Policy and Macro Signals as Inputs to Inflation Expectation Formation[*]

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October 2017

Abstract

How do private agents interpret central bank actions and communication? This paper investigates private agents' interpretation of central bank signals about future policy and the macroeconomic outlook that are conveyed by both policy decisions and macroeconomic projections. We assess the effects of monetary shocks and surprises in the Bank of England's inflation and output projections on the term structure of UK private inflation expectations. We find that expectations respond negatively to contractionary monetary policy shocks, consistent with the usual transmission mechanism. We also find that expectations respond positively to inflation projection surprises, consistent with agents taking a signal about the economic outlook.

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

JEL codes: E52, E58.

[*] We thank Christophe Blot, James Cloyne, Camille Cornand, Jérôme Creel, Martin Ellison, Rodrigo Guimarães, Refet Gürkaynak, Stephen Hansen, Frédéric Jouneau-Sion, Michael McMahon, Jon Relleen, Garry Young and seminar participants at the GATE, Bank of England, OFCE, European Central Bank, Deutsche Bundesbank, CEPII, Banque de France, the Workshop on Empirical Monetary Economics 2015, the Workshop on Probabilistic Forecasting and Monetary Policy, GDRE 2015, the Central Bank Design workshop of the 2015 BGSE Summer Forum, the 2015 World Congress of the Econometric Society and AFSE 2015 for helpful discussions and comments at different stages of this project. We also thank Simon Strong for research assistance. Paul Hubert thanks the Bank of England for its hospitality. Any remaining errors are our own responsibility. Any views expressed are solely those of the authors and so cannot be taken to represent those of the Bank of England or members of the Monetary Policy Committee or Financial Policy Committee or to state Bank of England policy.
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1. Introduction

Expectations matter in determining current and future macroeconomic outcomes. Hence, the management of private expectations has become a central feature of monetary policy, as private agents' interpretation of central bank decisions and communication is central to the formation of their beliefs (Woodford, 2005). One way in which some central banks communicate is by publishing macroeconomic projections. While there is variation in terms of the variables forecasted, and how those projections are published, a number of central banks – including the Bank of England, Federal Reserve, European Central Bank, Riksbank, Norges Bank and Reserve Bank of New Zealand – release projections on a regular basis.

In a framework with perfect information, the value of publishing such projections is limited, as private agents are able to infer the pure monetary innovation from the central bank's policy decision based on their knowledge of its reaction function and its input variables. However, in a set-up with information frictions, both the macroeconomic projections and the policy decision can convey information about the central bank's view of both macroeconomic and policy developments. For instance, on the one hand, an increase in the policy rate could signal to private agents that the macro outlook has changed and that an inflationary shock will hit the economy in the future, causing higher inflation. On the other hand, the same increase in the policy rate may be interpreted as a simple contractionary monetary shock, which will lead to lower inflation in the future. If the first interpretation is given more weight, then increasing the policy rate will lead to higher private inflation expectations, whereas if the second is, then increasing the policy rate will decrease private inflation expectations. The same issue applies to central bank projections. An increase in central bank inflation projections could signal a future inflationary shock, causing higher inflation; alternatively, the same increase in central bank inflation projections may be interpreted as a signal about a future policy tightening, leading to lower expected inflation.

The channel whereby information is provided about the macroeconomic outlook arises from the fact that private agents might have different information sets to the central bank. In that case, both the central bank's policy decisions and its projections can signal its view of macroeconomic developments to private agents, influencing their beliefs about the economic outlook. We define this as a 'macro outlook signal'.[1] The channel that affects private agents' view of policy developments stems from the central bank's ability to affect the economy by setting monetary policy. Because policy decisions will be informed by the economic outlook, the central bank's projections – as well as its policy decision – can provide private agents with information about the outlook for policy. We define this as a 'policy signal'.[2] Which channel – the macro outlook or policy signal – dominates matters, given that the effects of monetary policy depend on how private agents interpret changes in the policy rate or in central bank projections. This paper aims to investigate which of those interpretations is given more weight.[3]

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[1] The macro outlook signal of monetary policy shocks might then be one of the explanations for the positive response of inflation to monetary shocks documented in the VAR literature as the "price puzzle" (Sims 1992). Indeed, Castelnuovo and Surico (2010) finds that including inflation expectations in VARs captures this price puzzle, which could be consistent with an outlook signal of policy.

[2] We use the term 'policy signal' for the classical monetary transmission channel and the term 'macro outlook signal' for what Melosi (2017) calls the 'signaling channel' of monetary policy. That is because we study the information content of a central bank's macroeconomic projections, so the usual terminology is not appropriate.

[3] It is worth stressing that the focus of this paper is on the effects of the release of central bank macroeconomic information, not policy announcements, communication about the future likely path of the policy rate, the Forward Guidance policy (see e.g. Andrade et al. 2015; Campbell et al. 2016) or whether communication is relatively more hawkish or dovish (see e.g. Ehrmann and Fratzscher, 2007; Rosa and Verga, 2007).

This paper assesses for the United Kingdom (UK), whether and how the term structure of market-based inflation expectations responds to policy decisions and central bank macroeconomic projections, and so which signal dominates. If a positive signal about the macro outlook is taken from either a policy decision or a change in central bank economic projections, inflation expectations will increase. Whereas if either a higher policy setting or economic projections is taken to signal a future contractionary policy shock, inflation expectations will decrease. So the sign of the estimated effects of shocks to Bank Rate and Bank of England (Bank hereafter) macroeconomic projection surprises on private inflation expectations is indicative of the relative weight private agents put on each signal.

The literature has focused extensively, both theoretically and empirically, on the classical monetary policy transmission. In contrast, the signalling issue has received less attention and most of the analyses are theoretical in nature. For instance, Morris and Shin (2002) show that public signals – for instance those from a central bank – affect private agents' actions. Angeletos et al. (2006) study the signalling effects of policy in a coordination game. Walsh (2007) studies optimal transparency when the central bank provides public information by setting its policy instrument. In Baeriswyl and Cornand (2010), the central bank instrument discloses information about policymakers' assessment of shocks which are imperfectly observed by firms. Kohlhas (2014) shows how central bank information disclosure may increase the information content of public signals about the state of the economy. Tang (2014) builds a model in which policy actions can signal information about macro developments, because policymakers are more informed than private agents. Melosi (2017) develops a model in which the policy rate has signalling effects about the macro outlook because aggregate variables are not observed by individual firms.

The contribution of this paper is to bring the signalling issue to the data to analyse the importance of the signals that both monetary shocks and central bank macroeconomic projection surprises send about both the macroeconomic and the policy outlook. We do so at different horizons of the term structure of private inflation expectations to assess whether monetary shocks and central bank macroeconomic projections have different effects at different horizons. The signalling content (macro or policy) may vary with horizons for a number of reasons. One relates to lags in the transmission of policy. For example, the term structure could be thought of as being split into three groups: (i) the short term (i.e. 1 year ahead), which, given the lags associated with the transmission of monetary policy, should be relatively unaffected by policy decisions, (ii) the medium term (i.e. 2-4 years ahead), when interest rates are thought to have their peak effects on the economy, and (iii) the long term (i.e. ≥ 5 years ahead), when the impact of any monetary shocks should have died out.

This paper makes use of a specific feature of the Bank data to overcome the main empirical challenge of this paper. The research question requires that the central bank projections are not a function of the current policy decision so we can separately identify both the monetary shocks and the projection surprises. In this particular dataset, Bank projections are conditioned on the market interest rate instead of the policy rate, so Bank projections are orthogonal to contemporary policy decisions, a necessary feature for identification issues.[4]

Our empirical analysis proceeds in three steps. First, we correct our dependent variables, UK market-based inflation expectation measures, for risk, liquidity and inflation risk premia

[4] This paper focuses on quantitative communication, central bank projections, and abstracts from the issue of quantifying qualitative communication like statements, minutes and speeches (see Hansen and McMahon, 2016, for this kind of exercise, and Hubert, 2017, for a comparison of the effects of both types of communication).

following the methodology used by Gürkaynak et al. (2010a, 2010b) and Soderlind (2011). Second, we deal with the issue of endogeneity by extracting series of exogenous shocks to the Bank's policy rate and to its inflation and output projections by removing their systematic component, following the identification methodology of Romer and Romer (2004) applied to UK data by Cloyne and Huertgen (2016). Blanchard et al. (2013) and Miranda-Agrippino and Ricco (2016) discuss how information frictions modify the econometric identification problem. Because of potential non-nested information sets, we augment the Romer and Romer (2004) approach so that exogenous shocks are not only orthogonal to the central bank's information set but also to private agents' information set. Third, we estimate the effects of these exogenous shocks in a framework derived from the information frictions literature, controlling for the contribution of private output and interest rate expectations and for inflation surprises.

We find that private inflation expectations respond negatively to contractionary monetary shocks, consistent with the usual transmission mechanism. However, private inflation expectations respond positively to positive surprises to central bank inflation projections. That suggests that private agents put more weight on the signal that the Bank's inflation projections convey about future economic developments than about the policy outlook, providing evidence of the existence of a macro outlook signalling channel, in contrast to the predictions of full information models. One interpretation of those results is that when private agents face a signal extraction problem, they rely on the underlying nature of that information disclosed by the central bank: a monetary shock primarily conveys a policy signal and a projection surprise primarily conveys a signal about the macro outlook.

This work is related to the finding documented by Romer and Romer (2000), Campbell et al. (2012), and Nakamura and Steinsson (2013) that contractionary United States' federal fund rate surprises can have, under certain conditions, positive effects on private inflation or output expectations.[5] This work is also related to the role of central bank communication in policymaking (see e.g. Woodford, 2005; Blinder et al. 2008; Reis, 2013), its effects on inflation expectations (see e.g. Gürkaynak et al., 2005; King, Lu and Pasten, 2008) or their dispersion (see e.g. Fujiwara, 2005; Ehrmann et al., 2012; Hubert, 2014), or how it may help predicting future policy decisions (see e.g. Jansen and De Haan, 2009; Hayo and Neuenkirch, 2010; Sturm and De Haan, 2011).

The results of this paper give policymakers some insights on how private agents interpret and respond to policy decisions and central bank information. The signals provided by central bank action and communication, and importantly the horizon at which they are conveyed, appear to be important for the management of private inflation expectations.

The rest of the paper is organised as follows. Section 2 describes our framework, section 3 the data, section 4 the correction of swap data for different premia, section 5 the first stage regression, and section 6 the estimates. Section 7 concludes.

[5] This paper also refers to a large literature focusing on the expectation formation process departing from the full-information rational expectation hypothesis to account for some empirical regularities about the persistence of private expectations (sticky and noisy information models or adaptive learning models, and classes of models with heterogeneity in beliefs or in loss functions) led by Evans and Honkapohja (2001), Bullard and Mitra (2002), Mankiw and Reis (2002), Sims (2003), Orphanides and Williams (2005, 2007) and Branch (2004, 2007). Another strand of the literature tries to explain macroeconomic outcomes with expectations (see e.g. Nunes 2010 and Adam and Padula 2011), while another strand focuses on the characteristics, responsiveness to news, dispersion or anchoring of expectations (see e.g. Swanson 2006, Capistran and Timmermann 2009, Crowe 2010, Gürkaynak et al. 2010a, Beechey et al. 2011, Coibion and Gorodnichenko 2012, 2015, Hubert 2014, 2015, Ehrmann 2015).

2. Framework

This section sets out our approach. First, we derive predictions about how private inflation expectations might react to monetary shocks under different assumptions about the central bank's and private agents' information sets. Second, we present the empirical specification, which allows us to test which of those predictions appear to hold for UK data.

2.1. Theoretical predictions

First, we derive predictions for the expected effects of monetary shocks and central bank projection surprises on private inflation expectations based on a standard macroeconomic framework, such as a 3-equation New-Keynesian model. In such a framework where agents have full information, contractionary monetary shocks have a negative effect on private inflation expectations, through the usual transmission channels. Positive surprises to central bank projections also have a negative effect on private inflation expectations, because central bank projections enter the Taylor rule and are interpreted only as signals about future policy reactions: a higher inflation projection leads agents to anticipate higher future nominal interest rates, especially when the policy rate exhibits persistence. In this framework, central bank projections are perfectly observed, so the monetary shock is uncovered from the policy rule, and there is no room for signals about the macroeconomic outlook.

