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Contents

Abstract

The effectiveness of a central bank's monetary policymaking is determined by the merit of its policy actions and their perceived credibility. Since the 1990s central banks have placed more emphasis on clear communications and transparency as additional levers to help achieve their goals. In this paper we examine how UK financial markets react to Bank of England communication. We might expect interest rate expectations, and potentially other asset prices, to react to official communication if such communication helps inform market participants.

We find evidence that the publication of the *Minutes* of the Monetary Policy Committee meetings and the *Inflation Report* significantly affect near-term interest rate expectations, an effect particularly visible in intraday data. Speeches and parliamentary committee hearings appear to have less of an impact. Our results for the UK are arguably less strong than Kohn and Sack's (2003) findings for US Federal Reserve communication. Although differences in institutional frameworks between the UK and US mean communications are not directly comparable, our results might also reflect the different mandates of the FOMC and the MPC, with the Federal Reserve having greater freedom to interpret its objectives.

Key words: communication, monetary policy, transparency

JEL classification: E44, E52, E58, G14

Summary

The effectiveness of a central bank's monetary policymaking is determined both by the merit of its policy actions and their perceived credibility. Since the 1990s central banks have placed more emphasis on clear communications and transparency as additional levers to help achieve their goals. Past Bank of England work has considered whether the move to inflation targeting in the United Kingdom has affected financial markets' reaction to Bank of England policy rate announcements and macroeconomic data releases. In this paper, following the methodology of Kohn and Sack (2003), we examine how financial markets react to different forms of Bank of England communication. We also extend their work to look at intraday reactions following communication.

We might expect near-term interest rate expectations to react to communication, such as the publication of the *Minutes* of the Monetary Policy Committee (MPC) meetings, if this conveys information of interest to market participants. Communication about the future economic outlook, through the *Inflation Report*, speeches and testimonies to parliamentary committees might also be expected to influence interest rate expectations at longer horizons, and potentially other asset prices. Although our results for the UK are arguably less pronounced than Kohn and Sack's results for US communication, we find that official Bank of England communication does have a significant impact on near-term implied interest rate expectations. Specifically, we find that the *Minutes* of the MPC meetings and the publication of the *Inflation Report* have a marked impact on short run interest rate expectations; other forms of communication, such as speeches and parliamentary committee hearings have a less marked impact. Relative to the findings of Kohn and Sack, we argue that the evolution of institutional frameworks has resulted in different communication strategies in the UK and US – for example the *Report* has no direct equivalent in the US – so we should not expect the UK results to be identical to those for the US. Our results are also consistent with a greater dispersion of decision-making power on the MPC compared with the Federal Open Markets Committee (FOMC). It is also consistent with the different mandates of the FOMC and the MPC, with the Federal Reserve having greater freedom to interpret its objectives.

1 Introduction

Since the introduction of inflation targeting in the United Kingdom in 1992, the conduct of monetary policymaking at the Bank of England has become increasingly accountable and transparent. As put by Lambert (2004), the dual response to the ejection of sterling from the Exchange Rate Mechanism was:

> *'…a shift to inflation targeting as a way of imposing discipline on monetary policy and to greater transparency in an effort to build badly-needed credibility.'*

This reflects, and is consistent with, a broader shift to transparency in monetary policymaking by central banks internationally (discussed, for example, in Chortareas *et al*, 2001). Dissemination of information has increased as central banks communicate more frequently and openly with financial markets and the public to explain policy decisions, economic prospects and risks. This strategy stems from a view that communication can play a role in enhancing the credibility of central bank's actions, so helping to maintain low inflation and a stable macroeconomic environment. As a result, clarity and congruency of this communication becomes more important. The increase in transparency in the UK coincided with the move to inflation targeting, with communication especially important in helping to explain the operation of a new regime.

Previous work undertaken at the Bank of England has studied whether the move to inflation targeting has affected financial markets' reaction to Bank of England policy announcements and macroeconomic variables.[1] In this paper, we investigate the extent to which financial markets respond to the different forms of official communication issued by the Bank of England since its operational independence in 1997.

Effective communication can help anchor expectations and assist in achieving the central bank's objectives. Although policy makers only have direct control of the overnight interest rate, they want to shape interest rate expectations along the yield curve. As Bernanke (2004a) notes:

> *'Control of the federal funds rate is (therefore) useful only to the extent that it can be used as a lever to influence more important asset prices and yields – stock prices, government and corporate bond yields, mortgage rates – which in turn allow the Fed to affect the overall course of the economy'.*

The specific use of language and communications in shaping interest rate expectations – achieved by the Federal Reserve after the summer of 2003, when fears of deflation prompted unprecedented indications of the accommodative future path of interest rates – is discussed, for example, by Lambert (2004) and Bernanke, Reinhart and Sack (2004). Formally, Eggertsson and Woodford (2003) stress the crucial role of expectations in the making of monetary policy.

[1] See, for example, Lasaosa (2005), Clare and Courtenay (2001), Haldane and Read (2000).

Whether financial markets react to Bank of England communication will depend on such communication containing 'news', as well as on the extent to which market participants listen to what the central bank says. The empirical importance of central bank communication for financial markets has been emphasised by Kohn and Sack (2003), who find that communication from the Federal Reserve in the form of the statements released by the Federal Open Markets Committee (FOMC) and testimony to Congress by Chairman Greenspan have a significant impact on financial markets on the day of their release, in particular affecting interest rate expectations. Confirming these results for a broader set of communications for several countries, Connolly and Kohler (2004) find that interest rate expectations, for the UK, US, euro area, Canada, Australia and New Zealand, are affected by central bank communication.

We test how different types of Bank of England communication impact on financial market prices. For example, we might expect the MPC *Minutes* to provide new information about immediate and near term policy decisions while the *Inflation Report* and speeches may better convey the Bank of England's long term views about the economy.[2] This might be reflected in an impact on longer-horizon interest rate expectations. The key forms of communication from the Bank of England's MPC are the *Minutes* of the meetings of the MPC, the quarterly *Inflation Report*, regular speeches given by the Governor and other committee members and evidence given to parliamentary committees.

In this paper we test for the impact of official Bank of England communication on the variance of interest rate expectations implicit in fixed income markets, on equity prices and the exchange rate, using selected daily and intraday data. Our key hypothesis is that volatility *increases* following official communication – as markets react to its content. Consistent with the methodology of Kohn and Sack (2003), we look at the variance (rather than the mean) of financial asset prices because it is difficult to quantify, or even determine the direction, of a communication 'surprise'. This contrasts with macroeconomic data releases, where outturns can be compared to quantified measures of expectations. Using daily data, we find evidence that Bank of England communication, specifically the MPC *Minutes*, increases the variance of implied interest rates from short-maturity short sterling futures contracts. Using intraday data, where we can better isolate the effect of communication, we get stronger results, with a significant response to the publication of the *Minutes* and the *Inflation Report*.

Our results are somewhat less pronounced than those documented for the United States. Kohn and Sack (2003) find that FOMC communication – in the form of written policy statements and testimony to Congress by Chairman Greenspan – significantly affects interest rate expectations along the yield curve using daily data. This might suggest that FOMC communication matters more for US financial markets than Bank of England communication matters for UK financial markets. We consider why this might be the case.

[2] In the introduction to the *Report* it is noted that "its preparation provides a comprehensive and forward-looking framework for discussion among MPC members as an aid to our (the Committee's) decision making."

The remainder of the paper is structured as follows. Section 2 describes the framework for monetary policy in the UK and the relationship between transparency and the conduct of monetary policy. Section 3 reviews the literature on communication and financial markets. Section 4 details the forms of Bank of England communication we consider. Sections 5 and 6 explain our methodology and the data, and section 7 sets out our results, including an analysis of possible explanations for the different results in the literature. Section 8 offers some conclusions.

2 Transparency and the conduct of monetary policy

2.1 Purpose and value of transparency in central banking

The conduct of monetary policymaking has changed markedly since the early 1990s, both in the UK and internationally. One of the key dimensions of this development has been the extent to which *"mystery and mystique has given way to transparency and openness".*[3]

Central banks use communication to explain decisions and to provide information on their assessment of economic developments, risks and uncertainties, making it an essential tool in meeting their increasing commitments to transparency and accountability. Ehrmann and Fratzscher (2005) define transparency in central banking as *"the absence of asymmetric information between policy makers and the public"*.

Transparency is increasingly regarded as beneficial to an independent central bank with clear policy objectives. Geraats (2002) – in a comprehensive survey of the literature – argues that greater central bank transparency could reduce private sector uncertainty, give the central bank greater flexibility to stabilise economic disturbances, and reduce the volatility of output.

But the idea that transparency is always good is not universal. Amato, Morris and Shin (2002) argue that information from central banks may crowd out private forecasting and thinking, thus depriving policy makers of useful external information. The definition of transparency in the context of central banking is also debated. Bernanke (2004a) argues that committee members airing their individual perspectives enhances transparency. Issing (1999) on the other hand makes the case that clarity is pre-requisite for transparency and for clarity it is important that committees speak with one voice.

2.2 Monetary policy objectives and communication

In traditional models of central bank objective functions – for example, Barro and Gordon (1983) or Kydland and Prescott (1977), the central bank faces the problem of time inconsistency. One

[3] Mervyn King's address to the American Economic Association and the American Finance Association, January 2000.

proposed solution to the time inconsistency problem is for the central bank to commit to an explicit rule: for example, Friedman's (1960) *k-percent* money growth rule.[4]

Given the problem of time inconsistency we might expect financial markets to take little notice of central bank communication. Monetary policymakers may say they are committed to low inflation, but agents would expect them to renege – so central bank communication could be just 'cheap talk'. On the other hand, if agents know that the central bank is following a rule rigidly then there is nothing they can learn about the course of monetary policy from communication, and hence are unlikely to react to it.

However, central banks – the Bank of England included – typically do not follow simple rules. Although the mandate of the Bank of England is clear, the MPC has discretion in terms of their use of the policy rate to meet the symmetric inflation target set by the Chancellor of the Exchequer.[5] As King (1997) points out:

> *'Mechanical policy rules are not credible – in the literal sense that no-one will believe that a central bank will adhere rigidly to such a rule irrespective of circumstances. No rule could be written down that describes how policy would be set in all possible outcomes. Some discretion is inevitable.'*

In a framework of 'constrained discretion' – where some discretion is exercised to limit swings in resource utilisation, but constrained by commitment to an inflation target – communication is likely to play an important part in resolving uncertainty about the course of monetary policy.[6] We might therefore expect communication to influence financial markets.

2.3 Why economic agents listen to the Bank of England

Transparent communication can help economic agents, including financial market participants, understand the reasons behind interest rate decisions and explain how policymakers react to information in the context of the economic conjuncture, reducing uncertainty about the future path of monetary policy. In the literature on central bank transparency the Bank of England is recognised, along with the Reserve Bank of New Zealand and the Riksbank of Sweden, as among the most transparent central banks in the world.[7]

[4] Of course, even with a specific money growth rule, the monetary authorities could renege on the commitment ex-post and so such a rule might not provide a solution to the time-inconsistency problem.
[5] See http://bankofengland/monetarypolicy/pdf/chancellorletter050316.pdf for details of the remit for monetary policy in the UK.
[6] See, for example, Bernanke (2003).
[7] See for example, Blinder (2004) for an analysis of central bank communication and strategies, Geraats (2002) for a summary of the transparency literature. Other papers that have discussed central bank transparency in some detail include: Bernanke *et al* (1999), Blinder *et al* (2001), Fry *et al* (2000) and Eijffinger and Geraats (2002). For a description of the Bank of England's institutional arrangements, see Bean and Jenkinson (2001), and for an informal description of the workings of the MPC, see Lambert (2005).

