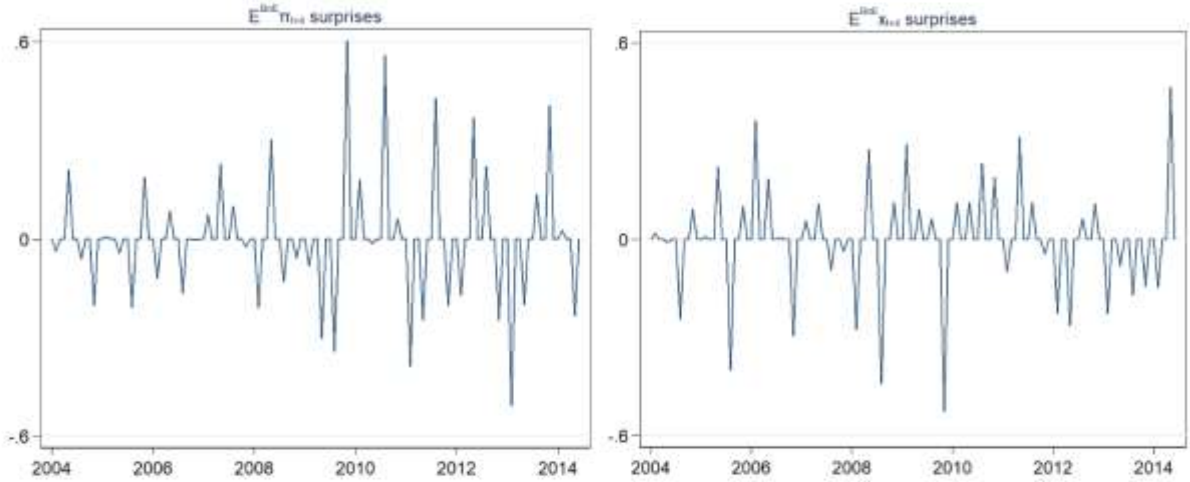
Note: These timelines represent the days around MPC announcement and IR publication dates in IR and non-IR months. The figure shows the different options for allocating the interaction term to a date and the different options for the window on which to compute the response of inflation swaps. MPC monetary surprises and IR surprises are computed as the daily change in one-year gilt nominal yields. Note that the interaction term during non-IR moths is not represented in this figure since it is zero by construction.

Figure 4 – Timeline of the effects of monetary surprises



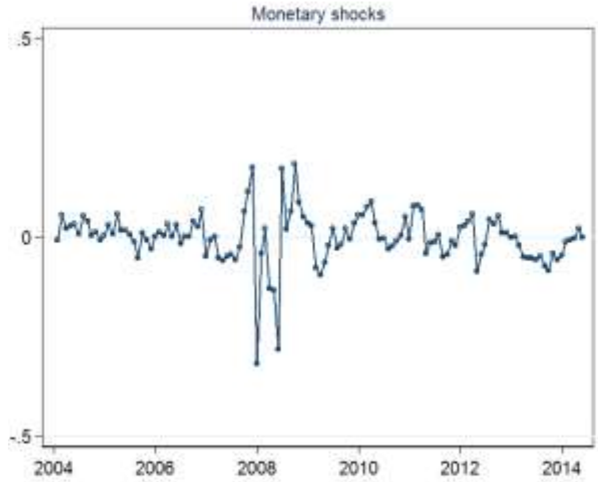
Note: The monetary surprises and the IR publication surprises are computed as the daily change in one-year gilt nominal yields on the day of MPC decisions and of the IR publication. Impulse responses are estimated for each horizon h separately following Jordà (2005) and based on equation (4). The x-axis is in days, date 0 corresponds to the MPC decision, and the red vertical line to the IR publication. Shaded areas represent the 68 and 90% confidence intervals.

Figure 5 – BoE's projection surprises



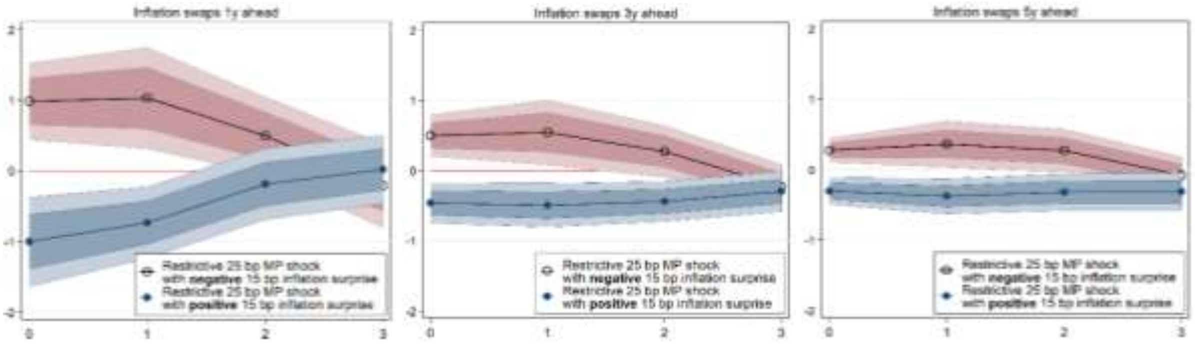
Note: Inflation and output projection surprises are estimated with equation (5). Parameter estimates are shown in Table A8 in the Appendix.

Figure 6 – Monetary shocks



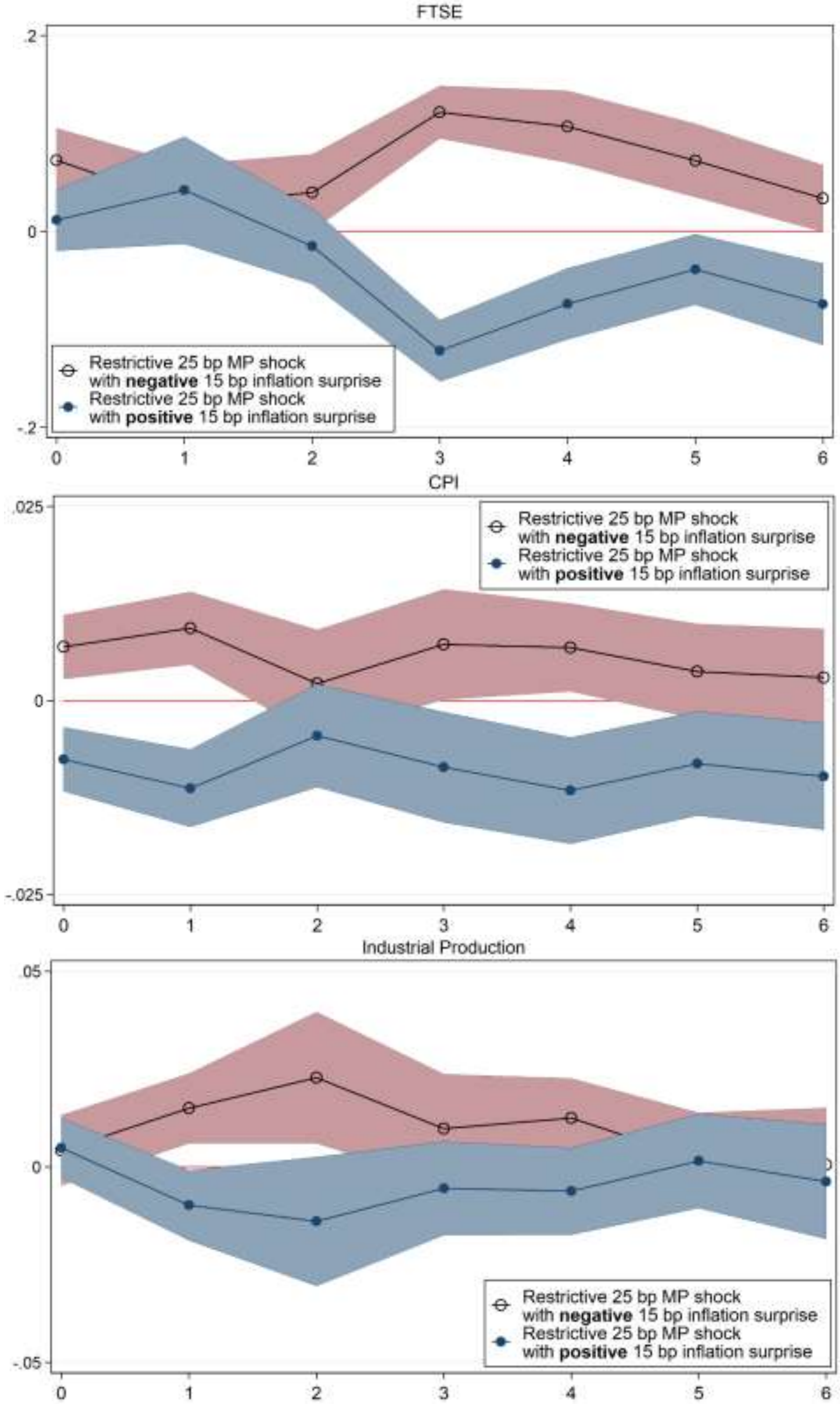
Note: Monetary shocks are estimated with equation (8). Parameter estimates are shown in Table A8 in the Appendix.