Second, we derive predictions for the expected effects of monetary shocks and projection surprises under a framework with information frictions. That assumption is consistent with works by Coibion and Gorodnichenko (2012, 2015) and Andrade and Le Bihan (2013), which provide empirical evidence of rejection of full information models.[6] In a framework with non-nested information sets, we assume the central bank sets its interest rate i_t as a function of its own inflation, $\pi_{t,h}^{CB}$, and output, $x_{t,h}^{CB}$, projections for horizon h, and potentially some other macro variables, ω_t:

$$i_t = f(i_{t-1}, \pi_{t,h}^{CB}, x_{t,h}^{CB}, \omega_t) + \varepsilon_t^i \quad (1)$$

and where ε_t^i is the monetary innovation, capturing policymakers' deviations from their policy rule, and which is orthogonal to central bank inflation and output projections. The central bank's inflation and output projections depend on the central bank's information set, Ω_t, and are formed prior to policy decision meetings, so do not contain the effect of the policy decision (i.e., they are uncorrelated with the error term ε_t^i). They are defined by:

$$\begin{aligned} \pi_{t,h}^{CB} &= g(\Omega_t) + \varepsilon_t^{\pi_{CB,h}} \text{ with } \pi_{t,h}^{CB} \perp i_t \mid \Omega_t \\ x_{t,h}^{CB} &= g'(\Omega_t) + \varepsilon_t^{x_{CB,h}} \text{ with } x_{t,h}^{CB} \perp i_t \mid \Omega_t \end{aligned} \quad (2)$$

It is a crucial assumption that central bank projections do not already contain the effect of the policy decision, so private agents can infer the monetary innovation (ε_t^i) from the central bank reaction function (equation 1).

In a set-up where private agents and the central bank have different information sets, when the observed policy rate differs from private agents' policy expectations, private agents would not be able to infer whether the central bank has changed its *own* view of future inflation and output, or whether there has been a monetary shock. Shocks to the policy rate

[6] In addition, recent works on rational expectation models with information frictions such as Woodford (2001), Mankiw and Reis (2002), and Sims (2003) highlight how departing from the assumption of full information can account for empirical patterns about private expectations, as well as leading to policy recommendations different from those with full information.

may therefore convey signals about both future macroeconomic developments and the policy stance to private agents. Private agents face a multidimensional signal processing problem: they could take either of two signals – one about macro developments and one about future policy – from one observable variable. Said differently, private agents can misperceive changes in policy or projections for a mix of shocks in the economy, which gives room for macro or policy signals – as modelled by Melosi (2017). The same reasoning applies to surprises to central bank projections. Depending on the information set of private agents, they could either convey a signal to private agents about a change in central bank's view of future inflation and output or a signal about future policy.

Policy and macro signals are expected to have different implications for private inflation expectations. If either a higher policy setting or higher projections are taken to signal a contractionary policy shock (i.e. the policy signal dominates the macro outlook signal), inflation expectations will decrease. In contrast, if a positive signal about the macro outlook is taken from either a policy decision or a change in the central bank's projections (i.e. the macro outlook signal outweighs the policy signal), inflation expectations will increase.

The rest of the paper aims to investigate which predictions the data appear to support. The simple sign-identification strategy allows us to infer the relative weight given to each signal based on the movement in private inflation expectations, and to assess whether there is any evidence of a macro signal (in contrast to full information model predictions).

We make use of a specific feature of the Bank data to test our research question. We exploit the fact that the Bank of England publishes macroeconomic projections that are conditioned on the path for the policy instrument implied by financial market interest rates prior to the policy meeting, rather than a preferred interest rate path of the Monetary Policy Committee (MPC).[7] As these projections are not conditioned on the Bank's policy decision, it enables us to separately identify projection surprises and monetary shocks.

2.2. Empirical strategy

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. However, if 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 observed 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 available information because incorporating all noisy signals is impossible (Moscarini, 2004).[8]

We can bridge the two different strands of the literature in a simple and general specification by modelling private inflation forecasts as a linear combination of past inflation forecasts

[7] 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 Fed's dual objectives of maximum employment and price stability.

[8] Another interpretation of this reduced-form equation is that private agents have an initial belief about future inflation (their past inflation expectations) at the beginning of each period, and during each period, they incorporate relevant - but potentially noisy - information about future inflation.

$\pi^{PF}_{t-1,h}$ and a vector Λ_t, which captures new information between *t-1* and *t*.[9] To do that, we explicitly assume private agents have homogeneous inflation forecasts in the case of sticky information models, which allows us to match the point forecasts nature of the data used:[10]

$$\pi^{PF}_{t,h} = \beta_0 + \beta_L\, \pi^{PF}_{t-1,h} + \beta_\Lambda\, \Lambda_t + \varepsilon_t \quad (3)$$

The value of the β_L parameter, which we expect to be positive and significant, should shed light on whether the limited adjustment mechanism in which information is only partially absorbed over time is at work in the data.[11] The vector Λ_t includes the exogenous components of Bank Rate, the Bank's inflation and output projections, as well as two additional vectors. The first one, X_t, aims to capture news shocks and surprises to macro developments that are contemporaneous to central bank projections. It comprises the change between *t-1* and *t* in private output forecasts, to control for their link with private inflation forecasts as evidenced by Fendel et al. (2011), Dräger et al. (2016) and Paloviita and Viren (2013). It also includes the change between *t-1* and *t* in private interest rate forecasts orthogonal to Bank Rate. The vector X also includes a news variable capturing the set of macroeconomic data released between *t-1* and *t* based on the announcement literature (see Andersen et al., 2003), the three indices of Scotti (2016): 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 economy, as well as a high-frequency financial index: the FTSE. The second vector, Z_t, includes macroeconomic variables that are likely to affect inflation and therefore to be used by private forecasters to predict future inflation: Consumer Price Index (CPI) inflation, industrial production, oil prices, the sterling effective exchange rate, net lending, and housing prices. Thus, equation (3) can be written as:

$$\pi^{PF}_{t,h} = \beta_0 + \beta_1\, \varepsilon^{i}_{t} + \beta_2\, \varepsilon^{\pi_{CB,h}}_{t} + \beta_3\, \varepsilon^{x_{CB,h}}_{t} + \beta_L\, \pi^{PF}_{t-1,h} + \beta_X\, X_t + \beta_Z\, Z_t + \varepsilon_t \quad (4)$$

where ε^{i}_{t}, $\varepsilon^{\pi_{CB,h}}_{t}$ and $\varepsilon^{x_{CB,h}}_{t}$ are the monetary shock and projection surprises at a given horizon (obtained from equations 1 and 2) that we explicitly incorporate in private agents' forecasting function. This equation can be interpreted through the lens of noisy or sticky information models where rational or professional forecasts are substituted with monetary shocks, projection surprises and additional control variables.[12]

After having corrected our dependent variables for potential risk, liquidity and inflation risk premia, and extracted exogenous shocks from our three variables of interest to circumvent a potential endogeneity bias, we estimate equation (4) with OLS for the term structure of inflation expectations. Because our dependent variables are financial market variables that are likely to introduce heteroskedasticity and as confirmed by the Breusch-Pagan/Cook-Weisberg test for constant variance, we compute heteroskedasticity-robust standard errors.
The sign of the β_1-β_3 parameters should shed light on whether monetary shocks and inflation and output projection surprises convey a macro signal: if that dominates, the parameters will

[9] This specification can be interpreted through the lens of either noisy information models or augmented sticky-information models where rational or professional forecasts are substituted with the vector Λ_t which captures information relevant to forecast inflation.

[10] 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.

[11] This specification allows us to be agnostic about whether information is imperfect or not and let the data speak.

[12] The timing of policy decisions and Bank projection releases - detailed in the next section - which are made public at the beginning of the relevant 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.

be positive; if the policy signal does, they will be negative. In order to check that the signals conveyed by each piece of information are specific to it (i.e. that a positive inflation projection surprise is not interpreted differently when we do or do not include monetary shocks in our specification for instance), we have also estimated equation (4) with monetary shocks or inflation projection surprises alone or with pairs of these variables.[13]

3. Data

Our dependent variable, π^{PF}, is derived from inflation swaps. These instruments are financial market contracts to transfer inflation risk from one counterparty to another. We consider instantaneous forwards at different maturities that measure expected inflation at the date of the maturity of the contract. 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. In general, the advantage of financial market expectations over survey measures of expectations is that they are directly related to payoff decisions, so there is no strategic response bias or no difference between stated and actual beliefs. Although one disadvantage is that financial market expectations do not provide a direct measure of inflation expectations as they are affected by credit risk, liquidity and inflation risk premia. Swaps tend to be a better market measure for deriving inflation expectations than index-linked gilts because they are generally less sensitive to liquidity and risk premia.

Another advantage of market measures is that they are available for all horizons from 1 to 10 years ahead. We perform our empirical analysis at the monthly frequency and take the average of all the working day observations in each month.[14] These are available since October 2004, which determines the starting date of our sample. For robustness purposes, we also consider the last observation of the month[15] and survey data from Citigroup/YouGov and the Survey of External Forecasters.

The Bank's policy interest rate, i, called Bank Rate, is the intended policy target rate, which previously was also referred to as the Minimum Lending Rate, Repo Rate, or Official Bank Rate. In addition, because the policy rate is at its effective lower bound during a significant part of our sample, and monetary policy has taken many different dimensions over the last years, we also use a shadow rate measure that translates unconventional policies into a single variable expressed in interest rate space to measure the overall stance of monetary

[13] As the Bank is an inflation targeting central bank, one could argue that only inflation projections should matter.
[14] Given that we are primarily interested in the interaction effects of monetary and projection shocks on private inflation expectations, and that policy decisions and projections were released on different days in a given month (the Inflation Report started to be published, in the relevant months, at the same time as policy decisions in August 2015 following the Warsh's report "Transparency and the Bank of England's Monetary Policy Committee"), we cannot perform an event-study analysis at a daily frequency and need to work at the monthly frequency. Moreover, since we take advantage of the fact that the Bank Rate decisions happen every month whereas the Bank's projections are published quarterly, working at the monthly frequency does not weaken the estimation of the interaction effects of monetary and projection shocks. Finally, because most of the macroeconomic variables are reported at a monthly frequency at best, we are interested in the lower-frequency effects of monetary and projection shocks on private inflation expectations, not their daily changes.
[15] This frequency transformation is more extreme as it discards all inflation expectation data points before the last observation. However, by doing so, we make sure that (i) all shocks or information happening during a month are available to private agents and potentially incorporated in the last observation of the month; and (ii) there is no endogeneity issue between our left-hand side variable and its potential explanatory variables.

policy. We use a shadow rate measure that augments Bank Rate to include a Bank of England in-house estimate of the effect of QE.[16]

We also focus on the Bank's inflation and output projections, π^{CB} and x^{CB} respectively. They are available from the quarterly Inflation Report (IR) for each quarter up to three years ahead. They are released in February, May, August and November. These forecasts are published with fan charts capturing the uncertainty and skewness of the forecasts.[17] 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 rates just prior to the previous policy meeting. A crucial assumption to ensure identification is that forecasts do not already contain the effect of the policy decision (in other words, they are uncorrelated with Bank Rate) as if the forecasts included the effect of the policy change, the regression results would be biased. We therefore use the latter set of forecasts.

The vector X_t includes private output forecasts obtained from Consensus Forecasts for horizons from 1 to 6 quarters ahead (monthly constant-interpolated from surveys in March, June, September and December) and from the Bank's Survey of External Forecasters for horizons from 2 to 3 years ahead (monthly constant-interpolated from surveys in February, May, August and November). Private interest rate forecasts are 3-month market interest rate expectations derived from nominal government bonds 1 to 10 years ahead. The news variable π^s represents inflation surprises: the information set of macroeconomic data released between *t-1* and *t* having an impact on the inflation outcome. Following the announcement and news literature (Andersen et al., 2003, and references within), this 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 the private inflation forecast error and captures the news published between the two dates. Bloomberg provides the market average expected one month ahead CPI inflation outturn at a monthly frequency.

The vector Z_t comprises various macroeconomic controls that are likely to capture expected inflation dynamics: CPI inflation, industrial production, oil prices, net lending, the sterling ERI, and housing prices (all included as 12-month percentage changes). Our overall sample period is 2004m10-2015m03. Data sources and descriptive interest are presented in Tables A1 and A2 in the Appendix.

4. 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 credit risk, 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

[16] The shadow rate is derived by computing a sequence of unanticipated monetary policy shocks to match the time series for the estimated effect of QE on GDP using estimates from Joyce, Tong, and Woods (2011) – see also Section 8.4 of Burgess et al. (2013). The underlying assumption that underpins this approach 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.

[17] Analyzing whether the uncertainty and skewness matter for the responses of inflation expectations is beyond the scope of this paper and left for future research. Moreover, our intuition is that it should not matter that much as the variance of the measures is rather small.