Monetary policymaking at the Bank of England has become more transparent since the early 1990s, with many important changes to structure and process. These include: an inflation target since 1992; publication of the *Inflation Report* since 1993; publication of the minutes of the meetings between the Chancellor and Governor since 1994; and operational independence, with measures to make the Bank of England more transparent and accountable in 1997. These changes are likely to have made Bank of England communication more important, in particular immediately after the move to the new institutional arrangements for monetary policymaking following operational independence in 1997.

The Bank of England reveals a great deal of information with regards to its deliberations, models and thinking. As well as the forms of communication analysed in this paper, the Bank publishes its econometric model, and considerable research and analysis.[8] Communication may be enhanced further by informal and formal discussions between Bank staff, MPC members and economic agents, for example during regional visits.

In this context economic agents, and arguably financial market participants in particular, are likely to have a firm understanding of the thinking of the MPC. Indeed, the Bank of England's commitment to transparency makes a virtue out of being 'boring' and predictable; King (2000) notes:

> *"A transparent monetary policy reaction function means that the news should be in the developments of the economy not in the announcements of decisions by the central bank…Hence a successful central bank should be boring – rather like a referee whose success is judged by how little his or her decisions intrude into the game itself".*

This view also has support in the theoretical literature. Chadha and Nolan (2001) argue that higher variance in financial markets resulting from monetary policy announcements or communication reflects a lack of understanding about what the central bank is doing. So, large movements in financial markets in reaction to central bank communication might suggest a lack of transparency.

An alternative view would be that the MPC structure with independent members might make it hard for financial market participants to interpret communication if they have to look for points of consensus. The MPC consists of nine individually accountable members, a different structure to that of most other central banks where the emphasis is on building a consensus within the committee before taking a decision, or with one member being dominant.[9] Given the likely dispersion of views among the committee, market participants may pay less attention to individual communications.

Overall, given the inflation target and the importance of constrained discretion in UK monetary policy making – and hence the need to explain monetary policy decisions in the context of the Bank's objectives and the economic outlook – it seems likely that market participants will pay attention to official communication from the central bank. However, structural differences in

[8] See, for example, *The Bank of England Quarterly Model*, January 2005.
[9] See, for example, Kohn and Sack (2003) p29, and Ehrmann and Fratzscher (2005) p4.

monetary policymaking between the UK and US may be important in explaining the differences between our results and those in the US literature.

3 Evidence in the literature

3.1 Financial markets and economic news

A large body of previous Bank research has looked at the reaction of UK financial markets to economic news rather than considering the impact of official communication. Two intraday studies by Clare and Courtenay (2001) and Lasaosa (2005) have attempted to infer whether changes in the UK monetary policy framework have affected UK markets' response to key announcements, testing the hypothesis – based on Haldane and Read (2000) – that market participants should react to policy announcements less and macroeconomic news more as policymaking gets more transparent.[10] The key findings of these papers in fact go against the hypothesis: the evidence suggests that markets appear to react less to macroeconomic announcements since the Bank of England became independent in 1997, and about the same to policy rate changes.

A number of explanations have been suggested for why other changes in the conduct of monetary policy may mean that financial market reactions to macroeconomic surprises have not increased, in spite of greater transparency. Lasaosa (2005) points to decision-making by a committee: individual members may attach different weights to particular macroeconomic releases, such that it may be hard to infer which piece of economic news is important to the committee's overall reaction function; and the process of making the policy decision may itself yield new information as a result of committee discussion. Additionally, the ability to exercise flexibility and judgment within a proactive rather than reactive committee may make policy decisions more difficult to anticipate by market participants.

An alternative explanation comes from a model suggested by Mahadeva (forthcoming). Even with a transparent framework for monetary policy, market participants could focus and react more to central bank actions, rather than the data itself, if the actions serve as a 'beacon' for guiding market participants' beliefs about the shocks hitting the economy. This could occur if the central bank possesses an advantage in processing publicly available information for its monetary policy implications, leading market participants to attach more weight to the central bank's judgments.

Although both Clare and Courtenay (2001) and Lasaosa (2005) have looked at the impact of interest rate decisions, no UK-specific papers have looked at the impact of communication on UK financial markets in particular: this is the focus of our paper.

[10] Haldane and Read (2000) focus on the reaction of the yield curve to policy rate changes, where the reaction function of the monetary authorities is assumed to be uncertain in terms of the target and macroeconomic indicators. The impact of these sources of uncertainty is likely to differ along the yield curve, allowing the identification of the type of uncertainty that is reduced with increasing transparency on the basis of where along the curve a response takes place.

3.2 Official communication and financial markets

Communication is an important tool available to central banks to influence the transmission mechanism of monetary policy. Most central banks, including the Bank of England, only have a single formal tool, the short term policy rate. But through communication monetary authorities can also exercise some influence over longer-term asset prices.[11] In this way, communication could be considered as an important indirect tool in the transmission mechanism for monetary policy.

Looking at a panel of six central banks, Connolly and Kohler (2004) find that commentaries accompanying rate decisions, monetary policy reports and particularly parliamentary hearings influence the variance of asset prices.[12] Among UK communications in between policy meetings, they find that MPC *Minutes*, and to a lesser extent, evidence to the House of Commons Treasury Committee, are the most significant forms of official communication. They do not find significant results for either the *Inflation Report* or speeches.[13]

Ehrmann and Fratzscher (2005) also investigate the impact of central bank communication on interest rate futures. They find that monetary policy communication has a significant effect on the short and medium-term horizons of the yield curve. The result is particularly strong for the Governing Council of the ECB followed by the FOMC, where all maturities from three-months to five years are affected. For the MPC, looking at speeches and testimonies, the results are less strong, and are not always suggestive of an *increase* in volatility as a result of communication.

Chirinko and Curran (2005) complement the above studies by using intraday data to assess the importance of FOMC communication. The authors find that FOMC statements in particular, as well as congressional testimony, have a significant effect on the volatility of 30-year Treasury bond futures; they do not find that speeches have a significant impact on market prices.

Our work builds on the framework developed in Kohn and Sack (2003), assessing whether the variance of financial market asset prices increases on days of central bank communication. Kohn and Sack show empirically that communication is an important tool for the FOMC in conducting monetary policy. FOMC statements accompanying policy decisions and congressional testimony given by Chairman Greenspan are found to have a significant effect on market interest rates. They also find that for longer-horizon interest rate expectations communication appears more important than policy decisions, suggesting that in some instances what the FOMC says is more important than what it actually does.

[11] An argument put forward by a number of authors, including Bernanke (2004b), Kohn and Sack (2003), Connolly and Kohler (2004) and Ehrmann and Fratzscher (2005)

[12] The economies covered in their analysis are Australia, Canada, the euro area, New Zealand, the United Kingdom and the United States.

[13] Connolly and Kohler (2004) look at speeches by all senior officials at the Bank of England listed on the Bank's website.

Testimony by Chairman Greenspan appears particularly important for interest rate expectations at longer horizons, probably reflecting the importance of this form of communication in conveying the FOMC's view on the economic outlook. Speeches on the other hand were not found to have a significant effect on the variance of financial market variables. This is potentially surprising as speeches sometimes provide similar information to that contained in the Congressional testimony. Kohn and Sack suggest that these weak results might reflect the fact that Chairman Greenspan talks on a wide range of issues, including on subjects with little relation to monetary policy (or the economic conjuncture).[14]

Building on the work by Kohn and Sack (2003), Bernanke, Reinhart and Sack (2004) consider whether the surprise component of FOMC statements affects financial markets, categorising communication as positive, negative or neutral compared with expectations.[15] Again, they find that statements influence the variance of financial market variables and that asset prices moved in the expected direction following communication.

4 Types of Communication in the UK

We investigate the impact of Bank of England communication from June 1997 until December 2004.[16] We look at four types of communication:

a) *Minutes* of MPC meetings
b) The *Inflation Report*
c) Speeches by MPC members
d) Evidence by members of the MPC to the House of Commons Treasury Committee, and the House of Lords the Economic Affairs Committee (previously known as the Committee on Monetary Policy).

4.1 Minutes of the MPC meetings

The *Minutes* of the MPC meetings are published at 9:30am on the Wednesday thirteen days following the meeting, so that the minutes of the previous meeting are available to the public before the MPC next meets.[17] The choice of a two week delay was based on a recommendation by Donald Kohn of the US Federal Reserve from a review of the conduct of monetary policy in the UK. The *Minutes* provide useful information to financial market participants on a timely basis on the range of

[14] Kohn and Sack (2003), p12.
[15] Bernanke, Reinhart and Sack (2004) focus on FOMC statements alone: they do not investigate the impact of other communication such as congressional testimonies or speeches.
[16] There are two reasons for this choice of time frame. First, 1997 corresponds to the granting of operational independence to the Bank of England, and so tests the importance of central bank communication in a specific context or framework for monetary policy. Second, data limitations mean that obtaining consistent data before 1997 is difficult. For some of our data sources, specifically for intraday long gilt and FTSE futures, our sample finishes on 28 November 2003.
[17] Before October 1998 the *Minutes* were published with a six week lag. Note that 9:30am is a standard release time for UK macroeconomic releases, and the release of the *Minutes* sometimes overlaps with publication of labour market data.

views of the Committee on both the appropriate policy stance and the economic outlook and risks, often containing a discussion of the key data and arguments underpinning the decision.

The *Minutes* also include a voting record of the members. Again, the vote can convey information to the public about the views of members and so potentially about their future policy stance (see Gerlach-Kristen 2004). Ninety one sets of *Minutes* were published between June 1997 and December 2004. We would expect the *Minutes* to give the timeliest read on the past policy decision and the near term policy inclination.[18]

4.2 Inflation Report

The *Inflation Report* is a quarterly publication released in February, May, August and November. The *Report* includes the MPC's central projections for output growth and inflation, depicted within a fan chart which quantifies the magnitude of the risks around that central projection. If there are significant differences of view among the committee, those differences are explained and presented along with the likely impact on the inflation and growth forecasts. The *Report* also gives a detailed analysis of the economic outlook and risks, showcasing some of the thinking underlying the MPC's decisions. The publication of the *Report* is accompanied by a press conference given at 10:30am that day by the Governor, Chief Economist, and Executive Director for Markets at the Bank of England.[19] The press conference lasts for one hour. Thirty *Report*s have been published between June 1997 and December 2004.

The forward-looking nature of the *Report* implies that it might contain a mix of news about the near term policy inclinations – in its assessment of the balance of risks and the modal path for inflation, for example – but also provide some information about longer term economic questions.[20]

4.3 Speeches

All MPC members give speeches and interviews. In this paper we concentrate on speeches given by the Governors George and King (the latter both as a Deputy Governor, and from 1 July 2003, as Governor) over our sample period. Speeches by the Governor arguably receive the most press coverage and commentary, suggesting they might also be watched most closely by financial market participants. Nevertheless, speeches by other MPC members are likely to be similarly cross-examined for clues as to policy inclinations, and we do not discount their importance. In our analysis we also test the entire set of speeches made by MPC members over this period.

