Monetary Policy Transparency and the Information Effect

Marco Pinchetti* Andrzej Szczepaniak†

ECARES and Bank of England *Ghent University*

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Abstract

In this paper, we investigate the impact of monetary policy transparency measures on the relevance of the information effect channel of central bank communication. Our paper focuses on the switch in the Bank of England's communication strategy, occured in August 2015, from a multi-day to a single-day release schedule. Before August 2015, the minutes of the monetary policy committee and the inflation report (i.e. the Bank's analysis of the economic outlook), were published only some weeks after the monetary policy decision. By contrast, after August 2015, the Bank of England started releasing all accompanying documents alongside the policy rate announcement, in the attempt to increase the transparency of its policy-making process. We construct an interest rate surprise series for the release of each one of the three communication documents of the Bank, and provide evidence that information effects are a key driver of the financial market response to central bank communication for each one of these documents. Before August 2015, according to our results, the information effect accounted for approximately two thirds of the interest rate surprise, the inflation expectations, and the equity price variation on the release days. However, we find that the switch from a multi-day release schedule to a single-day communication strategy markedly reduced the importance of information effects. Our findings suggest that the degree of transparency of a central bank's policies significantly affects the quantitative relevance of the information effect and the associated asset price response.

*Bank of England and ECARES, Solvay Brussels School of Economics and Management, Université libre de Bruxelles. E-mail: marco.pinchetti@bankofengland.co.uk

†Macroeconomics, Policy, and Econometrics Research Group, Department of Economics, Ghent University. E-mail: Andrzej.Szczepaniak@UGent.be

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JEL Classification: E30, E40, E50

1. Introduction

During the last decades, central banks have taken several measures to increase the transparency of their monetary policy. While only some decades ago central banks used to conduct their monetary policies in total confidentiality, today central banks regularly publish reports about the economic outlook, their approach to formulate policy decisions, and their long term objectives. With the increase in the focus on the communication of monetary policy decisions, transparency has become essential for central banking communication to achieve credibility and accountability[1]. The transition to a regime of full transparency had, according to many, a profound impact on the way in which central banks communicate to financial markets.

In the meanwhile, the recent literature about monetary event-studies has developed techniques to analyse the effect of central bank communication. In particular, papers like Nakamura and Steinsson (2018), have shown that central bank communication affect markets' expectations via two distinct channels: the communication of its policy decisions (the monetary policy effect) and the communication of its views about the state of the economy (the central bank information effect). The concept of information effect hinges on the idea that, when central banks announce their policy decisions, they can influence market inflation expectations as well as their beliefs about future developments of the economic conjuncture. This process can either be explicit, whereby the central bank affects market expectations by releasing its economic projections or implicit, whereby financial markets try to infer the central bank's beliefs from the policy decision and communication releases. The information channel of central bank communication, in principle, arises as a consequence of the misalignment between the central bank and the private sector expectations. Therefore, transparency policies which aim to make more explicit how central banks formulate their expectations, have the potential to reduce the quantitative relevance of this channel.

In this paper, we exploit a change in the Bank of England's communication release schedule, which occurred in August 2015, in order to evaluate the effect of transparency policies on the quantitative relevance of the information effect. The natural experiment we consider is the switch of the Bank of England communication strategy from a multiple-day to a single day release of its key communication documents, occurred in August 2015.

The simultaneous release of the MPC[2] minutes and the Inflation Report, alongside the MPC an-

[1] In this work, we adopt the definition of central bank transparency provided by Faust and Svensson (2002), i.e. "how easily the public can deduce central bank goals and intentions from observables'".

[2] MPC is the standard acronym for the Bank of England's Monetary Policy Committee, the main governance body of the Bank, composed of nine members – the Governor, the three Deputy Governors, the Chief Economist and four external members appointed directly by the Chancellor.

nouncement, was part of an ambitious plan to modernise the Bank of England's communication approach in response to the publication of the Warsh Review in December 2014, a comprehensive review of the Bank of England communication strategy which had four strategic policy objectives: "making sound policy decisions, communicating judgments effectively, ensuring accountability for its actions, and creating a fair and accurate historical record".

In practice, the aim of this reform of the communication setup was to make the financial markets immediately aware of the rationale underlying policy decisions. In the words of the former Bank of England governor Mark Carney, these arrangements would "enhance the effectiveness of monetary policy communications, making the policy signals [...] as clear as possible", removing the "drip-feed of news" (Carney, 2014). In support to this idea, Armstrong et al. (2015) provide survey evidence that according to the vast majority of leading UK-based macroeconomists, the simultaneous release of the policy decision would facilitate inference on the likely stance of monetary policy.

Before the introduction of the so-called new release strategy in August 2015, the Bank of England would release its monetary policy announcement at a different moment in time to news about the economy[3]. In particular, the three most relevant documents for financial markets were regularly released on distinct days in the following order: (1) the MPC statement containing *only* the interest rate decision (at a monthly frequency) and *without any* accompanying explanation, (2) the Inflation Report (one week later, quarterly in the middle month of the quarter), and (3) the MPC meeting minutes (two weeks after the monetary policy decision announcement, following every meeting). The Inflation Report, released quarterly, serves two purposes. First (1), it "*provides a comprehensive and forward-looking framework for discussion among Monetary Policy Committee members as an aid to decision-making*", and second (2) allows the Bank's staff to "*share its thinking and explain the reasons for their decisions*". Therefore the Inflation Report represents, for the financial sector, an important source of information regarding the medium-term future economic outlook and the Bank's beliefs about the future up to three years ahead. Meanwhile, the MPC meeting minutes was the only document available to investors in order to understand the motivation underlying the Bank's policy decision; the minutes would provide a detailed analysis of recent economic data justifying the decision, along with commentary about the Committee's beliefs regarding the immediate to short-term future.

[3]See Figure 1 for a detailed comparison of the communication release schedule before and after August 2015.

Figure 1: Communication Release Schedule Before and After August 2015

	Before August 2015	From August 2015
Wednesday		"Pre-MPC" meeting with staff presentations to the MPC (joint MPC-FPC briefing meetings will take place four times a year).
Thursday		Stage 1: MPC deliberation meeting
Friday	"Pre-MPC" meeting with staff presentations to the MPC	
Monday		Stage 2: MPC policy discussion meeting
Tuesday		
Wednesday	Stage 1: MPC deliberation meeting	Stage 3: MPC decision meeting
Thursday	• Stage 2: MPC discussion and decision meeting • Announcement of monetary policy decision	• Announcement of monetary policy decision and simultaneous publication of minutes • Inflation Report and press conference in Inflation Report months
Wednesday one week later	Inflation Report and press conference in Inflation Report months	
Wednesday two weeks later	Minutes published	

Source: BankofEngland (2014)

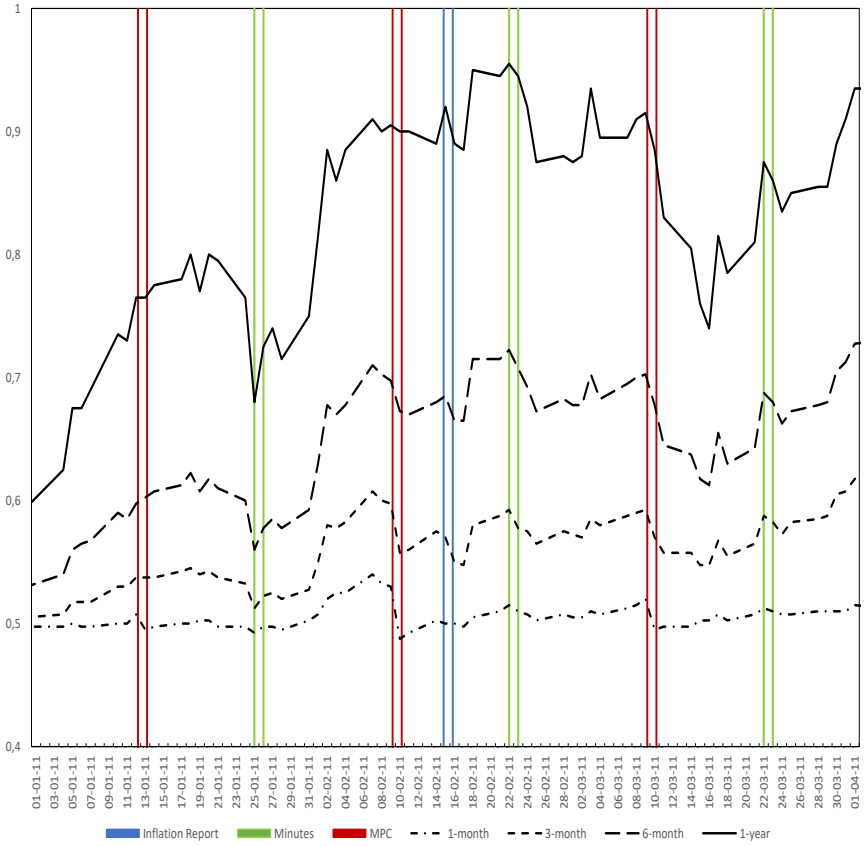
The information release process therefore comprised three stages, as illustrated in Figure 2, where we show the communication sequence of the Bank of England during the first quarter of 2011. First, the central bank releases the monetary policy decision, and agents form some conjectures (beliefs) with respect to the motivation of the decisions and the informational content of the announcement. Second, in months where the Inflation Report is released, agents acknowledge the Bank's perspective about future economic developments and update their beliefs for (potentially) the first time. Third, the MPC meeting minutes are released. Therefore, agents acknowledge the actual motivation behind the monetary policy decision and the Committee's beliefs about the immediate future, and agents update their beliefs (potentially) for the second time (or for the third time in Inflation Report months). Hence we are able to, using daily data, construct three separate surprise series, one for each event, and thus disentangle the effects of the Inflation Report and the MPC meeting minutes on financial market expectations from the effect of the monetary policy announcement itself.

Our paper comprises four empirical exercises. First, we construct an interest rate surprise series for each Bank of England communication event. Second, in a high-frequency exercise, we evaluate how financial markets react to each of these different communication releases before and after the change in the communication strategy. In particular, we look at nominal government bond yields, inflation expectations, as well as equity prices. Third, using the sign restrictions methodology of Jarociński and Karadi (2020), we decompose each of our series into pure monetary policy and pure information effects, and we compare the informational content in each surprise pre- and post- the Bank of England communication strategy change. Finally, we evaluate the impact of the introduction of the simultaneous release of the three key communication documents on the financial markets' response to interest rate surprises by estimating a time-varying parameter linear regression model.

The paper contributes to the literature by evaluating the empirical relevance of the informational content of central bank communication in the United Kingdom, and by assessing the impact of the release schedule reform on the financial market response to central bank announcements.

The article is structured as follows. In Section 2, we review the literature adopting high-frequency identification methods in monetary policy analysis as well as the literature about the monetary policy consequences of central bank transparency, and the literature about the central bank information effects. In Section 3, we provide full details on how we construct our central bank interest rate surprises. In Section 4, we look to understand how central bank communication affects expectations with respect to inflation, equity prices, and government bond yields under different communication regimes. In Section 5, we disentangle the content of the Bank of England announcements via a sign restriction methodology. In Section 6, we analyse the impact of the introduction of the new release

Figure 2: OIS Rates and Central Bank Releases - Extract From 2011Q1



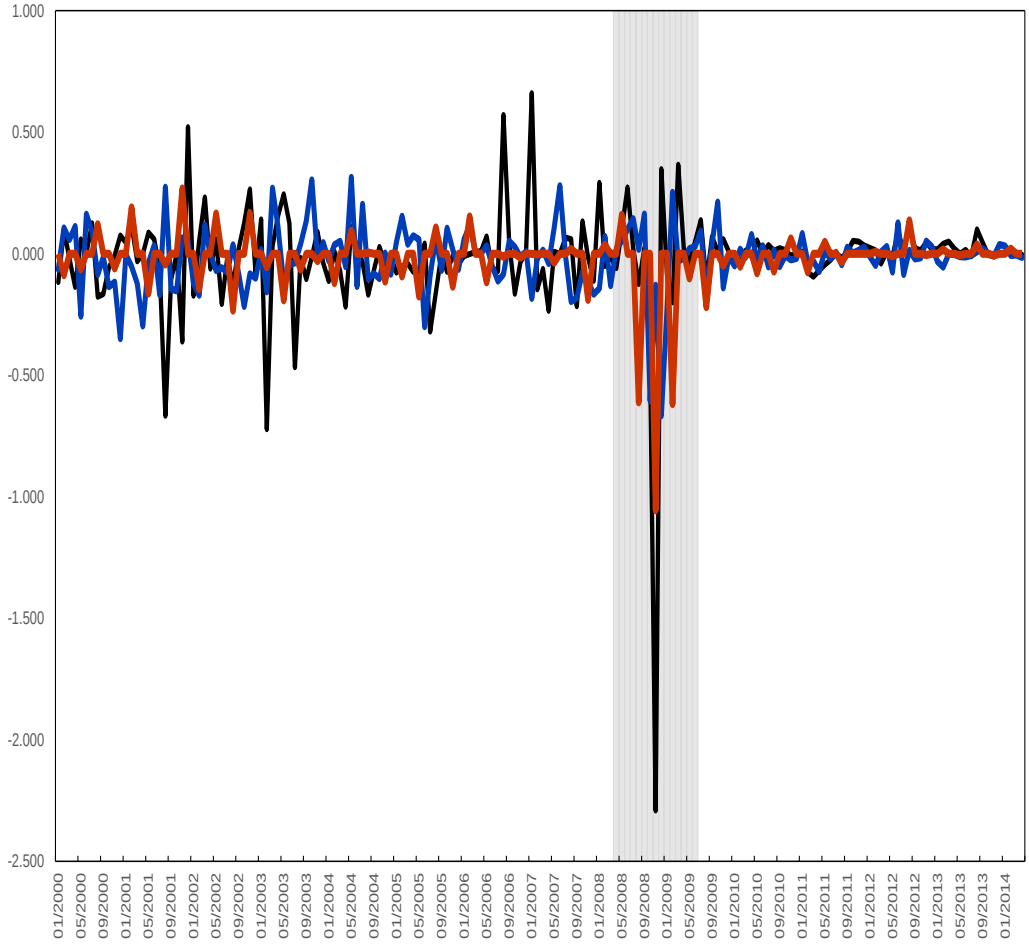
The figure displays 1-month, 3-month, 6-month, and 1-year OIS rates between January and March 2011. Red lines define MPC meeting dates, green lines define MPC minutes release dates, and blue lines define Inflation Report release dates. Source: authors' computations based on Bank of England data.

schedule reform on the financial markets' response to the BoE announcements. Finally, Section 7 concludes the paper.