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) and Soderlind (2011) decompose inflation compensation, $\pi_{t,h}^{COMP}$ between 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.[18] We also include a risk premium, $\varphi_{t,h}^{risk}$, compensating investors for holding a risky asset.[19] Assuming t is the time subscript and h is the horizon of inflation expectations, this breakdown can be written:

$$\pi_{t,h}^{COMP} = \pi_{t,h}^{PF} + \varphi_{t,h}^{risk} + \varphi_{t,h}^{l} + \varphi_{t,h}^{ir} \quad (5)$$

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).[20] 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, following Soderlind (2011).[21] This leads us to estimate the following equation:

$$\pi_{t,h}^{COMP} = \alpha + \beta_h^{s}\, spread + \beta_h^{cds}\, cds + \beta_h^{f}\, ftsev + \beta_h^{i}\, impvol + \varepsilon_{t,h}^{COMP} \quad (6)$$

We estimate equation (6) using OLS. We use monthly observations – calculated simply as the average of daily observations. And we estimate it separately for each horizon of inflation compensation from 1 year ahead to 10 years ahead. The risk premium, the liquidity premium and the inflation risk premium – directly related to inflation uncertainty – should push inflation compensation up.[22] 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.[23] We also expect the risk and inflation risk premia to increase with the maturity of

[18] Because the central bank may intend to affect the inflation risk premium as well as inflation expectations, we also compute adjusted series for risk and liquidity premia only and assess the effect of this alternative in table A4.
[19] The credit risk 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 credit risk premium.
[20] An extension would be to correct for the micro liquidity premium affecting investors' appetite for inflation hedging instruments compared to nominal instruments and for the maturity-specific liquidity premium affecting investors' appetite for each maturity differently. One option would be to use maturity-specific residuals from a fitted term structure model as a proxy for maturity-specific liquidity premia (Garcia and Fontaine 2009, Hu, Pan and Wang 2013) and the average of all yield curve fitting errors for indexed bonds over the average of all yield curve fitting errors for nominal bonds to capture the micro liquidity premium.
[21] An alternative indicator to measure inflation uncertainty more precisely would be the standard deviation of the probability density function of inflation options maturing in 10 years, which are available for the UK only since 2007. Over the same sample, the correlation between this measure and our proxy is 0.76.
[22] 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.
[23] 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.

the swap. Table A3 in the Appendix shows the estimated coefficients for each maturity of the term structure of inflation expectations. Using these estimated parameters, we adjust the inflation compensation series by subtracting the fitted values of the contributions of the risk, liquidity and inflation risk premia to obtain corrected inflation expectation series.[24]

Overall, for compensation measures ten-years ahead, we estimate that the total combined premium has averaged about 60 basis points since 2004, and has varied between around 30 and 160 basis points. For comparison, D'Amico, Kim and Wei (2010) find that the liquidity premium on US TIPS has varied between 0 and 130 basis points and Gürkaynak et al. (2010) 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) 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 ten-year inflation compensation derived from UK gilts.

5. Extracting Exogenous Innovations

When estimating the effects of Bank Rate and the Bank's inflation and output projections on private inflation expectations, we need to overcome one major econometric challenge. Our three variables of interest are likely to be endogenous to inflation expectations. To correct for this, we perform a first-stage regression to extract the unpredictable component of i, π^{CB}, x^{CB} orthogonal to its systematic component. Said differently, we remove the contribution of the most relevant endogenous factors that would underlie the evolution of these variables, in the spirit of Romer and Romer (2004)'s identification strategy. In order to cope with the potential presence of non-nested information sets, we make sure that exogenous monetary shocks are not only orthogonal to the central bank's information set but also to private agents' information set. We aim to remove the contribution of *lagged* macro and private forecasts (so that innovations can have contemporaneous effects on these) and the contribution of *contemporaneous* Bank variables (so as to remove the information of policymakers).[25]

Starting with the monetary shock and based on equation (1) defining a standard central bank reaction, we estimate the following equation:

$$i_t = f\left(\pi_{t,pca}^{CB}, x_{t,pca}^{CB}, mc_{t,pca}, \Psi_{t-1}, I_{t,ZLB}, I_{t,IR}\right) + \varepsilon_t^i \quad (7)$$

We assume that changes in i_t are driven by the policymakers' response to the first principal component of its own inflation $\pi_{t,pca}^{CB}$ and output $x_{t,pca}^{CB}$ projections, where $f(\cdot)$ is the function

[24] The correlation between the original and corrected series is comprised between 0.69 and 0.97. We assess the robustness of our baseline results using the original market-based measures –inflation compensation– in table A5. Figure A1 in the Appendix shows the evolution of the three estimated premia. While the risk proxies started to become positive in mid-2007, they had a negative contribution for maturities under 6-years to inflation compensation when financial stress was most acute at the end of 2008, pushing inflation compensation to negative values, whereas their effects remained positive for longer maturities. After this episode of severe financial stress, the risk 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 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 which may be associated with the implementation of QE.

[25] The main advantage of this approach over a VAR estimation is that the identification of innovations does not rely on short-run timing restrictions in a recursive set-up, while only one restriction is needed (and justifiable): projections are not a function of the 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.

capturing its systematic reaction, and the error term ε_t^i reflects monetary shocks orthogonal to the macroeconomic outlook.[26] We introduce inflation and output projections using the respective first principal component of the Bank's inflation and output projections at all different maturities to avoid multicollinearity.[27,28] We also include $mc_{t,pca}$ the first principal component of the market interest rate curve at the 1 to 3-year maturities used as conditioning path for the Bank's macroeconomic projections. Later in the robustness section, we replace these three first principal components by the underlying series at all different horizons. The vector of macro and private forecast data Ψ_{t-1} includes a lag of the change in the policy rate capturing the last policy decision, a lag of the first principal component of private inflation expectations from 1- to 10-year-ahead measured from inflation swaps, a lag of the first principal component of private output forecasts from 1 quarter to 3 years ahead measured from surveys, a lag of the first principal component of private short-term interest rate forecasts from 1- to 10-year-ahead measured from nominal government bonds, and a lag of the vector Z of macroeconomic controls described in sections 2.2 and 3. We also include a dummy for when Bank Rate is at its effective lower bound and another dummy for when the Bank publishes its *Inflation Report* (IR). These two dummies are meant to capture (i) that expectations of policy decisions may have been formed differently when the conventional policy tool reached its effective lower bound;[29] (ii) that expectations of policy decisions may be different in IR and non-IR months, because private agents may expect the central bank to update its policy more frequently during IR months when it updates its published assessment of the current and future state of the economy.[30]

We assess the robustness of this methodology by estimating alternative monetary shock measures: (i) a measure based on a shadow rate which includes an estimate of the effect of QE because the policy rate is at its effective lower bound during a significant part of our sample and monetary policy has taken many different dimensions over the last years, (ii) a measure identified from a standard Taylor rule, (iii) a measure reproducing the one from Cloyne and Huertgen (2016), (iv) a measure estimated on two subsamples pre and post the reaching of the Effective Lower Bound (ELB) in March 2009 (the former estimation features the Bank Rate while the latter features the shadow rate), (v) a measure that does not include the IR dummy, and (vi) a measure that does not include the first principal components but individual series of private and central bank forecasts at different horizons.

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[26] In our baseline analysis, we consider Bank Rate as the policy rate while we will consider a shadow rate capturing both conventional and unconventional policies in the robustness section.

[27] The inclusion of both private and central bank forecasts in the regression model enables us to deal with three concerns. First, forecasts encompass rich information sets. Private agents' and policymakers' information sets include a large number of variables. 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 summarise a large variety of macroeconomic variables as well as their expected evolutions. Second, forecasts are real-time data. Private agents and policymakers base their decisions on their information set in real-time, not on ex-post revised data. Orphanides (2001, 2003) show that Taylor rule-type reaction functions estimated on revised data produce different outcomes when using real-time data. Third, private agents and policymakers are mechanically incorporating information about the current state of the economy and anticipate future macroeconomic conditions in their forecasts and we need to correct for their forward-looking information set when estimating the exogenous part of their respective forecasts.

[28] We consider the first principal component from a Principal Component Analysis of a given forecast variable at various horizons so as not to include all horizons into the estimated model and avoid multicollinearity. The first principal component intends to capture the forward-looking information set of forecasters for all horizons together. The first principal component of private inflation expectations captures 76% of the common variance of the underlying series, the one of the market curve captures 97% of the common variance and the one of private output forecasts captures 85% of variance. We assess the impact of using first principal components later on.

[29] To further control for this effect, we also estimate our specification with a shadow rate.

[30] While Bean and Jenkinson (2001) report that the Bank is more likely to change interest rates in Inflation Report months, our sample includes 7 interest rate changes in IR months and 8 changes in non-IR months.

Central bank inflation or output projection surprises at a given horizon should be seen as the unpredictable innovation of a projection at a given horizon, conditional on the information available to private agents at the date when the projections are published. We estimate these surprises by using the Bank's inflation and output projections conditioned on the path for Bank Rate implied by market interest rates prior to the policy meeting, so independent from the policy decision, using the following equation (for inflation projections, as an example):

$$\pi_{t,h}^{CB} = g\ (mc_{t,pca}, \Psi'_{t-1}, I_{t,ZLB}) + \varepsilon_t^{\pi_{CB,h}} \quad (8)$$

So that changes in $\pi_{t,h}^{CB}$ (or in $x_{t,h}^{CB}$) are driven by $mc_{t,pca}$ the first principal component of the market interest rate curve at the 1 to 3-year maturities. The vector of macro and private forecast data Ψ'_{t-1} includes a lag of the first principal components of the Bank's inflation and output projections, a lag of the shadow rate, a lag of the first principal component of private inflation expectations, of private output forecasts, and of private short-term interest rate forecasts. It also includes a lag of the vector Z of macroeconomic controls. We also add a dummy for when Bank Rate is at its effective lower bound. Equation (8) is estimated on IR months only since no projections are published during non-IR months (during which, by construction, projection surprises are zero). Table A4 in the Appendix shows the estimated parameters of equations (7)-(8), and the properties and the correlation structure of innovations. Figure 1 plots the estimated monetary shocks and projection surprises.

Because the Bank's inflation and output projections are published quarterly, the estimation of equation (8) for these two variables is performed for the specific months when the Bank's projections are released but without affecting the lag structure (for instance, the surprise to February projections takes January values for the lagged variables). The estimated surprises therefore have non-zero values during the months when the Bank's projections are published and zeros otherwise, which is consistent with the fact that no re-assessment or releases of the Bank's projections happen during these months. A potential alternative would be to proceed to a constant-interpolation of the Bank projection surprises for the following two months during each quarter to fill these gaps as one could argue that the projections are still available during the following two months. We choose to focus on the most conservative choice and keep all zeros for the months with no Inflation Report.

The relative timing of the variables in equations (7)-(8) is driven by the implicit assumption that monetary shocks and projection surprises can affect macroeconomic and private forecast variables contemporaneously (so those latter variables enter with a lag). Monetary shocks are orthogonal to the policymakers' information set, so central bank projections enter contemporaneously in equation (7), whereas projection surprises precede the policy decision, so the policy rate enters with a lag in equation (8). The remaining information contained in these monetary shocks and projection surprises beyond the policymakers' information set and macro and private forecast variables is interpreted in terms of policy and macro signals disclosed to the public.

Finally, for our estimated series of monetary shocks and projection surprises to be relevant, they should be unpredictable from movements in data. We assess the predictability of these series with Granger-causality type tests.[31] The F-stats and adjusted R^2 in the bottom panel of Table A4 in the Appendix show that the null hypothesis that these estimated innovations are unpredictable cannot be rejected. It suggests that these series are relevant to be used in our second stage estimations to assess their effects on private inflation expectations.

[31] We consider a set of standard macro and financial variables: inflation, industrial production, oil prices, wages, net lending, the UK move and expected future short-term interest rates.

6. The Response of Inflation Expectations

6.1. The effect of monetary shocks

We test our predictions by estimating equation (4) with OLS. Our baseline analysis is realised for central bank projections 4-quarters ahead.[32] This horizon falls before interest rates are generally estimated to have their peak effect on inflation - around 18-24 months ahead - and therefore enables us to minimise the control issue,[33] but should also convey information about inflation at the 1-year horizon, the shortest horizon of the term structure of private inflation expectations studied here. Those results are shown in Table 1. The results show that β_L is positive and significant, consistent with inertia in inflation expectations, suggesting that the information frictions framework is likely to be appropriate for this analysis.

Table 1 provides evidence that contractionary shocks to Bank Rate decrease private inflation expectations at all horizons from 1 to 6-years ahead – β_1 is negative. That is consistent with contractionary policy shocks affecting private inflation expectations through the usual transmission mechanism channel and suggests that a policy signal is taken from monetary shocks. For horizons from 2 to 8-years ahead, shocks to Bank Rate account for 4 to 7% of the variance of inflation expectations.[34] The magnitude of the effect decreases with the horizon, consistent with waning effects of monetary policy on inflation. The transmission lags of monetary policy are often estimated to be around 18 to 24 months for inflation (see e.g. Bernanke and Blinder, 1992, or Bernanke and Mihov, 1998), so negative effects at horizons shorter and longer than the transmission lags could be interpreted as a policy signal effect going through the expectations channel.[35] Even if the macro outlook signal does have a non-null weight, there is no evidence that it outweighs the policy signal given the consistently negative response of private agents' inflation expectations.