[18] The MPC always issues a statement to accompany the interest rate decision. On some occasions this statement also provides a brief explanation for the decision. As this statement does not accompany every policy decision, we cannot separately test for its effect.
[19] Before August 2003, the Deputy Governor for Monetary Policy, Chief Economist, and Executive Director for Markets at the Bank of England gave the press conference.
[20] For example, there are usually several 'boxes' in the *Report* which focus in more detail on particular economic issues and questions relevant to the outlook for the economy – for example on migration, margins and productivity.

Seventy speeches were given by Governor George between June 1997 and December 2004, and twenty five by Governor King, giving a total of ninety-four speech dates.[21] A total of 197 speeches were made by all MPC members over our sample period, giving a total of 191 speech dates.

It can be difficult to identify the precise time when speeches have an impact on financial markets. Many occur after UK markets have closed, and even for those that occur during the day, the response of market participants is likely to be affected by the flow of headlines on wire services. For this reason we are unable to accurately identify speech times for our intraday study, and focus only on an analysis of daily data.

4.4 Testimony by the MPC

The MPC most regularly gives testimony to the Treasury Committee after the publication of the *Report*. Owing to Parliament's summer recess, the August *Report* is not always cross-examined. Although there is no set time-period between the publication of the *Report* and the evidence, it tends to take place in the month of publication.[22] It is not clear ex ante that such communication would yield any further insights into either the future stance of monetary policy or the economic outlook, given its specific focus on the issues covered in the *Report*. However, as there is a lag between the publication of the *Report* and evidence to the Treasury Committee, it provides a separate opportunity to quiz members: evidence is usually taken from 4 or 5 MPC members, always including the Governor. We regard such testimony as a further example of Bank of England communication and will test for its impact on financial markets.

In addition, we look at evidence given to the Treasury Committee on occasions unrelated to the publication of the *Report*, and to the House of Lords Economic Affairs/Monetary Policy Committee. In total evidence has been given to parliamentary committees thirty four times between June 1997 and December 2004.

As with speeches, it is difficult to identify the precise timing of the impact of testimonies on financial markets. Although the time the hearings begin is typically announced in advance, market participants are again likely to react to any wire service headlines appearing throughout the testimony. As with speeches, we are therefore unable to use our intraday data to analyse the impact of testimonies.

5 Methodology

A model testing for the importance of central bank communication would ideally fully control for all other news that affects financial markets, focusing on the surprise element of official communication to test whether the coefficient on these surprises is significantly different from zero. A focus on surprises in all cases is motivated by the insight that asset prices should embody all information

[21] On one occasion, a speech by the then governor Sir Edward George and Mervyn King were made on the same day.
[22] The specific arrangements for testimony to parliamentary committees have changed over time.

available to market participants at any time. So it is only the news relative to market participants' expectations – either for data, communications, policy decisions, or any other events – that would be expected to affect asset prices.

Achieving this goal is not trivial, however, for several reasons. First, a huge number of factors affect asset prices. To quantify the impact of MPC communication alone one would wish to keep all other influences equal. In reality they are not, and markets may react to a range of information including central bank communication. Second, there is no obvious fully encompassing way to quantify the content of MPC communication. So it is hard to benchmark the 'strength' of what is announced. Third, and related, there are no readily available measures of what investors had expected official communications to say, so as to assess the strength or sign of the news. A final problem may be that communications are endogenous, i.e. the central bank may choose to communicate because of a sudden change in the economic conjuncture or some other news. In this case asset prices would probably be more volatile on the days of communication, but not because of the communication.

We are, to an extent, able to address some of these problems. First and foremost, we control for the impact of monetary policy decisions and macroeconomic surprises, where the surprise is computed as the outturn for the macroeconomic data release or interest rate decision less its expected value from surveys. Second, as we are unable to quantify the content and investors' expectations of communications, we follow the methodology used by Kohn and Sack (2003). We focus on the impact of communications on the variance of the unexplained component of asset prices on the day of, or minutes following, official communication. Since any change in the mean may also effect the variance of the asset price, and we have no objective priors about the directional impact of communication, this is regarded as a good proxy for analysing the overall importance of communication for financial markets.

Our final concern on the endogeneity of communications is unlikely to be pressing – the dates of major communications are likely to be known some way in advance. This is particularly true for the *Minutes* and the *Report,* but dates of parliamentary committee hearings and speeches are also frequently known some time in advance. Therefore, we can take the days of communication to be exogenous, and hence orthogonal to the errors we are testing.[23]

5.1 Estimation procedures

In this framework, if central bank communication affects financial markets we would expect the volatility of financial market variables to be higher on the days, or minutes following, communication. We assess this by testing whether the variance of yields or prices of variable *j*

[23] Ehrmann and Fratzscher (2005) p11-12 find some evidence that the Bank of England increases the frequency of communication in the lead up to meetings when interest rates are subsequently changed. However, Kohn and Sack (2003) and Chirinko and Curran (2005) argue that communication dates are exogenous, and treat them as such in their event studies.

increases on communication days. Formally, we would expect α_{j1}s to be positive and significant in an equation of the form below:

$$\varepsilon_{jt}^2 = \alpha_{j0} + \alpha_{j1} dummy + \eta_{jt} \quad (1)$$

where ε_{jt}^2 are the squared residuals from regressions of yield changes controlling for monetary and macroeconomic surprises, as per equations (2) described subsequently; *dummy* captures announcement dummies for individual communication events, such as the publication of the *Minutes*, *Inflation Report*s and so on. The dummy variables are set to one on the days of that communication and zero otherwise.

Such regressions amount to comparing the variance of our asset prices on communication and non-communication days. With intraday data we look at the price or yield response within a narrow window around the announcement time, again for the set of communication days compared with non-communication days.

To perform these regressions we first need to extract our best measure of the variance of asset prices that we can attribute to official communications. We do this by controlling for monetary policy and macroeconomic surprises, described below.

5.2 Controlling for surprises

In our analysis we follow Lasaosa (2005) in controlling for macroeconomic data releases. We use expectations of data releases as calculated by Money Market Services International; and from September 2003 to December 2004, from Bloomberg.[24] These polls are conducted a few days before the release; similarly for monetary policy surprises we use mean survey expectations derived from Reuters polls.

We label the unexplained or surprise component of the *i*th macroeconomic release $mac^u_{i,t}$. To make the regression coefficients comparable across indicators, we standardise the surprises by their sample standard deviation for each macroeconomic series:

$$mac^u_{i,t} = (A_i - E_i)/\Omega_i \quad (2)$$

where A_i is the announcement value of the data, E_i is the expectation of the announcement and Ω_i is the sample standard deviation of surprises. Each $mac^u_{i,t}$ is set to zero on days where there is no data

[24] We switch surveys owing to data limitations: MMS data for survey expectations are not consistently available after September 2003, but typically have longer historic backruns. However, the Bloomberg poll surveys a similar group of economists, and is similar in the available back data.

release for that macroeconomic indicator. Similarly, $baserate^{u}_{t}$ is our standardised monetary policy surprise variable, set to zero on days where there is no monetary policy decision.[25]

We allow the change in each of the financial market variables *j* under investigation to respond linearly to the unexpected component of monetary policy decisions and macroeconomic data surprises *i*, as per the regression (3) below:[26]

$$\Delta y_{jt} = \beta_{j0} + \beta_{j1} baserate^{u}_{t} + \sum_{i=2} \beta_{ji} mac^{u}_{it} + \varepsilon_{jt} \qquad (3)$$

where Δy_{jt} is the change in the financial variable *j* under investigation at time *t*. For our daily data, we look at the change over the day. Correspondingly the intraday series, Δy_{jt} measures the x-minute reaction in yields or prices starting from the announcement time. For example, we compare the 09:30 to 09:35 interval on the day of the *Minutes* with the same time period for all other days in the sample.

We estimate equation (3) using both OLS and GARCH, motivating the second by the observation that financial market data tend to exhibit shifting variances.[27] Given the relatively simple form of equation (3), it is unlikely that the surprises we are able to control for will render the equation residuals well-behaved. As using the OLS framework remains our baseline, we exercise care in the interpretation of the t-statistics which may be biased downward as a result of the non-normality: all our inferences are based on Newey-West corrected standard errors.[28] We present our OLS results in Section 7 and the GARCH estimation procedures and results and are detailed in Appendix 2. The OLS and GARCH methods give us broadly the same results.

For both our daily and intraday data, each regression contains one observation per working day over the sample running from June 1997 to December 2004, making our sample size 1976.[29] The total number of Bank of England communications that we will look at during this time period is 346.[30]

[25] A general problem with the macroeconomic forecast data, and indeed any survey expectation, is that forecasts are compiled several days before the data are released. Typically both the MMS and Bloomberg surveys are conducted and published on Friday for data being released the following week. Accordingly, if expectations change in the intervening time period this is not incorporated.

[26] One possible extension to this approach would be to test for non-parametric responses of financial market variables to macro-economic variables. Ehrmann and Fratzscher (2002) for example test for threshold effects, whereby financial markets respond to data releases only when they lie beyond some pre-conceived 'normal' range (the 'normal' range defined as the second and third quartiles of the past values).

[27] The GARCH methodology is suggested by Engle (1982) and Bollerslev (1986).

[28] Newey-West is a more general covariance estimator consistent in the presence of heteroskedasticity and serial correlation.

[29] Our sample starts after the first MPC meeting under operational independence, to ensure all communications are treated consistently by market participants. Our sample size is 1691 for long gilt and FTSE futures regressions.

[30] Some release days for speeches overlap.

6 Data and pre-processing

For our analysis we consider a set of daily and intraday data. Our daily data consists of several measures of interest rate expectations, the FTSE 100 equity index, and the sterling exchange rate index. Our measures of interest rate expectations include: first, three-month forward rates at constant 3-, 6-, and 12-month maturities implied by short sterling futures contracts.[31] Second, 10-year spot yields from a yield curve fitted to risk-free government securities, as well as several implied forward rates: respectively 1 to 2, 2 to 3, 3 to 4, and 4 to 5 year forwards and the 10-year instantaneous forward rate. Our intraday data covers the prices of short sterling, long gilt and FTSE 100 futures contracts.[32] For short sterling, we again use implied 3-month forward rates at 3-, 6- and 12-month constant maturities. We might expect the responses of short sterling contracts to be relatively cleaner than that of fitted yields: short sterling futures are predominantly used for speculating on, and for hedging against, future interest rate movements. But by looking at forward rates along the yield curve we can investigate whether communication has an impact on interest rate expectations beyond the most immediate meetings.

Our intraday data looks at the change in prices or yields over a 5-, 15- and 60- minute window following the announcement. We look at the release of MPC *Minutes* at 9:30am, and the *Inflation Report* press conference held at 10:30am.[33]

6.1 Controlling for monetary policy and macroeconomic surprises

To obtain series of asset price responses we can attribute to official communication, we first strip out the effect of monetary policy decisions and macroeconomic data surprises.

We include a UK monetary policy surprise variable for all our daily asset price regressions. As the policy announcement is made at noon, we do not need to control for monetary policy surprises in intraday regressions. Measures of overseas monetary policy surprises for the FOMC and ECB, derived from Reuters survey expectations, were not found to be significant in any of the asset prices investigated and hence were not included.