Figure 7 – Dynamic low-frequency effects



Note: Impulse responses to a restrictive monetary shock (estimated from equation 8) when interacted with positive (black line) or negative (blue line) inflation projection surprises (estimated from equation 5), over four months, using local projections à la Jordà (2005) as described in equation (9) with 68 and 90% confidence intervals.

Figure 8 – Macro effects



Note: Impulse responses to a restrictive monetary shock (estimated from equation 8) when interacted with positive (black line) or negative (blue line) inflation projection surprises (estimated from equation 5), over four months, using local projections à la Jordà (2005) as described in equation (9) with 1 S.E. confidence intervals.

APPENDIX

Table A1 - Data description

Variable	Source	Description
		Daily data
Swap_h	Bloomberg and Bank of England calculations	Inflation expectation measures derived from inflation swaps. Instantaneous forward inflation rates for annual RPI inflation h years ahead. Monthly average of daily observations.
Monetary surprises	Datastream	Daily change in the 1-year spot nominal interest rate on the day of the policy decision announcement
IR surprises	Datastream	Daily change in the 1-year spot nominal interest rate on the day of the publication of the Inflation Report
FTSE	Datastream	Daily returns of the FTSE 100 index
spot_10y	Datastream	Gilts 10-year spot nominal interest rates
		Monthly data
$E^{BoE}\pi_{t+h}$	Bank of England	Bank of England's modal projections for annual CPI inflation h quarters
$E^{BoE}x_{t+h}$	Bank of England	Bank of England's modal projections for annual GDP growth h quarters ahead, based on market interest rate expectations.
BoE_SR	Bank of England	Bank Rate adjusted for internal estimates of the impact of QE.
BoE_SR1	Wu and Xia (2016)	UK shadow rate estimated using a nonlinear term structure model.
BoE_SR2	Krippner (2013, 2014)	UK shadow rate estimated using a two state-variable yield curve model.
Bank Rate	Bank of England	Bank of England's policy interest rate.
FG	Authors' computation	Dummy that equals 1 when the Forward Guidance policy is in place.
ZLB	Authors' computation	Dummy that equals 1 when the policy rate is at 0.5%.
mc_h	Bank of England	Market interest rate curve used as conditioning path for BoE's macroeconomic projections.
PF_gdp_h	Consensus Forecasts / Survey of External Forecasters	Consensus Forecasts' average projections for annual GDP growth h quarters ahead, for h=1 to 6. Survey of External Forecasters' average projections for annual GDP growth h quarters ahead, for h=8 and 12. Monthly constant interpolation from quarterly frequency.
Oil	FRED	Crude oil spot prices, Brent - Europe. Annual % change.
Sterling	Bank of England	Effective exchange rate index, January 2005 = 100. Annual % change.
CPI	ONS	Annual % change in the Consumer Price Index.
Indpro	ONS	Annual real Industrial Production growth seasonally adjusted.
Netlending	Bank of England	12 month growth rate of monetary financial institutions' sterling net lending to private non-financial corporations (excluding the effects of securitisations and loan transfers) (SA).
Housing	Halifax and Nationwide	Average of (SA) Halifax and Nationwide measures of average house prices. Annual % change.
RPI surprises	ONS and Bloomberg	Difference between the outturn for annual RPI inflation in a given month and the market median forecast 1 month before.
scottiactiv	Scotti (2016)	UK real-time real activity index, capturing the economic conditions.
scottinews	Scotti (2016)	UK real-time surprise index, summarizing economic data surprises.
scottiuncert	Scotti (2016)	UK real-time uncertainty index, measuring uncertainty related to the state
FTSE	Bloomberg	FTSE index. Annual change.
UKmove	Bank of England	The Merrill lynch Option Volatility Estimate (MOVE) Index is a yield

Table A2 - Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Daily data					
Swap1y	2829	2.69	0.55	-1.20	4.08
Swap2y	2829	2.82	0.36	0.17	3.99
Swap3y	2829	2.93	0.29	0.93	3.98
Swap4y	2829	3.04	0.26	1.63	4.01
Swap5y	2829	3.14	0.27	2.34	4.04
Monetary surprises	130	0.0	0.04	-0.19	0.10
IR surprises	43	0.0	0.06	-0.24	0.10
FTSE returns	2829	0.0	1.17	-9.27	9.38
10y yields	2829	3.5	1.07	1.39	5.44
Monthly data					
Swap1y	126	3.13	0.38	1.50	4.15
Swap2y	126	3.07	0.26	2.04	3.72
Swap3y	126	3.02	0.22	2.19	3.57
Swap4y	126	3.02	0.23	2.23	3.42
Swap5y	126	3.05	0.27	2.26	3.50
Monetary surprises	126	0.0	0.04	-0.19	0.10
IR surprises	42	0.0	0.06	-0.24	0.10
Exogenous innovations estimated from equations (5) and (8)					
$E^{BoE}\pi_{t+4}$	126	0.0	0.14	-0.51	0.60
$E^{BoE}\pi_{t+8}$	126	0.0	0.06	-0.15	0.30
$E^{BoE}x_{t+4}$	126	0.0	0.13	-0.52	0.47
$E^{BoE}x_{t+8}$	126	0.0	0.12	-0.41	0.42
BoE_SR	125	0.0	0.06	-0.32	0.19
BoE_SR1	125	0.0	0.29	-0.89	1.82
BoE_SR2	125	0.0	0.46	-1.34	2.32
Bank Rate	125	0.0	0.12	-0.49	0.29
mc_1y	125	2.42	2.02	0.22	5.93
mc_2y	125	2.88	1.81	0.28	5.89
mc_3y	125	3.22	1.61	0.56	5.79
PF_gdp_1	126	1.42	1.67	-3.90	3.10
PF_gdp_4	126	1.81	0.73	-0.70	2.60
PF_gdp_8	126	2.30	0.24	1.82	2.63
Oil	126	14.9	35.2	-56.1	86.4
Sterling	126	-1.07	6.49	-21.60	11.00
CPI	126	2.62	1.04	0.00	5.20
Indpro	126	-0.98	3.44	-11.10	5.10
Netlending	126	4.65	8.77	-4.40	19.60
Housing	126	2.71	7.27	-17.10	17.60
RPI surprises	126	0.03	0.17	-0.50	0.70
scottiactiv	126	-0.17	0.62	-2.44	0.51
scottinews	126	-0.08	0.28	-0.96	0.53
scottiuncert	126	0.92	0.32	0.41	1.98
FTSE	126	6.04	15.50	-36.20	51.20
UKmove	126	90.3	32.6	52.6	220.0

A1. Sensitivity analysis

We assess the robustness of the main result along various dimensions. First, we focus on some key assumptions underlying the event-study method and high-frequency estimates.

We use different maturities of spot nominal yields for computing the monetary and IR surprises. Assuming that unconventional monetary policy has had a direct effect on yields further away along the term structure of interest rates and that forward guidance has disclosed policy signals beyond a 1-year horizon, we use the daily changes in 2-year and 5-year spot nominal yields to measure monetary and IR surprises. We also use the estimated series of Cesa-Bianchi et al. (2016) who use intraday data to measure monetary surprises. Table A3 shows these estimates. In addition, we measure the responses of inflation swaps over a 1-day window (from t-1 to t). This goes against the view that it could take some time for financial market participants to digest the information content of a central bank communication, especially when most of the statements are published around noon and markets close at 6pm. However, considering a 1-day window reduces the scope for other news to interfere with the estimation of the effect of monetary surprises. Table A4 shows that the state-dependent effect does not depend on this assumption. Because zeros in non-IR months can be seen as measurement errors, we estimate the effect of monetary surprises on non-IR months and the non-linear effects of monetary surprises on IR months separately. Table A5 confirms that the state-dependent effect of monetary policy is not due to this specification of IR surprises. Finally, Table A6 provides estimates of equation (3) with stock price returns (FTSE) and long-term yields (10-year Gilts) as the dependent variable, while Table A7 shows subsample estimates of equation (3). The upper panel shows the output for a subsample ending in February 2009 when the policy rate hit the ZLB, and the lower panel shows estimates for a subsample ending in July 2013 when the FG policy was introduced. The effect of monetary surprises conditional on the release of central bank macroeconomic information is confirmed in both cases.

Turning to inflation projection surprises, Table A10 shows the estimates of their influence on the effect of monetary surprises on stock prices. In addition, we use a constant-interpolated measure of the projections such that they take the value of the projections released in a given month during the two months after the IR publication. We then estimate equation (5) on all months rather than on IR months only. If projection surprises are well identified, this should not affect the state-dependent estimates. We also run use a constant-interpolated measure of the projection surprises such that the value of the IR surprise during an IR month is also attributed to the next two non-IR MPC decisions. We test that private agents interpret the next two policy decisions in light of the last information set published, so the state-dependent effect would persist across policy decisions. Table A11 shows the estimates for these two specifications. While the state-dependent effect holds, as expected, with interpolated projections, this is not the case when the last IR surprise is interacted with the next two MPC surprises. The state-dependent coefficient is negative but not significant.