This contrasts with one of the results of Melosi (2017) which finds that inflation expectations may respond positively to contractionary monetary shocks under certain calibrated parameters. If 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 macro outlook signalling channel may be at work. Similarly, Tang (2015) finds a positive effect when prior uncertainty about inflation is high.

6.2. The effect of projection surprises

We also test whether the dominant signal that the Bank's inflation and output projections convey is about the state of the economy or about the policy path. Table 1 suggests that positive surprises to the Bank's inflation projections at 4 quarters ahead increase private inflation expectations 1 to 6 years ahead – β_2 is positive. That effect is strongest 1 year ahead and is most significant from 2 to 4-years ahead. On horizons from 1 to 4-years ahead,

[32] We later show the effects of surprises to central bank projections 8 and 12 quarters ahead, see Table 2.
[33] The interest rate instrument gives the central bank some control over the forecasted variables, and this issue is circumvented when the horizon of forecasts is shorter than the transmission lag of monetary policy.
[34] We compute this variance decomposition using partial R^2 that indicates the fraction of the improvement in R^2 that is contributed by the excluded covariate.
[35] Fatum and Hutchison (1999) find no evidence in the United States supporting the policy signalling hypothesis that policy actions are related to changes in expectations about the stance of future monetary policy. However, their analysis focuses specifically on foreign exchange market interventions.

surprises to the Bank's inflation projections account for 4 to 6% of the variance of inflation expectations. The sign of the effect suggests that the information conveyed about the macro outlook outweighs the policy signal conveyed by these projections. That is consistent with private agents and the central bank having non-nested information sets.[36]

The Bank's inflation projections 8 quarters ahead also have a positive effect on inflation expectations between 1 and 8 years ahead, although those 12 quarters ahead have no effect (see Table 2). The fact that surprises to the Bank's short- and medium-term inflation projections affect private inflation expectations at medium- and long-term horizons suggests that private agents take a signal about the inflation outlook further ahead. However, the positive effect of the Bank's inflation projections on inflation expectations decreases monotonically as the horizon increases.

Surprises to the Bank's output projections result in a different pattern. Projections 4 and 8 quarters ahead have no effect on private inflation expectations, while those 12 quarters ahead have a positive effect on inflation expectations 7 to 8-years ahead. This finding suggests that private agents take some macro outlook signal from surprises to 12-quarter ahead output projections, inferring that they imply increasing inflationary pressures – and that it dominates the policy signal. Two potential explanations of the long-run positive effect on inflation expectations may be that either private agents believe that the transmission of the shock from output to inflation takes time, or that the MPC would be less likely to change policy in response to output surprises than inflation surprises – consistent with the MPC's inflation targeting mandate – so that the effect of the former on inflation expectations are more pronounced than the latter on the long-end of the term structure.

Overall, these results suggest that, in contrast to the theoretical predictions of full information models, there is some evidence that weight is placed on the signals about the macro outlook that projections contain. One interpretation of the results from sections 6.1 and 6.2 is that when private agents face a signal extraction problem from one piece of information only, they rely on the underlying nature of the information disclosed by the central bank: a monetary shock primarily conveys a policy signal and a projection surprise primarily conveys a macro outlook signal.

6.3. Sensitivity analysis

We run several alternative tests to ensure the robustness of the baseline results. They are decomposed into tests about the left-hand side variables, about the identification of the monetary shocks and projection surprises, and about additional right-hand side variables and subsample estimates.

Starting with inflation expectation measures, we first compute adjusted series for risk and liquidity premia only, because the central bank may intend to affect the inflation risk premium as well as inflation expectations. Second, we use raw inflation compensation rather than our derived inflation expectation measure, so as to observe the impact of the correction for the risk, liquidity, and inflation risk premia. Third, we correct inflation compensation measures for risk, liquidity, inflation risk premia by estimating equation (6) on two subsamples pre and post ELB. By doing so, we assess the impact of the hypothesis that the

[36] Table 1 also shows alternative specifications of equation (4) when introducing Bank Rate only, both projections only, or each projection only, so as to control that our estimated effects for each variable do not depend on the inclusion of the other Bank variables. These estimates confirm the stability of the baseline results.

ELB may affect the transmission of shocks and macro and financial dynamics, so that the pricing relationship of premia may change pre and post ELB. Fourth, because the proxies we use to correct inflation compensation for the different premia might be correlated with the business cycle, we turn to an alternative methodology using survey expectation measures that do not contain these various premia. We regress market-based expectations on survey expectations and consider the predicted value as our left-hand side variables. Table A5 in the Appendix shows that both the negative effect of Bank Rate and the positive effect of inflation projections are robust. The biggest change is related to the longer horizons at which monetary shocks impact private inflation expectations, suggesting that survey expectations do not react at horizons as short as market expectations.

Table A6 in the Appendix shows another set of tests related to the left-hand side variables. First, we replace the level of inflation expectations by their first difference. Second, we replace the level of private expectations by their deviation from the Bank's inflation target (corrected for the sample mean of the wedge between RPI and CPI).[37] Third, we consider a more extreme information assumption, replacing the monthly average of all observations of market-based (daily) inflation expectations by the last observation of the month. While we discard all inflation expectation data points before the last observation by doing so, we ensure that: (i) all shocks or information happening during a month are available to private agents and potentially 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. Fourth, we replace the swap-based inflation expectation measures by the break-even inflation rates obtained from the difference between inflation-indexed and nominal gilts. The negative effect of Bank Rate and the positive effect of inflation projections are confirmed, though the effect of monetary shocks is similar in magnitude to the baseline case but not significant.[38]

When analysing the sensitivity of the identification of monetary shocks, we substitute our series of exogenous shocks to Bank Rate with alternative measures of monetary shocks. First, because changes in UK monetary policy since March 2009 have in large part been conducted via asset purchases, we use a shadow rate measure that augments Bank Rate to include a Bank of England in-house estimate of the effect of QE.[39] Second, we estimate a standard Taylor rule monetary shock. Third, we reproduce the measure of Cloyne and Huertgen (2016) of UK monetary shocks.[40] Fourth, we identify monetary shocks by not controlling for IR months. Fifth, we assess the effects of big and small monetary shocks (greater and lesser

[37] The wedge is computed as the difference between RPI and CPI inflation corrected for the uncertainty created by the announcement by the Office for National Statistics' Consumer Prices Advisory Committee (CPAC) of a potential revision in the RPI calculation methodology, between May 2012 and January 2013.

[38] We also performed quantile regressions to assess whether estimates approximating the conditional mean of the dependent variable were similar across its entire distribution. Estimates of the conditional median or of other quantiles are similar to the OLS estimates. These outputs are available from the authors upon request.

[39] The shadow rate is derived by computing a sequence of unanticipated monetary policy shocks to match the time series for the estimated effect of QE on GDP using estimates from Joyce, Tong, and Woods (2011) – see also Section 8.4 of Burgess et al. (2013). The underlying assumption that underpins this approach 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.

[40] While we regress the level of Bank Rate on the previous change in Bank Rate, Cloyne and Huertgen regress the change in Bank Rate on the level of past Bank Rate (equation (2) in their paper). Since the majority of macro models (including the one described in section 2) and conventional VARs introduce interest rates in levels, they cumulate their new monetary shock series afterwards. Their series stops in 2007 just before Bank Rate converged towards the effective lower bound. Using their methodology and the Bank of England's shadow rate, we compute an equivalent to their monetary shock series. The shadow, Taylor rule and Cloyne-Huertgen monetary shock series have a correlation of 0.81, 0.10, and 0.27 with our own monetary shock series.

than 25 basis points) so as to evaluate the impact of potential outliers. Sixth, because the ELB may affect macroeconomic dynamics, the transmission of macroeconomic shocks and the way private agents form their expectations, we estimate equation (7) on two subsamples pre and post ELB. Seventh, we replace the first principal components of private inflation and output expectations in the vector Ψ_{t-1} in equations (7)-(8) by the individual series of private inflation and output expectations at different horizons. Table A7 in the Appendix confirms the magnitude and sign of the effects of monetary shocks and Bank's inflation projection surprises, although some of them lose significance.

We then assess the impact of variations to projection surprises. First, we use a constant-interpolated measure of the projection surprises, so the observations during the two months after the publication the Inflation Report take the value of the surprise happening in the first month instead of zeros. Second, we interpolate projections the same way and estimate equation (8) on all observations rather than on IR months only. Third, we replace the shadow rate measure by the Bank Rate in equation (7). Fourth, we estimate equation (4) with the raw projections rather than projection surprises. Table A8 in the Appendix confirms the negative effect of monetary shocks and the positive effect of Bank's inflation projections.

We then estimate our benchmark equation on two subsamples until March 2009 and after March 2009, when Bank Rate reached its lower bound, so as to check that our results are robust to the sub-sample when Bank Rate was considered the main policy instrument. Second, we estimate equation (4) without the vectors X_t and Z_t to examine potential over-identification issues and further check the orthogonality condition of our estimated shocks and surprises. Third, 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. Fourth, 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.[41] Table A9 in the Appendix shows that our main results are robust to these alternatives.

Finally, because news shock at time t may raise private inflation expectations as well as central bank inflation projections, the estimation requires controlling for as many news shocks as possible. In our benchmark analysis, we control for a news variable *à la* Andersen et al. (2003), the real activity, surprise and uncertainty indices of Scotti (2016) and the FTSE. We also test a specification in which we include various macroeconomic variables to further control that our result is not driven by some omitted variable bias. We add to equation (4) the growth rate of retail prices, input producer prices, import prices, the level of unemployment, capacity constraints, capacity utilisation, and the cycle component of an HP filter of real GDP. Second, we include in equation (4) the changes in the VIX, the UK move and the Saint-Louis Financial Stress Index, three high-frequency financial indices reacting in real-time to macroeconomic and financial developments. Third, to further control that central bank projections do not capture the presence of potential news shocks, we augment X_t with the three European Commission (EC)'s UK sentiment measures for the industry, services and consumers. Finally, we include five more lags of the dependent variable (so up to 6 lags) in equation (4). Table A10 in the Appendix shows that the main effects evidenced do not stem from the omission of variables enabling private agents to forecast future inflation.

[41] 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.

7. Conclusion

This paper investigates the effect of shocks to the policy rate and surprises to the Bank of England's macroeconomic projections on private inflation expectations. We find that private inflation expectations respond negatively to contractionary monetary shocks, as would be expected given the transmission mechanism of monetary policy. However, we also find that inflation expectations increase in response to a positive surprise to the central bank's inflation projections, consistent with private agents putting more weight on the signal that they convey about future economic developments than the signal about the policy outlook, providing evidence of the existence of a macro outlook signalling channel, in contrast to the theoretical predictions of full information models. One interpretation of the empirical results could be that policy decisions and inflation projections together enable private agents to differentiate the inflationary shock and the monetary shock, thus reducing the signalling effect of policy actions. The analysis of this hypothesis is left for future research. The results of this paper give policymakers some insights on how private agents interpret and respond to policy decisions and central bank information. The signals provided by central bank action and communication, and importantly the horizon at which they are conveyed, appear to be important for the management of private inflation expectations.