In controlling for UK and US macroeconomic surprises in daily data, we chose the subset of surprise variables that were significant at the 10% level in either the 3-month short sterling regression, or the 1 to 2 year forward rate regression (Table 1 in Appendix 1). These were used as explanatory variables for all other financial market prices. From UK data, this included releases of: average earnings/unemployment, first and second releases of GDP, industrial production, retail sales, RPI/RPIX; from US data, this comprises: consumer confidence, first release of GDP, purchasing

[31] These are calculated from intraday short sterling data provided by euronext-liffe. To calculate a constant maturity implied forward rate, we linearly interpolate between the rate implied by the two closest short sterling contracts.
[32] UK long gilt futures are relatively sparsely traded, such that the prices used may not be fully representative. For this reason, and owing to a longer sample, we prefer to focus on the response of short sterling futures.
[33] For the *Report*, we also look at the two-hour window after 10:30, to see if the impact unwinds at the end of the press conference.

managers' index (ISM), non-farm payrolls and retail sales. Overall in the daily data, macroeconomic data surprises are not uniformly significant and of the correct sign for all the asset prices we look at, but we include them in all our regressions for consistency.[34]

For our intraday data, we included the relevant subset of macroeconomic announcement for the appropriate time of the data release. For intraday windows around 09:30, we include our full set of UK macroeconomic releases, which include releases as above plus trade data, the third release of GDP, provisional M0, provisional M4, PSBR, and producer prices, as all variables are significant at least at the 10% level in explaining the response of short sterling or long gilt futures. As no macroeconomic releases occur at 10:30, we do not include any surprise variables for intraday windows around the 10:30 release time.[35]

Although we control for significant US macroeconomic indicators, ideally we would wish to also control for the impact of euro area macro releases, with the euro area representing the UK's largest trade partner. However, since the advent of monetary union both area-wide as well as country-specific indicators are produced, and it is unclear whether market participants focus on one or the other. Because of this problem, as well as the sheer volume of potential euro area macro releases to control for, we do not include euro area macroeconomic indicators in our analysis.

Anecdotally we know that integrated world markets sometimes focus on, and respond strongly to, some specific data releases. UK interest rate expectations have on occasion reacted very strongly to the release of US non-farm payrolls data in 2003 and 2004, for example. However, a consistent response in UK financial market prices to only a few US macroeconomic releases may not be too surprising, and might in part reflect the credibility of monetary policy: if investors expect most shocks to be absorbed through appropriate monetary policy at home and abroad then they might not have a marked effect on market prices.

6.2 Controlling for uncertainty

One complication is that markets may react differently to a given macroeconomic surprise in different macroeconomic climates. The significance of a given surprise to agents attempting to predict future monetary policy may depend on the amount of uncertainty surrounding future states of the economy. The value of additional information from macroeconomic indicator surprises may be relatively low if the expected path of monetary policy is clear. But if the immediate path of monetary policy is very uncertain, the amount of information in macroeconomic data may be relatively high.

In our OLS regressions, we attempt to control for the uncertainty about the immediate path of monetary policy by using implied volatility from options prices. When implied volatility is low

[34] The same macroeconomic surprises are included in our GARCH regressions; these are shown in Table 2.
[35] Some UK survey data are released at 11:00am. However, obtaining a consistent backrun of survey expectations for these is difficult, and consequently we do not control for the impact of the resulting surprises.

(high), uncertainty about the likely path of interest rates, relative to that implied by interest rate futures prices, is low (high). However, as the variables we initially included to proxy uncertainty were typically not significant, we did not include them in our final regressions. An alternative specification to capture changing uncertainty is to model it in a GARCH framework: both the method and detailed results from this analysis are described in Appendix 2, although the following section also briefly summarises our GARCH results.

7 Results

The key hypothesis tested in this paper is that the volatility of financial variables increases following the release of Bank of England communication. As we know anecdotally, particular communications have on occasion substantially moved market interest rates. Such moves have occurred at turning points in interest rate cycles, or when policy decisions were unexpected and market participants looked to official communication for an explanation of the reasons. Three such examples were the minutes of the June 1998 and October 2003 MPC meetings, and the February 1999 *Inflation Report*.

These communications were important for specific reasons. The June 1998 *Minutes*, which discussed the unexpected 25 basis point increase, had a large impact on market prices – market participants were generally of the opinion that interest rates had already peaked. Similarly, the MPC cut rates by a larger-than-expected 50 basis points in February 1999. The February *Inflation Report*, published shortly after that policy decision, and before the February *Minutes*, had a large impact on market prices as market participants updated their outlook for the path of interest rates. The split vote revealed by the October 2003 *Minutes* was seemingly interpreted by market participants as a trailer for a rate increase, an increase that materialised at the November 2003 meeting.

Charts 1 to 3 in Appendix 1 give a graphical representation of the three events, plotting the squared residuals from our OLS regressions on 3-month short sterling implied interest rates, in daily and intraday space. The charts suggest that the variance of implied interest rates increased markedly following communication, indicated by a stalk in the centre of the charts. The results are clearest with the intraday data, where few other reactions of these magnitudes were observed in the one month window around the communications. By comparison, large events are apparent over the periods in daily data, pointing to economic or other news – outside of the variables we are able to control for – also having an impact on financial markets. Intraday data better enable us to isolate the impact of communication. In our analysis we investigate whether communication more generally influences financial markets, or whether its impact is limited to some specific examples.

The formal econometric results for the four types of communication tested are shown in Tables 2 and 3 of Appendix 1, describing respectively the results for our baseline OLS regressions from our daily and intraday data. Table 7 reproduces the results obtained by Kohn and Sack (2003) for comparison with the daily data. Our intraday results, one of the most important innovations in this paper, have not, to the best of our knowledge, been attempted elsewhere in the literature on central bank

communication. In the following sub-sections we document our results for the four types of communication we investigate.

7.1 Minutes of MPC Meetings

Using daily data, we find the impact of the *Minutes* – a particularly important form of communication of the MPC's views – is positive and significant at the 5% level for 3-month short sterling implied rates against all observations in the sample. Focusing on the comparison of the communication day against the previous five working days (Table 2) – thus potentially capturing the importance of broader trends in market volatility – we find that the impact of the *Minutes* becomes more positive and significant for a number of measures of interest rate expectations extending along the yield curve. This result highlights the importance of the *Minutes* for affecting market participants' near-term policy expectations. At longer horizons it might suggest that the *Minutes* contain information about how policymakers' interpret and react to information.

Moving to intraday data, we find a more significant reaction to communication: the 5-, 15- and 60-minute responses for both short sterling (at all maturities) and long gilt futures suggest that the *Minutes* increase the variance of price changes, and this is significant at least at the 5% level (Table 3). The intraday data thus provide more convincing evidence of the impact of the *Minutes* on financial prices.

These results appear relatively robust to excluding particularly large responses: for 3-month short sterling implied rates in the intraday data, excluding the top ten largest reactions to the *Minutes* still leaves the response significant at the 1% level for the remaining observations. By contrast, in the daily data, excluding the three largest responses is sufficient to render the response insignificant at even the 10% level, again highlighting the relative volatility of the daily data.

In October 1998 the MPC began to publish the *Minutes* after just two weeks, as opposed to after six weeks. This meant that the *Minutes* would become available before the next MPC meeting. We test whether market participants reacted more to the *Minutes* after October 1998. We find that the response to publication only becomes significant after the timetable was shortened. This suggests that timeliness is important.[36] These results are available in Table 4.

An additional interesting result is the impact of vote splits on the Committee, as indicated by the voting record contained in the *Minutes*. Vote splits could be taken to represent a degree of uncertainty about prospects for inflation and growth. For this reason one might expect MPC *Minutes* which reveal a split vote to induce more volatility in financial markets compared with *Minutes* that show that the decision was unanimous, at least if this split was unexpected. However, dummy variables for splits, or any variables capturing the extent or change in dissent, are not significantly

[36] This might suggest that the recent decision to speed up the timing of publication of the FOMC's minutes may have had a similar impact on increasing the market reaction, making the minutes an additional source of news to market participants.

associated with any more volatility above that usually associated with publication. Given that we find the *Minutes* to be significant, it might suggest that financial market participants pay quite close attention to the publication and care more about the discussion they contain rather than some crude proxy.[37] As suggested by Lambert (2004), the publication of the voting record without the supporting paragraphs explaining the policy decision may not enlighten market participants as to the reasons for the decisions and the direction of monetary policy. These results are available in full in Table 5.

7.2 Inflation Report

Overall, we find that markets react strongly in the hour following the publication of the *Inflation Report*. However, reflecting other 'news' affecting financial markets, this reaction tends to be lost in the daily data.

For our daily data, the *Report* did not appear to be both significant and positive for any of the financial market variables tested (Table 2), including short-horizon measures of interest rate expectations.[38] This conclusion is robust to comparing volatility with all non-communication days, the five working days before the policy decision, or all non-communication days.

However, moving to our intraday data, we find convincing evidence of the impact of the *Report* on market prices (Table 3). The variance of short sterling futures reacts positively, and significantly (at least at the 5% level) for the 5-, 15- and 60-minute intervals tested. This effect is also visible, and of a similar size, two hours after publication. This might suggest that any deeper inspection of the contents of the document – after the end of the press conference – does not typically unwind all of the initial market reaction. The effect of the *Report* on long gilt futures is also significant, but we do not find evidence of an impact on the variance of FTSE futures. These results support our prior that interest rate expectations do respond to the *Report*, but that the response may be lost due to other news occurring during the day.

As with the *Minutes*, the intraday results are robust to excluding the largest responses to the *Report* publication. For 3-month short sterling implied rates, excluding the top ten largest reactions (fully a third of the total number of *Reports* in our sample) still leaves the response significant at the 5% level.

We found no strong systematic relationship between the size of the market reaction following the *Report* and summary statistics describing the shape of the inflation fan chart contained in the *Report*

[37] This would appear to be consistent with Kohn and Sack's finding that the balance of risks statement that the FOMC have published, since 1999, with their interest rate decision does not have any effect on volatility, over and above the effect of the short statement that they had published previously.

[38] Only for the FTSE 100 index was the effect significantly non-zero, but strongly negative: the implication would be that the variance of the FTSE index in fact falls after the publication of the *Inflation Report*. Given the absence of such an impact on other asset prices investigated, our conclusion is that this result is spurious, and hence overall we judge that we do not find support for our hypothesis in the daily data.

(see Tables 6a and 6b). Specifically, we tested whether the deviation of inflation from target, the width of the fan chart, the 'balance of risks' as evidenced by the skew, or the gradient of the projection two years ahead affected the market reaction to publication. We might expect some reaction to these summary statistics if, for example, the inflation projection at the two-year horizon differs materially from target – suggesting that interest rates might change if the modal projection unfolds – or the gradient of that projection is strongly upward or downward sloping at that forecast horizon.

Although there was some evidence that the deviation of inflation from target (conditioned on market interest rates) and the gradient of the modal projection (conditioned on constant interest rates) has explanatory power, this evidence was only weak.[39] As with the MPC *Minutes*, market participants may attach more significance to the supporting analysis in the *Report*, and to the comments given during the press conference, than any single crude proxy for what the document contains.

One related question that we can investigate using intraday data is whether an increase in volatility occurs after the publication of an announcement, or in the run-up to it, as market participants adjust their positions in advance of the communication. Chart 10 and 11 suggest that that the increase in the volatility in 5-, 15- or 60-minute windows after the publication of either the MPC *Minutes* or the *Inflation Report* is much larger – as well as more significant – than in similar time windows before the communication. This result confirms more directly that MPC communication conveys new information to market participants.