We also assess the robustness of the estimation of monetary shocks. First, we estimate monetary shocks with two alternative shadow rate measures by Wu and Xia (2016) and Krippner (2013, 2014). Second, because private agents may expect the central bank to update its policy more frequently during IR months when it updates its assessment of the state of the economy, expectations of policy changes may be different in IR and non-IR months. We therefore estimate equation (8) on IR months only but extract residuals for all months. We also proceed to two estimations for IR and non-IR months and extract series of residuals for each that we combine in a single time series. Third, because the ZLB may affect macroeconomic dynamics, the transmission of macroeconomic shocks and the way private agents form their expectations, we estimate equation (8) on two subsamples pre and post ZLB using Bank Rate in the former case and the shadow rate in the latter case. Fourth, we reproduce the monetary shock measure of Cloyne and Huertgen (2016) with shadow rate measures. Fifth, we replace the first principal components of private inflation and output expectations in the vector Ψ_{t-1} by all individual series of private inflation and output expectations at different horizons. Tables A12 and A13 confirm that the state-dependent effect of monetary policy does not depend on these factors.

Turning to the dependent variable, we first consider a more extreme information assumption, replacing the monthly average of all daily observations of inflation swaps by the last observation of the month. By doing so, we ensure that: (i) all shocks or information happening during a month are incorporated in the last observation of the month; and (ii) that there is no endogeneity issue between our left-hand side variable and its potential explanatory variables. Second, we replace inflation swaps by the break-even inflation rates obtained from the difference between inflation-indexed and nominal gilts. Because of liquidity issues on short maturities, inflation-indexed bonds are only considered from the 3-year horizon onwards. Third, we replace the level of inflation swaps by their first difference. Tables A14 shows that these alternatives about the dependent variable considered does not affected the state-dependent result.

We then estimate equation (7) on IR months only for the reasons discussed in section 3.3. Turning to right-hand side variables, we first estimate equation (7) without the vectors X_t and Z_t to examine potential over-identification issues. Second, we augment the vector of macro controls with a Value Added Tax (VAT) dummy which takes the value of one in December 2008, January 2010 and January 2011 when the UK government raised the VAT causing inflation to rise. Third, we test a specification in which we introduce a dummy for the dates of the announcements of explicit forward guidance on future policy rates in August 2013 and February 2014.[1] Fourth, because news shock at time t may raise private inflation expectations as well as central bank inflation projections, the estimation requires controlling for news shocks. Our benchmark specification already includes some instruments for that. Yet, we augment the X_t to include the change in private output and interest rate forecasts between $t-1$ and t, to control for their link with private inflation forecasts.[2] That allows us to control for the changes in private inflation expectations which are related to changes in private beliefs about other macro variables. Fifth, we control for sentiment measures and add the three European Commission (EC)'s UK sentiment measures for the industry, services and consumers. Sixth, we also test a specification in which we include various other macroeconomic, financial and expectation variables to further control that our result is not driven by some omitted variable bias. We add to equation (7) the growth rate of retail prices, input producer prices, output producer prices, wages, import prices, the level of unemployment, capacity constraints, capacity utilization, the (HP filtered) cycle component of real GDP, the change in the VIX and the Saint-Louis Financial Stress Index, and private output expectations at the 2 and 3-years horizon. Table A15 shows that the state-dependent effect evidenced does not stem from an omitted variable bias or from inflation projection surprises capturing the presence of news.

[1] The Monetary Policy Committee has provided guidance on the setting of future monetary policy since 7 August 2013. For details, see http://www.bankofengland.co.uk/monetarypolicy/Pages/forwardguidance.aspx. Because this policy is supposed to affect the private agents' expected future policy path via a commitment device, it may affect private inflation expectations, and we need to control for this potential effect at the end of our sample.

[2] We use Consensus Forecasts and the market curve used by the BoE as conditioning path for its projections for private output and interest rate expectations.

Table A3 - Alternative monetary and IR surprises

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
2-year nominal spot rates					
Monetary surprises	0.307	0.341*	0.196*	0.051	-0.057
	[0.39]	[0.19]	[0.11]	[0.11]	[0.14]
IR surprises	1.133	0.515	0.236	0.161	0.133
	[1.09]	[0.38]	[0.18]	[0.14]	[0.13]
Monetary surprises * IR surprises	5.928	-7.526*	-9.312***	-5.950***	-2.545
	[9.30]	[4.53]	[1.37]	[1.38]	[2.22]
N	130	130	130	130	130
R^2	0.05	0.24	0.31	0.19	0.06
5-year nominal spot rates					
Monetary surprises	0.139	0.194	0.14	0.1	0.079
	[0.38]	[0.18]	[0.12]	[0.10]	[0.12]
IR surprises	1.419	0.671*	0.270*	0.152	0.107
	[1.01]	[0.36]	[0.15]	[0.11]	[0.11]
Monetary surprises * IR surprises	6.698	-7.024	-10.425***	-7.434***	-4.081*
	[14.59]	[7.35]	[3.65]	[1.87]	[2.38]
N	130	130	130	130	130
R^2	0.08	0.22	0.26	0.19	0.08
Cesa-Bianchi, Thwaites and Vicondoa (2016)'s monetary surprises					
Monetary surprises	0.099	0.346	0.155	-0.178	-0.373
	[0.91]	[0.31]	[0.22]	[0.24]	[0.29]
IR surprises	0.699	0.696***	0.627**	0.499**	0.368**
	[0.92]	[0.22]	[0.26]	[0.21]	[0.18]
Monetary surprises * IR surprises	-0.481	-3.628**	-3.361***	-2.532*	-1.534
	[4.89]	[1.70]	[1.25]	[1.29]	[1.51]
N	130	130	130	130	130
R^2	0.02	0.25	0.29	0.14	0.05

Note : Heteroskedasticity robust standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Each column corresponds to equation (3) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. The independent variables are the surprise component of MPC announcements and the surprise component of the IR publication, both computed as the daily change in one-year gilt nominal yields, and their interaction. The dependent variable is the change in inflation swaps at different maturities from 1-year to 5-year over the CB-announcement-period window. The constant is around zero and never significant, so has been removed from each panel for the sake of parsimony.

Table A4 - Changes in inflation swaps over a 1-day window

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
CB-announcement-period window					
Monetary surprises	0.787**	0.600*	0.283	0.058	-0.078
	[0.40]	[0.35]	[0.25]	[0.15]	[0.14]
IR surprises	0.959	0.574	0.408	0.33	0.269*
	[1.12]	[0.35]	[0.25]	[0.20]	[0.16]
Monetary surprises * IR surprises	5.821	-8.197***	-9.052***	-4.956***	-1.097
	[7.00]	[2.88]	[2.03]	[1.74]	[1.57]
N	130	130	130	130	130
R^2	0.03	0.28	0.33	0.19	0.05
Sum of MPC and IR windows					
Monetary surprises	0.55	0.630*	0.420*	0.205*	0.055
	[0.41]	[0.34]	[0.23]	[0.12]	[0.11]
IR surprises	0.139	0.167	0.400***	0.351**	0.21
	[1.03]	[0.37]	[0.13]	[0.14]	[0.19]
Monetary surprises * IR surprises	4.421	-9.615***	-7.910***	-3.209**	0.226
	[4.98]	[2.57]	[1.51]	[1.40]	[1.57]
N	130	130	130	130	130
R^2	0.02	0.34	0.38	0.20	0.02
Smallest window (on IR day only)					
Monetary surprises	0.492	0.571	0.364	0.166	0.029
	[0.39]	[0.34]	[0.23]	[0.10]	[0.10]
IR surprises	-0.08	0.35	0.485***	0.314**	0.118
	[0.58]	[0.34]	[0.14]	[0.13]	[0.22]
Monetary surprises * IR surprises	-11.293***	-6.088**	-0.724	1.005	1.524
	[3.32]	[2.58]	[1.39]	[1.09]	[1.53]
N	130	130	130	130	130
R^2	0.14	0.28	0.17	0.06	0.01

Note : Heteroskedasticity robust standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Each column corresponds to equation (3) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. The independent variables are the surprise component of MPC announcements and the surprise component of the IR publication, both computed as the daily change in one-year gilt nominal yields, and their interaction. The dependent variable is the change in inflation swaps at different maturities from 1-year to 5-year over the different windows considered. The constant is around zero and never significant, so has been removed from each panel for the sake of parsimony.