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Table 1 - Baseline estimates

	1	2	3	4	5	6	7	8	9	10
4-quarter-ahead BoE projections										
	PF_1y	PF_2y	PF_3y	PF_4y	PF_5y	PF_6y	PF_7y	PF_8y	PF_9y	PF_10y
ε_Bankrate	-0.244**	-0.218**	-0.190**	-0.159**	-0.128**	-0.102**	-0.080	-0.062	-0.048	-0.039
	[0.12]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.06]
ε_BoE_cpi_4	0.258*	0.221**	0.190**	0.150**	0.113*	0.084*	0.062	0.045	0.032	0.021
	[0.14]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.096	0.11	0.101	0.073	0.036	0.000	-0.034	-0.064	-0.092	-0.118
	[0.15]	[0.11]	[0.09]	[0.08]	[0.07]	[0.07]	[0.07]	[0.07]	[0.08]	[0.08]
Lag dep var	0.654***	0.709***	0.759***	0.782***	0.789***	0.788***	0.782***	0.774***	0.767***	0.760***
	[0.10]	[0.09]	[0.08]	[0.07]	[0.07]	[0.07]	[0.07]	[0.07]	[0.07]	[0.07]
Constant	0.857**	0.672**	0.532**	0.473**	0.462**	0.477**	0.505***	0.542***	0.584***	0.629***
	[0.38]	[0.27]	[0.24]	[0.21]	[0.19]	[0.18]	[0.18]	[0.18]	[0.19]	[0.20]
Controls: X_t & Z_t	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	125	125	125	125	125	125	125	125	125	125
R^2	0.64	0.69	0.74	0.78	0.81	0.83	0.84	0.84	0.83	0.83
Partial R^2 - Variance decomposition										
ε_Bankrate	0.04	0.06	0.07	0.07	0.05	0.04	0.03	0.02	0.01	0.01
ε_BoE_cpi_4	0.04	0.06	0.06	0.05	0.04	0.02	0.01	0.01	0.00	0.00
ε_BoE_gdp_4	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.02	0.02
Alternatives speficifications of equation (4)										
Bankrate only										
ε_Bankrate	-0.235**	-0.202**	-0.175**	-0.150**	-0.125**	-0.105**	-0.087*	-0.074	-0.065	-0.059
	[0.12]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]
Projections only										
ε_BoE_cpi_4	0.264*	0.222**	0.191**	0.152**	0.116*	0.086*	0.064	0.046	0.032	0.021
	[0.14]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.016	0.039	0.038	0.021	-0.005	-0.032	-0.059	-0.084	-0.108	-0.130*
	[0.14]	[0.10]	[0.08]	[0.07]	[0.06]	[0.06]	[0.06]	[0.07]	[0.07]	[0.08]
Inflation projections only										
ε_BoE_cpi_4	0.263*	0.220**	0.189**	0.151**	0.116*	0.088*	0.066	0.05	0.038	0.028
	[0.14]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.06]
Ouput projections only										
ε_BoE_gdp_4	0.002	0.026	0.026	0.011	-0.012	-0.039	-0.063	-0.087	-0.11	-0.132*
	[0.14]	[0.11]	[0.09]	[0.07]	[0.06]	[0.06]	[0.06]	[0.07]	[0.07]	[0.08]
Bankrate and inflation projections only										
ε_Bankrate	-0.228**	-0.199**	-0.172**	-0.146**	-0.122**	-0.102**	-0.085*	-0.072	-0.064	-0.059
	[0.11]	[0.09]	[0.08]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]
ε_BoE_cpi_4	0.256*	0.217**	0.186**	0.147**	0.112*	0.084*	0.063	0.048	0.036	0.026
	[0.13]	[0.10]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.05]	[0.05]	[0.06]

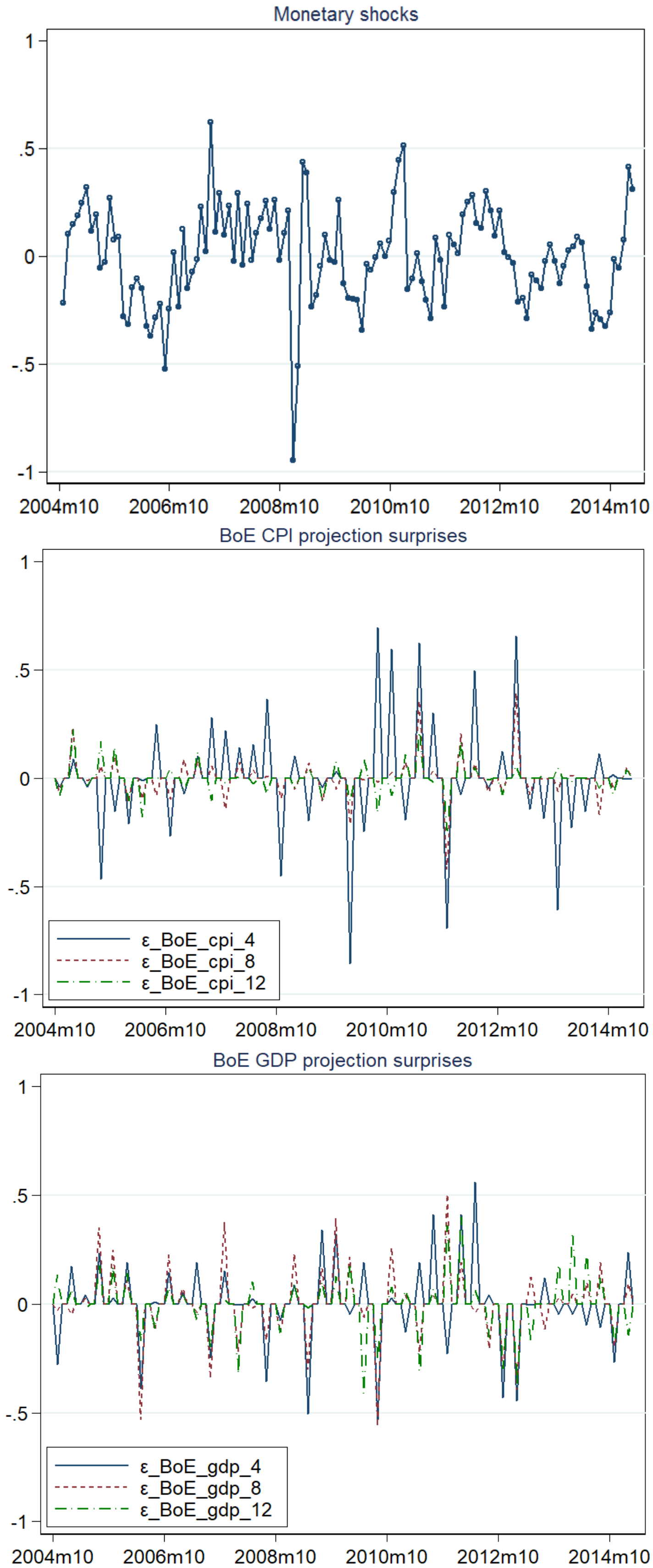
Heteroskedasticity-robust standard errors in brackets. * p<0.10, ** p<0.05, *** p<0.01. Each column corresponds to the OLS estimation of equation (4) for a given horizon of private inflation expectations. The two lower panels shows only the parameters for Bankrate and BoE projections when alternatives specifications of equation (4) are estimated. 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 change between *t-1* and *t* in private output forecasts and in private 3-month interest rate forecasts, the FTSE index, the real activity, uncertainty and news indices of Scotti (2016), and FG and ZLB dummies. Z_t includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Table 2 - Longer-horizon BoE projection estimates

	1	2	3	4	5	6	7	8	9	10
	PF_1y	PF_2y	PF_3y	PF_4y	PF_5y	PF_6y	PF_7y	PF_8y	PF_9y	PF_10y
8-quarter-ahead BoE projections										
ε_Bankrate	-0.275**	-0.232**	-0.201**	-0.173**	-0.146**	-0.123**	-0.102**	-0.085*	-0.072	-0.064
	[0.13]	[0.10]	[0.09]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]
ε_BoE_cpi_8	0.512*	0.443*	0.384**	0.328**	0.276**	0.230**	0.190**	0.159*	0.137	0.125
	[0.29]	[0.24]	[0.19]	[0.15]	[0.12]	[0.10]	[0.09]	[0.09]	[0.09]	[0.11]
ε_BoE_gdp_8	0.272	0.209	0.174	0.155	0.135	0.112	0.087	0.06	0.035	0.014
	[0.22]	[0.17]	[0.13]	[0.11]	[0.08]	[0.07]	[0.06]	[0.06]	[0.07]	[0.08]
R^2	0.63	0.68	0.73	0.77	0.81	0.83	0.84	0.84	0.83	0.82
12-quarter-ahead BoE projections										
ε_Bankrate	-0.242**	-0.207**	-0.181**	-0.158**	-0.135**	-0.115**	-0.097**	-0.083*	-0.074	-0.068
	[0.12]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]
ε_BoE_cpi_12	0.125	0.116	0.111	0.101	0.086	0.069	0.052	0.041	0.036	0.036
	[0.31]	[0.21]	[0.17]	[0.14]	[0.13]	[0.13]	[0.13]	[0.14]	[0.16]	[0.18]
ε_BoE_gdp_12	0.034	0.012	0.036	0.08	0.116	0.138	0.149*	0.149*	0.142	0.133
	[0.19]	[0.15]	[0.13]	[0.11]	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]	[0.10]
R^2	0.62	0.67	0.72	0.77	0.80	0.83	0.84	0.84	0.84	0.82

Heteroskedasticity robust standard errors in brackets. * p<0.10, ** p<0.05, *** p<0.01. Each column corresponds to the OLS estimation of equation (4) for a given horizon of private inflation expectations. 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 change between *t-1* and *t* in private output forecasts and in private 3-month interest rate forecasts, the FTSE index, the real activity, uncertainty and news indices of Scotti (2016), and FG and ZLB dummies. Z_t includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Figure 1 – Exogenous shocks
to Bank Rate and Bank of England's inflation and output projections



Note: The exogenous shocks plotted on these panels are estimated from equations (7)-(8). Parameters are presented in Table A4.

APPENDIX
NOT FOR PUBLICATION

Table A1 - Data description

Variable	Source	Description
PF_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.
Bankrate	Bank of England	Bank of England's policy interest rate.
Shadow rate	BoE calculations	Bankrate adjusted for internal estimates of the impact of QE.
BoE_cpi_h	Bank of England	Bank of England's modal projections for annual CPI inflation h quarters ahead, based on market interest rate expectations.
BoE_gdp_h	Bank of England	Bank of England's modal projections for annual GDP growth h quarters ahead, based on market interest rate expectations.
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.
ir3m_h	Bloomberg and Bank of England calculations	3-Month market interest expectations derived from nominal government bonds h years ahead. Monthly average of daily observations.
irchange	Authors' computation	Dummy that equals 1 when there is a change in Bankrate in a month in which the *Inflation Report* is published.
mc_h	Bank of England	Market interest rate curve used as conditioning path for BoE's macroeconomic projections.
PF-G_h	Bloomberg and Bank of England calculations	Breakeven inflation expectation measures derived from nominal and index-linked government bonds.
CITI_1y	Citigroup/YouGov	Citigroup/YouGov measure of households' inflation expectations 1 year ahead.
SEF_2y	Survey of External Forecasters	Survey of External Forecasters' measure of annual CPI inflation expectations 2 years ahead. Monthly constant interpolation from quarterly frequency.
SEF_3y	Survey of External Forecasters	Survey of External Forecasters' measure of annual CPI inflation expectations 3 years ahead. Monthly constant interpolation from quarterly frequency.
CITI_5y5	Citigroup/YouGov	Citigroup/YouGov measure of households' inflation expectations 5-10 years ahead.
CPI	ONS	Annual % change in the Consumer Price Index.
Indpro	ONS	Annual real Industrial Production growth seasonally adjusted.
Oil	FRED	Crude oil spot prices, Brent - Europe. Annual % change.
Sterling	Bank of England	Effective exchange rate index, January 2005 = 100. Annual % change.
Netlending	Bank of England	12 month growth rate of monetary financial institutions' sterling net lending to private
Housing	Halifax and Nationwide	Average of (SA) Halifax and Nationwide measures of average house prices. Annual % change.
ZLB	Authors' computation	Dummy that equals 1 when Bankrate is at its effective lower bound of 0.5%.
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.
FTSE	Bloomberg	FTSE all-share index. Annual change.
FG	Authors' computation	Dummy that equals 1 when Forward Guidance is in place.
scottiactiv	Scotti (2016)	UK real-time real activity index, capturing the state of economic conditions.
scottinews	Scotti (2016)	UK real-time surprise index, summarizing economic data surprises.
scottiuncert	Scotti (2016)	UK real-time uncertainty index, measuring uncertainty about the state of the economy.
LIBOR-OIS	FRED and Thomson DataStream	3-Month London Interbank Offered Rate and 3-Month Overnight Indexed Swap rates. Monthly average of daily observations.
CDS	Markit Group Limited and BoE calculations	Unweighted average of the five-year CDS premia for the major UK lenders. Monthly average of daily observations.
FTSE-Vol	Bloomberg	FTSE 100 Implied Volatility Index, 3 months constant maturity. Monthly average of daily observations.
ImpVol20	Barclays Live	At-the-money implied volatility of 1 year LIBOR swaptions, 20 years constant maturity. Monthly average of daily observations.