7.3 Testimony to Parliamentary Committees

Although an important part of the accountability of the MPC, for the most part these communications were not significant in terms of financial market reaction. The results for testimonies to the parliamentary committees were generally much weaker than those to the *Minutes* and the *Report*. For the most part, testimonies were not significant, and frequently of the wrong sign to support our hypothesis (Table 2), suggesting that the variance of asset prices falls following communication. More generally, results for testimonies relating to the *Report* seemed weaker than for testimonies relating to other topics. This may not be surprising: hearings following the *Report* may not contain much incremental news relative to the release of the *Report* itself. More ad hoc testimonies may concern the broader conduct of monetary policymaking, although it is not clear that these should have a direct impact on market participants' interest rate expectations. We are not able to test the impact of testimony to parliamentary committees using intraday data, as we do not have precise timings for the meetings and it is unclear precisely when market participants would receive information on the proceedings.

[39] The variables capturing those summary statistics were typically not positive and significant when included along with a dummy for the *Inflation Report*, but resulted in some increase in the overall explanatory power of the equations.

7.4 Speeches

For speeches, we found very little impact. We do not find a consistently positive and significant impact on the variance for any of the variables tested (Table 2). Our results in fact suggest a decrease in the variance of some forward interest rates from fitted yield curves: however, the size of the estimated coefficients varies considerably with the reference comparison, suggesting these results are not robust, and typically they are not significant. This weak result does not appear to be attributable to the wide subject matter covered in the speeches diluting our results: excluding speeches that have little to do with monetary policy or the economic conjuncture does not make a material difference to the results. And the results are similar whether we consider the entire set of speeches by all MPC members, or just those by the Governors. Similarly for testimony to parliamentary committees, we are not able to test the impact of speeches using intraday data. Speeches are often made after markets close and so it is unclear when we would observe a market reaction. Further, we do not have precise timings for all speeches and again it is unclear whether market participants would receive information at the beginning or during the speech.

Although our results suggest that speeches do not have a systematic effect, we do not suggest that individual speeches or comments never materially influence market prices. Several speeches in our sample discussing the economic conjuncture have indeed occurred on days of large movements in financial markets. Across the full sample, however, the impact of individual speeches can fade away.

7.5 Results summary

Using daily data in our OLS regressions, we find evidence of a significant positive impact of MPC *Minutes* on the variance of market prices. This significant impact is most visible in near-term implied interest rate expectations from short sterling futures, but this is driven by large responses to particular instances of the *Minutes*. We find less impact on other asset prices, and on interest rates from further along fitted yield curves. The weak response of other asset prices might suggest they are less directly affected by incremental news on the near term policy direction.

Our tentative findings from daily data are supported by strong further evidence from intraday data, which confirm that the *Minutes*, and additionally the *Inflation Report*, have a large effect on short sterling and long gilt futures immediately following publication. These findings still hold when we exclude some of the largest instances of market response to the *Minutes* and *Report*. The intraday results, compared with the somewhat more muted response in daily data, might suggest that we are not fully able to control for other news occurring during the day, and some of the impact of the communication may subsequently get lost in the noise. This can clearly be seen in Charts 4 and 5 in the Appendix: the increase in variance observed over our intraday windows is much more visible than for the daily data for both the MPC *Minutes* and the *Inflation Report*.

Appendix 2 expands on our analysis and details corresponding results from our GARCH regressions. Consistent with our OLS results, we find a significant impact of the *Minutes* and *Inflation Report* in the intraday data. Such effects are more difficult to detect in the daily data for the *Report*. However, again consistent with our OLS results, the response of the *Minutes* in the daily data tentatively appears to extend further along the yield curve. Lastly, the reaction to speeches and parliamentary testimonies appears to be muted, and is not significant in the daily data.[40]

7.6 Comparison with results for the Federal Reserve

Kohn and Sack analyse the effect of Federal Reserve communication between January 1989 and April 2003. Overall, they find that the volatility of several measures of interest rate expectations – in particular for implied rates from Federal Funds and Eurodollar futures – increase significantly on days of FOMC statements and Greenspan's testimony to Congress, although the response to speeches, and the response of other asset prices to communication generally, is more muted. These results are reproduced in Table 7 in the Appendix, which show responses at horizons out to 2 years significant at least at the 5% level. Quantitatively, these results with daily data appear stronger than those we find for the UK, with typically larger and more significant estimated coefficients for the response of interest rate expectations (compare Table 7 with Table 3).

There are several possible explanations for the different results for the UK and US. First, all central banks have their own communication strategies, and so forms of communication that look similar might have different purposes and some central banks will communicate in ways that others do not. For example, there is no obvious US equivalent to the UK *Inflation Report*, which is one of the MPC's most important forms of communication. Similarly, the FOMC statement, which has a significant impact on market prices above and beyond the policy decision itself, does not have a regular equivalent in the UK. Our results for speeches – arguably the most comparable – are broadly in line with those of Kohn and Sack, where we, and they, do not find a significant response, a result robust to attempting to narrow the subset of speeches to those relevant to monetary policy and the economic outlook.

Second, the Bank of England has an explicit and symmetric inflation target. There is likely to be less to be learned from the communication of a central bank that has an explicit target and therefore has less discretion regarding its policy decisions. The impact on long bond yields might be relatively modest if official communication would at best give a steer on the likely timing of changes in rates over the next year. The volatility of US long bond yields, reacting to both data and communication, may be a reflection of the investors revising their estimate of the implicit Federal Reserve inflation target, as suggested by Gürkanyak, Sack and Swanson (2003) – a power that the Bank of England

[40] As an additional cross check we carry out non-parametric Kruskall-Wallis tests to compare squared residuals on communication relative to non-communication days. Our results, available from the authors on request, are consistent with those from our OLS regressions. For the *Minutes* using daily data the Kruskall-Wallis tests suggest a stronger effect, extending along the yield curve.

does not have. Our results from daily data for the UK suggest a much more limited impact of communication on financial market instruments beyond a one year horizon.

Third, decision making power is arguably more dispersed on the MPC compared with the FOMC. Voting dispersion has typically been greater on the MPC with nine individually appointed and accountable members. Even with regards to communications such as *Minutes* and the *Report* – where a congruent committee message is articulated – one might expect financial market participants to react more to similar reports from the FOMC if they are taken to be more representative of a single prevailing view, rather than reflecting the range of views across the nine MPC members. The particularly strong US result for Congressional testimonies – which we do not pick up in the broadly equivalent UK parliamentary hearings – might reflect a market assumption that the opinion of Federal Reserve Chairman is representative of the committee as a whole. The biannual Congressional testimony is also likely to be a more important source of new information relative to the parliamentary hearings in the UK, which typically cross-examine judgments already communicated in the *Report*. Testimony to the US Congress is a more high profile news event compared with testimony to parliamentary committees in the UK.

Lastly, the significance of the results reported by Kohn and Sack might also suggest that investors better understand the reaction function and role of communication at the Federal Reserve. This is possible considering that the framework at the Bank of England is still relatively new, although the role of Federal Reserve communications has also evolved over time, in particular in recent years. Gürkanyak, Sack and Swanson (2004) and Lambert (2004), for example, note the importance of the language chosen for phrasing official statements as evidence of the continuing evolution of official communications. The choice of language has been particularly important in the context of the FOMC's recent shift away from historically-low interest rates, where the committee has explicitly used communication to inform market participants about future policy.

7.7 Comparison with the ECB and other UK results

Our analysis broadly follows that of Kohn and Sack (2003), such that our results are most directly comparable with their findings for the Federal Reserve. However, Connolly and Kohler (2004) and Ehrmann and Fratzscher (2005) have looked at the effect of communication on financial markets for panels of central banks. For the UK, our results for MPC *Minutes* using daily data are consistent with those of Connolly and Kohler, despite some methodological differences in our approaches. However, our results for the *Minutes* are most clear-cut in our intraday analysis, which does not have a comparison in the existing literature, which only use daily data. Connolly and Kohler additionally find that parliamentary hearings have a marked impact on financial markets: we do not. The absence of a systematic, significant impact of speeches on financial markets is consistent with both Connolly and Kohler (2004) and Ehrmann and Fratzscher (2005).

In comparing the communication strategies of the ECB, Federal Reserve and Bank of England, Ehrmann and Fratzscher (2005) conclude that overall markets appear to react less to Bank of

England communication compared with that from the other two central banks in the study. We would argue that this conclusion is sensitive to the choice of official communication considered in their paper. In particular, Ehrmann and Fratzscher focus only on communication by individual members – speeches, interviews, testimonies – rather than on collective communication, such as minutes and forecasts. For the Bank of England these latter publications are arguably the most important forms of communication, as shown in our results. Excluding them from any analysis is likely to omit a large part of the information available to market participants.

Further, because the vote at the interest rate decision meetings is revealed in the MPC *Minutes*, market participants have a good understanding of the thinking of individual members. Any subsequent speeches or interviews by MPC members may only expand slightly on known information, compared with central banks that do not publish their voting records or do not vote.

8 Conclusions

We find support for the hypothesis that Bank of England communication conveys information to investors, with a measurable impact on financial market prices. We observe the strongest impact on implied rates from short sterling futures, which we might expect to reflect most closely changes in interest rate expectations.

Using daily data, we find that financial markets respond to the publication of the MPC *Minutes*. However, daily data have potential drawbacks. In particular, all the other events that occur during the day may drown out the importance of MPC communication. Reflecting this problem, we use intraday data to focus more closely on communication events. We find that the *Minutes* of MPC meetings and the publication of the *Inflation Report* result in increased variance of asset prices – particularly of short sterling futures.

The relatively strong impact on financial markets in response to the publication of the MPC *Minutes* and the *Report* suggests that these collective forms of communication contain information most relevant in conveying the MPC's immediate policy inclination. More individual forms of communication, such as speeches and parliamentary testimony, may contain information explaining the MPC's view of the wider economic outlook and so might include a greater array of information that is more difficult for market participants to interpret. Such communications may have a relatively more subtle influence on asset prices – harder to pick up in our empirical tests, particularly using daily data, even if individual communications are significant.

Our results are less marked than the US findings by Kohn and Sack – which use daily data – where the impact of official communication extends significantly along the yield curve. However, all central banks have their own communication strategies, and so cross country comparisons are difficult. Forms of communication that look similar might in fact serve different purposes. Our results might just reflect different communication frameworks in the UK and the US.

Our results might also reflect the different nature of the committees in the US and UK with the UK MPC made up of nine individually accountable members. The smaller impact of MPC communication on longer-horizon interest rate expectations might also reflect the Bank of England's explicit and symmetric inflation target, which might mean that there is less opportunity to influence longer-horizon asset prices. This is in contrast to the FOMC which has more freedom to interpret its objectives.

Communication gives the MPC a means of explaining its decisions and rationale, and thus informs financial market participants about the economic and policy outlook. In a framework of constrained discretion for monetary policy this offers an important avenue for policymakers to explain their decisions and help investors understand the Committee's thinking. In this way it complements the power that the central bank has to set interest rates, as well as helping the Bank of England fulfil its commitments to transparency and accountability.