Table A5 - Estimation on non-IR or IR months separately

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Non-IR months					
Monetary surprises	0.735	0.584*	0.426*	0.277*	0.133
	[0.48]	[0.33]	[0.24]	[0.15]	[0.15]
N	87	87	87	87	87
r2	0.04	0.07	0.05	0.03	0.01
IR months only					
CB-announcement-period window					
Monetary surprises	0.778	0.605	0.111	-0.265	-0.521
	[1.17]	[0.60]	[0.46]	[0.43]	[0.38]
IR surprises	0.981	0.454	0.307	0.263	0.223
	[1.17]	[0.32]	[0.26]	[0.20]	[0.14]
Monetary surprises * IR surprises	5.841	-8.518**	-10.194***	-6.755**	-3.427
	[8.47]	[3.50]	[3.01]	[2.76]	[2.36]
N	43	43	43	43	43
R^2	0.03	0.36	0.53	0.37	0.18
Sum of MPC and IR windows					
Monetary surprises	0.291	0.538	0.268	-0.103	-0.353
	[1.17]	[0.43]	[0.27]	[0.27]	[0.27]
IR surprises	-0.843	-0.076	0.348	0.351	0.295
	[2.44]	[0.60]	[0.33]	[0.35]	[0.22]
Monetary surprises * IR surprises	4.783	-7.990*	-8.517***	-5.414**	-2.502
	[14.37]	[4.03]	[2.39]	[2.56]	[2.09]
N	43	43	43	43	43
R^2	0.04	0.25	0.62	0.39	0.17
Smallest window (on IR day only)					
Monetary surprises	-0.209	0.473	0.224	-0.175	-0.460*
	[0.76]	[0.41]	[0.17]	[0.18]	[0.26]
IR surprises	0.434	0.387	0.232**	0.068	-0.038
	[0.89]	[0.29]	[0.09]	[0.10]	[0.18]
Monetary surprises * IR surprises	2.586	-7.153**	-7.120***	-4.822***	-2.964
	[5.69]	[2.78]	[1.01]	[1.14]	[1.78]
N	43	43	43	43	43
R^2	0.01	0.43	0.71	0.38	0.09

Note : Heteroskedasticity robust standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Each column corresponds to equation (3) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. The independent variables are the surprise component of MPC announcements and the surprise component of the IR publication, both computed as the daily change in one-year gilt nominal yields, and their interaction. The dependent variable is the change in inflation swaps at different maturities from 1-year to 5-year over the different windows considered. By construction, in non-IR months, the window considered around the MPC day is similar in all cases. The constant is around zero and never significant, so has been removed from each panel for the sake of parsimony.

Table A6 - Alternative independent variables: stock prices and long-term yields

	1	2	3	4	5	6
	FTSE	10y yields	FTSE	10y yields	FTSE	10y yields
	All months		**Non-IR months**		**IR months**	
Monetary surprises	0.152**	0.669**	0.184**	0.677*	0.039	0.702*
	[0.06]	[0.31]	[0.07]	[0.39]	[0.10]	[0.37]
IR surprises	-0.010	1.515***	.	.	-0.019	1.623***
	[0.04]	[0.33]			[0.04]	[0.34]
Monetary surprises * IR surprises	-1.378***	2.722	.	.	-1.967***	3.196
	[0.43]	[2.44]			[0.62]	[2.83]
N	130	130	87	87	43	43
R^2	0.22	0.26	0.16	0.05	0.31	0.52

Note : Heteroskedasticity robust standard errors in brackets. *p < 0.10, **p < 0.05, ***p < 0.01. Each column corresponds to equation (3) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. The independent variables are the surprise component of MPC announcements and the surprise component of the IR publication, both computed as the daily change in one-year gilt nominal yields, and their interaction. The dependent variable is the change in the FTSE index and 10-year nominal spot rates over the CB-announcement-period window. The constant is around zero and never significant, so has been removed from each panel for the sake of parsimony.

Table A7 - Subsample estimates

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Subsample before February 2009					
Monetary surprises	1.197**	0.619*	0.207	-0.017	-0.176
	[0.47]	[0.31]	[0.25]	[0.19]	[0.16]
IR surprises	0.928**	0.211	0.068	0.161	0.237
	[0.36]	[0.37]	[0.46]	[0.42]	[0.34]
Monetary surprises * IR surprises	4.661	-10.575***	-10.594***	-5.522**	-1.219
	[3.26]	[2.69]	[2.74]	[2.20]	[1.69]
N	52	52	52	52	52
R^2	0.23	0.57	0.55	0.31	0.08
Subsample ending in July 2013					
Monetary surprises	0.768	0.609**	0.367*	0.158	-0.019
	[0.47]	[0.29]	[0.22]	[0.17]	[0.16]
IR surprises	1.082	0.671*	0.483*	0.389*	0.310*
	[1.23]	[0.39]	[0.26]	[0.22]	[0.18]
Monetary surprises * IR surprises	6.4	-7.464**	-8.061***	-4.004**	-0.459
	[7.81]	[2.93]	[2.03]	[1.86]	[1.66]
N	105	105	105	105	105
R^2	0.04	0.29	0.36	0.19	0.04

Note : Heteroskedasticity robust standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each column corresponds to equation (3) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. The independent variables are the surprise component of MPC announcements and the surprise component of the IR publication, both computed as the daily change in one-year gilt nominal yields, and their interaction. The dependent variable is the change in inflation swaps at different maturities from 1-year to 5-year over the CB-announcement-period window. The constant is around zero and never significant, so has been removed from each panel for the sake of parsimony.

Table A8 - Estimation of projection surprises & monetary shocks

	1	2	3	4		5
	$E^{BoE}\pi_{t+4}$	$E^{BoE}\pi_{t+8}$	$E^{BoE}x_{t+4}$	$E^{BoE}x_{t+8}$		Δ BoE_SR
L.BoE_SR	-0.469**	-0.288***	-0.898***	-0.184	L.BoE_SR	-0.021*
	[0.17]	[0.07]	[0.15]	[0.14]		[0.01]
L.PCA_PF_cpi	-0.076	-0.01	-0.160***	-0.067	L.PCA_PF_cpi	0.014***
	[0.05]	[0.02]	[0.05]	[0.04]		[0.00]
L.PCA_PF_gdp	0.116	0.146***	0.057	-0.047	L.PCA_PF_gdp	0.017*
	[0.10]	[0.05]	[0.09]	[0.09]		[0.01]
L.$E^{BoE}\pi_{t+4}$	-0.205	-0.042	-0.438**	0.107	$E^{BoE}\pi_{t+4}$	0.024
	[0.23]	[0.10]	[0.21]	[0.19]		[0.03]
L.$E^{BoE}\pi_{t+8}$	0.458	0.465	0.746	-0.819	$E^{BoE}\pi_{t+8}$	0.071
	[0.80]	[0.35]	[0.70]	[0.67]		[0.11]
L.$E^{BoE}\pi_{t+12}$	-0.793	-0.59	-0.532	1.085	$E^{BoE}\pi_{t+12}$	-0.004
	[0.96]	[0.41]	[0.84]	[0.80]		[0.13]
L.$E^{BoE}x_{t+4}$	0.041	-0.408***	0.207	0.212	$E^{BoE}x_{t+4}$	0.052*
	[0.26]	[0.11]	[0.23]	[0.22]		[0.03]
L.$E^{BoE}x_{t+8}$	-0.462	0.357*	0.074	-0.373	$E^{BoE}x_{t+8}$	-0.057
	[0.40]	[0.17]	[0.35]	[0.33]		[0.06]
L.$E^{BoE}x_{t+12}$	-0.156	-0.412**	0.561	0.832**	$E^{BoE}x_{t+12}$	0.015
	[0.40]	[0.17]	[0.35]	[0.33]		[0.05]
mc_1y	2.013***	1.143***	0.651	-1.082**	Δ $E^{BoE}\pi_{t+4}$	-0.012
	[0.57]	[0.25]	[0.50]	[0.47]		[0.03]
mc_2y	-2.884*	-1.558**	0.195	2.511**	Δ $E^{BoE}\pi_{t+8}$	0.135
	[1.45]	[0.63]	[1.27]	[1.20]		[0.11]
mc_3y	1.695	0.902*	0.029	-1.484*	Δ $E^{BoE}\pi_{t+12}$	-0.094
	[1.04]	[0.45]	[0.91]	[0.86]		[0.13]
.	.	.	.	.	Δ $E^{BoE}x_{t+4}$	-0.018
						[0.04]
.	.	.	.	.	Δ $E^{BoE}x_{t+8}$	-0.018
						[0.06]
.	.	.	.	.	Δ $E^{BoE}x_{t+12}$	0.066
						[0.08]
Constant	4.102**	3.485***	-0.658	-0.792	Constant	-0.241
	[1.47]	[0.63]	[1.29]	[1.22]		[0.19]
Controls: Z_{t-1}	Yes	Yes	Yes	Yes	Controls: Z_{t-1} & IR_t	Yes
N	42	42	42	42	N	125
R^2	0.81	0.92	0.93	0.77	R^2	0.84

Predictability of exogenous shock series

	$E^{BoE}\pi_{t+4}$	$E^{BoE}\pi_{t+8}$	$E^{BoE}x_{t+4}$	$E^{BoE}x_{t+8}$	BoE_SR
VAR(3) - F-stat	1.01	0.64	0.89	0.86	0.42
VAR(3) - *p* -value	0.45	0.83	0.58	0.61	0.97
VAR(6) - F-stat	0.64	0.48	0.78	0.57	0.63
VAR(6) - p-value	0.92	0.99	0.78	0.96	0.92

Note : Standard errors in brackets. *p < 0.10, **p < 0.05, ***p < 0.01. L is the lag operator and Δ the first difference operator. Columns 1to 4 and column 5 correspond to the OLS estimation of equation (5) and (8) respectively. The Z vector of controls includes CPI, industrial production, net lending, housing prices as well as oil prices and the sterling effective exchange rate.