Table A2 - Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Variable	Obs	Mean	Std. Dev.	Min	Max
PF_1y	126	2.98	0.40	1.43	4.07	PF-G_4y	126	2.98	0.29	2.11	3.77
PF_2y	126	3.01	0.30	1.84	4.01	PF-G_5y	126	2.93	0.29	2.33	3.72
PF_3y	126	2.95	0.27	1.96	3.84	PF-G_6y	126	2.89	0.31	2.29	3.68
PF_4y	126	2.91	0.25	2.04	3.68	PF-G_7y	126	2.87	0.33	2.21	3.66
PF_5y	126	2.87	0.24	2.12	3.54	PF-G_8y	126	2.86	0.35	2.15	3.65
PF_6y	126	2.86	0.24	2.20	3.43	PF-G_9y	126	2.87	0.37	2.13	3.64
PF_7y	126	2.85	0.24	2.29	3.35	PF-G_10y	126	2.88	0.37	2.10	3.69
PF_8y	126	2.85	0.24	2.39	3.35	CF_gdp_1	126	1.42	1.67	-3.90	3.10
PF_9y	126	2.86	0.25	2.34	3.36	CF_gdp_2	126	1.54	1.36	-3.10	2.90
PF_10y	126	2.88	0.25	2.31	3.37	CF_gdp_3	126	1.69	1.01	-1.50	2.80
ε_Bankrate	125	0.00	0.23	-0.95	0.62	CF_gdp_4	126	1.81	0.73	-0.70	2.60
ε_Shadowrate	125	0.00	0.29	-1.02	0.83	CF_gdp_5	126	1.92	0.52	0.00	2.50
ε_BoE_cpi_4	126	0.00	0.20	-0.85	0.70	CF_gdp_6	126	1.99	0.40	0.60	2.50
ε_BoE_gdp_4	126	0.00	0.15	-0.53	0.56	ir3m_1y	126	2.27	1.90	-0.05	5.78
CITI_1y	113	2.59	0.72	0.80	4.60	ir3m_2y	126	2.78	1.61	0.24	5.56
SEF_2y	126	1.97	0.15	1.52	2.34	ir3m_3y	126	3.21	1.35	0.80	5.42
SEF_3y	110	2.03	0.10	1.78	2.17	ir3m_4y	126	3.56	1.14	1.35	5.34
CITI_5y5	113	3.35	0.31	2.62	4.07	ir3m_5y	126	3.84	0.98	1.83	5.27
CPI	126	2.62	1.04	0.00	5.20	ir3m_6y	126	4.06	0.88	1.98	5.41
Indpro	126	-0.98	3.44	-11.10	5.10	ir3m_7y	126	4.24	0.81	2.11	5.70
Oil	126	14.88	35.21	-56.10	86.40	ir3m_8y	126	4.37	0.77	2.23	5.86
Sterling	126	-1.07	6.49	-21.60	11.00	ir3m_9y	126	4.46	0.74	2.34	5.91
Netlending	126	4.65	8.77	-4.40	19.60	ir3m_10y	126	4.52	0.71	2.45	5.87
Housing	126	2.71	7.27	-17.10	17.60	mc_1y	125	2.42	2.02	0.22	5.93
ZLB	126	0.58	0.50	0	1	mc_2y	125	2.88	1.81	0.28	5.89
RPI surprises	126	0.03	0.17	-0.50	0.70	mc_3y	125	3.22	1.61	0.56	5.79
FTSE	126	6.04	15.50	-36.2	51.2	LIBOR-OIS	126	0.34	0.41	0.09	2.21
scottiactiv	126	-0.17	0.62	-2.44	0.51	CDS	126	0.97	0.73	0.06	2.61
scottinews	126	-0.08	0.28	-0.96	0.53	FTSE-Vol	126	17.59	7.53	8.85	48.68
scottiuncert	126	0.92	0.32	0.41	1.98	ImpVol20	126	-1.42	5.48	-12.93	7.16

Table A3 - Correction of raw market-based measures on proxies for premia

	1	2	3	4	5	6	7	8	9	10
	swap_1y	swap_2y	swap_3y	swap_4y	swap_5y	swap_6y	swap_7y	swap_8y	swap_9y	swap_10y
LIBOR-OIS	-0.881***	-0.412***	-0.263*	-0.166	-0.096	-0.046	-0.011	0.014	0.029	0.038
	[0.20]	[0.15]	[0.14]	[0.13]	[0.12]	[0.12]	[0.12]	[0.12]	[0.13]	[0.13]
CDS	0.349***	0.170***	0.117**	0.095**	0.084*	0.076*	0.071	0.067	0.065	0.065
	[0.07]	[0.06]	[0.05]	[0.05]	[0.04]	[0.04]	[0.04]	[0.05]	[0.05]	[0.05]
FTSE-Vol	-0.021*	-0.013	-0.004	0.004	0.011	0.017**	0.022***	0.026***	0.029***	0.030***
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
ImpVol20	-0.030***	-0.014*	-0.01	-0.009	-0.009	-0.007	-0.006	-0.004	-0.002	0.001
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Constant	2.982***	3.005***	2.952***	2.906***	2.875***	2.855***	2.847***	2.850***	2.862***	2.882***
	[0.13]	[0.10]	[0.09]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]
N	126	126	126	126	126	126	126	126	126	126
R^2	0.46	0.29	0.12	0.06	0.17	0.32	0.42	0.48	0.51	0.53

Standard errors in brackets. * p<0.10, ** p<0.05, *** p<0.01. Each column corresponds to equation (6) for a different horizon and estimated with OLS.

Table A4 - Extracting Exogenous Shocks

	1		2	3	4	5	6	7
	Bankrate		BoE_cpi_4	BoE_cpi_8	BoE_cpi_12	BoE_gdp_4	BoE_gdp_8	BoE_gdp_12
L.Δ*i*	0.772***	L.*i*	-0.345	-0.117	-0.06	-0.907***	-0.267*	0.16
	[0.18]		[0.21]	[0.09]	[0.06]	[0.16]	[0.15]	[0.12]
PCA_BoE_cpi	-0.178***	L.PCA_BoE_cpi	0.156*	0.044	0.014	-0.083	-0.105*	-0.049
	[0.03]		[0.08]	[0.03]	[0.02]	[0.06]	[0.06]	[0.05]
PCA_BoE_gdp	0.038*	L.PCA_BoE_gdp	-0.222	-0.160***	-0.07	0.186*	0.191*	0.044
	[0.02]		[0.14]	[0.06]	[0.04]	[0.11]	[0.10]	[0.08]
PCA_BoE_mc	0.535***	PCA_BoE_mc	0.478	0.345**	0.198**	1.004***	0.183	-0.114
	[0.07]		[0.32]	[0.13]	[0.09]	[0.24]	[0.22]	[0.18]
ZLB dummy	-0.007	ZLB dummy	0.160	0.803**	0.514*	-1.279*	-1.326**	-0.037
	[0.01]		[0.89]	[0.36]	[0.26]	[0.67]	[0.63]	[0.50]
L.PCA_PF_cpi	-0.100***	L.PCA_PF_cpi	-0.070*	-0.021	-0.026**	-0.056*	-0.011	0.019
	[0.03]		[0.04]	[0.02]	[0.01]	[0.03]	[0.03]	[0.02]
L.PCA_PF_gdp	-0.077***	L.PCA_PF_gdp	-0.052	0.05	0.064	0.043	0.056	0.028
	[0.02]		[0.14]	[0.06]	[0.04]	[0.10]	[0.10]	[0.08]
L.PCA_PF_ir3m	-1.231***	L.PCA_PF_ir3m	-0.053	-0.103***	-0.051*	-0.103	0.023	0.059
	[0.23]		[0.09]	[0.04]	[0.03]	[0.07]	[0.06]	[0.05]
Constant	2.317***	Constant	2.205**	1.405***	1.775***	4.071***	3.667***	2.451***
	[0.22]		[0.84]	[0.34]	[0.25]	[0.63]	[0.59]	[0.48]
Controls: Z_{t-1}	Yes	Controls: Z_{t-1}	Yes	Yes	Yes	Yes	Yes	Yes
N	125	N	42	42	42	42	42	42
R^2	0.99	R^2	0.64	0.86	0.84	0.90	0.69	0.67

Properties of exogenous shock series

	N	Mean	SD	Min	Max	AR(1)	AR(3)	SF-test pval.
ε_Bankrate	125	0.00	0.23	-0.95	0.62	0.45	0.20	0.02
ε_BoE_cpi_4	126	0.00	0.20	-0.85	0.70	0.00	0.10	0.00
ε_BoE_cpi_8	126	0.00	0.08	-0.42	0.39	0.00	-0.12	0.00
ε_BoE_cpi_12	126	0.00	0.06	-0.24	0.22	0.00	-0.18	0.00
ε_BoE_gdp_4	126	0.00	0.15	-0.53	0.56	0.00	-0.05	0.00
ε_BoE_gdp_8	126	0.00	0.14	-0.56	0.50	0.00	0.00	0.00
ε_BoE_gdp_12	126	0.00	0.11	-0.41	0.40	0.00	0.37	0.00

Correlation of exogenous shock series

	ε_Bankrate	ε_BoE_cpi_4	ε_BoE_cpi_8	ε_BoE_cpi_12	ε_BoE_gdp_4	ε_BoE_gdp_8	ε_BoE_gdp_12
ε_Bankrate	1						
ε_BoE_cpi_4	0.07	1					
ε_BoE_cpi_8	0.03	0.53	1				
ε_BoE_cpi_12	0.08	0.04	0.69	1			
ε_BoE_gdp_4	0.18	-0.05	0.12	0.47	1		
ε_BoE_gdp_8	0.09	-0.44	-0.37	0.11	0.56	1	
ε_BoE_gdp_12	0.03	-0.46	-0.30	-0.02	0.31	0.71	1

Predictability of exogenous shock series

	ε_Bankrate	ε_BoE_cpi_4	ε_BoE_cpi_8	ε_BoE_cpi_12	ε_BoE_gdp_4	ε_BoE_gdp_8	ε_BoE_gdp_12
VAR(1) - F-stat	1.21	0.25	0.25	0.13	0.18	0.05	0.32
VAR(1) - adj. R^2	0.01	-0.04	-0.04	-0.05	-0.05	-0.06	-0.04
VAR(3) - F-stat	1.11	1.28	0.51	0.38	1.24	1.00	1.15
VAR(3) - adj. R^2	0.02	0.05	-0.09	-0.12	0.04	0.00	0.03

Standard errors in brackets. * $p<0.10$, ** $p<0.05$, *** $p<0.01$. L is the lag operator. Column 1 and columns 2 to 7 correspond to the OLS estimation of equation (7) and (8) respectively. The Z_t vector of controls includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, and housing prices. Equation (7) also includes a dummy for when the Inflation Report is published. The SF-test is the Shapiro-Francia W' test for normal data.

Table A5 - Robustness tests about the left-hand side variable

	1	2	3	4	5	6	7	8	9	10
	PF_1y	PF_2y	PF_3y	PF_4y	PF_5y	PF_6y	PF_7y	PF_8y	PF_9y	PF_10y
Without correction for the inflation risk premium										
ε_Bankrate	-0.266**	-0.225**	-0.195**	-0.163**	-0.132**	-0.106**	-0.083*	-0.063	-0.049	-0.038
	[0.13]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.06]
ε_BoE_cpi_4	0.248*	0.219**	0.190**	0.150**	0.113*	0.084*	0.062	0.045	0.031	0.021
	[0.14]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.067	0.095	0.09	0.063	0.027	-0.008	-0.04	-0.068	-0.094	-0.117
	[0.15]	[0.11]	[0.09]	[0.08]	[0.07]	[0.07]	[0.07]	[0.07]	[0.08]	[0.08]
Without correction for credit, liquidity and inflation risk premia										
ε_Bankrate	-0.235	-0.214*	-0.186**	-0.157**	-0.126**	-0.099*	-0.074	-0.052	-0.032	-0.015
	[0.16]	[0.12]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.04]	[0.05]
ε_BoE_cpi_4	0.307**	0.245**	0.203**	0.161**	0.125**	0.096**	0.073*	0.054*	0.038	0.026
	[0.15]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.03]	[0.03]	[0.04]
ε_BoE_gdp_4	0.006	0.066	0.092	0.093	0.08	0.062	0.043	0.024	0.003	-0.019
	[0.13]	[0.11]	[0.09]	[0.08]	[0.07]	[0.06]	[0.06]	[0.05]	[0.05]	[0.05]
Pre/Post ZLB pricing of premia										
ε_Bankrate	-0.191*	-0.204**	-0.181***	-0.140***	-0.098**	-0.066	-0.038	-0.015	0.004	0.019
	[0.12]	[0.08]	[0.06]	[0.05]	[0.04]	[0.04]	[0.04]	[0.05]	[0.05]	[0.05]
ε_BoE_cpi_4	0.192*	0.134	0.106	0.076	0.048	0.026	0.011	0.003	0.000	0.001
	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.04]	[0.04]	[0.05]
ε_BoE_gdp_4	0.092	0.073	0.069	0.068	0.059	0.046	0.035	0.025	0.017	0.012
	[0.15]	[0.11]	[0.09]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.06]	[0.06]
Survey expectations-based correction of premia										
ε_Bankrate	0.041	-0.020	0.000	0.000	-0.013*	-0.024*	-0.032*	-0.038**	-0.043**	-0.046**
	[0.07]	[0.02]	[0.01]	[0.00]	[0.01]	[0.01]	[0.02]	[0.02]	[0.02]	[0.02]
ε_BoE_cpi_4	0.145***	0.01	-0.004	-0.001	-0.006	-0.011	-0.015	-0.019	-0.021	-0.023
	[0.04]	[0.06]	[0.03]	[0.01]	[0.01]	[0.01]	[0.01]	[0.02]	[0.02]	[0.02]
ε_BoE_gdp_4	0.018	0.097	0.049	0.016	-0.011	-0.020	-0.026	-0.031	-0.035	-0.037
	[0.07]	[0.08]	[0.04]	[0.01]	[0.01]	[0.02]	[0.02]	[0.02]	[0.03]	[0.03]