2. Related literature

Central bank transparency. Our paper relates to the literature investigating the effects of central bank transparency measures on the effectiveness and the transmission of monetary policy. Faust and Svensson (2002) and Geraats (2002), show that transparency increases the sensitivity of the public's inflation expectations to changes in monetary policy via a reputational effect. Chortareas et al. (2002) find that a higher degree of central bank transparency is associated with lower average inflation. Liu et al. (2008) find that with higher transparency, monetary policy is more effective on short-term interest rates. Dincer and Eichengreen (2014) show that central bank transparency reduces inflation volatility, yet not inflation persistence. However, van der Cruijsen and Demertzis (2007) find that

Figure 3: Monetary and Information Surprise Series
(January 2000 - December 2014)



The figure displays the first covariance matrix based Dynamic Principal Component extracted from the OIS curve variation during announcement and news release dates, aggregated at monthly frequency. Red lines represents the OIS curve response to Inflation Report surprises, the blue line represents the OIS curve response to MPC minute release surprises, and the black line represents the OIS curve response to MPC announcements. Source: Bank of England and authors' computations.

monetary policy is more effective for low-transparency central banks, and Lustenberger and Rossi (2020) show that there is only a limited gain from transparency in terms of accuracy of the private forecasts.

High-frequency event studies in monetary policy analysis.. Methodologically, our paper builds on the literature which uses high-frequency methods in order to identify the effect of conventional and unconventional monetary policies. Cook and Hahn (1989) and Kuttner (2001) pioneered the use of high-frequency identification of monetary policy surprises in order to study the effects of Fed announcements on interest rates and money issuances. Cochrane and Piazzesi (2002), meanwhile, proposed to aggregate daily surprises derived from high-frequency data in order to construct a monthly monetary policy surprise series for use in SVAR analysis on financial data. In the construction of our central bank communication surprises, our paper follows the methodology of Gürkaynak et al. (2005) which exploits principal components analysis in order to condense a number of Fed fund futures series into a single time series which represents overall future monetary policy expectations. In particular, our approach follows Gürkaynak et al. (2005) and Campbell et al. (2012), who stresses the necessity to include future expectations of monetary policy to correctly evaluate the impact of forward guidance announcements with respect to asset prices.

Several authors exploit event-study methodologies in order to study the effect of central bank communication on financial markets. Krishnamurthy and Vissing-Jørgensen (2011) find evidence that quantitative easing measures affect several classes of assets, including long-term bonds. Rosa (2012) studies the effect of quantitative easing using data from financial newspapers, news releases, and finds quantitative easing to qualitatively have similar results to conventional interest rate cuts. Wright (2012) combines a VAR with a high-frequency approach, finding that unconventional monetary policy has significant but short-lived effects. Gilchrist et al. (2015), using daily data, conclude that the effect of unconventional policies on real borrowing costs is comparable to that of conventional policy. Hanson and Stein (2015) find that monetary policy affects bonds at long maturities, in contrast to conventional business cycle models.

The information effect of central bank communication. Our paper more directly relates to the literature concerning the identification of information effects on the macroeconomy. The original idea dates back to Romer and Romer (2000), who show that a central bank's information set is typically larger than the one of the private sector, and they attribute long-term interest rate dynamics in response to monetary announcements to the disclosure from the central bank of news about the future economic conditions. Nakamura and Steinsson (2018) show that the market response to central bank announcements reflects a balance of monetary and information components. Several contribu-

tions developed identification strategies to disentangle these two components. Miranda-Agrippino and Ricco (2020) and Lakdawala (2019) use high-frequency identification as an external instrument in a SVAR model in order to capture the informational component of forward guidance announcements. Matheson and Stavrev (2014), Jarociński and Karadi (2020), and Andrade and Ferroni (2016) use high-frequency data on asset prices in conjunction with sign restrictions to disentangle monetary policy shocks from central bank information shocks. Lewis et al. (2019) use household survey data from the US in order to extract surprises in household expectations and study the dynamics of such shocks using the local projections method of Jordá (2005). Cieslak and Schrimpf (2019) observe a number of communication releases by four major central banks and exploit the co-movement of interest rates and asset prices jointly with monotonicity restrictions across the yield curve in order to separate information effects from monetary policy effects.

High-frequency event studies and UK monetary policy. Several authors have conducted event studies around central bank announcements using data from the UK, although they focus on different aspects. Gerko and Rey (2017) study the effects of monetary and information surprises on, primarily, financial markets in the US and the UK, seeking ultimately to ascertain if there are financial spillovers. Hubert (2019) studies the interaction of monetary policy and information shocks with the aim of understanding whether monetary policy effects are different in months without the publication of the Inflation Report versus months with. Hansen et al. (2019) use textual analysis techniques in order to extract the informational content of the Inflation Report. Cesa-Bianchi et al. (2020) study the effect of monetary policy in the UK in a VAR identified using external instruments.

3. Constructing the central bank communication release surprise series

In this section, we explain in detail how we construct the monetary policy surprise series which we will employ in our empirical exercises. The technique we employ falls within the class of high-frequency identification schemes pioneered by Gürkaynak et al. (2005).

Expectations of monetary policy. A number of financial markets instruments can be used to convey expectations concerning the path for monetary policy of a given central bank, and in particular, the key policy rate. In the US, for example, Fed funds futures are used to convey expectations of the path for the Fed Funds (Target) Rate. In the UK, an often quoted measure of monetary policy expectations is the GBP overnight index swap (OIS) curve. The OIS curve comprises different tenors, i.e. the duration or time-to-maturity of each section of the curve. For illustration, the 1-month tenor is the expectation of Bank Rate in one month's time, whereas the 12th-month tenor is the expectation

of Bank Rate in one year time, and so on. Hence by using the informational content of the whole curve, we capture a more comprehensive set of information, eliminating any possible bias induced by the use of a single tenor.

The use of OIS contracts has several advantages compared to more standard policy rate futures, as explained by Lloyd (2018). First, liquidity premia on OIS contracts are smaller as there is no initial cash flow between the counterparts. Second, as there is no exchange of principal, so counterparty risk is limited. Third, many OIS trades are collateralised, so credit risk is also minimised. Lastly, OIS contracts are preferable to futures contracts for being internationally comparable.

The data. For our baseline analysis, OIS curve yields are obtained from ICAP, available on Refinitiv Datastream. Tenors from 1m to 12m are available, from January 2000 to July 2015, at daily frequency (close-to-close). In a sensitivity analysis, we also use OIS data available from the Bank of England[4] which is available from January 2009 onwards but includes tenors 1m to 60m. The dates of MPC meetings, the release of the inflation report, and the release of the MPC meeting minutes are all available on the Bank of England website[5]. Our database includes 437 announcements and news release episodes from January 2000 to July 2015, including 188 monetary policy decision announcements, 187 MPC meeting minutes releases, and 62 Inflation Report releases, and 40 joint announcements from August 2015 to December 2019.

Identifying the shock. We compute the change in each tenor along the whole of the OIS curve between t and $t-1$, where t is the day of release for the Bank Rate announcement (BR), the MPC minutes (MIN), or the Inflation Report (IR). Yields are reported as close of business on each day for which a yield is published. The change in an OIS tenor directly reflects new informational content from the central bank release which was not anticipated by financial market participants. From the set of daily changes in the different tenors, we obtain the whole curve of the market reaction for each tenor, as defined in Equation (1), where $k = \{\text{BR}, \text{MIN}, \text{IR}\}$ determines the type of release in question, and m is the tenor:

$$\mathcal{O}_{t,m,k} = OIS_{t,m,k} - OIS_{t-1,m,k} \tag{1}$$

In the high-frequency literature, much debate remains regarding the time window used. Work by Gürkaynak et al. (2005) and Lewis et al. (2019) suggest that a daily window is optimal despite an increasing amount of research using half an hour windows. Namely, Gürkaynak et al. (2005) show that results from high-frequency identification exercises are typically robust to the extension from

[4]Bank of England yield curve data is available from https://www.bankofengland.co.uk/statistics/yield-curves

[5]See https://www.bankofengland.co.uk/about/people/monetary-policy-committee and https://www.bankofengland.co.uk/news/

an intra-day to a daily sampling window and that the selection of a daily window versus longer windows reduces any possible contamination in the analysis. Lewis et al. (2019) meanwhile argue that some financial market participants may not fully incorporate all the information on the impact of the release due to interpretation complexities.

In our view, the use of data at daily frequencies brings two advantages. Firstly, as argued by Hansen et al. (2019), the complexity of documents such as the Inflation Report or the MPC meeting minutes implies a non-trivial processing lag in the market reaction to the release of such documents. Secondly, choosing a daily window avoids any potential disturbance attributable to occasional changes in the event schedule, delays, and extensions of the press conferences.

Constructing the surprise series. In order to exploit the informational content of the whole OIS curve, we take a weighted average of all possible *dynamic* principal components of equation (1) for each k separately, where the weights are the proportion of the original data explained by that principal component score. Hence we obtain three separate series of policy index surprises: one for the Bank Rate announcement; one for the release of the MPC minutes; and one for the release of the Inflation Report. We denote this $i_{t,k}$. An advantage of our approach is that it can incorporate all the information conveyed by the whole of the OIS curve, as opposed to arbitrarily relying on some author self-selected tenors. In our baseline analysis, we have expectations of monetary policy up to a year from t. Furthermore, using high-frequency identification means that our policy surprise index for the MPC minutes and Inflation Report will likely only reflect forward guidance or central bank information effects, given that the monetary policy shock will have *already* occurred. Additionally, one can plausibly argue that the OIS curve would not be markedly affected by other events not related to the central bank releases in such a short time frame.

Selection of the principal component analysis methodology. We construct our principal component scores with the dynamic principal component analysis (DPCA), following the approach of Brillinger (2001), widely used in vector time series and uses frequency domain analysis. This specification has the advantage of being robust to correlations between tenor surprises. We implement this method based on the covariance matrix as opposed to the correlation matrix, without standardising the data, given that the daily changes in each tenor of the OIS curve have the same unit of measurement, as well as almost the same mean and standard deviation. Therefore, the interpretation of the resulting series is straightforward as the unit of measure of the surprise policy index is the same as the policy rate[6].

[6]Broadly speaking, this means that a 0.1% shock to our policy surprise index corresponds to a 0.1% shock to the whole expected path of future policy rates from 1m to 12m.

4. Financial market expectations

4.1. Econometric methodology

The primary aim of this section is to understand how the different announcements and releases of information by the Bank of England affect expectations of inflation and output in the two different periods we consider: the pre July-2015, and the post-August 2015 period.

The model. In order to do capture the high-frequency market response of the information and policy communications, we estimate Equation (2). We follow the standard procedure of Gürkaynak et al. (2005) whereby we regress our shock variables on a selection of variables of interest, as detailed below. This will allow us to ascertain which if any of our constructed policy index exhibit characteristics of central bank information effects. Given our shock variables were obtained using a high-frequency identification scheme, the dependent variables we consider need to reflect the same time frame in order to minimise noise in our estimation or unwanted influence from other variables.

$$s_{t,k} = \gamma_k i_{t,k} + \epsilon_t \tag{2}$$

$i_{t,k}$ is the series which measures the unexpected change in the OIS curve for a given k. $s_{t,k}$ is the change in the corresponding variable between t and $t-1$, depending on the type of release indexed by k, where t corresponds to the date of the release of information k. ϵ_t is the error term and γ is a parameter. Estimation is by OLS and using Newey-West standard errors.