Table A9 - Alternative projections

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
$E^{BoE}\pi_{t+8}$ surprises					
Monetary surprises	0.62	1.004**	0.774**	0.393**	0.065
	[0.39]	[0.41]	[0.32]	[0.18]	[0.12]
$E^{BoE}\pi_{t+8}$ surprises	-0.264	0.03	0.132	0.126*	0.104*
	[0.41]	[0.16]	[0.09]	[0.07]	[0.06]
Monetary surprises * $E^{BoE}\pi_{t+8}$ surprises	-10.273	-11.594**	-10.484**	-8.051**	-5.911*
	[8.72]	[5.06]	[4.89]	[4.06]	[3.19]
N	130	130	130	130	130
R^2	0.03	0.17	0.20	0.13	0.06
$E^{BoE}x_{t+4}$ surprises					
Monetary surprises	0.553	0.756**	0.601**	0.330**	0.078
	[0.53]	[0.32]	[0.24]	[0.17]	[0.13]
$E^{BoE}x_{t+4}$ surprises	-0.051	-0.059	-0.05	-0.054	-0.063**
	[0.13]	[0.07]	[0.06]	[0.04]	[0.03]
Monetary surprises * $E^{BoE}x_{t+4}$ surprises	-2.846	-5.160**	-3.466	-1.425	-0.029
	[2.60]	[2.59]	[2.48]	[1.54]	[0.74]
N	130	130	130	130	130
R^2	0.02	0.18	0.17	0.07	0.02
$E^{BoE}x_{t+8}$ surprises					
Monetary surprises	0.476	0.671**	0.537**	0.284*	0.049
	[0.51]	[0.30]	[0.23]	[0.16]	[0.14]
$E^{BoE}x_{t+8}$ surprises	0.169	-0.048	-0.114*	-0.114***	-0.101***
	[0.20]	[0.08]	[0.06]	[0.04]	[0.03]
Monetary surprises * $E^{BoE}x_{t+8}$ surprises	-4.034	-6.458**	-4.445	-2.094	-0.416
	[2.89]	[2.62]	[2.72]	[1.67]	[0.83]
N	130	130	130	130	130
R^2	0.04	0.19	0.19	0.10	0.04

Note : Heteroskedasticity robust standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each column corresponds to equation (3) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. The independent variables are the surprise component of MPC announcements computed as the daily change in one-year gilt nominal yields. Inflation or output projection surprises are estimated based on equation (5). The dependent variable is the change in inflation swaps at different maturities from 1-year to 5-year over the CB-announcement-period window. The constant is around zero and never significant, so has been removed from each panel for the sake of parsimony.

Table A10 - The effect of central bank projections on stock prices

	1	2	3	4
	FTSE	FTSE	FTSE	FTSE
	$E^{BoE}\pi_{t+4}$	$E^{BoE}\pi_{t+8}$	$E^{BoE}x_{t+4}$	$E^{BoE}x_{t+8}$
Monetary surprises	0.167***	0.207***	0.164**	0.186***
	[0.05]	[0.07]	[0.06]	[0.06]
CB surprises	-0.016*	0.024	0.01	0.020*
	[0.01]	[0.03]	[0.01]	[0.01]
Monetary surprises * CB surprises	-1.251***	-0.856	-0.707**	-0.352
	[0.21]	[0.77]	[0.29]	[0.43]
N	130	130	130	130
R^2	0.25	0.19	0.21	0.20

Note : Heteroskedasticity robust standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Each column corresponds to equation (3) estimated with OLS for a different central bank projection surprise. The sample period goes from October 2004 to July 2015. The independent variables are the surprise component of MPC announcements computed as the daily change in one-year gilt nominal yields and inflation or output projection surprises are estimated based on equation (5). The dependent variable is the change in the FTSE index over the CB-announcement-period window. The constant is around zero and never significant, so has been removed from each panel for the sake of parsimony.

Table A11 - Alternative specifications for estimating projection surprises

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Projections interpolated in equation (5)					
Monetary surprises	0.589	0.750**	0.537***	0.244	-0.009
	[0.48]	[0.29]	[0.20]	[0.15]	[0.14]
$E^{BoE}\pi_{t+4}$ surprises	-0.079	0.015	0.053*	0.058**	0.050**
	[0.11]	[0.04]	[0.03]	[0.02]	[0.02]
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-2.366	-4.355***	-3.500***	-2.026***	-0.882
	[1.80]	[0.90]	[0.63]	[0.65]	[0.78]
N	130	130	130	130	130
R^2	0.03	0.24	0.28	0.16	0.05
Projection surprises attributed to following non-IR months					
Monetary surprises	0.669	0.926***	0.673**	0.324*	0.033
	[0.42]	[0.34]	[0.27]	[0.18]	[0.14]
$E^{BoE}\pi_{t+4}$ surprises	-0.009	0.024	0.023	0.021	0.019
	[0.08]	[0.03]	[0.02]	[0.02]	[0.02]
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-0.837	-2.329	-2.341	-1.547	-0.746
	[2.89]	[2.47]	[1.98]	[1.19]	[0.85]
N	130	130	130	130	130
R^2	0.02	0.15	0.16	0.08	0.01

Note : Heteroskedasticity robust standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Each column corresponds to equation (3) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. The independent variables are the surprise component of MPC announcements and the surprise component of the IR publication, both computed as the daily change in one-year gilt nominal yields, and their interaction. The dependent variable is the change in inflation swaps at different maturities from 1-year to 5-year over the CB-announcement-period window. The constant is around zero and never significant, so has been removed from each panel for the sake of parsimony.

Table A12 - Robustness: Alternative identifications of monetary shocks

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Alternative policy variables - Benchmark identification					
Wu and Xia (2016)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-1.414***	-1.133***	-0.916***	-0.705***	-0.519***
	[0.28]	[0.23]	[0.23]	[0.20]	[0.17]
Krippner (2013, 2014)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.806**	-0.644**	-0.549**	-0.468**	-0.395***
	[0.33]	[0.28]	[0.24]	[0.19]	[0.14]
Estimation on IR months only / shocks prediction on all months					
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.555	-0.397	-0.27	-0.195	-0.133
	[0.45]	[0.30]	[0.21]	[0.17]	[0.14]
Wu and Xia (2016)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.562***	-0.466***	-0.385***	-0.297***	-0.219***
	[0.16]	[0.11]	[0.09]	[0.08]	[0.07]
Krippner (2015)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.481**	-0.389**	-0.314**	-0.258**	-0.213**
	[0.20]	[0.15]	[0.13]	[0.10]	[0.08]
Two estimations of monetary shocks (IR and non-IR months)					
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.467	-0.333	-0.225	-0.16	-0.108
	[0.37]	[0.25]	[0.18]	[0.14]	[0.12]
Wu and Xia (2016)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.388***	-0.333***	-0.277***	-0.214***	-0.157***
	[0.11]	[0.07]	[0.07]	[0.06]	[0.05]
Krippner (2013, 2014)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.408**	-0.316**	-0.251**	-0.207**	-0.173**
	[0.17]	[0.13]	[0.11]	[0.09]	[0.07]

Note: Heteroskedasticity and autocorrelation robust Newey-West standard errors in brackets. *p < 0.10, **p < 0.05, ***p < 0.01. Each column corresponds to equation (7) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. Inflation projection surprises are estimated based on equation (5). Monetary shocks are estimated based on modified versions of equation (8). The dependent variable is the level of monthly averaged inflation swaps at different maturities from 1-year to 5-year. For parsimony, only the key coefficient is reported. Complete tables are available from the authors upon request. Xt includes a news variable capturing the information flow between t-1 and t of macro data releases related to inflation, the real activity, uncertainty and news indices of Scotti (2016), the changes in the FTSE and UK move indices. Zt includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Table A13 - Robustness: Alternative identifications of monetary shocks

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Two estimations (Pre/Post ZLB)					
Bank Rate + BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.711*	-0.473	-0.37	-0.300*	-0.236*
	[0.42]	[0.30]	[0.23]	[0.17]	[0.12]
Bank Rate + Wu and Xia (2016)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.676***	-0.455**	-0.311	-0.226	-0.168
	[0.26]	[0.22]	[0.19]	[0.16]	[0.13]
Bank Rate + Krippner (2013, 2014)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.106	-0.089	-0.079	-0.073	-0.065
	[0.19]	[0.12]	[0.10]	[0.08]	[0.07]
Cloyne and Huertgen (2016)					
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.224	-0.102	-0.076	-0.072	-0.069
	[0.30]	[0.20]	[0.15]	[0.12]	[0.10]
Wu and Xia (2016)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.426***	-0.331***	-0.281***	-0.220***	-0.159***
	[0.10]	[0.10]	[0.09]	[0.07]	[0.05]
Krippner (2013, 2014)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.117	-0.100	-0.098	-0.098	-0.088
	[0.15]	[0.11]	[0.08]	[0.07]	[0.06]
No PCA variables in equations (8)					
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.683	-0.267	-0.098	-0.063	-0.059
	[0.47]	[0.32]	[0.24]	[0.19]	[0.15]
Wu and Xia (2016)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.653***	-0.506***	-0.395***	-0.310***	-0.239***
	[0.18]	[0.16]	[0.14]	[0.11]	[0.09]
Krippner (2013, 2014)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.405**	-0.308**	-0.245**	-0.199**	-0.160**
	[0.16]	[0.13]	[0.11]	[0.08]	[0.06]