Appendix 1: Tables and charts for OLS results

Table 1: Effect of standartised monetary policy and economic surprises on interest rates (OLS regressions)

	3-month short sterling future implied rate		1 to 2 year implied forward rate	
UK monetary policy	5.48***	(5.67)	2.08***	(2.73)
Average earnings	2.30***	(4.33)	2.49***	(3.13)
GDP (1st release)	1.74***	(2.99)	2.25***	(3.27)
GDP (2nd release)	1.26*	(1.67)	0.87	(0.74)
Industrial production	1.02**	(2.53)	1.96***	(3.57)
Retail sales	1.53***	(4.09)	1.35**	(2.54)
RPI	1.24**	(1.97)	1.06	(1.16)
RPIX	2.32***	(2.95)	2.40**	(2.35)
Unemployment	0.04	(0.09)	0.81	(1.37)
US consumer confidence	0.82**	(2.28)	1.25***	(2.73)
US GDP (1st release)	1.09*	(1.86)	1.26	(1.08)
US ISM (NAPM)	1.58***	(3.17)	2.84***	(4.61)
US non-farm payrolls	1.67***	(4.48)	2.58***	(4.14)
US retail sales	0.36	(1.16)	1.78***	(2.63)
$\bar{R}^2$	0.15		0.07	
Standard error of regression	3.80		5.54	
White Heteroscedasticity F-statistic (p-value)	7.08***	(0.00)	1.14	(0.28)

Results from a regression of daily bp changes in each interest rate on the surprise components of monetary policy actions and economic data releases. Sample 6 June 1997 to 31 December 2004 (1976 observations). Newey-West heteroscedasticity adjusted t-statistics shown in brackets. Surprises are measured against the median MMS or Bloomberg survey expectation for macroeconomic releases or mean of the Reuters poll of economists expectations.
*** indicates significance at the 1% level; ** at the 5% level; and * at the 10% level.

Table 2: Impact of official communications in daily data (OLS regressions)

		Increase in Var(ε) due to:							
		MPC minutes		Inflation Report		Parliamentary testimonies (all)		Speeches (EG & MK)	
	Var(ε) on non-communication days:	Relative to full sample	Relative to week before	Relative to full sample	Relative to week before	Relative to full sample	Relative to week before	Relative to full sample	Relative to week before
Short sterling futures:									
3-month	13.984	8.470**	10.574**	2.007	5.252	-5.592	-6.088	0.051	0.073
6-month	24.754	9.687	11.853**	3.216	10.211	-4.095	-4.526	1.608	3.036
12-month	36.578	13.209	15.772*	-3.834	2.135	0.491	4.594	3.786	7.084
Government forward rates:									
1 to 2 year	29.585	10.342	14.896*	-6.238	-2.674	3.753	7.207	5.183	5.984
2 to 3 year	28.783	4.657	9.806*	-6.590	-4.316	-4.050	-1.273	2.698	1.780
3 to 4 year	28.791	2.885	8.277	-5.163	-5.009	-6.003	-1.618	-0.702	-3.978
4 to 5 year	29.473	4.282	9.710*	-2.119	-3.588	-4.927	0.358	-3.361	-7.236
Instantaneous 10-year	23.966	10.062*	12.506**	10.412	12.127	10.231	16.072*	-4.313	-2.553
10-year spot yield	21.171	4.925	8.154**	-0.563	-1.154	-0.043	4.633	-0.797	-1.726
Sterling ERI	0.160	-0.011	0.005	0.104*	0.126*	0.169***	0.172**	-0.024	-0.011
FTSE 100	1.513	0.122	0.179	-0.860	-0.640***	-0.470	-0.179	0.516	0.576

Table shows changes in the variance of the error term relative to the average for the entire sample, or the variance in the five days preceding the official announcement. *** indicates significance at the 1% level; ** at the 5% level; and * at the 10% level based on F-statistic for the significance of the dummy regression. Full set of test statistics available from the authors on request.

Table 3: Impact of official communications in intraday data (OLS regressions)

		Increase in Var(ε) due to MPC minutes (09:30am)			Increase in Var(ε) due to Inflation Report (10:30am)	
	Var(ε) on non-minutes days:	Relative to full sample	Relative to week before	Var(ε) on non-IR days:	Relative to full sample	Relative to week before
3m short sterling futures:						
5-minute response	0.859	6.413***	6.450***	0.170	6.502***	6.523***
15-minute response	1.103	8.122***	8.090***	0.384	10.424***	10.458***
60-minute response	1.771	9.995***	9.893***	1.033	14.785***	14.995**
6m short sterling futures:						
5-minute response	1.166	8.632***	8.500***	0.302	9.593***	9.668***
15-minute response	1.689	11.637***	11.504***	0.632	14.366***	14.544***
60-minute response	2.942	14.449***	14.410***	1.675	23.405***	23.753***
12m short sterling futures:						
5-minute response	1.104	6.749***	6.723***	0.234	8.878***	8.845***
15-minute response	1.846	13.270***	13.348***	0.631	18.310***	18.396***
60-minute response	3.778	15.895***	16.214***	2.330	28.152***	28.558***
Long gilt futures:						
5-minute response	14.286	53.646***	52.649**	7.943	29.785***	27.723*
15-minute response	33.933	110.197***	105.334***	22.612	135.944***	137.467*
60-minute response	108.308	260.123***	262.148***	83.845	180.144***	186.726
FTSE futures:						
5-minute response	0.015	-0.006	-0.005**	0.009	-0.002	0.000
15-minute response	0.040	-0.010	-0.017**	0.026	-0.001	0.004
60-minute response	0.159	-0.040	-0.058	0.103	0.015	0.045

Table shows changes in the variance of the error term relative to the average for the entire sample, or the variance in the five days preceding the official announcement. *** indicates significance at the 1% level; ** at the 5% level; and * at the 10% level based on F-statistic for the significance of the dummy regression. Full set of test statistics available from the authors on request.

Table 4: Impact of shortened publication schedule on the response to MPC minutes in intraday data (OLS regressions)

	Increase in Var(ε) due to the publication of the MPC minutes published with a lag of:	
	6-weeks (June 1997 - September 1998)	2-weeks (October 1998 - December 2004)
3m short sterling futures:		
5-minute response	10.559	5.513***
15-minute response	9.336	7.851***
60-minute response	14.212	9.077***
6m short sterling futures:		
5-minute response	12.810	7.687***
15-minute response	11.625	11.617***
60-minute response	17.004	13.892***
12m short sterling futures:		
5-minute response	5.579**	6.958***
15-minute response	12.572	13.366***
60-minute response	18.733	15.273***
Long gilt futures:		
5-minute response	177.169**	21.782*
15-minute response	170.775	94.442*
60-minute response	332.370	241.174**
FTSE futures:		
5-minute response	-0.004	-0.006***
15-minute response	-0.008	-0.010
60-minute response	-0.021	-0.044

Table shows changes in the variance of the error term relative to the average for the entire sample. *** indicates significance at the 1% level; ** at the 5% level; and * at the 10% level

Table 5: Incremental impact of proxies of committee sentiment in MPC minutes (OLS regressions)

	Increase in Var(ε) due to:								
	Vote split dummy[1]			Number of dissenters (net)[2]			Change in voting 'skew'[3]		
	Minutes dummy	Additional impact	Increase in $\bar{R}^2$	Minutes dummy	Additional impact	Increase in $\bar{R}^2$	Minutes dummy	Additional impact	Increase in $\bar{R}^2$
3m short sterling futures:									
5-minute response	4.968***	2.287	0.002	3.995**	2.046	0.011	4.112***	7.437	0.020
15-minute response	6.119***	3.182	0.003	5.059*	2.597	0.014	5.237***	9.344	0.023
60-minute response	7.700***	3.640	0.002	7.526**	2.087	0.005	6.509***	11.282	0.022
6m short sterling futures:									
5-minute response	6.948***	2.618	0.001	4.857**	3.173	0.020	6.008***	8.385	0.017
15-minute response	9.974**	2.625	0.000	6.998	3.929	0.013	8.079***	11.503	0.014
60-minute response	12.030***	3.846	0.001	11.179**	2.773	0.003	10.664***	12.270	0.009
12m short sterling futures:									
5-minute response	6.486***	0.366	0.000	2.920	3.228	0.028	5.406***	4.255	0.006
15-minute response	13.482***	-0.407	0.000	8.586*	3.947	0.012	10.410***	9.155	0.008
60-minute response	14.107***	2.833	0.000	11.927**	3.363	0.004	11.157***	15.357	0.011
Long gilt futures:									
5-minute response	70.422**	-24.218	0.001	67.598**	-10.456	0.002	38.329**	45.983	0.007
15-minute response	86.465	34.139	0.000	39.511	52.942	0.013	42.681	202.257	0.026
60-minute response	42.428	314.098**	0.011	113.992	109.416	0.010	41.823	654.171***	0.050
FTSE futures:									
5-minute response	-0.005**	-0.001	-0.001	-0.004	-0.002**	0.000	-0.008***	0.007	0.000
15-minute response	-0.007	-0.004	-0.001	-0.006	-0.003	-0.001	-0.013**	0.009	-0.001
60-minute response	-0.043	0.005	-0.001	-0.047	0.005	-0.001	-0.050*	0.033	-0.001

Table show s changes in the variance of the error term relative to the average for the entire sample, attributable to a dummy on the day of the MPC minutes, and a 'summary statistic' vari the 5% level; and * at the 10% level. Also reported is the increase int he goodness of fit as a result of including the additional variables.

[1] Takes a value of 1 w hen the vote is not unanimous

[2] Net number of votes cast against the final decision: votes in opposite directions netted off

[3] Takes a value of 1 on the first instance a vote moves from being unanimous to split; and from split to unanimous

[4] Net number of new MPC members voting in the minority

Table 6a: Incremental impact of proxies describing inflation projection in Inflation Report (OLS regressions)

	Increase in Var(ε) due to:								
	Inflation overshoot relative to target at 2 years (ME)[1]			Inflation overshoot relative to target at 2 years (CIR)[2]			Skew of inflation fanchart (mean minus mode)[3]		
	IR dummy	Additional impact	Increase in $\bar{R}^2$	IR dummy	Additional impact	Increase in $\bar{R}^2$	IR dummy	Additional impact	Increase in $\bar{R}^2$
3m short sterling futures:									
5-minute response	4.160**	17.193	0.027	8.978***	-29.750	0.025	6.832***	-2.033	0.000
15-minute response	5.243	38.032	0.037	13.857***	-41.253	0.014	10.951**	-3.246	0.000
60-minute response	1.499	97.535	0.061	21.916*	-85.683	0.015	19.341*	-28.066	0.006
6m short sterling futures:									
5-minute response	7.754**	13.505	0.002	13.822***	-50.811*	0.010	9.947**	-2.180	0.000
15-minute response	10.419*	28.981	0.005	19.118***	-57.096	0.006	15.385***	-6.279	0.000
60-minute response	9.990	98.484	0.025	36.573***	-158.214*	0.021	29.977**	-40.489	0.005
12m short sterling futures:									
5-minute response	8.458	3.085	0.000	13.488**	-55.379	0.037	9.893***	-6.248	0.002
15-minute response	20.752**	-17.922	0.002	23.718***	-64.976	0.011	18.095**	1.328	0.000
60-minute response	21.202	51.024	0.005	44.189**	-192.683*	0.024	36.664**	-52.434	0.007
Long gilt futures:									
5-minute response	17.015	87.598	0.003	45.080	-190.416	0.003	36.196	-35.693	0.000
15-minute response	162.405	-181.504	0.001	104.353	393.300	0.001	106.321	164.922	0.001
60-minute response	-91.494	1863.237	0.014	281.236	-1258.579	0.001	315.794	-755.225	0.002
FTSE futures:									
5-minute response	0.003	-0.035**	0.000	0.001	-0.038*	0.000	-0.004*	0.010	-0.001
15-minute response	0.005	-0.043	0.000	0.009	-0.133	0.000	0.005	-0.037	0.000
60-minute response	0.091	-0.522	0.000	0.070	-0.683	0.000	0.027	-0.063	-0.001

Table shows changes in the variance of the error term relative to the average for the entire sample, attributable to a dummy on the day of the Inflation Report, and a 'summary statistic' variable.*** indicates significance at the 1% level; ** at the 5% level; and * at the 10% level. Also reported is the increase in the goodness of fit as a result of including the additional variables.