The data. We focus on financial markets' expectations for inflation and output, thus allowing us to cleanly see the effects of each type of shock, which is a novelty of our paper. For inflation expectations, we consider two widely used measures. First, we use Inflation-Linked Government Liability Curve ("GLC") yields from January 2000 up to July 2015, published by the Bank of England[7] at 2.5-years, 5-years, and 10 years. Second, we infer inflation expectations from inflation swaps data published by ICAP, available on Refinitiv Datastream at 1-year, 2-years, 5-years, and 10 years. In order to assess the effect of information on the macroeconomy, we use equity prices from the UK stock market (from January 2000 up to July 2015) from two different indices: the FTSE 100 (mainly comprising large multinational companies) and the FTSE All-Share (an equity index which represents 98% of the full capital value of all UK companies). Equity price data is from FTSE, downloaded from Refinitiv Datastream.

Sensitivity analysis. Economic data is released almost daily and this may introduce noise into our estimation. In the Appendix, we show that this should not be of material concern. Firstly, the

[7] This is available at https://www.bankofengland.co.uk/statistics/yield-curves

mean of positive versus negative macro news is zero. In order to control for the effect of said news, we make use of the Bloomberg UK Economic Calendar[8], which contains all the release dates of economic and financial macro data from January 2011 up to July 2019 and includes information about the time of the release, the kind of data, the degree of expected volatility in response to the release, and the market reaction to the release. Second, for robustness, we re-estimate all results including as an additional independent variable the Citi Economic Surprise Index[9] (for the UK and the G10[10], separately) and our results remain unchanged.

4.2. The high-frequency response of asset prices before August 2015

Tables 3 reports results for nominal GLC yields, respectively. Table 4 reports results for inflation expectations. Finally, Table 5 shows results for UK equity prices. All results found are from OLS regressions with Newey-West corrected standard errors, as outlined in Section 4.1. In each case, the independent variable is the extracted principal component as explained in Section 3.

For GLC yields, we find that positive interest rate surprises raise nominal GLC yields. Results are strongly significant for each surprise series considered. Interestingly, the effect is stronger for Inflation Report and Minutes releases and for intermediate maturities (between 1y and 2y). A 1% shock to our interest rate surprise index has an a 0.25% effect on nominal yields when associated to an Inflation report release, a 0.27% when associated to a MPC Minutes release, and a 0.14% effect when associated to a Bank rate announcement. At 1-year maturities, interest rate surprises associated to Inflation Reports explain up to the 81% of the daily nominal government yield variance, whereas 70% for Minutes releases, and 53% for Bank rate announcements.

For inflation expectations, we find that the effects of positive interest rate surprises are strongly significant for each of the considered proxies. A 1% unexpected interest rate increase raises inflation expectations at 1-year by 0.13% when associated to Inflation report releases, by 0.1% when associated to Minutes releases, and 0.2% for Bank Rate announcement events. The explanatory power of interest rate surprises associated to Inflation Report releases and Bank Rate Announcements is higher at short horizons, and decreases at higher maturities. Interest rate surprises associated to Interest rate events explain the 36% of the daily inflation expectation variance at 1 year, and the 13% at 10 years. Interest rate surprises associated to bank rate announcements explain the 18% of the daily inflation

[8] Available on the Bloomberg website at https://www.bloomberg.com/markets/economic-calendar.

[9] This is available from January 2003 to July 2015 on Refinitiv Datastream. The surprise index measures the financial markets' reaction to the release of economic data with the index taking a positive value when data releases come in above consensus and a negative value when data comes in below consensus. The consensus is defined as the median forecast by professional forecasters as collected by Bloomberg and Refinitiv.

[10] We include the CESI for the G10 as it maybe the case that foreign macro data or macro events have spillovers onto UK financial markets data.

expectation variance at 1 year, and the 1% at 10 years. However, interest rate surprises associated with MPC Minutes releases, never explains fraction of the inflation expectation variance greater than 10%. The significance of inflation expectation reactions at long horizons is another fact at odds with conventional theory, and might be associated to information effects concerning the long-run, as for instance the long-run inflation level.

While conventional theory suggests that inflation expectations should drop in response to contractionary monetary policy surprises, our findings suggest instead that agents' inflation expectations rise in response to each type of shock. On one hand, a positive sign on Inflation Reports and MPC meeting minutes suggests that, when the central bank releases positive news about the future, financial markets expect higher inflation and therefore higher interest rates. On the other hand, a positive sign for the Bank Rate announcement suggests that, when the central bank raises its policy rate (or equivalently expectations of future policy rates), agents interpret the central bank's decision as a response to concerns about future inflationary pressures. Therefore, the sign of the reactions to each shock seems to be driven by the information effect rather than by the conventional monetary policy effect.

In Table 4 we report our baseline estimates for how each type of shock affects the FTSE 100 (the UK equity index comprising of the 100 largest companies listed on the London Stock Exchange by market capitalisation) and the FTSE All-Share (a UK equity index comprising approximately 600 of the largest companies by market capitalisation traded on the London Stock Exchange). Importantly, the sign of co-movement between equity prices and interests rates defines whether or not the shock observed is interpreted as a central bank information shock or as a monetary policy shock, with positive co-movement representing the former and negative co-movement indicating the latter (Jarociński and Karadi, 2020). In our results we observe a positive sign, suggesting that the information component *strictly* dominates any monetary policy component. Our results indicate that an unexpected 1% increase in our policy measure associated to a Bank Rate Announcement event implies a 1.9% rise in the FTSE100 index, and that an unexpected 1% increase associated to a minutes release event implies a 1.8% rise in the FTSE100. Although the interest rate announcements can explain up to the 11% of the daily equity price variance, the fraction of the variance of equity price variation explained by the Inflation Reports and the Minutes is extremely low.

In order to check the robustness of these results, we enlarge the scope of our analysis to some small capitalization indices as the FTSE Small (consisting of the 351st to the 619th largest-listed companies on the London Stock Exchange) or the FTSE Fledgling (which comprises companies listed on the main market of the London Stock Exchange which qualify as eligible for inclusion in the FTSE

UK series but are too small to be included in the FTSE All-Share Index). The conjecture here is that large firms might be operating on a global scale and therefore being only marginally affected by the monetary policy stance in the UK. By contrast, smaller firms are more likely to be more sensitive to domestic market fluctuations. However, according to our results, equity prices of firms with smaller capitalisation are not significantly more affected than the price of firms with large capitalisation.

In summary, it appears that for each of our constructed surprise series, central bank information effects dominate monetary policy effects as illustrated by the positive co-movement of the surprise series and equity prices as well as the fact that a contractionary shock raises both expectations of future inflation and future output. Furthermore, our minutes surprise series appears most reminiscent of a central bank information shock. Intuitively this is not necessarily surprising for a number of reasons. Firstly, the monetary policy announcement, and hence the traditionally viewed monetary policy shock, occurs two weeks prior to the release of the minutes. So whilst the monetary policy announcement may appear to be a mixture of monetary policy and information effects, it is plausible to believe that the minutes is more representative of an information shock. Secondly, the Bank of England did not adopt forward guidance until August 2013, which is towards the very end of our considered sample, and hence it is reasonable that the forward guidance component of the minutes would be minimal, especially considering that the most reasonable communication for forward guidance would likely be the Inflation Report and accompanying press conference where the Bank releases its forecasts for the next three years. Finally, the MPC meeting minutes is a document which justifies the monetary policy decision by describing in detail the evolution of recent macroeconomic data, and outlining how MPC members feel about the current and immediate upcoming economic outlook.

Our findings suggest that the information effect is, on average, more powerful than the conventional monetary policy effect. Conventional theory would predict in fact that inflation expectations should react negatively to contractionary monetary policy shocks. By contrast, we find robust evidence that agent's response to positive monetary policy surprises is positive. This sign could be possibly interpreted via two different theories: either (i) agents have expectations consistent to Neo-Fisherian models, or, more likely, (ii) the information effect dominates the conventional monetary policy effect. The second conjecture finds support in the fact that positive policy surprises, in the GLC-based specification, have a consistently more powerful effect on agents' expectations with respect to monetary policy announcements (whereas in the Swaps-based specification the effect is quantitatively similar, although markedly greater in terms of explained volatility).

4.3. The high-frequency response of asset prices after July 2015

In addition to the above exercises, which are based on data for prior to the August 2015 Bank of England communication change, in each table we estimate the asset price responses for the post-July 2015 sample, covering the period August 2015 to December 2019 inclusive.

In terms of signs, the results obtained for the nominal government yield curve are in-line with results for the pre-August 2015 sample, with each coefficient statistically significant at the 1% level and positive, but the estimated response coefficient is now much higher. For inflation expectations, although no result is statistically significant, the signs for inflation expectations 2-years ahead are now all negative, in-line with the theoretical response to contractionary monetary policy shocks. Equity prices, similarly, now exhibit a negative response to a positive interest rate surprise, with the response of the FTSE All-Share and the FTSE 100 being statistically significant at the 10% level.

In sum, two main results emerge from the analysis. First, the increase in transparency seems to have markedly increased the response of government bond yields to policy rate surprises. This result echoes the findings of some contribution in the theoretical literature, like Faust and Svensson (2002) or Geraats (2002), in which an increase in transparency, can lead to a greater sensitivity of the public to changes in monetary policy via a reputational effect. Second, following the change in the Bank of England communication strategy in August 2015, information effects *no longer* dominate. This is illustrated by a negative response in both equity prices and inflation expectations to a positive interest rate surprise, which is in-line with expectations from a conventional monetary policy tightening. This suggests that, even though information effects may still exist, they are no longer prevalent on the monetary policy effect. By contrast, conventional monetary policy now dominates in sign the asset price response to an interest rate surprise. Thus suggesting the change in communication strategy and increased transparency, have markedly reduced the information effects component inferred by financial markets on policy releases.

Table 1: Response of Nominal Yields to a Positive Interest Rate Surprise

	Inflation Report	**Minutes**	**Announcement**	**Post-July 2015**
3m Nominal GLC	0.105***	0.136***	0.100***	
	(*0.009*)	(*0.030*)	(*0.015*)	-
	0.75	0.47	0.40	
6m Nominal GLC	0.168***	0.180***	0.124***	
	(*0.010*)	(*0.026*)	(*0.017*)	-
	0.82	0.26	0.36	
1y Nominal GLC	0.255***	0.273***	0.136***	1.613***
	(*0.021*)	(*0.019*)	(*0.027*)	(*0.257*)
	0.81	0.70	0.53	0.47
2y Nominal GLC	0.309***	0.323***	0.133***	1.179***
	(*0.035*)	(*0.022*)	(*0.033*)	(*0.178*)
	0.68	0.60	0.36	0.42
5y Nominal GLC	0.243***	0.268***	0.085***	0.757***
	(*0.041*)	(*0.028*)	(*0.024*)	(*0.120*)
	0.40	0.38	0.12	0.34
10y Nominal GLC	0.161***	0.180***	0.044**	0.660***
	(*0.039*)	(*0.031*)	(*0.018*)	(*0.126*)
	0.22	0.18	0.03	0.29

Note: The first line shows the estimated coefficient in response to a contractionary shock in the OIS curve due to the corresponding event, the second line indicates the Newey-West standard errors, and the third line is the adjusted R2 value. All results reported are from equations estimated without a constant; a constant is found to be statistically insignificant in each case. With regards to the estimated coefficients, *** represents statistical significance at the 1% level, ** at the 5% level, and * at the 10% level. Results for the post- Super Thursday sample for the 3m and 6m nominal GLC tenors cannot be reported due to data availability issues.