Note: Heteroskedasticity and autocorrelation robust Newey-West standard errors in brackets. *p < 0.10, **p < 0.05, ***p < 0.01. Each column corresponds to equation (7) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. Inflation projection surprises are estimated based on equation (5). Monetary shocks are estimated based on modified versions of equation (8). The dependent variable is the level of monthly averaged inflation swaps at different maturities from 1-year to 5-year. For parsimony, only the key coefficient is reported. Complete tables are available from the authors upon request. Xt includes a news variable capturing the information flow between t-1 and t of macro data releases related to inflation, the real activity, uncertainty and news indices of Scotti (2016), the changes in the FTSE and UK move indices. Zt includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Table A14 - Robustness: Alternative dependent variables

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Last observation of the month					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-1.029***	-0.705***	-0.528***	-0.395***	-0.302***
	[0.29]	[0.24]	[0.19]	[0.14]	[0.11]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.288	-0.251	-0.184	-0.125	-0.089
	[0.22]	[0.17]	[0.14]	[0.11]	[0.09]
Wu and Xia (2016)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.653*	-0.518*	-0.359	-0.226	-0.147
	[0.35]	[0.28]	[0.23]	[0.16]	[0.11]
Krippner (2013, 2014)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.348**	-0.179	-0.077	-0.023	0.007
	[0.17]	[0.14]	[0.12]	[0.08]	[0.06]
Gilts					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	.	.	-0.526***	-0.427***	-0.306**
			[0.19]	[0.14]	[0.12]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	.	.	-0.253	-0.301**	-0.340**
			[0.17]	[0.15]	[0.14]
Wu and Xia (2016)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	.	.	-0.257**	-0.199**	-0.115
			[0.12]	[0.09]	[0.08]
Krippner (2013, 2014)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	.	.	-0.338**	-0.271**	-0.255***
			[0.15]	[0.12]	[0.09]
First difference					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-1.150**	-0.762**	-0.551**	-0.394**	-0.252**
	[0.48]	[0.31]	[0.23]	[0.17]	[0.11]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.778***	-0.458**	-0.340**	-0.257**	-0.178**
	[0.30]	[0.19]	[0.15]	[0.11]	[0.08]
Wu and Xia (2016)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.543***	-0.419***	-0.324***	-0.244***	-0.169***
	[0.18]	[0.14]	[0.11]	[0.07]	[0.04]
Krippner (2013, 2014)'s UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.483***	-0.379***	-0.297**	-0.234***	-0.178***
	[0.18]	[0.14]	[0.11]	[0.09]	[0.06]

Note: Heteroskedasticity and autocorrelation robust Newey-West standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each column corresponds to equation (7) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. Inflation projection surprises are estimated based on equation (5). Monetary shocks are estimated based on equation (8). The dependent variable is defined in each panel header for different maturities from 1-year to 5-year. For parsimony, only the key coefficient is reported. Complete tables are available from the authors upon request. Xt includes a news variable capturing the information flow between t-1and t of macro data releases related to inflation, the real activity, uncertainty and news indices of Scotti (2016), the changes in the FTSE and UK move indices. Zt includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Table A15 - Robustness: Alternative specifications

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Estimation on IR-months only					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-0.937**	-0.696**	-0.558**	-0.465**	-0.382**
	[0.34]	[0.25]	[0.20]	[0.18]	[0.15]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-1.072***	-0.813***	-0.631***	-0.508***	-0.404***
	[0.31]	[0.21]	[0.16]	[0.13]	[0.10]
No controls					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-1.064***	-0.771***	-0.611***	-0.469***	-0.353***
	[0.28]	[0.19]	[0.15]	[0.12]	[0.09]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.881**	-0.589**	-0.451**	-0.378***	-0.309***
	[0.37]	[0.23]	[0.18]	[0.14]	[0.12]
Including a VAT dummy					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-0.918***	-0.663***	-0.524***	-0.414***	-0.317***
	[0.30]	[0.20]	[0.15]	[0.12]	[0.10]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.991***	-0.676***	-0.482***	-0.373***	-0.288***
	[0.34]	[0.22]	[0.16]	[0.13]	[0.10]
Including dummies for FG dates					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-0.931***	-0.667***	-0.525***	-0.414***	-0.314***
	[0.29]	[0.19]	[0.14]	[0.12]	[0.10]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.990***	-0.675***	-0.481***	-0.372***	-0.289***
	[0.35]	[0.22]	[0.16]	[0.13]	[0.10]
Change in private output and interest rate forecasts between *t-1* and *t*					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-0.976**	-0.680***	-0.530***	-0.422***	-0.325***
	[0.37]	[0.24]	[0.18]	[0.14]	[0.11]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-1.084**	-0.759**	-0.549**	-0.421**	-0.322**
	[0.42]	[0.29]	[0.22]	[0.17]	[0.13]
Including EC sentiment measures					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-0.863***	-0.649***	-0.521***	-0.411***	-0.311***
	[0.29]	[0.20]	[0.15]	[0.12]	[0.09]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.985***	-0.665***	-0.473***	-0.368***	-0.288***
	[0.36]	[0.23]	[0.17]	[0.13]	[0.10]
More macro controls					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-0.941**	-0.673**	-0.507***	-0.370**	-0.250**
	[0.42]	[0.26]	[0.19]	[0.15]	[0.11]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.924***	-0.590***	-0.399***	-0.287**	-0.202**
	[0.29]	[0.19]	[0.15]	[0.11]	[0.09]

Note: Heteroskedasticity and autocorrelation robust Newey-West standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each column corresponds to modified versions of equation (7) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. Inflation projection surprises are estimated based on equation (5). Monetary shocks are estimated based on equation (8). The dependent variable is the level of monthly averaged inflation swaps at different maturities from 1-year to 5-year. For parsimony, only the key coefficient is reported. Complete tables are available from the authors upon request. Xt includes a news variable capturing the information flow between t-1and t of macro data releases related to inflation, the real activity, uncertainty and news indices of Scotti (2016), the changes in the FTSE and UK move indices. Zt includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

A2. Correcting market-based expectation measures

We aim to derive accurate estimates of market-based measures of inflation expectations by correcting inflation compensation, as measured by inflation swaps, for term, liquidity and inflation risk premia. Market-based measures of inflation compensation are an appropriate indicator of inflation expectations if investors are risk neutral and there is no liquidity premium. However, that is unlikely to be the case, and these premia might have sizable values and be time-varying. We use a model-free regression approach to correct our compensation measure, rather than a no arbitrage approach based on term-structure models.

Gürkaynak et al. (2010a, 2010b) decompose inflation compensation, $\pi_{t,h}^{COMP}$, obtained from inflation swaps maturing h-years ahead into: expected inflation, $\pi_{t,h}^{PF}$, a liquidity premium, $\varphi_{t,h}^{l}$, that investors demand to encourage them to hold these assets when they are illiquid, and an inflation uncertainty premium, $\varphi_{t,h}^{ir}$, that compensates investors for bearing inflation risk.[3] We include a term premium, $\varphi_{t,h}^{risk}$, compensating investors for holding a risky asset.[4] Assuming t is the time subscript and h is the horizon, this breakdown can be written:

$$\pi_{t,h}^{COMP} = \pi_{t,h}^{PF} + \varphi_{t,h}^{risk} + \varphi_{t,h}^{l} + \varphi_{t,h}^{ir} \tag{A1}$$

We estimate a linear regression model of inflation compensation on proxy measures capturing the different premia. In the spirit of Chen, Lesmond and Wei (2007) who control for risk premium using bond ratings, the credit risk premium is proxied by the Libor-OIS spread and by the average of UK major banks' CDS premia. Those measures should capture the riskiness of holding financial instruments, especially during the global financial crisis. The liquidity premium is proxied by the FTSE Volatility index (the UK-equivalent of the VIX), following Gürkaynak et al. (2010b) and Soderlind (2011). For the inflation risk premium, we use the implied volatility from swaptions – options on short-term interest rate swaps – maturing in 20 years which captures inflation uncertainty as Soderlind (2011).[5] This leads us to estimate the following equation:

$$\pi_{t,h}^{COMP} = \alpha + \beta_h^{s}\, spread + \beta_h^{cds}\, cds + \beta_h^{f}\, ftsev + \beta_h^{i}\, impvol + \varepsilon_{t,h}^{COMP} \tag{A2}$$

We estimate equation (A2) using OLS for each horizon of inflation compensation from 1 to 5 years ahead. We use monthly observations because of data availability constraints for the independent variables used. The term, liquidity and inflation risk premia – directly related to

[3] Because the central bank may intend to affect the inflation risk premium as well as inflation expectations, we also compute adjusted series for term and liquidity premia only (see table A18).

[4] The term premium has been neglected in most of the literature so far for two reasons. First, most of the studies focus on US treasury bonds and TIPS, and therefore implicitly assume there is no credit risk, those bonds being considered as risk-free (see Gürkaynak et al. 2010b). Second, when considering swap contracts to derive inflation expectations, the collateral is supposed to remove any potential credit risk. However, in a post-Great Recession sample in which sovereign bonds have been shown to be not as risk-free as previously thought and collateral value may have changed rapidly, we explicitly assess whether proxies for credit risk correlate with supposedly risk-free inflation compensation rather than assuming ex ante the absence of a term premium.