[1] Absolute value of divergence from target of the inflation rate from the projection based on market interest rates 8 quarters ahead.

[2] Absolute value of divergence from target of the inflation rate from the projection based on constant interest rates 8 quarters ahead.

[3] Absolute value of the mean less modal inflation projection 8 quarters ahead.

Table 6b: Incremental impact of proxies describing inflation projection in Inflation Report (OLS regressions)

	Increase in Var(ε) due to:								
	Gradient of inflation projection at 2 years (ME)[1]			Gradient of inflation projection at 2 years (CIR)[2]			Uncertainty (width of inflation fanchart)[3]		
	IR dummy	Additional impact	Increase in $\bar{R}^2$	IR dummy	Additional impact	Increase in $\bar{R}^2$	IR dummy	Additional impact	Increase in $\bar{R}^2$
3m short sterling futures:									
5-minute response	7.896***	-14.805	0.009	10.937***	-42.789***	0.084	-3.628	12.856	0.023
15-minute response	10.504**	-0.849	0.000	17.359***	-66.905*	0.059	-2.434	16.318	0.010
60-minute response	14.123	7.031	0.000	23.191*	-81.094	0.021	-20.433	44.697	0.019
6m short sterling futures:									
5-minute response	11.869***	-24.177	0.003	16.116***	-62.925***	0.024	2.105	9.504	0.001
15-minute response	14.508**	-1.509	0.000	22.708***	-80.476*	0.019	18.774	-5.594	0.000
60-minute response	23.009*	4.204	0.000	35.384*	-115.570	0.017	-0.104	29.836	0.003
12m short sterling futures:									
5-minute response	9.478**	-6.365	0.000	13.307***	-42.720**	0.035	21.035	-15.429	0.014
15-minute response	22.340**	-42.800	0.007	26.278***	-76.872	0.026	28.701	-13.187	0.002
60-minute response	28.574	-4.480	0.000	38.375*	-98.627	0.010	30.362	-2.805	0.000
Long gilt futures:									
5-minute response	44.411*	-155.569*	0.004	51.841*	-216.481	0.010	-130.848	195.541	0.016
15-minute response	219.253	-886.159	0.016	217.457*	-800.053	0.014	-375.842	623.002	0.016
60-minute response	243.029	-668.900	0.000	345.123	-1619.272	0.005	-1085.145	1540.249	0.010
FTSE futures:									
5-minute response	-0.002	-0.002	-0.001	-0.005*	0.028*	0.000	-0.007	0.006	-0.001
15-minute response	-0.006	0.054	0.000	-0.005	0.036	-0.001	0.030	-0.038	0.000
60-minute response	0.019	-0.044	-0.001	-0.002	0.174	-0.001	0.327	-0.379	0.000

Table shows changes in the variance of the error term relative to the average for the entire sample, attributable to a dummy on the day of the Inflation Report, and a 'summary statistic' variable.*** indicates significance at the 1% level; ** at the 5% level; and * at the 10% level. Also reported is the increase in the goodness of fit as a result of including the additional variables.

[1] Absolute value of the pick-up in the inflation rate from the projection based on market interest rates between 7 and 8 quarters ahead.

[2] Absolute value of the pick-up in the inflation rate from the projection based on constant interest rates between 7 and 8 quarters ahead.

[3] Width of fanchart 8 quarters ahead.

Table 7: Kohn & Sack results

	Increase in Var(ε) due to:		
	FOMC Statements	***Greenspan Testimony***	***Greenspan Speeches***
Federal Funds Futures:			
3 months ahead	24.1***	10.0**	1.00
Eurodollar Futures:			
2 quarters ahead	48.7**	45.6**	7.40
4 quarters ahead	64.5**	101.7***	13.20
Treasury Yields:			
2-year	37.5**	41.4***	4.30
10-year	16.40	37.1***	3.90
Treasury Forward Rates:			
0 to 1 years ahead	28.9**	21.8**	2.10
1 to 2 years ahead	49.7**	69.3***	6.20
2 to 3 years ahead	43.70	57.8***	4.10
3 to 4 years ahead	28.70	45.2***	1.80
Dollar	-0.01	-0.05	-0.01
S&P 500	0.01	-0.10	-0.10

*,**,*** indicate significance at the 10%, 5% and 1% level respectively

Source: Kohn and Sack (2003)

Case Studies: three examples of variance of three month short sterling on specific communication days

Chart 1: June 1998 *Minutes*

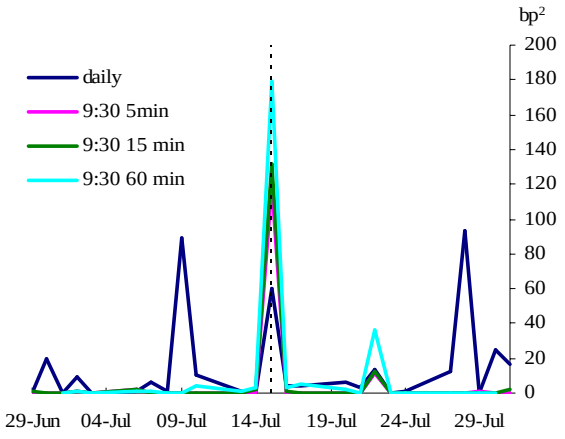


Chart 2: February 1999 ***Inflation Report***

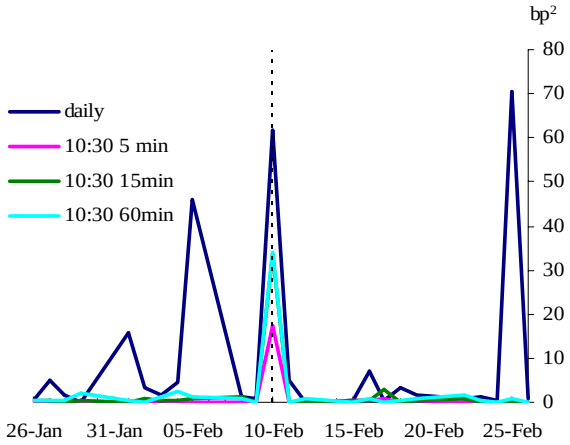
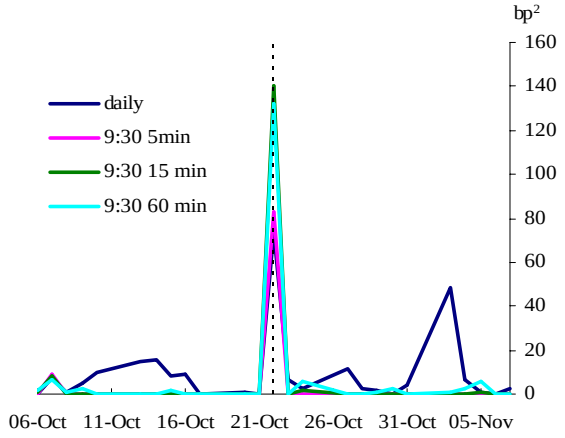


Chart 3: October 2003 *Minutes*



Variance of three month short sterling on communication days, compared to non-communication days

Chart 4: *Minutes*

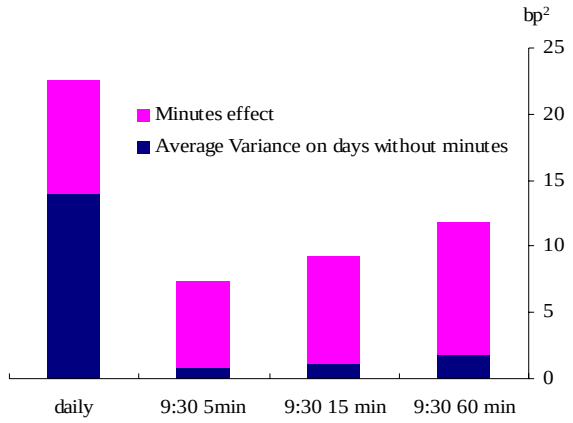


Chart 5: *Inflation Report*

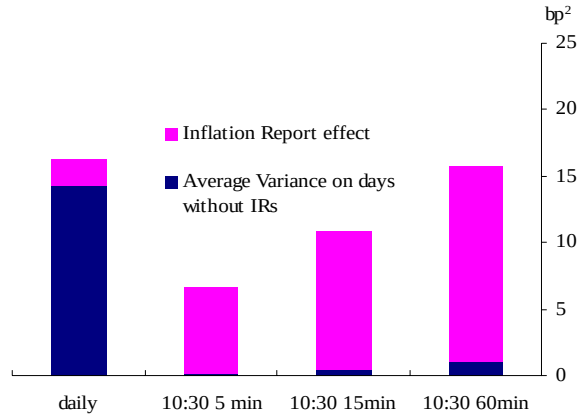


Chart 6: Speeches by the Governor

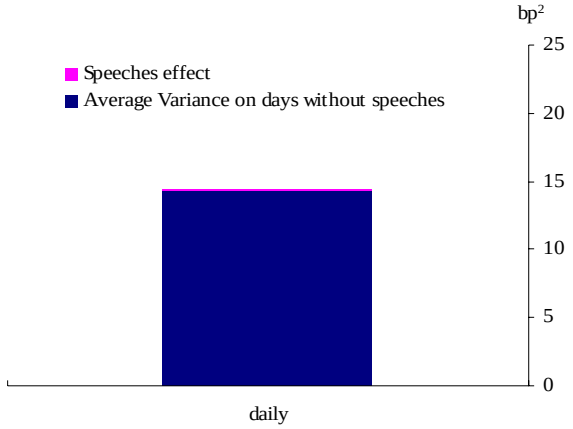


Chart 7: Speeches by all MPC members

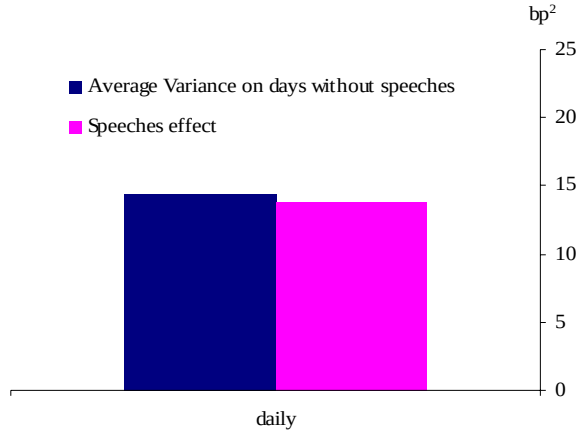


Chart 8: Evidence to Treasury Select Committee

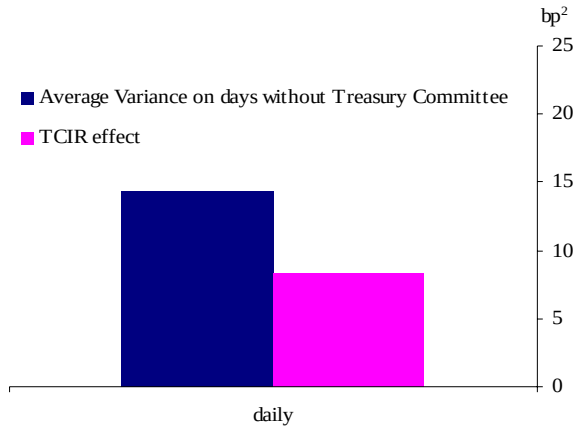
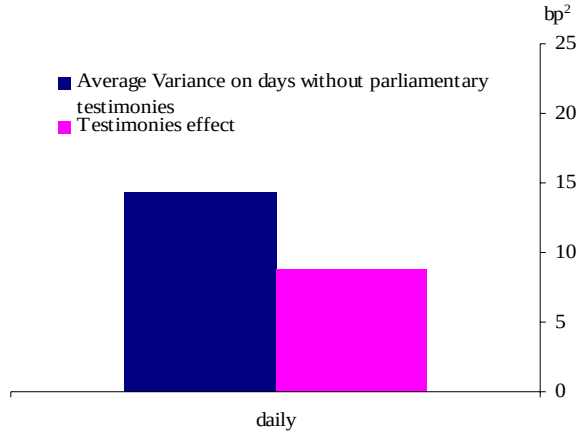