Table 2: Response of Inflation Expectations to a Positive Interest Rate Surprise

	Inflation Report	**Minutes**	**Announcement**	**Post-July 2015**
GBP Swaps 1y	0.126***	0.101*	0.196***	0.027
	(*0.015*)	(*0.060*)	(*0.038*)	(*0.113*)
	0.36	0.03	0.18	0.00
GBP Swaps 2y	0.123***	0.121***	0.159***	-0.096
	(*0.015*)	(*0.046*)	(*0.025*)	(*0.175*)
	0.44	0.09	0.19	0.00
GBP Swaps 5y	0.110***	0.095*	0.097***	-0.282
	(*0.018*)	(*0.053*)	(*0.014*)	(*0.220*)
	0.46	0.08	0.15	0.01
GBP Swaps 10y	0.030***	0.068*	0.022***	-0.239
	(*0.007*)	(*0.039*)	(*0.005*)	(*0.382*)
	0.13	0.07	0.01	0.01
BoE GLC 2.5y	0.213***	0.184***	0.118***	-0.128
	(*0.046*)	(*0.064*)	(*0.014*)	(*0.173*)
	0.23	0.08	0.26	0.01
BoE GLC 5y	0.135***	0.094***	0.064***	-0.188
	(*0.028*)	(*0.030*)	(*0.015*)	(*0.218*)
	0.28	0.06	0.06	0.01
BoE GLC 10y	0.055**	0.036**	0.025	-0.166
	(*0.028*)	(*0.015*)	(*0.016*)	(*0.349*)
	0.10	0.02	0.00	0.00

Note: The first line shows the estimated coefficient in response to a contractionary shock in the OIS curve due to the corresponding event, the second line indicates the Newey-West standard errors, and the third line is the adjusted R2 value. All results reported are from equations estimated without a constant; a constant is found to be statistically insignificant in each case. With regards to the estimated coefficients, *** represents statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 3: Response of Equity Prices to a Positive Interest Rate Surprise

	Inflation Report	Minutes	Announcement	Post-July 2015
FTSE All Share	0.683	1.645*	1.791***	-0.030**
	(*0.535*)	(*0.889*)	(*0.552*)	(*0.011*)
	0.00	0.00	0.10	0.10
FTSE 100	0.612	1.785*	1.937***	-0.030**
	(*0.542*)	(*0.934*)	(*0.568*)	(*0.011*)
	0.00	0.00	0.11	0.11
FTSE 250	1.208*	0.835	0.953**	-0.014
	(*0.669*)	(*0.730*)	(*0.468*)	(*0.010*)
	0.06	0.00	0.03	0.03
FTSE Small	0.855**	0.792	0.700**	-0.016
	(*0.352*)	(*0.494*)	(*0.286*)	(*0.020*)
	0.04	0.01	0.03	0.02
FTSE Fledgling	0.329*	0.772**	0.409**	0.004
	(*0.196*)	(*0.314*)	(*0.205*)	(*0.032*)
	0.01	0.02	0.01	0.00

Note: The first line shows the estimated coefficient in response to a contractionary shock in the OIS curve due to the corresponding event, the second line indicates the Newey-West standard errors, and the third line is the adjusted R2 value. All results reported are from equations estimated without a constant; a constant is found to be statistically insignificant in each case. With regards to the estimated coefficients, *** represents statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

5. Decomposing the Bank of England communication releases

Following the methodology of Matheson and Stavrev (2014), Cieslak and Schrimpf (2019), and Jarociński and Karadi (2020), we use sign restrictions to decompose our three surprise series described in Section 3 (and displayed in Figure 3): the Bank Rate announcement, the MPC minutes release, and the Inflation Report release. This exercise allows us to structurally disentangle the contribution of central bank information and monetary policy effects in each of our surprise series.

We consider two possible decompositions. Within the first one, we consider on the one hand monetary policy shocks, and on the other hand central bank information shocks under the form of news about future demand as in the baseline decomposition by Jarociński and Karadi (2020). The identification, as explained in Table 4, is based on the co-movement between each surprise series and the FTSE 100 price index: a negative co-movement between the policy surprise and the equity surprise is defined as a pure monetary policy shock, and a positive co-movement is defined as a pure

central bank information shock. In order to ensure the orthogonality of the monetary policy and the central bank information shocks, we apply the median target method by Fry and Pagan (2011).

In the second decomposition, we also consider central bank information shocks about supply. The identification, as explained in Table 6, makes use of the inflation expectation surprise series, based on 2-year ahead GBP inflation swaps. A supply shock will be identified as an inflationary shock which depresses output, therefore exploiting the negative co-movement between equity prices and inflation expectations. In parallel, we do not make any specific prior assumption on the monetary policy response to supply shocks. This choice is driven by, essentially, two considerations. The first one is that the literature is yet to reach a clear consensus about whether central banks should respond to supply shocks or not. The second reason is that supply shocks have an ambiguous effect on the Taylor rule, driving inflation and the output gap in opposite directions, and might threfore result in either a policy rate increase or a decrease. In Tables 5 and 7, we report the overall contribution of each component in the various historical decompositions.

Our results suggest that when the Bank of England would release the Bank Rate announcement, the minutes, and the Inflation Report all separately, the information component was quantitatively more important monetary policy component in the pre-2015 period, explaining from 50% up to 60% of the surprise in the baseline decomposition. When considering supply shocks in the historical decomposition, information effects accounted for up to 70% of the surprise, with information about demand having a more important role in explaining movements in the OIS curve. The monetary policy vs. information effect simple decomposition suggests that the informational component of Inflation Report events was greater than the other events. On the other hand, the decomposition distinguishing information about demand and supply gives a more balanced view, showing that for the three surprises, the informational component accounts for the 60% up to the 70% of the surprise. The results suggest information about supply being approximately as important as information about demand in explaining inflation expectations and equity price responses (yet noticeably more important for the MPC meeting minutes and the Inflation Report series).

We now turn to analysing the effect of the change in the release structure of the Bank of England communication strategy. The methodology we adopt is the following. We produce a surprise series for the post-July 2015 monetary surprises, following the methodology of Section 3, and decompose this into monetary policy and central bank information components using the VAR coefficients estimated in the pre-2015 sample. This approach allows us to assess whether the relevance of the information effects increased or decreased after the change in the Bank of England communication strategy.

Our results suggest that monetary policy shocks play a stronger role post-July 2015, and that, accordingly, the relevance of the information effect is reduced. While for the pre-August 2015 period the informational component was between the 51% and the 56% for the OIS variations, and between the 52% and the 60% for the FTSE 100; in the post-August 2015 period the contribution is 42% for the OIS variations, and 52% for the FTSE 100 variations

A similar picture is depicted by the decomposition including information effects about supply. While before August 2015 the sum of the informational components was between the 58% and the 68% for the OIS variations, between the 64% and the 75% for 2-year inflation expectations, and between the 68% and the 77% for the FTSE 100; after August 2015 period the contribution is 25% for the OIS variations, the 44% for inflation expectations, and 52% for the FTSE 100 variations.

The diminished importance of information effects can be attributed to a reduction in the information asymmetry between financial markets and the central bank driven by transparency policies. First, the communication regime switch, with the decision of accompanying the policy rate decision by exhaustive explanations, might have reduced the information asymmetries between the Bank of England and the financial markets. In other words, the communication regime switch made the rationale underlying monetary policy decisions more transparent to financial markets. Consistently to these results, Hoesch et al. (2020) show for the US economy, that the forecasting advantage of the central banks compared to private forecasters is gradually disappearing. In order to illustrate our results in greater detail, we provide plots of the historical decompositions which we have analysed in this section.

Table 4: Identifying Restrictions for Central Bank Information

	Monetary policy	Central bank information
Interest Rate surprise	+	+
Equity Index surprise	−	+

Table 5: Historical decomposition of UK central bank announcements

Pre August 2015 Surprise	Event	Monetary policy	Central bank information
OIS (1m-12m)	Bank Rate	0.46	0.54
OIS (1m-12m)	Minutes	0.49	0.51
OIS (1m-12m)	Inflation Report	0.44	0.56
FTSE 100	Bank Rate	0.48	0.52
FTSE 100	Minutes	0.45	0.55
FTSE 100	Inflation Report	0.40	0.60

Post-July 2015 Surprise	Monetary policy	Central bank information
OIS (1m-12m)	0.58	0.42
FTSE 100	0.48	0.52

Note: The above table represents the share of each component of the decomposition. For illustrative purposes, the OIS surprise prior to August 2015 is 46% pure monetary policy and 54% central bank information effects.

Table 6: Identifying Restrictions for Central Bank Information About Supply

	Monetary policy	CBI about demand	CBI about supply
Interest rate surprise	+	+	•
Stock index surprise	−	+	+
Inflation exp. surprise	−	+	−

Note: • indicates that no restriction is in place. For the inflation expectation surprise, we use the 2y GBP Inflation Linked Swaps.

Table 7: Historical decomposition of UK central bank announcements

Pre August 2015 Surprise	Event	Monetary policy	CBI about demand	CBI about supply
OIS (1m-12m)	Bank Rate	0.32	0.48	0.20
OIS (1m-12m)	Minutes	0.34	0.64	0.02
OIS (1m-12m)	Inflation Report	0.42	0.48	0.10
Inflation exp.(2y)	Bank Rate	0.26	0.35	0.40
Inflation exp.(2y)	Minutes	0.33	0.35	0.32
Inflation exp.(2y)	Inflation Report	0.36	0.25	0.39
FTSE 100	Bank Rate	0.23	0.47	0.30
FTSE 100	Minutes	0.29	0.22	0.48
FTSE 100	Inflation Report	0.23	0.28	0.49

Post -July 2015 Surprise	Monetary policy	CBI about demand	CBI about supply
OIS (1m-12m)	0.46	0.29	0.25
Inflation exp.(2y)	0.38	0.18	0.44
FTSE 100	0.42	0.21	0.37

Note: The above table represents the share of each component of the decomposition. For illustrative purposes, the OIS surprise prior to August 2015 is 32% pure monetary policy, 48% demand related central bank information, and 20% supply related central bank information. Inflation exp.(2y) refers to the decomposition of the 2y GBP Inflation-Linked Swap. Identification of the above is as detailed in Table 4.

6. The effect of transparency measures on asset price responses

In this section, we investigate whether the response of asset prices to BoE announcements changed across the sample, and in particular, whether it changed after the introduction of the release schedule reform, i.e the switch from a multiple-day to a single-day release strategy.

The hypothesis we evaluate here is that the change in the communication strategy would leave less room for misinterpretation of BoE policy decisions, and therefore modify the decomposition of policy rate surprises, in terms of monetary policy and information effects, as suggested by the historical decomposition exercise. The idea underlying this exercise is that in absence of accompanying explanations, it might not be clear a priori for agents whether an unexpected policy rate surprise is due to a change in the policy function coefficients (i.e. a more or less aggressive response to inflationary pressures) or to a misalignment of the central bank expectations from those of the financial markets. In such a context, every decision of the central bank had to be second-guessed, leaving room for an incorrect interpretation. In this context, a decision due to a change in the BoE's responsiveness to inflation might be attributed to a divergence of the central bank's and the financial market's assessment of the economic conjuncture. In other words, the importance of information effects could be underestimated or overestimated by financial markets. A more transparent communication would instead allow agents to disentangle the rationale underlying unexpected policy responses. The assumption we implicitly make here is that, if the central bank gives exhaustive explanations about its policy actions, agents can properly disentangle information effects from monetary policy effects.

A change in the decomposition of interest rate surprise, in terms of the mix of monetary policy and information effects, would alter the quantitative effect of interest rate surprises on asset prices. For instance, if information effects were to be present to a greater extent in a given period, we would observe that the equity price response coefficient would rise in a given period. By contrast, if monetary policy effects were to be present to a greater extent in a given period, we would observe that the equity price response coefficient would decline in a given period. The same considerations apply to the inflation expectations response.

From a broader perspective, by comparing the Bank Rate announcement strategy before and after August 2015, our aim is to assess the extent to which clearer up front communication and more transparency lessens the information effect, as suggested by Hoesch et al. (2020).

In order to investigate this question, we study the time variation of the asset price response coefficient to policy rate surprises in a time-varying parameter model. Namely, we estimate equation (3) under the following specification:

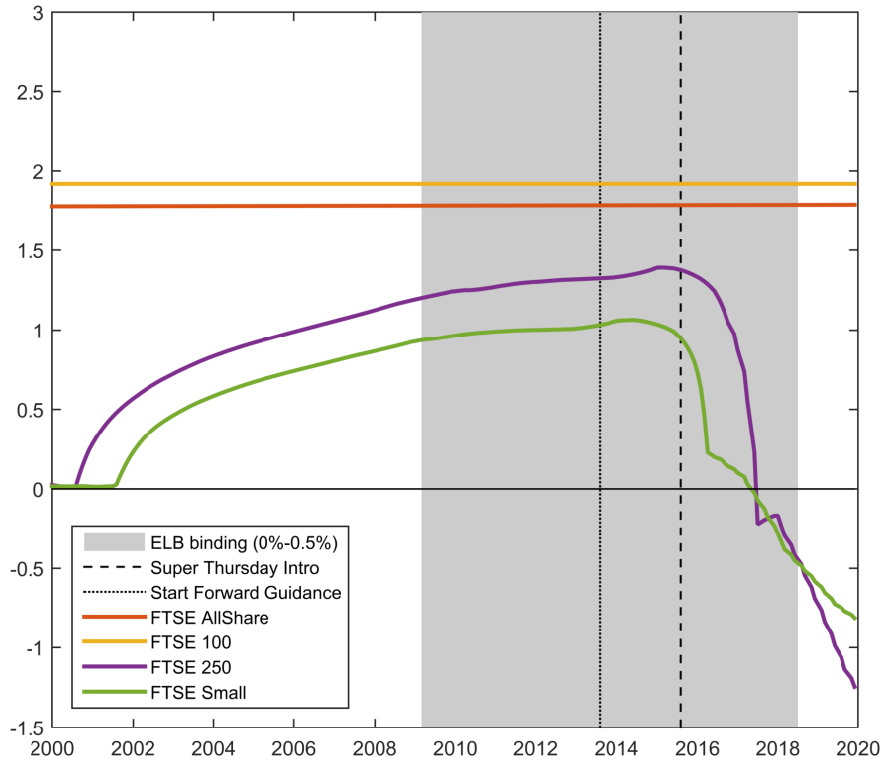
$$s_t = \eta_t \, i_t + \epsilon_t \tag{3}$$

The object of interest here are the dynamics of η_t, which represent the response of a given asset price to an policy rate surprise. The set of asset prices which we consider, defined by s_t, is the same we consider in Section 4. In particular, we evaluate the response of UK equity prices, UK nominal government bond yields, and UK inflation expectations as measured by GBP Inflation-Linked Swaps. s_t is the daily change in a given asset price on the day of the Bank of England Bank Rate announcement from January 2000 until July 2015, and the daily change in the asset price on the day of the Bank of England joint monetary policy event[11] from August 2015 to December 2019. i_t is, as defined in Section 3, the daily interest rate surprise associated to a given event. Before August 2015 the considered event is the Bank Rate announcement, and after August 2015 the considered event is the joint Bank of England monetary policy release.