[5] The LIBOR (3-Month London Interbank Offered Rate) and OIS (3-Month Overnight Indexed Swap rates) measures are obtained from FRED and Thomson DataStream. The CDS measure is the unweighted average of the five-year CDS premia for the major UK lenders from Markit Group Limited and BoE calculations. The FTSEvol measure is the FTSE 100 Implied Volatility Index (3 months constant maturity) from Bloomberg. The ImpVol20 measure is the at-the-money implied volatility of 1 year LIBOR swaptions for 20 years constant maturity, from Barclays Live. All variables are available as monthly average of daily observations.

inflation uncertainty – should all push inflation compensation up.[6] So we expect the coefficients on the LIBOR-OIS spread, CDS premia, the FTSE Volatility index (*ftsev*) and implied volatility (*impvol*) variables to be positive.[7] We also expect the term and inflation risk premia to increase with the maturity of the swap. We estimate equation (A2) on the full sample and on two subsamples pre and post ZLB. Because the ZLB may affect the transmission of shocks and macro and financial dynamics, the pricing relationship of premia may also change pre and post ZLB. Table A16 shows the estimated coefficients for each maturity of the term structure of inflation swaps.

Using these estimated parameters, we adjust the inflation compensation series by subtracting the fitted values of the contributions of the term, liquidity and inflation risk premia to obtain corrected inflation expectation series. Figure A2 in the Appendix shows on the left-hand side the raw inflation compensation series and the corrected inflation expectations series (either with constant pricing or pre/post ZLB pricing), and on the right-hand side the evolution of the estimated term premium (in blue), the liquidity premium (in red) and the inflation risk premium (in green) in the constant pricing estimation.[8]

While the risk proxies started to become non-null and positive in mid-2007, they had effects of different signs for short and long maturities during the financial turmoil of late 2008: they had a negative contribution to inflation compensation when financial stress was most acute after Lehman Brothers' collapse for maturities under 6-years, pushing inflation compensation to negative values, whereas their effects remained positive for longer maturities. After this episode of severe financial stress, the term premium had a positive contribution for all maturities of around 20-50 basis points. The liquidity premium spiked at almost 120 basis points for longer maturities in the second half of 2008 and remained elevated at around 40-50 basis points after that. The inflation risk premium has declined over time, particularly at longer maturities, and became negative during 2011 (moving from +20 basis points to -10 basis points), which might be associated with the implementation of QE. Overall, the correction results in flatter series for inflation expectations and in lower inflation expectations at the longer horizons for which the difference between the unadjusted and adjusted series is larger.

For comparison, D'Amico, Kim and Wei (2010) find that the liquidity premium on US TIPS has varied between 0 and 130 basis points. Gürkaynak et al. (2010b) find that the liquidity premium has varied between 0 and 140 basis points. Risa (2001) finds an inflation risk premium in the UK of around 170 basis points, and Joyce et al. (2010) estimate it to be between 75 and 100 basis points. Ang et al. (2008) find an inflation risk premium of between 10 and 140 basis points in the US over the last two decades. Finally, using Gaussian affine dynamic term structure models, Guimarães (2012) finds a total combined premium of 190 basis points over 1985-1992 and of 30 basis points over 1997-2002 for 10-years inflation compensation derived from UK gilts.

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[6] This is in contrast to inflation compensation derived from inflation indexed bonds, for which we would expect the liquidity proxy to have a negative coefficient, because they are generally less liquid than nominal bonds.
[7] Because these proxies might be correlated with the business cycle, we use an alternative methodology based on survey expectation measures that do not contain these various premia by construction. We consider the predicted value of market-based expectations when regressed on survey expectations, which we use as instruments.
[8] The constant in equation (A2) may include other constants related to term, liquidity or inflation risk. This does not invalidate the main result since the mean of inflation expectations has no effect when estimating equation (7). However, the series on the left-hand side of Figure A2 should be considered cautiously and are indicative only.

Table A17 shows the estimates of equation (7) when interacting of monetary surprises with IR surprises or inflation projection surprises as well as when interacting monetary shocks with inflation projection surprises once we consider the term structure of corrected measures of inflation expectations. The state-dependent effect of monetary policy holds.

We assess the robustness of this correction in two ways. First, we correct inflation compensation measures for term, liquidity, inflation risk premia on the full sample, therefore assuming a constant pricing of these premia. Second, because central banks may intend to affect the inflation risk premium as well as inflation expectations, we compute adjusted series for term and liquidity premia only. Table A18 shows that the non-linear effect of monetary policy is robust to these corrections of inflation swaps.

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Table A16 - Correction of raw market-based measures for premia

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Two subsamples					
Pre ZLB sample					
LIBOR-OIS	-0.867**	-0.732**	-0.597**	-0.465**	-0.347*
	[0.42]	[0.30]	[0.25]	[0.21]	[0.19]
CDS	0.996***	0.963***	0.846***	0.733***	0.637***
	[0.29]	[0.21]	[0.17]	[0.15]	[0.13]
FTSE-Vol	-0.044*	-0.030*	-0.019	-0.009	-0.001
	[0.02]	[0.02]	[0.01]	[0.01]	[0.01]
ImpVol20	-0.037*	-0.028*	-0.027**	-0.027**	-0.027***
	[0.02]	[0.02]	[0.01]	[0.01]	[0.01]
Constant	3.064***	3.031***	2.965***	2.889***	2.825***
	[0.25]	[0.18]	[0.15]	[0.13]	[0.11]
N	53	53	53	53	53
R^2	0.53	0.51	0.45	0.44	0.55
Post ZLB sample					
LIBOR-OIS	-1.183***	-0.174	0.138	0.304**	0.396***
	[0.26]	[0.17]	[0.15]	[0.14]	[0.14]
CDS	0.219**	-0.08	-0.167***	-0.207***	-0.232***
	[0.09]	[0.05]	[0.05]	[0.05]	[0.05]
FTSE-Vol	-0.017	-0.003	0.006	0.009	0.011
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
ImpVol20	-0.030**	0.006	0.011	0.006	0.000
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Constant	3.186***	3.099***	3.054***	3.121***	3.217***
	[0.18]	[0.12]	[0.10]	[0.10]	[0.10]
N	73	73	73	73	73
R^2	0.40	0.22	0.16	0.26	0.40
Full sample					
LIBOR-OIS	-0.881***	-0.412***	-0.263*	-0.166	-0.096
	[0.20]	[0.15]	[0.14]	[0.13]	[0.12]
CDS	0.349***	0.170***	0.117**	0.095**	0.084*
	[0.07]	[0.06]	[0.05]	[0.05]	[0.04]
FTSE-Vol	-0.021*	-0.013	-0.004	0.004	0.011
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
ImpVol20	-0.030***	-0.014*	-0.01	-0.009	-0.009
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Constant	2.982***	3.005***	2.952***	2.906***	2.875***
	[0.13]	[0.10]	[0.09]	[0.08]	[0.08]
N	126	126	126	126	126
R^2	0.46	0.29	0.12	0.06	0.17

Note : Standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01. Each column corresponds to equation (A2) estimated with OLS for a different horizon.

Table A17 - Correcting inflation swaps for risk, liquidity and inflation risk premia

	1	2	3	4	5
	Swap1y_c	Swap2y_c	Swap3y_c	Swap4y_c	Swap5y_c
Monetary surprises * IR surprises					
Monetary surprises	-0.044	-0.013	-0.003	-0.002	-0.001
	[0.06]	[0.04]	[0.03]	[0.03]	[0.02]
IR surprises	-0.035	0.005	0.017	0.02	0.021
	[0.06]	[0.04]	[0.03]	[0.03]	[0.02]
Monetary surprises * IR surprises	-0.051***	-0.031***	-0.023**	-0.016**	-0.009
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Lag dep var	0.728***	0.739***	0.765***	0.807***	0.833***
	[0.08]	[0.08]	[0.08]	[0.07]	[0.06]
Constant	0.683	0.619*	0.578*	0.534*	0.538**
	[0.45]	[0.35]	[0.31]	[0.27]	[0.24]
N	125	125	125	125	125
R^2	0.59	0.58	0.61	0.73	0.85
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises					
Monetary surprises	-0.038	-0.007	0.002	0.003	0.002
	[0.06]	[0.04]	[0.03]	[0.03]	[0.02]
$E^{BoE}\pi_{t+4}$ surprises	0.228	0.126	0.075	0.038	0.009
	[0.15]	[0.10]	[0.09]	[0.07]	[0.06]
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-0.755**	-0.519**	-0.395**	-0.293**	-0.185*
	[0.34]	[0.24]	[0.19]	[0.15]	[0.10]
Lag dep var	0.721***	0.722***	0.735***	0.778***	0.811***
	[0.08]	[0.08]	[0.07]	[0.06]	[0.06]
Constant	0.708*	0.701**	0.704**	0.654**	0.634***
	[0.40]	[0.32]	[0.29]	[0.25]	[0.23]
N	125	125	125	125	125
R^2	0.59	0.57	0.59	0.72	0.84
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises					
Monetary shocks	-0.100***	-0.057*	-0.035	-0.026	-0.023
	[0.04]	[0.03]	[0.03]	[0.02]	[0.02]
$E^{BoE}\pi_{t+4}$ surprises	0.04	0.021	0.004	-0.017	-0.033
	[0.11]	[0.08]	[0.07]	[0.06]	[0.05]
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.598***	-0.346***	-0.235**	-0.190***	-0.143**
	[0.20]	[0.11]	[0.09]	[0.07]	[0.06]
Lag dep var	0.696***	0.670***	0.687***	0.750***	0.802***
	[0.08]	[0.09]	[0.09]	[0.07]	[0.06]
Constant	0.833**	0.891**	0.871***	0.759***	0.676***
	[0.40]	[0.34]	[0.30]	[0.26]	[0.23]
N	125	125	125	125	125
R^2	0.63	0.59	0.59	0.71	0.84