Heteroskedasticity robust standard errors in brackets. * p<0.10, ** p<0.05, *** p<0.01. Each column corresponds to the OLS estimation of equation (4) for a given horizon of private inflation expectations. 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 change between *t-1* and *t* in private output forecasts and in private 3-month interest rate forecasts, the FTSE index, the real activity, uncertainty and news indices of Scotti (2016), and FG and ZLB dummies. Z_t includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Table A6 - Robustness tests about the left-hand side variable

	1	2	3	4	5	6	7	8	9	10
	PF_1y	PF_2y	PF_3y	PF_4y	PF_5y	PF_6y	PF_7y	PF_8y	PF_9y	PF_10y
First difference										
ε_Bankrate	-0.317**	-0.233*	-0.185*	-0.151*	-0.123	-0.100	-0.077	-0.055	-0.037	-0.022
	[0.16]	[0.13]	[0.10]	[0.08]	[0.07]	[0.07]	[0.07]	[0.06]	[0.06]	[0.07]
ε_BoE_cpi_4	0.231	0.218**	0.187**	0.140**	0.095*	0.06	0.035	0.019	0.009	0.001
	[0.16]	[0.11]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.06]	[0.06]	[0.06]
ε_BoE_gdp_4	0.058	0.065	0.079	0.064	0.032	-0.006	-0.045	-0.08	-0.112	-0.139
	[0.17]	[0.11]	[0.09]	[0.08]	[0.07]	[0.07]	[0.07]	[0.08]	[0.08]	[0.08]
Deviation from target										
ε_Bankrate	-0.244**	-0.218**	-0.190**	-0.159**	-0.128**	-0.102**	-0.080	-0.062	-0.048	-0.039
	[0.12]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.06]
ε_BoE_cpi_4	0.258*	0.221**	0.190**	0.150**	0.113*	0.084*	0.062	0.045	0.032	0.021
	[0.14]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.096	0.11	0.101	0.073	0.036	0.000	-0.034	-0.064	-0.092	-0.118
	[0.15]	[0.11]	[0.09]	[0.08]	[0.07]	[0.07]	[0.07]	[0.07]	[0.08]	[0.08]
Last observation of each month										
ε_Bankrate	-0.259	-0.240	-0.226	-0.206	-0.177	-0.147	-0.120	-0.095	-0.073	-0.055
	[0.23]	[0.22]	[0.18]	[0.14]	[0.11]	[0.09]	[0.08]	[0.07]	[0.07]	[0.07]
ε_BoE_cpi_4	0.323**	0.213*	0.132	0.069	0.024	-0.006	-0.026	-0.038	-0.046	-0.05
	[0.16]	[0.12]	[0.10]	[0.08]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]
ε_BoE_gdp_4	0.085	0.048	0.024	0.000	-0.029	-0.06	-0.092	-0.123	-0.153*	-0.180*
	[0.17]	[0.14]	[0.13]	[0.11]	[0.10]	[0.09]	[0.09]	[0.09]	[0.09]	[0.10]
Gilts										
ε_Bankrate	.	.	.	-0.083	-0.070	-0.064	-0.057	-0.048	-0.040	-0.033
				[0.10]	[0.07]	[0.06]	[0.05]	[0.06]	[0.06]	[0.06]
ε_BoE_cpi_4	.	.	.	0.203***	0.149**	0.101	0.064	0.035	0.009	-0.012
				[0.07]	[0.06]	[0.06]	[0.07]	[0.08]	[0.09]	[0.10]
ε_BoE_gdp_4	.	.	.	-0.078	-0.082	-0.098	-0.121	-0.147*	-0.174*	-0.201**
				[0.07]	[0.06]	[0.07]	[0.07]	[0.08]	[0.09]	[0.10]

Heteroskedasticity robust standard errors in brackets. * p<0.10, ** p<0.05, *** p<0.01. Each column corresponds to the OLS estimation of equation (4) for a given horizon of private inflation expectations. 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 change between *t-1* and *t* in private output forecasts and in private 3-month interest rate forecasts, the FTSE index, the real activity, uncertainty and news indices of Scotti (2016), and FG and ZLB dummies. Z_t includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Table A7 - Robustness tests about the identification of monetary shocks

	1	2	3	4	5	6	7	8	9	10
	PF_1y	PF_2y	PF_3y	PF_4y	PF_5y	PF_6y	PF_7y	PF_8y	PF_9y	PF_10y
Shadow rate										
ε_Shadow rate	-0.124	-0.171**	-0.165**	-0.137**	-0.104**	-0.076	-0.054	-0.036	-0.022	-0.01
	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]
ε_BoE_cpi_4	0.262*	0.224**	0.193**	0.152**	0.115**	0.086*	0.063	0.046	0.032	0.021
	[0.14]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.065	0.108	0.107	0.079	0.039	-0.001	-0.036	-0.069	-0.099	-0.126
	[0.15]	[0.10]	[0.08]	[0.07]	[0.07]	[0.07]	[0.07]	[0.07]	[0.08]	[0.08]
Taylor rule identification										
ε_Bankrate_rob1	-0.012	-0.049	-0.048	-0.046	-0.036	-0.023	-0.009	0.003	0.013	0.022
	[0.16]	[0.11]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]
ε_BoE_cpi_4	0.264*	0.225**	0.196**	0.157**	0.118*	0.087*	0.064	0.046	0.032	0.022
	[0.14]	[0.11]	[0.09]	[0.08]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.015	0.036	0.036	0.018	-0.007	-0.034	-0.060	-0.083	-0.106	-0.128*
	[0.14]	[0.10]	[0.08]	[0.07]	[0.06]	[0.06]	[0.06]	[0.07]	[0.07]	[0.07]
Cloyne and Huertgen (2016)'s identification										
ε_Bankrate_rob2	-0.608	-0.229	-0.071	-0.054	-0.067	-0.075	-0.069	-0.051	-0.028	-0.006
	[0.42]	[0.28]	[0.21]	[0.18]	[0.16]	[0.14]	[0.13]	[0.13]	[0.13]	[0.14]
ε_BoE_cpi_4	0.280*	0.226**	0.191**	0.153**	0.120*	0.093*	0.071*	0.053	0.038	0.025
	[0.15]	[0.11]	[0.09]	[0.08]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.035	0.027	0.026	0.02	0.005	-0.016	-0.038	-0.063	-0.088	-0.112
	[0.15]	[0.11]	[0.09]	[0.07]	[0.07]	[0.06]	[0.07]	[0.07]	[0.07]	[0.08]
Monetary shock identification not controlling for IR months										
ε_Bankrate_rob3	-0.244**	-0.218**	-0.189**	-0.158**	-0.128**	-0.102**	-0.080	-0.062	-0.048	-0.038
	[0.12]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.06]
ε_BoE_cpi_4	0.258*	0.221**	0.190**	0.150**	0.113*	0.084*	0.062	0.045	0.032	0.021
	[0.14]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.096	0.11	0.101	0.073	0.036	0.000	-0.034	-0.064	-0.092	-0.118
	[0.15]	[0.11]	[0.09]	[0.08]	[0.07]	[0.07]	[0.07]	[0.07]	[0.08]	[0.08]
Without small values of monetary shocks										
ε_Bankrate	-0.388*	-0.331**	-0.288**	-0.241**	-0.194**	-0.15	-0.108	-0.074	-0.052	-0.042
	[0.23]	[0.16]	[0.13]	[0.11]	[0.10]	[0.09]	[0.09]	[0.10]	[0.10]	[0.10]
ε_BoE_cpi_4	0.264*	0.223**	0.191**	0.150**	0.113*	0.084*	0.061	0.044	0.03	0.02
	[0.13]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.118	0.13	0.118	0.086	0.047	0.008	-0.029	-0.062	-0.091	-0.117
	[0.14]	[0.11]	[0.09]	[0.08]	[0.07]	[0.07]	[0.07]	[0.08]	[0.08]	[0.09]
Pre Post ZLB										
ε_Bankrate	0.003	-0.112	-0.139	-0.144	-0.146*	-0.143*	-0.135*	-0.121	-0.101	-0.077
	[0.20]	[0.14]	[0.11]	[0.09]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.09]
ε_BoE_cpi_4	0.263*	0.234**	0.205**	0.167**	0.131**	0.102**	0.078*	0.059	0.043	0.029
	[0.15]	[0.12]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.06]
ε_BoE_gdp_4	0.015	0.051	0.053	0.037	0.011	-0.017	-0.044	-0.071	-0.097	-0.123*
	[0.14]	[0.10]	[0.08]	[0.07]	[0.06]	[0.06]	[0.06]	[0.07]	[0.07]	[0.07]
No PCA in equations (7)-(8)										
ε_Bankrate	-0.177	-0.192	-0.183	-0.168	-0.163	-0.162	-0.163	-0.163*	-0.161*	-0.159
	[0.27]	[0.24]	[0.20]	[0.17]	[0.14]	[0.12]	[0.10]	[0.09]	[0.10]	[0.10]
ε_BoE_cpi_4	0.281	0.294	0.24	0.164	0.095	0.042	0.004	-0.021	-0.034	-0.039
	[0.24]	[0.18]	[0.15]	[0.13]	[0.11]	[0.11]	[0.11]	[0.11]	[0.12]	[0.13]
ε_BoE_gdp_4	0.215	0.193	0.142	0.093	0.047	0.000	-0.047	-0.091	-0.133	-0.170*
	[0.25]	[0.19]	[0.15]	[0.13]	[0.11]	[0.09]	[0.09]	[0.09]	[0.09]	[0.10]

Heteroskedasticity robust standard errors in brackets. * p<0.10, ** p<0.05, *** p<0.01. Each column corresponds to the OLS estimation of equation (4) for a given horizon of private inflation expectations. 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 change between *t-1* and *t* in private output forecasts and in private 3-month interest rate forecasts, the FTSE index, the real activity, uncertainty and news indices of Scotti (2016), and FG and ZLB dummies. Z_t includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Table A8 - Robustness tests about BoE projections

	1	2	3	4	5	6	7	8	9	10
	PF_1y	PF_2y	PF_3y	PF_4y	PF_5y	PF_6y	PF_7y	PF_8y	PF_9y	PF_10y
Projection surprises interpolated										
ε_Bankrate	-0.174	-0.189*	-0.164*	-0.130*	-0.095	-0.065	-0.041	-0.023	-0.011	-0.004
	[0.12]	[0.11]	[0.09]	[0.08]	[0.06]	[0.06]	[0.05]	[0.05]	[0.06]	[0.06]
ε_BoE_cpi_4	0.271***	0.119*	0.078	0.053	0.034	0.019	0.008	-0.001	-0.007	-0.011
	[0.10]	[0.07]	[0.05]	[0.05]	[0.04]	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]
ε_BoE_gdp_4	-0.126	-0.038	-0.031	-0.048	-0.071	-0.091**	-0.107**	-0.117***	-0.124***	-0.127**
	[0.10]	[0.07]	[0.06]	[0.05]	[0.05]	[0.04]	[0.04]	[0.04]	[0.05]	[0.05]
Projections interpolated										
ε_Bankrate	-0.346**	-0.257**	-0.204**	-0.162**	-0.123*	-0.089	-0.059	-0.035	-0.016	-0.005
	[0.15]	[0.12]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]
ε_BoE_cpi_4	0.186	0.135	0.111	0.087	0.063	0.041	0.022	0.006	-0.006	-0.015
	[0.11]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.04]	[0.04]
ε_BoE_gdp_4	0.215	0.096	0.04	0.008	-0.019	-0.044	-0.067	-0.088**	-0.105**	-0.118**
	[0.14]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.06]
Bankrate in equation (8)										
ε_Bankrate	-0.434	-0.359	-0.267	-0.188	-0.100	-0.014	0.064	0.129	0.176	0.207
	[0.27]	[0.23]	[0.18]	[0.14]	[0.11]	[0.09]	[0.09]	[0.09]	[0.11]	[0.13]
ε_BoE_cpi_4	0.361**	0.234*	0.193*	0.169**	0.151**	0.136**	0.119**	0.101**	0.082	0.068
	[0.15]	[0.12]	[0.10]	[0.08]	[0.07]	[0.05]	[0.05]	[0.05]	[0.05]	[0.06]
ε_BoE_gdp_4	0.018	0.043	0.025	-0.007	-0.046	-0.085	-0.12	-0.152**	-0.179**	-0.200**
	[0.17]	[0.15]	[0.13]	[0.11]	[0.09]	[0.08]	[0.07]	[0.07]	[0.07]	[0.07]
Raw projections										
ε_Bankrate	-0.251**	-0.207**	-0.173**	-0.144**	-0.116**	-0.092*	-0.073	-0.058	-0.049	-0.043
	[0.12]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.04]	[0.05]
ε_BoE_cpi_4	0.131**	0.056	0.033	0.019	0.006	-0.004	-0.012	-0.018	-0.022	-0.025
	[0.06]	[0.04]	[0.04]	[0.03]	[0.03]	[0.03]	[0.02]	[0.02]	[0.02]	[0.03]
ε_BoE_gdp_4	0.113	0.014	-0.022	-0.045	-0.065*	-0.080***	-0.090***	-0.096***	-0.098***	-0.098***
	[0.08]	[0.06]	[0.05]	[0.04]	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]