The model is estimated via non-parametric methods. We use the local constant estimator of Nadaraya-Watson (Bierens, 1988) with the kernel following a standard Epanechnikov distribution. For the bandwidth parameter, we rely on the cross-validation algorithm which chooses the bandwidth parameter to minimise the integrated mean-squared error (Tsybakov, 2008). For the estimation of the bootstrap confidence bands, we implement the algorithm of Chen et al. (2018).

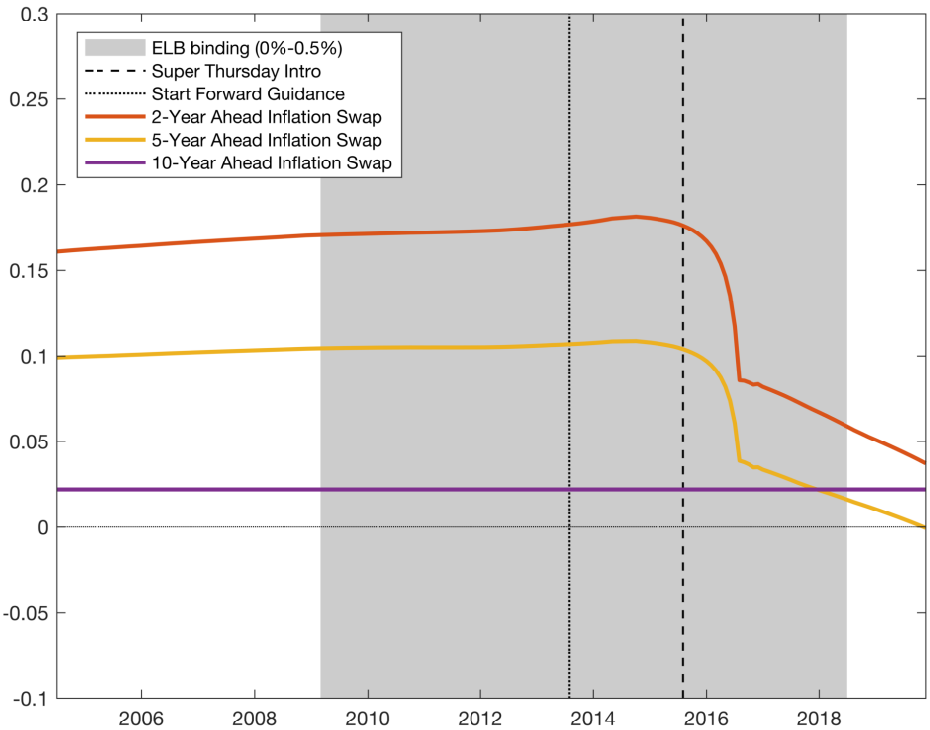
[11] As a reminder, from August 2015 onwards, the MPC meeting minutes and the Bank of England's economic outlook report would be released simultaneously alongside the monetary policy decision announcement, and hence from August 2015 there is only one monetary policy event in a given month.

Figure 4: Time varying response of equity prices to policy rate surprises



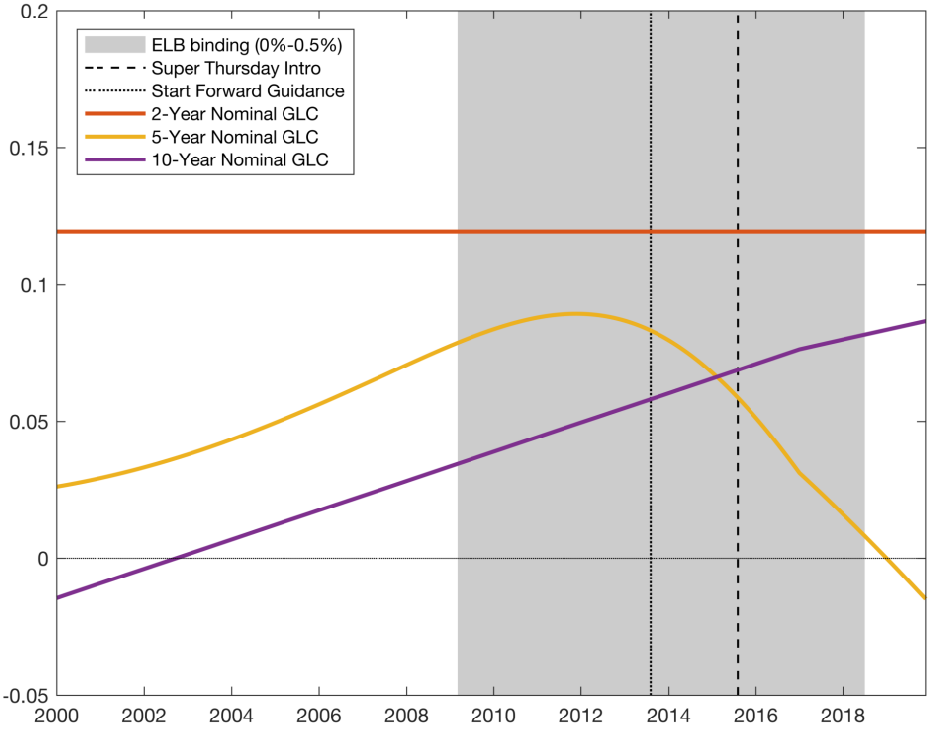
Note: The figure displays the estimated value of the time varying parameter η_t which denotes the response of the corresponding asset price to a given interest rate surprise.

Figure 5: Time varying response of GBP Inflation-Linked Swaps to interest rate surprises



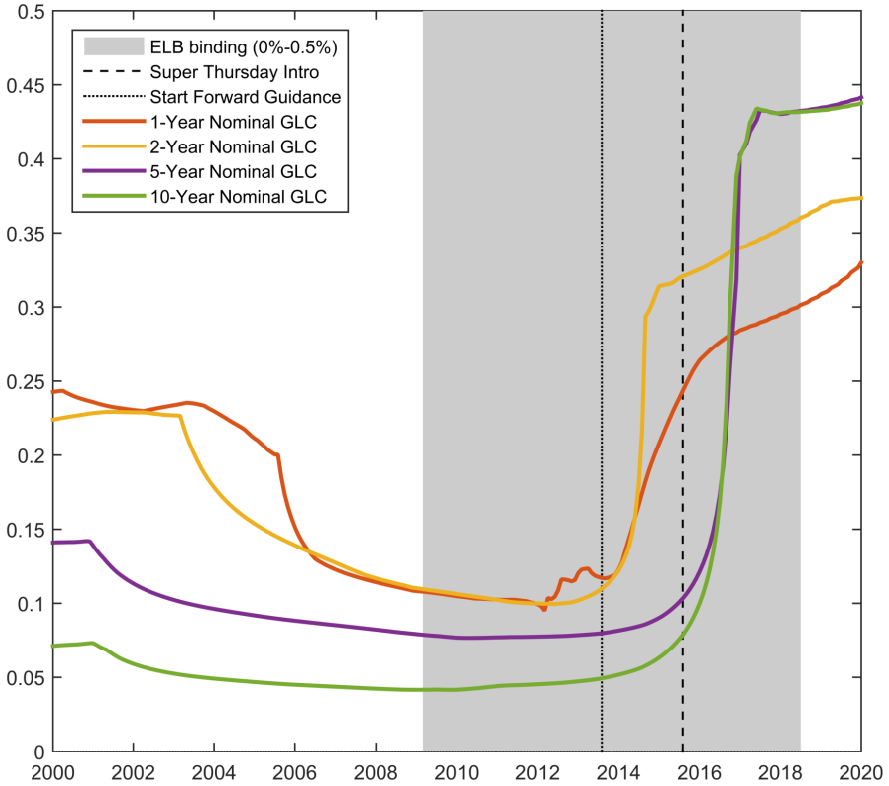
Note: The figure displays the estimated value of the time varying parameter η_t which denotes the response of the corresponding asset price to a given interest rate surprise.

Figure 6: Time varying response of UK Breakeven Inflation to interest rate surprises



Note: The figure displays the estimated value of the time varying parameter η_t which denotes the response of the corresponding asset price to a given interest rate surprise.

Figure 7: Time varying response of UK government nominal yields to interest rate surprises



Note: The figure displays the estimated value of the time varying parameter η_t which denotes the response of the corresponding asset price to a given interest rate surprise.

The results of the estimation are reported in Figures 4 to 7. In Figure 4, we illustrate the time-varying response of equity prices to interest rate surprises. We find mixed evidence for a reduction in the importance of information effects in the post-July 2015 period. For the FTSE AllShare and the FTSE 100, we see no time variation in the response. Consistent with Table 3, an unexpected 1% increase in our policy measure implies a 1.8% increase in the FTSE 100 index for any part of the sample. This indicates that the preferred specification for the data is the constant parameter model, and suggests that the introduction of the new communication strategy had no impact on the financial markets' response. However, the responses of the FTSE 250 and the FTSE SmallCap decline markedly following the change in the Bank of England communication strategy. This suggests that before August 2015, according to our estimates, the FTSE 250 used to increase approximately by 1.25% in response to an unexpected increase of 1% in the policy measure while the FTSE SmallCap would increase by approxiately 1%. After the change in the communication strategy, the response of the FTSE 250 and the FTSE SmallCap started decreasing markedly to an unexpected increase of 1% in the policy measure. Importantly, the coefficients turned negative, suggesting that information effects no longer dominate for mid-cap and small-cap UK firms. In other words, the sign of the coefficients suggest a prevalence of the monetary policy effect over the information effect.

For reference, the shaded area indicates the period in which the Effective Lower Bound (ELB) is binding, i.e. the policy rate is comprised between 0% and 0.5%. This period goes from March 2009 to August 2018. In our view the timing of the period excludes that the change in agent's responsiveness could be due to the proximity of the zero lower bound. In addition, we mark with a dotted line the start of the forward guidance program in August 2013. Our interest rate surprise measure includes expected interest rate changes up to 1-year in advance, hence the forward guidance is captured by our policy measure to the extent the announcements concern horizons lower than 12 months. Nevertheless, we find no evidence of a change in agents' response following August 2013. For the sake of clarity, we do not include in the graph the timing of the three main announcements concerning the three main rounds of the Asset Purchase program in January 2009, November 2012, and August 2016. Again, the timing of these episodes leaves very little or no room for attributing the estimated drop in the asset prices response to the Asset Purchase program announcements. Lastly, we believe that there is no room for arguing that the economic uncertainty caused by Brexit referendum, which took place in June 2016, might be the cause of the observed change in the response. In uncertain times, the information released by the central bank would be more valuable for the financial markets, and accordingly, we would observe more important information effects, and not less, as highlighted by our estimates. Therefore, the empirical pattern, is inconsistent with this hypothesis.

For inflation expectations, the evidence is mixed. In Figure 5, we show the time varying response of GBP Inflation-Linked Swaps to interest rate surprises. For each one of the selected inflation expectation proxies, the response markedly declines around the change in the Bank of England's communication strategy. The response coefficient of the 2-year ahead and the 5-year ahead inflation expectation response approximately halve their value after the change in the communications strategy. These results are again consistent with a reduced importance of the information effects, also highlighted by the historical decomposition exercise. Such change materializes in a reduction of the response coefficient, which is determined by a balance of the monetary policy effects (-) and the information effects (+). An alternative, natural candidate explanation for rationalizing the decrease in the inflation expectation responsiveness is the flattening of the Phillips curve. Nevertheless, Tuckett (2018), using regional UK data shows that the UK Phillips Curve slope dropped in 2010 already. Hence, the timing of the events seems excluding the presence of a causal relationship.

On the other hand, in Figure 6, we show the time varying response of another proxy of inflation expectations, namely the UK Breakeven Inflation, i.e. the inflation expectations computed as a difference of inflation-linked and non inflation-linked government bonds. The 2-year ahead inflation expectations are constant seem, while the 5-year ahead and the 10-year ahead responses exhibit a growing trend for a large part of the series. This trend is more robust for the 10-year ahead expectations, potentially reflecting an increase in the importance of the release of central bank information associated with the long-run steady-state of inflation. On the other hand, the 5-year ahead exhibits a gradual drop starting from 2012 could be associated to the start of forward guidance policies.