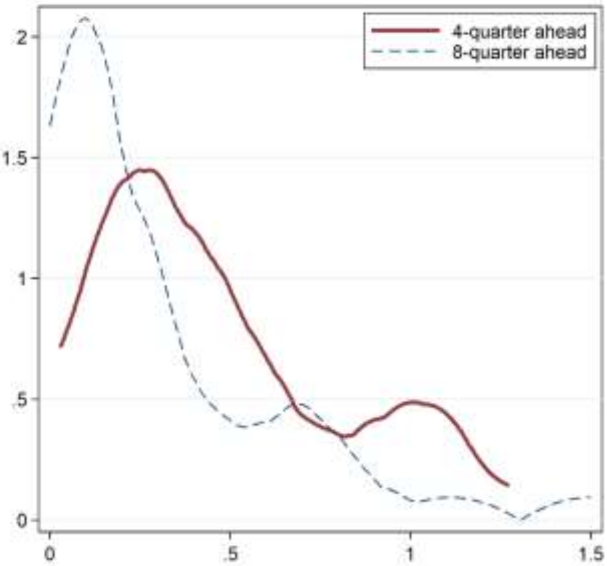
Note: Heteroskedasticity and autocorrelation robust Newey-West standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Each column corresponds to equation (7) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. Monetary and IR surprises are computed as the daily change in one-year gilt nominal yields Inflation projection surprises are computed from equation (5). Monetary shocks are computed from equation (8). The dependent variable is the change in monthly averaged inflation swaps at different maturities from 1-year to 5-year corrected for risk, liquidity and inflation risk premia as described in section A1 the Appendix. For parsimony, only the key coefficients are reported. Complete tables are available from the authors upon request. Xt includes a news variable capturing the information flow between t-1 and t of macro data releases related to inflation, the real activity, uncertainty and news indices of Scotti (2016), the changes in the FTSE and UK move indices. Zt includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Table A18 - Robustness: Alternative dependent variables

	1	2	3	4	5
	Swap1y	Swap2y	Swap3y	Swap4y	Swap5y
Constant pricing of premia correction					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-0.936***	-0.681***	-0.527***	-0.395***	-0.274***
	[0.34]	[0.21]	[0.15]	[0.12]	[0.10]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.831**	-0.575***	-0.429**	-0.355**	-0.297***
	[0.33]	[0.21]	[0.17]	[0.14]	[0.11]
Without correcting for the inflation risk premium					
High-Frequency monetary surprises					
Monetary surprises * $E^{BoE}\pi_{t+4}$ surprises	-0.967***	-0.690***	-0.533***	-0.400***	-0.279***
	[0.33]	[0.20]	[0.15]	[0.12]	[0.10]
BoE's UK shadow rate					
Monetary shocks * $E^{BoE}\pi_{t+4}$ surprises	-0.838**	-0.576***	-0.433**	-0.360**	-0.302***
	[0.34]	[0.22]	[0.17]	[0.14]	[0.11]

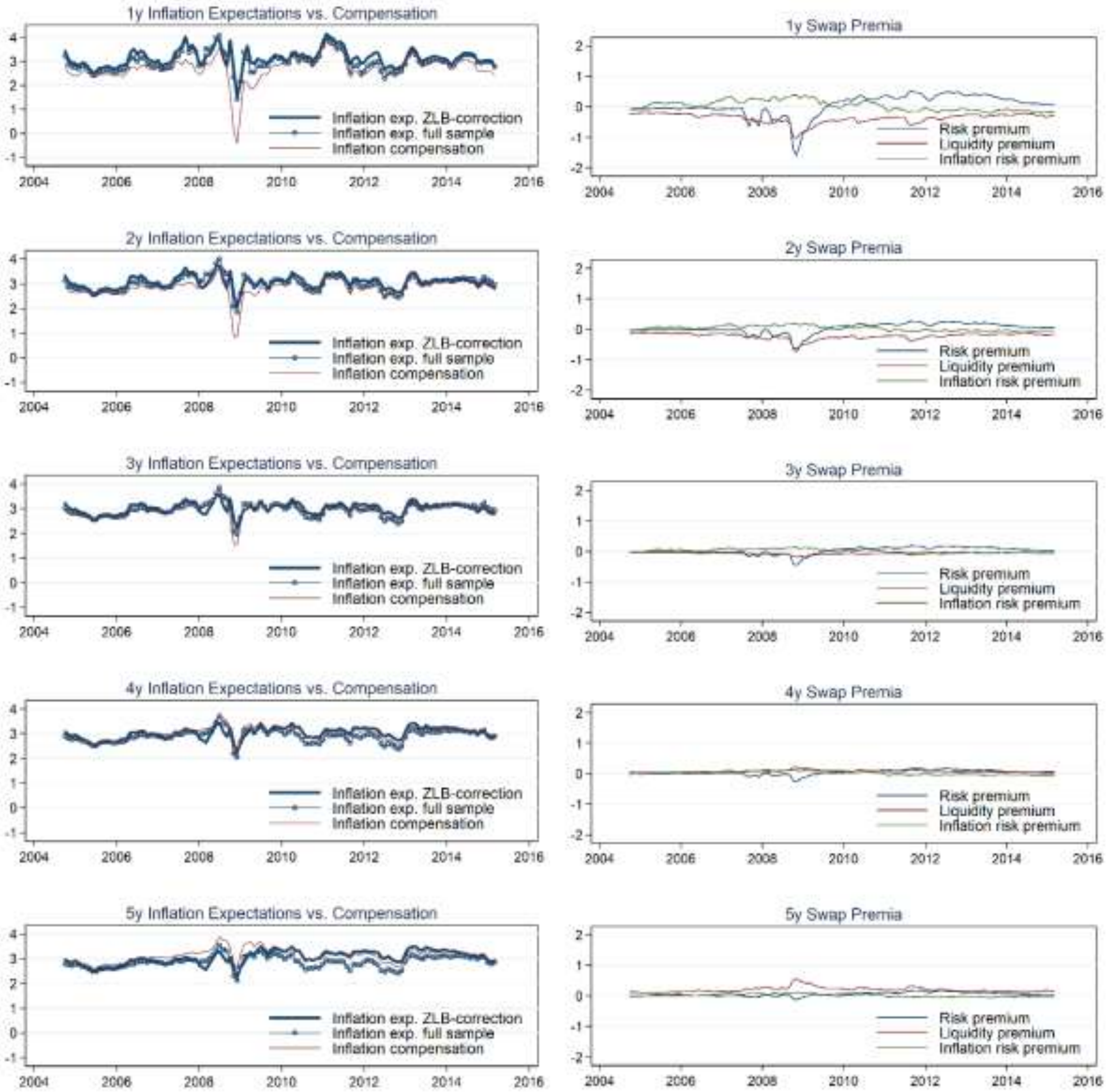
Note: Heteroskedasticity and autocorrelation robust Newey-West standard errors in brackets. *p < 0.10, **p < 0.05, ***p < 0.01. Each column corresponds to equation (7) estimated with OLS for a different horizon. The sample period goes from October 2004 to July 2015. Monetary and IR surprises are computed as the daily change in one-year gilt nominal yields Inflation projection surprises are computed from equation (5). Monetary shocks are computed from equation (8). The dependent variable is the change in monthly averaged inflation swaps at different maturities from 1-year to 5-year corrected for risk, liquidity and inflation risk premia as described in section A1 the Appendix. For parsimony, only the key coefficients are reported. Complete tables are available from the authors upon request. Xt includes a news variable capturing the information flow between t-1 and t of macro data releases related to inflation, the real activity, uncertainty and news indices of Scotti (2016), the changes in the FTSE and UK move indices. Zt includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Figure A1 – Kernel densities of the absolute value of deviations of BoE's inflation projections from the BoE's inflation target



Note: A kernel density produces a smoothed estimate of the probability density function. The y-axis unit of the probability density function is the reciprocal of the x-axis unit of the variable considered: the absolute value of the deviation of BoE's inflation projections at a given horizon to the BoE's inflation target: 2%.

Figure A2 – Raw and corrected inflation expectations (in %)
and the predicted values of the three premia (in pp)



Note: The first row is for 1-year ahead inflation expectations, the second for 2-years ahead, and so on. Inflation expectations with the ZLB correction correspond to the upper two panels of Table A16 whereas inflation expectations estimated on the full sample correspond to the lower panel of Table A16. The different premia on the right-hand are the full sample ones.

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