Heteroskedasticity robust standard errors in brackets. * p<0.10, ** p<0.05, *** p<0.01. Each column corresponds to the OLS estimation of equation (4) for a given horizon of private inflation expectations. 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 change between *t-1* and *t* in private output forecasts and in private 3-month interest rate forecasts, the FTSE index, the real activity, uncertainty and news indices of Scotti (2016), and FG and ZLB dummies. Z_t includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Table A9 - Robustness tests about samples and controls

	1	2	3	4	5	6	7	8	9	10
	PF_1y	PF_2y	PF_3y	PF_4y	PF_5y	PF_6y	PF_7y	PF_8y	PF_9y	PF_10y
Pre 2009										
ε_Bankrate	-0.502***	-0.391***	-0.336***	-0.305***	-0.276***	-0.240***	-0.194**	-0.143*	-0.092	-0.045
	[0.17]	[0.14]	[0.12]	[0.10]	[0.09]	[0.08]	[0.07]	[0.08]	[0.08]	[0.08]
ε_BoE_cpi_4	0.803**	0.748**	0.611**	0.480**	0.361**	0.270*	0.217*	0.191	0.176	0.16
	[0.39]	[0.34]	[0.29]	[0.23]	[0.18]	[0.14]	[0.12]	[0.13]	[0.14]	[0.15]
ε_BoE_gdp_4	0.701	0.675*	0.571*	0.497**	0.421**	0.340**	0.265**	0.212	0.18	0.161
	[0.44]	[0.37]	[0.29]	[0.23]	[0.17]	[0.13]	[0.12]	[0.13]	[0.15]	[0.16]
Post 2009										
ε_Bankrate	-0.256*	-0.257**	-0.221**	-0.188**	-0.156*	-0.133	-0.119	-0.112	-0.111	-0.111
	[0.14]	[0.11]	[0.10]	[0.09]	[0.08]	[0.08]	[0.09]	[0.09]	[0.09]	[0.08]
ε_BoE_cpi_4	0.084	0.054	0.045	0.028	0.012	0.003	-0.001	0.000	0.003	0.006
	[0.11]	[0.08]	[0.06]	[0.05]	[0.04]	[0.04]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	-0.034	0.094	0.105	0.092	0.068	0.04	0.014	-0.008	-0.03	-0.052
	[0.14]	[0.11]	[0.10]	[0.09]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]
No controls										
ε_Bankrate	-0.234*	-0.222**	-0.198**	-0.180**	-0.161**	-0.141**	-0.121**	-0.101*	-0.081	-0.061
	[0.13]	[0.09]	[0.08]	[0.07]	[0.07]	[0.06]	[0.06]	[0.06]	[0.06]	[0.06]
ε_BoE_cpi_4	0.241*	0.181	0.147	0.108	0.074	0.044	0.018	-0.002	-0.018	-0.029
	[0.14]	[0.12]	[0.10]	[0.09]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.06]
ε_BoE_gdp_4	0.112	0.136	0.12	0.087	0.047	0.008	-0.03	-0.064	-0.095	-0.122
	[0.14]	[0.12]	[0.10]	[0.09]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.09]
VAT dummies										
ε_Bankrate	-0.235**	-0.213**	-0.185**	-0.155**	-0.125**	-0.100*	-0.078	-0.062	-0.05	-0.042
	[0.11]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.06]
ε_BoE_cpi_4	0.258*	0.221**	0.189**	0.149**	0.113*	0.083*	0.061	0.045	0.032	0.023
	[0.14]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.092	0.109	0.1	0.072	0.035	-0.001	-0.034	-0.064	-0.091	-0.115
	[0.15]	[0.11]	[0.09]	[0.08]	[0.07]	[0.07]	[0.07]	[0.07]	[0.08]	[0.08]
FG dummies										
ε_Bankrate	-0.279**	-0.259**	-0.220**	-0.181**	-0.148**	-0.120**	-0.098*	-0.08	-0.067	-0.057
	[0.13]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.06]
ε_BoE_cpi_4	0.224*	0.187*	0.166*	0.130*	0.095	0.065	0.042	0.023	0.008	-0.005
	[0.13]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.108	0.123	0.112	0.081	0.043	0.005	-0.03	-0.061	-0.091	-0.117
	[0.15]	[0.11]	[0.09]	[0.08]	[0.07]	[0.07]	[0.07]	[0.08]	[0.08]	[0.09]

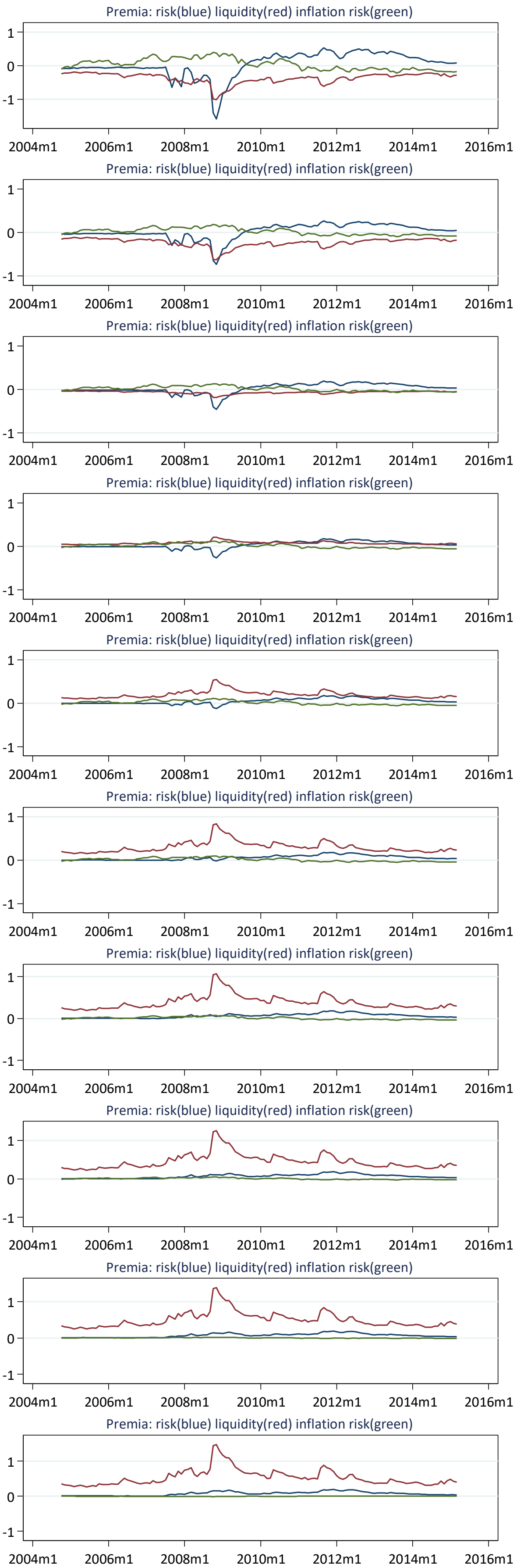
Heteroskedasticity robust standard errors in brackets. * p<0.10, ** p<0.05, *** p<0.01. Each column corresponds to the OLS estimation of equation (4) for a given horizon of private inflation expectations. For parsimony, only the key coefficients are reported. Complete tables are available from the authors 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 change between *t-1* and *t* in private output forecasts and in private 3-month interest rate forecasts, the FTSE index, the real activity, uncertainty and news indices of Scotti (2016), and FG and ZLB dummies. Z_t includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Table A10 - Robustness tests about controls

	1	2	3	4	5	6	7	8	9	10
	PF_1y	PF_2y	PF_3y	PF_4y	PF_5y	PF_6y	PF_7y	PF_8y	PF_9y	PF_10y
Slack measures										
ε_Bankrate	-0.250*	-0.210**	-0.179**	-0.152**	-0.128**	-0.108*	-0.09	-0.076	-0.066	-0.059
	[0.14]	[0.10]	[0.08]	[0.07]	[0.06]	[0.06]	[0.06]	[0.06]	[0.06]	[0.06]
ε_BoE_cpi_4	0.219	0.195*	0.169*	0.131*	0.096*	0.070	0.051	0.037	0.027	0.019
	[0.14]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.05]	[0.05]
ε_BoE_gdp_4	0.062	0.076	0.077	0.058	0.029	-0.002	-0.031	-0.058	-0.084	-0.106
	[0.15]	[0.10]	[0.08]	[0.07]	[0.07]	[0.07]	[0.07]	[0.08]	[0.08]	[0.09]
Financial stress measures										
ε_Bankrate	-0.266*	-0.224**	-0.190**	-0.156**	-0.124**	-0.097**	-0.073*	-0.053	-0.036	-0.022
	[0.14]	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.04]	[0.04]	[0.04]
ε_BoE_cpi_4	0.249**	0.215**	0.189**	0.152**	0.117**	0.087*	0.063	0.043	0.027	0.014
	[0.12]	[0.10]	[0.08]	[0.07]	[0.06]	[0.05]	[0.04]	[0.03]	[0.03]	[0.04]
ε_BoE_gdp_4	0.069	0.119	0.125	0.115	0.094	0.068	0.041	0.014	-0.013	-0.038
	[0.15]	[0.12]	[0.10]	[0.09]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]
More lags of the dependent variable										
ε_Bankrate	-0.060	-0.100	-0.110	-0.114*	-0.111**	-0.101*	-0.085*	-0.070	-0.061	-0.059
	[0.11]	[0.09]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]	[0.06]
ε_BoE_cpi_4	0.328**	0.247***	0.185***	0.134**	0.092**	0.055	0.029	0.016	0.013	0.014
	[0.14]	[0.09]	[0.07]	[0.05]	[0.04]	[0.04]	[0.04]	[0.05]	[0.05]	[0.06]
ε_BoE_gdp_4	0.112	0.107	0.102	0.078	0.048	0.013	-0.026	-0.061	-0.088	-0.109
	[0.17]	[0.11]	[0.08]	[0.06]	[0.06]	[0.06]	[0.07]	[0.07]	[0.08]	[0.09]
EC sentiment measures										
ε_Bankrate	-0.240*	-0.223**	-0.189**	-0.153**	-0.118**	-0.089*	-0.064	-0.044	-0.03	-0.02
	[0.12]	[0.09]	[0.07]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.06]	[0.06]
ε_BoE_cpi_4	0.209	0.192*	0.173**	0.137**	0.101*	0.072*	0.049	0.032	0.018	0.008
	[0.14]	[0.11]	[0.09]	[0.07]	[0.05]	[0.04]	[0.04]	[0.04]	[0.04]	[0.05]
ε_BoE_gdp_4	0.069	0.074	0.07	0.046	0.013	-0.021	-0.051	-0.078	-0.102	-0.124
	[0.14]	[0.10]	[0.08]	[0.07]	[0.06]	[0.06]	[0.06]	[0.07]	[0.08]	[0.08]

Heteroskedasticity robust standard errors in brackets. * p<0.10, ** p<0.05, *** p<0.01. Each column corresponds to the OLS estimation of equation (4) for a given horizon of private inflation expectations. 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 change between *t-1* and *t* in private output forecasts and in private 3-month interest rate forecasts, the FTSE index, the real activity, uncertainty and news indices of Scotti (2016), and FG and ZLB dummies. Z_t includes CPI, industrial production, oil prices, the sterling effective exchange rate, net lending, housing prices.

Figure A1 – Predicted values of the three premia (in pp)



Note: The first row is for 1-year ahead inflation expectations, the second for 2-year ahead, and so on. The risk premium is in blue, the liquidity one in red and the inflation risk one in green.