In Figure 7, we show the time-varying response of UK government nominal yields to interest rate surprises. For each tenor, from the 1 year to the 10 year, we see that the response markedly increases around the change in the Bank of England's communication strategy. Before August 2015, the 1-year and the 2-year nominal GLC used to respond with a 0.15% increase to an unexpected 1% increase in our policy measure. After August 2015, the response coefficient rises to a 0.25%. On the other hand, before August 2015, the 1-year and the 2-year nominal GLC used to respond with a 0.1% increase to an unexpected 1% increase in our policy measure. After August 2015, the response coefficient rises to a 0.45%.

This result has no implications for the importance of information effects, but highlights that the change in the communication strategy increased the responsiveness of Government Bond Yields to interest rate surprises. This phenomenon might be due to an increase in the credibility of the Bank of England's forward guidance announcements. However, the fact that two of the four series surge before July 2015, suggests that this increase might be associated to complementary transparency

measures which took place alongside the release schedule reform and helped the markets to better understand BoE's future policies.

Overall, these results suggest that the change in the Bank of England's communication strategy markedly affected how financial markets respond to central bank announcements. We observe that the sign of agent's response moves consistently with the idea that information effects are less prevalent since the introduction of the single-day release strategy. In our view, this suggests that prior to August 2015, financial markets used to overestimate the importance of information effects in unexpected monetary policy decisions. In other words, our results suggest that prior to August 2015, financial markets were often attributing policy actions due to changes to the BoE's responsiveness to inflation, to unexpected assessments of the economic conjuncture by the BoE. The increase in transparency due to the introduction of the joint release event seems to be consistent with the idea that the reduction in the response coefficients of equity prices and inflation expectations was due to the change in the communication strategy. Furthermore, the increased responsiveness of Government Bond Yields point to an increased credibility of the BoE's forward guidance policies.

A natural concern for our results is the effect of the beginning of the Bank of England's forward guidance program in August 2013. First of all, it is worth remembering here that, despite the official date of the start of the forward guidance program was August 2013, forward guidance policies were typically already in use. For instance, in the February 2013 Inflation Report, the MPC stated that, due to some inflationary shocks hitting the UK economy, it intended to bring inflation back to the target more slowly than previously announced.

Furthermore, our policy index, is specifically designed for capturing the effect of forward guidance shocks on policy expectations, as our dynamic principal component captures changes in the expected policy rate path up to 12 months. On the other hand, forward guidance shocks exclusively hitting the expected policy rate curve on tenors longer than 12 months could not be captured by our policy index. However, there are two reasons why the current approach would still be the preferable approach for this specific issue. First, it is unlikely for a forward guidance announcement targeting an horizon of 2 years not to have an impact at 1-year. Second, policy announcements at long term are typically less important for asset valuations, as the central bank might well decide to renege on its announcements in the meanwhile (see Debortoli and Lakdawala, 2016 or Haberis et al., 2019). Third, the longer tenors of the OIS curve are typically much less liquid than the first 12. Therefore, widening the OIS curve horizon might result in a worse, rather than in a better instrument.

7. Conclusion

In this paper, we have studied the response of asset prices to the Bank of England announcements before and after a key change in the Bank of England communication strategy, in order to understand how central bank transparency affects asset price responses to central bank announcements. We show that the communication releases by the Bank of England have sizable effects on inflation expectations and asset prices, and that changes in the degree of central bank transparency affects asset price responses to central bank announcements.

Before the change in the Bank of England communication strategy, we find that positive interest rate surprises increase inflation expectations and equity prices, suggesting that on average, the information effect dominates the monetary policy effect. Consistent with Hansen et al. (2019), we find our surprise series to affect inflation expectations both at short- and long-term maturities, suggesting that the market response cannot exclusively be reflective of conventional monetary policy effects.

However, after the introduction of the single-day release schedule, the effect of the BoE policy announcements on the financial markets markedly changed. First, the increase in policy transparency seems to have sharply increased the response of government bond yields. Second, the responsiveness of equity prices and inflation expectations dropped significantly after the introduction of the new communication strategy. We attribute this finding to a change in the balance between the monetary policy and information effect components of central bank communication. Policies to improve central bank transparency, can reduce the importance of information effects by aligning the expectations of the financial markets with the expectations of the central bank.

Our results suggest that information effects in the historical decomposition account for up to 70% of the interest rate surprise pre-August 2015. However, their relevance is markedly reduced to just over 50% subsequent to the Bank of England communication strategy change. We argue that the increased transparency concerning the rationale underlying the monetary policy decisions has reduced the information asymmetry between the central bank and the financial markets, leading to a reduction in the role of information releases. By estimating a time-varying parameter model, we show that the change in the asset prices response along the sample are consistent with this hypothesis.

The main takeaway of the paper is that central bank transparency measures can increase the effectiveness of monetary policy, by reducing the confounding factors which arise in the form of information effects, and helping central banks to shift inflation expectations.

These results shed light on the nature of the information effects, suggesting they might be driven by a partial understanding of the rationale underlying monetary policy decisions, and raise concerns

about the desirability of these effects from a market efficiency perspective.

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Appendix

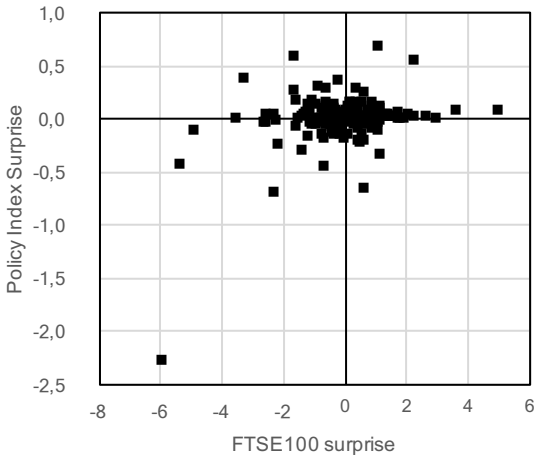
A1. Data and Event Tables

Table A1: Data Table

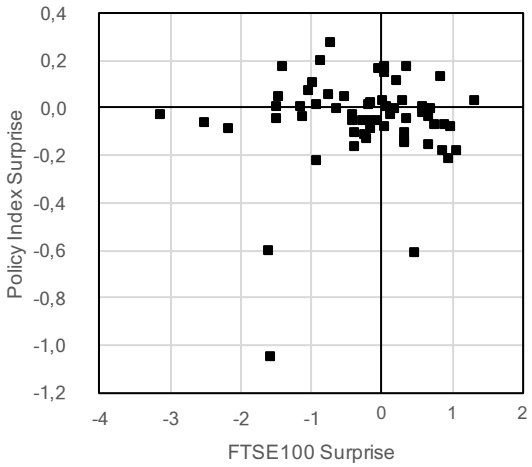
Data	Source	Description
OIS Rates	Bank of England	Daily measure of the expected Bank Rates from 1 up to 60 months ahead from January 2009 up to July 2015, derived from Overnight Index Swap contracts.
OIS Rates	ICAP	Daily measure of the expected Bank Rates from 1 up to 12 months ahead from January 2000 up to July 2015, derived from Overnight Index Swap contracts.
Gilt Yields	Bank of England	Interest rates paid on securities issued by the UK government at 1-year, 2-years, 5-years, and 10-years.
Inflation-Linked Gilt Yields	Bank of England	Interest rates paid on securities issued by the UK government whose payments are linked to changes in the inflation rate, at 1-year, 2-years, 5-years, and 10-years.
Inflation Swaps	ICAP	Daily measure of Expected Inflation derived from inflation swaps - derivative contracts in which one party can transfer inflation risk to a counterpart in exchange for a fixed payment.
FTSE 100	FTSE	Daily Returns of the FTSE 250 Index, a share index of the 250 companies listed on the London Stock Exchange with the highest market capitalisation.
FTSE 250	FTSE	Daily Returns of the FTSE 100 Index, a share index of the 100 companies listed on the London Stock Exchange with the highest market capitalisation.
FTSE All-Share	FTSE	Daily Returns of the FTSE All-Share, a capitalisation-weighted index comprising around 600 of more than 2,000 companies traded on the London Stock Exchange.
Citi Economic Surprise Index	Citi	Daily measure of the Surprise of the UK financial markets, defined as weighted historical standard deviations of data surprises (actual releases vs Bloomberg survey median).

Data published by the Bank of England was obtained from the Bank of England Interactive Database. All other data was obtained through Refinitiv Datastream.

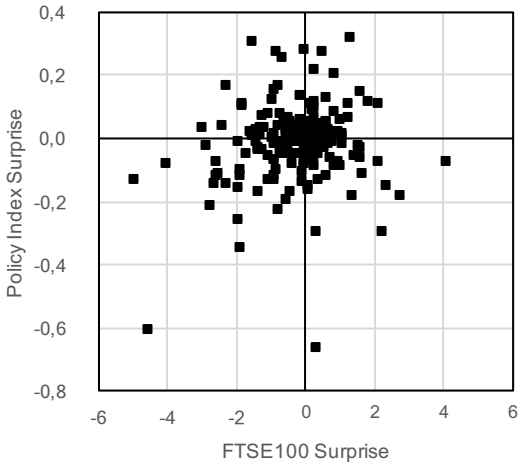
Bank Rate (Jan 2000 - July 2015): Policy Index Surprises vs. Equity Surprises



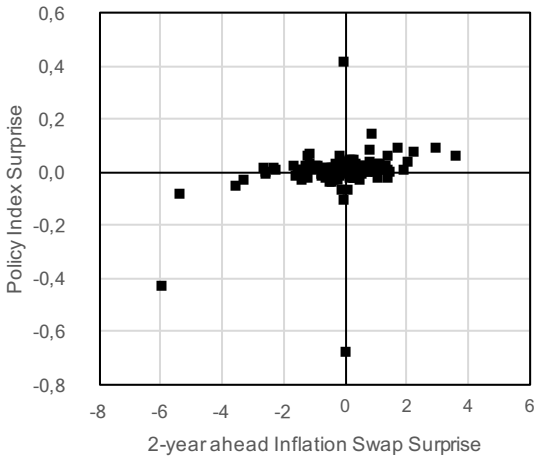
Minutes (Jan 2000 - July 2015): Policy Index Surprises vs. Equity Surprises



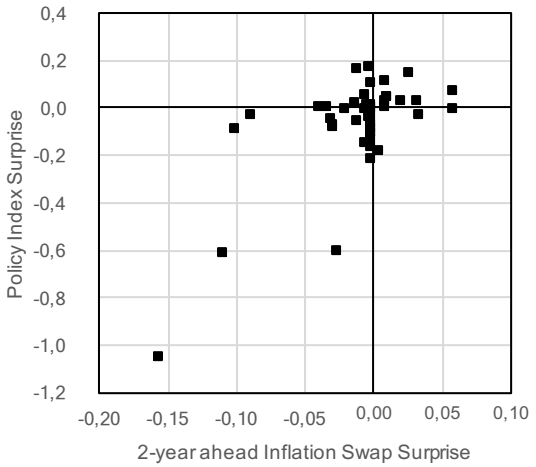
Inflation Report (Jan 2000 - July 2015): Policy Index Surprises vs. Equity Surprises



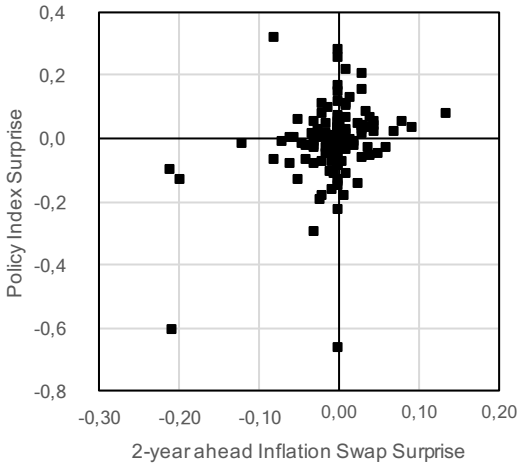
Bank Rate (Jan 2000 - July 2015): Policy Index Surprises vs. Inflation Exp. Surprises



Minutes (Jan 2000 - July 2015): Policy Index Surprises vs. Inflation Exp. Surprises

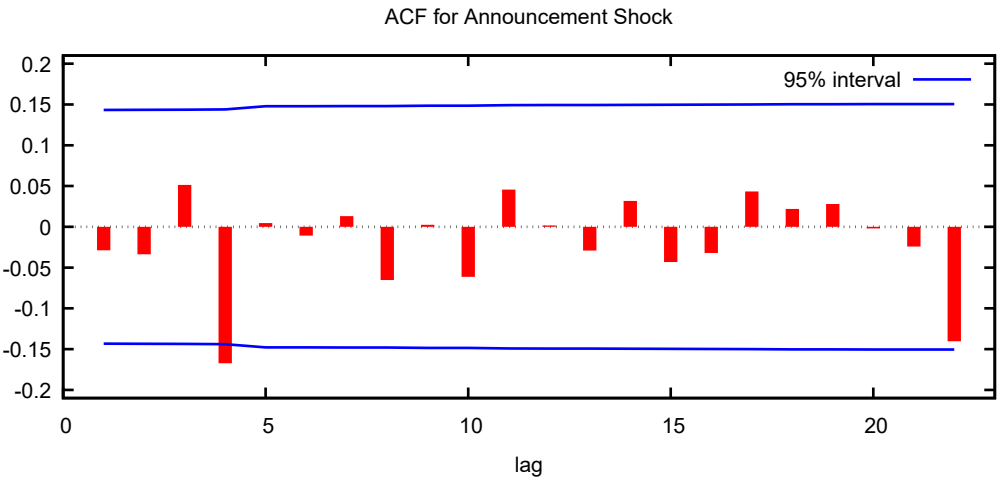


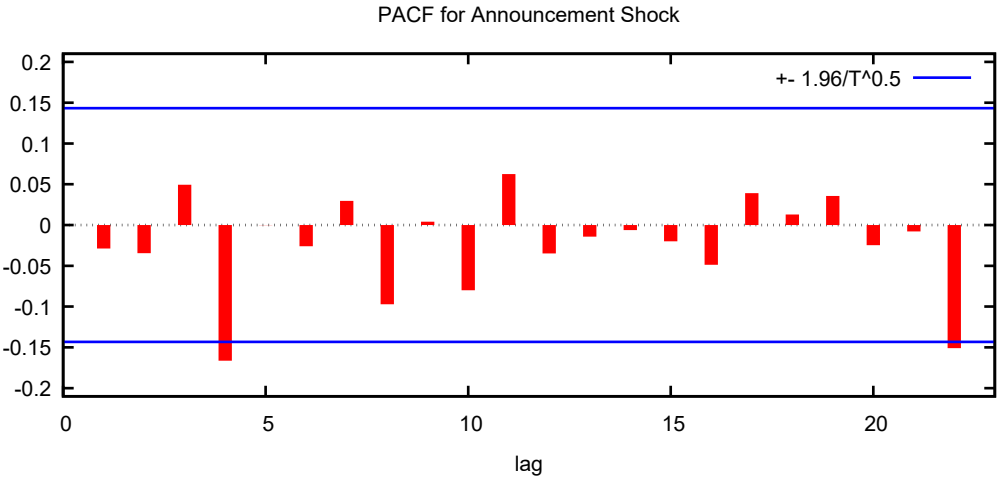
Inflation Report (Jan 2000 - July 2015): Policy Index Surprises vs. Inflation Exp. Surprises

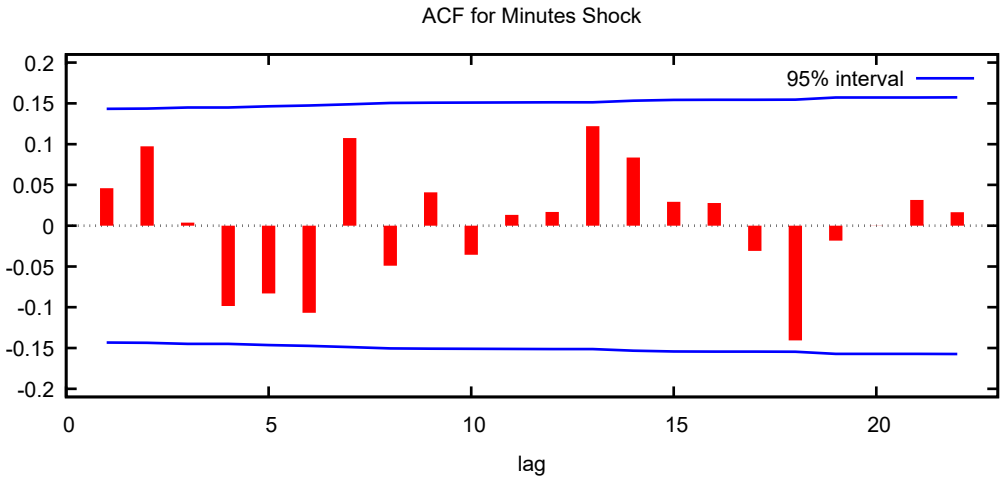


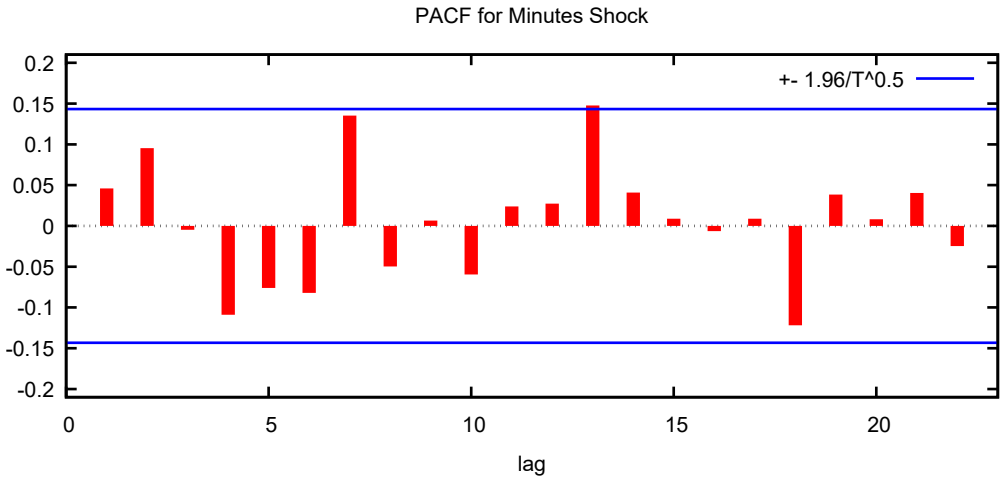
A2. Do our shocks exhibit serial correlation?

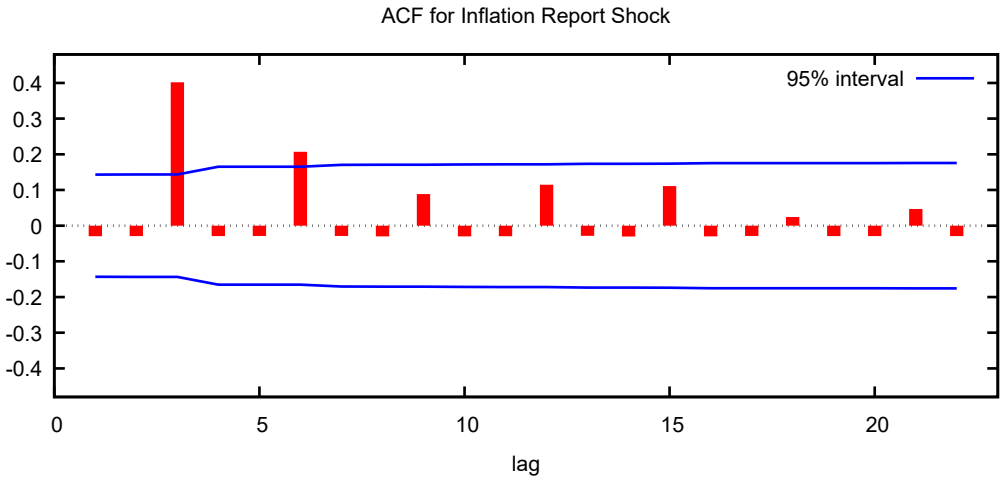
Here we plot the autocorrelation and partial autocorrelation functions of each surprise series. This tells us whether or not there is any serial correlation. Bartlett standard errors are used for the confidence bands.

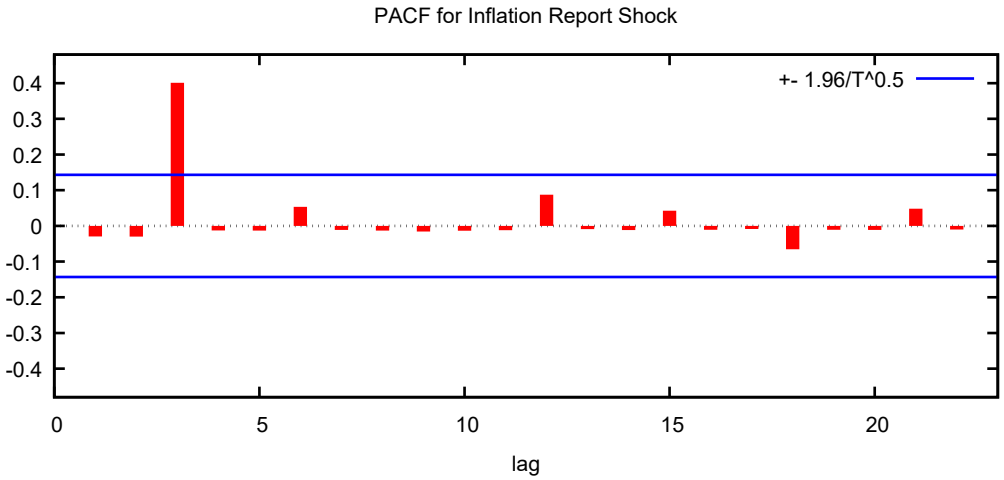





ACF for Minutes Shock
95% interval
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
5
10
15
20
lag


PACF for Minutes Shock
+- 1.96/T^0.5
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
5
10
15
20
lag


ACF for Inflation Report Shock
95% interval
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
0
5
10
15
20
lag


PACF for Inflation Report Shock
+- 1.96/T^0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
0
5
10
15
20
lag

A3. Do our three surprise series correlate?

Table A7: Correlations Between MPC Announcement, Minute Release, Inflation Report surprise series (Monthly Frequency)

Series	MPC Announcement	MPC Minutes	Inflation Report	Sample	N
MPC Announcement	-	-0.03	0.09	*Monthly*	*172*
	-	(0.69)	(0.22)	*2000M1-2014M4*	
MPC Minutes	-0.03	-	-0.05	*Monthly*	*172*
	(0.69)	-	(0.49)	*2000M1-2014M4*	
Inflation Report	0.05	-0.12	-	*Monthly*	*172*
	(0.74)	(0.39)	-	*2000M1-2014M4*	

Table A8: Correlations Between MPC Announcement, Minute Release, Inflation Report surprise series (Monthly Frequency, months including Inflation Report releases only)

Series	MPC Announcement	MPC Minutes	Inflation Report	Sample	N
MPC Announcement	-	-0.21	0.13	*Monthly*	*62*
	-	(0.11)	(0.34)	*2000Q1-2015Q2*	
MPC Minutes	-0.21	-	-0.08	*Monthly*	*62*
	(0.11)	-	(0.54)	*2000Q1-2015Q2*	
Inflation Report	0.13	0.34	-	*Monthly*	*62*
	(0.34)	(0.35)	-	*2000Q1-2015Q2*	

Table A9: Correlation Coefficients of our MPC Announcement, Minute Release, Inflation Report surprise series (Quarterly Frequency)

Series	MPC Announcement	MPC Minutes	Inflation Report	Sample	N
MPC Announcement	-	-0.15	0.05	*Quarterly*	*62*
	-	(-0.27)	(0.74)	*2000Q1-2015Q2*	
MPC Minutes	-0.15	-	-0.12	*Quarterly*	*62*
	(0.27)	-	(0.39)	*2000Q1-2015Q2*	
Inflation Report	0.05	-0.12	-	*Quarterly*	*62*
	(0.74)	(0.39)	-	*2000Q1-2015Q2*	

Tables A7, A8, and A9 show the cross-correlation coefficients of our MPC announcement, MPC minute release, and Inflation Report release surprise series at monthly and quarterly (aggregated) frequencies, excluding November 2008. In the first table all months are taken into account. In the second table, only the months in which Inflation reports were released are included into the sample. The numbers reported in the table are the correlation coefficients (first line, without brackets), and the p-values obtained from the Pearson Correlation test (second line, within brackets),.

A4. Correlation with Other Shocks

Table A10: Correlation Coefficients of our instruments with other shocks identified in the literature

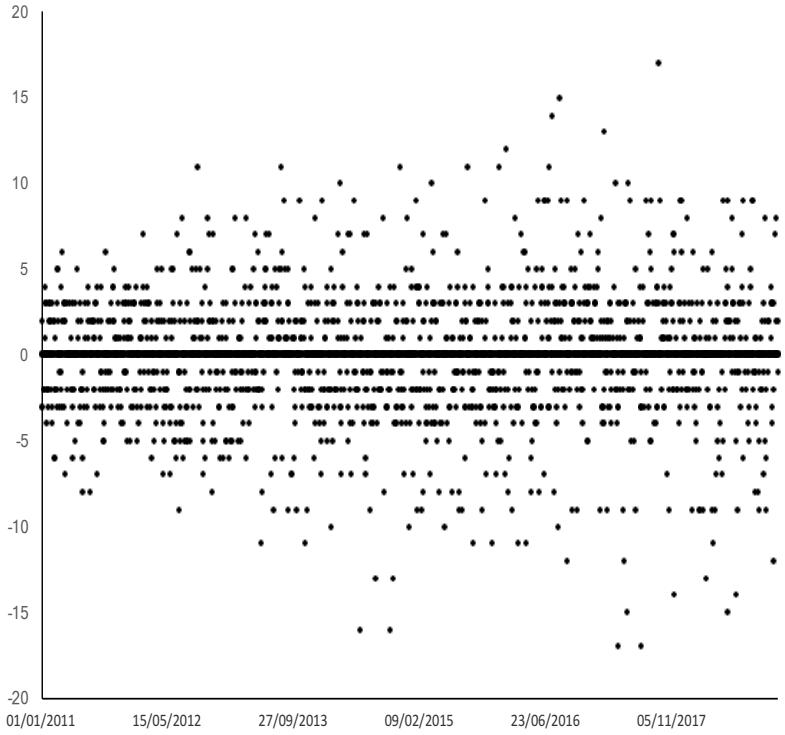
Series	MPC Decision	MPC Minutes	Inflation Report	Sample	N
UK Monetary	0.17	0.04	-0.23	*Monthly*	*97*
Cloyne and Hurtgen (2016)	(0.10)	(0.70)	(0.02)	*2000M1-2007M12*	
UK Bank Rate	0.66	-0.34	-0.05	*Monthly*	*182*
Gerko and Rey (2017)	(0.00)	(0.00)	(0.54)	*2000M1-2015M1*	
UK Minutes	-0.14	0.45	0.02	*Monthly*	*182*
Gerko and Rey (2017)	(0.06)	(0.00)	(0.78)	*2000M1-2015M1*	
UK IR Shock	0.02	-0.06	0.83	*Monthly*	*182*
Gerko and Rey (2017)	(0.81)	(0.39)	(0.00)	*2000M1-2015M1*	
UK Monetary	0.47	0.04	-0.23	*Monthly*	*187*
Cesa-Bianchi et al. (2020)	(0.00)	(0.59)	(0.00)	*2000M1-2015M6*	
UK Fiscal	0.01	0.15	0.03	*Quarterly*	*53*
Cloyne (2013)	(0.97)	(0.29)	(0.83)	*2000Q1-2009Q3*	
UK Productivity	-0.02	-0.06	-0.17	*Quarterly*	*62*
Office for National Statistics	(0.88)	(0.63)	(0.20)	*2000Q1-2015Q3*	
UK Policy Uncertainty	-0.03	-0.07	-0.07	*Monthly*	*189*
Baker et al. (2016)	(0.73)	(0.33)	(0.31)	*2000M1-2015M8*	
UK Macro Uncertainty	0.05	-0.17	-0.11	*Monthly*	*97*
Redl (2017)	(0.60)	(0.11)	(0.28)	*2000M1-2015M8*	
UK Financial Uncertainty	0.05	-0.20	-0.18	*Monthly*	*189*
Redl (2017)	(0.53)	(0.00)	(0.01)	*2000M1-2015M8*	
Global Oil	-0.07	-0.07	-0.00	*Monthly*	*189*
Baumeister and Hamilton (2019)	(0.32)	(0.32)	(0.97)	*2000M1-2015M8*	
Global Oil	0.13	0.14	-0.20	*Monthly*	*189*
Känzig (2018)	(0.65)	(0.08)	(0.92)	*2000M1-2015M8*	

This table shows the correlation coefficients of our MPC announcement, MPC minute release, and Inflation Report release surprise series with a set of different shocks from other authors in the literature, excluding November 2008. The numbers reported in the table are the correlation coefficients (first line), and the p-values obtained from the Pearson Correlation test (in brackets). Whenever quarterly frequency series are not available, we aggregate our surprise series by summing across months.

A5. Do Macroeconomic News Matter?

In this section, we address the concerns that, the release of news unrelated to the monetary policy and the information announcements might affect our results. We therefore proceed as follows. First, we consider the Bloomberg UK Economic Calendar between January 2011 and July 2019[12]. The Bloomberg UK Economic Calendar lists all the economic and financial news releases and includes data about release date, release time, type of data, expected volatility in response to the news, and the market surprise (whether the news was in line / better / worse than market expectations). Between January 2011 and July 2019, the calendar contains 6354 news, distributed over 2902 days. Second, we construct a non-monetary surprise index as follows. We attribute a score to each news. We construct the score attributed to each news as follows. We attribute a relevance of 1 if the expected volatility is low, 2 if it is moderate, and 3 if it is high. We attribute a negative sign if the news is worse than market expectations, a zero sign if the news is in line with the consensus, and positive if the market is positively surprised by the news. We then sum up the overall daily contribution of external news in each date between January 2011 and July 2019.

Figure 8: Our Daily Non-Monetary Surprise Index



We then run a t-test in order to check whether the mean of our index is statistically different from zero. Results are presented in the following table:

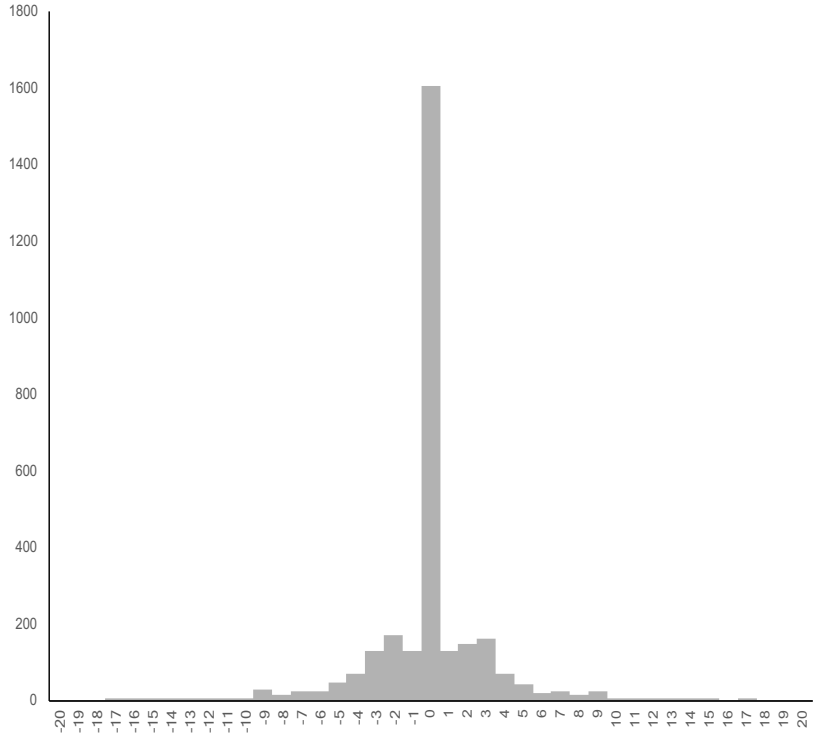
Under $\alpha = 0.05$, we cannot reject the null hypothesis that the mean of the news is statistically different from zero. We therefore infer that market reactions with respect to non-monetary news are very likely to have a mean not significantly different from zero. This evidence suggests that market expectations distribution with

[12]The sample selection is constrained by data availability, as only news from January 2011 to July 2019 are available in a computable format.

Table A11: Results of the t-Test (against the null hypothesis of zero mean)

t-Test	
Mean	-0.07
Variance	8.43
Observations	2902
t Stat	-1.34
P(T<=t)	0.18
t Critical	1.96

Figure 9: Distribution of the Non-Monetary News Surprise Index



respect to the revealed news have zero mean, as shown in the Figure below. We can therefore conclude that the presence of non-monetary macroeconomic and financial news is not likely to have affected our results.

A6. Robustness and sensitivity checks

A6.1. Sensitivity to data and sub-samples

In the main analysis for our findings discussed in Section 5, we use ICAP data for the OIS curves and have a sample from January 2000 to July 2015, inclusive, with tenors 1m to 12m in increments of 1m. However, two issues may arise. Firstly, it maybe that our results are sensitive to the data provider chosen. Indeed, we opted for ICAP brokerage data due to it offering the longest time series history. Other sources, including the Bank of England, exist, albeit with much shorter histories. Bank of England OIS curve data is published from January 2009 onwards, but includes tenors 1m to 60m in increments of 1m. Secondly, it maybe that the financial crisis of 2008/2009 is driving our results.

Hence we re-evaluate our analysis but under the following conditions:

a. Using Bank of England OIS data, tenors 1m to 12m; this ascertains if the source provider matters

b. Using ICAP OIS data, all tenors, from January 2010 to July 2015; this ascertains if our results are driven by the financial crisis

c. Using ICAP OIS data, all tenors, December 2007 and before; this ascertains if our results are driven by the financial crisis

From the above sensitivity analysis, our key results are unchanged. All reported variables (coefficient, standard error, and adjusted-R-squared) remain in line with our base analysis. For brevity, we report results from (a) with respect to inflation expectations using GBP Inflation Swaps. All other results are available on request.

Table A12: Response of Inflation Expectations to Monetary Policy and Information Shocks Bank of England Data

	Inflation Report	**Minutes**	**Announcement**
GBP Swaps 1y	0.003***	0.001**	0.005**
	(0.001)	(0.001)	(0.002)
GBP Swaps 2y	0.004***	0.001**	0.004**
	(0.001)	(0.001)	(0.002)
GBP Swaps 5y	0.004***	0.001*	0.003
	(0.001)	(0.001)	(0.002)
GBP Swaps 10y	0.002***	0.001**	0.002
	(0.000)	(0.000)	(0.002)

Notes: *** denotes statistical significance at the 1% level, ** denotes statistical significance at the 5% level, and * denotes statistical significance at the 10% level. Newey-West HAC robust standard errors are reported in parenthesis below the coefficient estimates.

A6.2. Sensitivity to omitted variables

As noted in Section 4, whilst our three shock variables are cleanly identified, it is important to consider whether or not our dependent variables are maybe responding to other macroeconomic news released during the same time frame or to general financial market volatility as opposed to the monetary policy and information shocks which we have identified.

Macroeconomic news surprises: There is a large literature on how asset prices are affected by macroeconomic news Gürkaynak and Wright (2013), and in particular, whether or not this news is in-line with expectations, above expectations, or below expectations (Caruso, 2019). In order to consider this, we re-estimate Section 4.2 in the following specification:

$$s_{t,k} = \alpha_k + \gamma_k i_{t,k} + \delta_k \mathcal{S}_{t,k} + \varepsilon_t$$

As previously, $i_{t,k}$ is the series which measures the unexpected change in the OIS curve for a given k. $s_{t,k}$ is the change in some variable between t and $t-1$, depending on the type of release indexed by k, where t corresponds to the date of the release of information k. ε_t is the error term and α and γ are parameters. Estimation is by OLS and using Newey-West standard errors.

δ_k is a parameter associated to $\mathcal{S}_{t,k}$. $\mathcal{S}_{t,k}$ is the Citi Economic Surprise Index where t is the day which information k is released. The Citi Economic Surprise Index measures quantitatively macroeconomic news surprises, calculated as the difference between the realised data value and the median consensus forecast value (obtained from sources such as Bloomberg and Refinitiv), with data being weighted for importance to financial markets. Given this, there cannot be concerns about the economic surprise index containing expectations about the monetary policy releases, at least for the minutes and the inflation report, since no forecasts regarding these are provided. Consensus forecasts are available for the Bank Rate, however, although a growing literature argues that financial markets more often than not correctly anticipate key policy rate changes (see for example Wilhelmsen and Zaghini (2011)).

We consider four specifications: 1) $\mathcal{S}$ is the UK economic surprise index; 2) $\mathcal{S}$ is the G10 economic surprise index; 3) $\mathcal{S}$ is the change in the UK economic surprise index between t and $t-1$; and 4) $\mathcal{S}$ is the change in the G10 economic surprise index between t and $t-1$. Indeed, given global interconnectedness, it maybe that UK yields are responding to movements in foreign yields driven by foreign macroeconomic news surprises.

Publication of the Citi Economic Surprised Indices began in January 2003, and hence we can only conduct this robust check from January 2003 to July 2015.

In each instance, our results remain robust. The shock remains statistically significant at the same confidence level as in the baseline analysis, and the adjusted-R-squared is comparable, as is the magnitude of the coefficient. Moreover, more often than not, the surprise index variable is statistically insignificant. For brevity, we report results from (1) with respect to inflation expectations using GBP Inflation Swaps. All other results are available on request.

Table A13: Response of Inflation Expectations to Monetary Policy and Information Shocks with Citi UK Economics Surprise Index

	Inflation Report	Surprise Index	Minutes	Surprise Index	Announce-ment	Surprise Index
GBP Swaps 1y	0.008***	0.000	0.003	0.000	0.013***	0.000
	(0.001)	(0.000)	(0.002)	(0.000)	(0.003)	(0.000)
GBP Swaps 2y	0.008***	0.000	0.004**	0.000	0.011***	0.000
	(0.001)	(0.000)	(0.002)	(0.000)	(0.002)	(0.000)
GBP Swaps 5y	0.007***	0.000	0.004**	0.000	0.007***	0.000
	(0.001)	(0.000)	(0.002)	(0.000)	(0.001)	(0.000)
GBP Swaps 10y	0.002***	0.000	0.003*	0.000	0.002***	0.000
	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)

Notes: *** denotes statistical significance at the 1% level, ** denotes statistical significance at the 5% level, and * denotes statistical significance at the 10% level. Newey-West HAC robust standard errors are reported in parenthesis below the coefficient estimates.