Chart 9: Evidence to all parliamentary committees



Impact on the variance of short sterling futures on communication days, compared to non-communication days

Chart 10: ***Minutes***

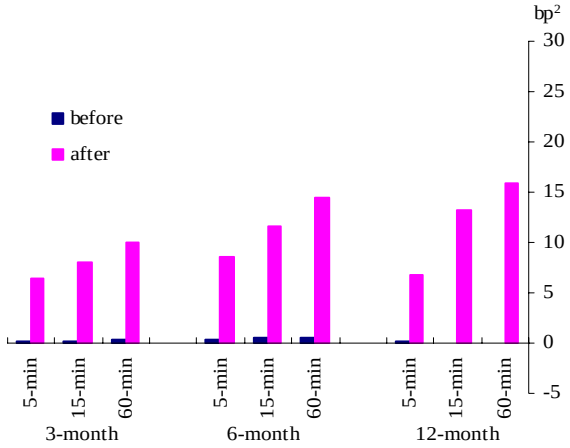
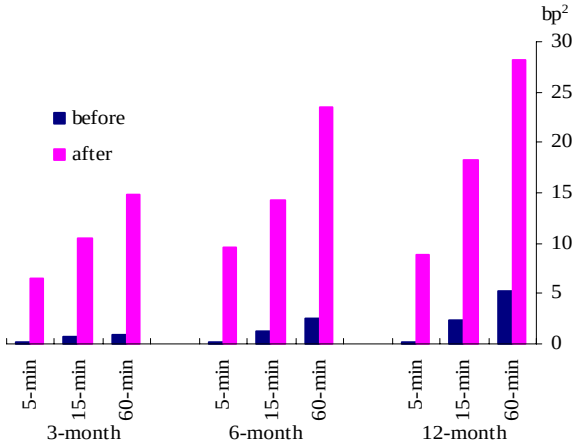


Chart 11: ***Inflation Report***



Appendix 2: GARCH methodology and results

A2.1. Methodology

In addition to our OLS analysis, to more directly address the problem of heteroskedastic errors, we also implement equation (3) in a GARCH framework. In this specification the residuals ε_{jt} from (3) – the mean equation – can be modelled as a function of the standard deviation of the residuals σ_{jt} and 'underlying' residual series u_{jt}. Formally:

$$\varepsilon_{jt} = u_{jt}\sigma_{jt} \sim (0, \sigma_{jt}^2)$$

The one-period ahead forecast variance for each asset price j, σ_{jt}^2, is modelled as a function of a constant, its own past values (GARCH terms), errors from the mean equation (ARCH terms), as well as a number of dummies capturing surprises and communication events. These are equal to one on the days of communication and zero otherwise, picking up changes in conditional volatility on days of monetary policy decisions, macroeconomic data releases, and communication events. Defined in this way, variance can change over time in response to changes in observed and forecasted volatility, consistent with patterns of 'volatility clustering' in asset returns. Formally the variance equation is written as:

$$\sigma_{jt}^2 = \gamma_{j0} + \sum_{m=1}^{p} \alpha_m \varepsilon_{j,t-m}^2 + \sum_{n-1}^{q} \chi_n \sigma_{j,t-n}^2 + dummies$$

Some papers, notably Ehrmann and Fratzscher (2005) and Connolly and Kohler (2004), use an exponential GARCH (EGARCH) structure, one advantage of which is that it avoids the need to impose non-negativity constraints on the conditional second moments. The model can be written in terms of the standardised residuals u_{jt} as:

$$\ln \sigma_{jt}^2 = \gamma_{j0} + \sum_{m=1}^{p} \left(\alpha_m u_{j,t-m} + \beta_m \left| u_{j,t-m} \right| \right) + \sum_{n-1}^{q} \chi_n \ln \sigma_{j,t-n}^2 + dummies$$

Overall, we found a strong role for including conditional heteroskedasticity terms; in choosing the structural form of the model we followed the established literature, using an EGARCH(1,1) function form.[41] Under the GARCH specification our analysis is most comparable with contrasting the response of financial markets on days of communication to non-communication.

Although very similar to Connolly and Kohler (2004), our GARCH methodology diverges slightly from that of Ehrmann and Fratzscher (2005). In Connolly and Kohler (2004), and in our analysis, communication dummies enter the variance equation only. In Ehrmann and Fratzscher

[41] For our intraday analysis, post-estimation testing suggested this functional form for the most part captured adequately the GARCH effects in the data. In our daily data, the tests suggested that our residuals were less well behaved. We tried other functional forms or orders of the model, but these did not perform consistently better. For consistency we therefore retained the EGARCH(1,1) structure in our daily data as well.

communication variables (containing a *qualitative* judgment of whether they are indicative of a tightening/loosening monetary policy or of an improving/worsening economic outlook) enter the mean equation, in addition to communication dummies in the variance equation.

This has implications in the conduct of hypothesis testing for the impact of the official communication: Ehrmann and Fratzscher (2005) look at the significance of the dummies separately in both the mean and variance equations, with potentially differing results. In our analysis we solely look at the impact of communication in the mean equation. Although this has the potential drawback that the level response of financial markets to communication may be partly reflected in the volatility term, this is still consistent with our stated aim of testing whether financial markets react to central bank communication *per se*, and also with the methodology of Kohn and Sack (2003) that we use in our OLS analysis.

A2.2. Results

Table 8 shows the estimated coefficients on the macroeconomic surprise variables included in the mean equations are similar to those used in our OLS analysis (Table 1 in Appendix 1). Tables 9 and 10 show the estimated impact of communication dummies in the volatility equation in respectively our daily and intraday data. In general, our GARCH results are broadly consistent with the results we have presented from our OLS analysis, lending further support to our conclusion that financial markets do react to some forms of official communication.

In the daily data, we find that the MPC *Minutes* have a positive and strongly significant impact on short-horizon measures of interest rate expectations, consistent with our OLS results. This positive impact also appears to extend further along the yield curve, although we cannot be sure of the robustness of this result: in our OLS analysis, this was sensitive to the choice of comparison days, which we do not carry out for our GARCH results. In response to other forms of communication – *Inflation Report*s, speeches and parliamentary testimonies – we did not find a consistently positive and significant reaction: this result also echoes those found in our OLS analysis in the daily data.

In our intraday analysis – again, as in our OLS results – we find evidence of significant responses to both the MPC *Minutes* and the *Inflation Report* in implied interest rates from short sterling futures and long gilt futures. We additionally find some significant reaction in FTSE futures prices. This reinforces our results for the *Minutes* from the daily data, and suggests that the *Inflation Report* does have an impact, although the response to it can get lost in the noise of news occurring during the day.

A2.3. Tables for GARCH results

Table 8: Effect of standartised monetary policy and economic surprises on interest rates (GARCH regressions, mean equation)

	3-month short sterling future implied rate		1 to 2 year implied forward rate	
UK monetary policy	5.51***	(13.06)	1.79***	(3.62)
Average earnings	2.27***	(5.30)	1.911***	(4.34)
GDP (1st release)	1.74**	(2.51)	2.13*	(1.94)
GDP (2nd release)	1.26	(1.62)	1.18	(1.26)
Industrial production	1.14***	(3.52)	1.59**	(2.36)
Retail sales	1.52***	(4.29)	1.38**	(2.39)
RPI	0.86*	(1.66)	1.17*	(1.76)
RPIX	2.33***	(4.97)	2.09***	(3.48)
Unemployment	0.19	(0.52)	0.54	(1.00)
US consumer confidence	0.83**	(2.39)	1.35**	(2.07)
US GDP (1st release)	1.12***	(2.73)	1.89***	(2.74)
US ISM (NAPM)	1.75***	(4.13)	2.95***	(5.35)
US non-farm payrolls	1.953***	(3.30)	3.18***	(5.63)
US retail sales	0.37	(1.07)	1.86***	(2.89)
$\bar{R}^2$	0.14		0.05	
Standard error of regression	3.82		5.57	
ARCH LM(1) test F-statistic (p-value)	0.52	(0.47)	0.05	(0.83)

Results from a GARCH regression of daily bp changes in each interest rate on the surprise components of monetary policy actions and economic data releases. Sample 6 June 1997 to 31 December 2004 (1976 observations). Surprises are measured against the median MMS or Bloomberg survey expectation for macroeconomic releases or mean of the Reuters poll of economists expectations. *** indicates significance at the 1% level; ** at the 5% level; and * at the 10% level.

Table 9: Impact of official communications in daily data (GARCH regressions, volatility equation)

	Increase in σ^2 due to:			
	MPC minutes	Inflation Report	Parliamentary testimonies (all)	Speeches (EG & MK)
Short sterling futures:				
3-month	0.746**	1.059	1.280	1.237
6-month	0.680***	1.156	1.013	1.168
12-month	0.780**	1.199	0.924	1.082
Government forward rates:				
1 to 2 year	1.086	0.907	0.983	0.974
2 to 3 year	0.956	0.913	0.989	1.000
3 to 4 year	0.824*	1.018	0.925	0.975
4 to 5 year	0.797**	1.092	0.882	0.959
Instantaneous 10-year	0.961	0.993	0.912	1.000
10-year spot yield	0.869	1.110	0.902	0.975
Sterling ERI	1.069	0.954	0.787***	1.069*
FTSE 100	0.999	0.965	0.918	1.035

Table shows the exponent of the coefficient on the communication dummy in the variance equation. *** indicates significance at the 1% level; ** at the 5% level; and * at the 10% level. Comparison against all days in sample.

Table 10: Impact of official communications in intraday data (GARCH regressions, volatility equation)

	Increase in σ^2 due to:	
	MPC minutes (09:30 release)	Inflation Report (10:30 release)
3m short sterling futures:		
5-minute response	3.309***	76.274***
15-minute response	6.638***	36.638***
60-minute response	4.761***	11.269***
6m short sterling futures:		
5-minute response	5.601***	57.295***
15-minute response	5.809***	16.571***
60-minute response	3.891***	12.877***
12m short sterling futures:		
5-minute response	0.635***	7.019***
15-minute response	1.084	5.958***
60-minute response	1.595***	0.043**
Long gilt futures:		
5-minute response	1.748***	0.368***
15-minute response	1.266**	3.060***
60-minute response	0.895***	1.744***
FTSE futures:		
5-minute response	0.691***	0.757**
15-minute response	0.858	0.798
60-minute response	1.117	0.756**

Table shows the exponent of the coefficient on the communication dummy in the variance equation. *** indicates significance at the 1% level; ** at the 5% level; and * at the 10% level. Comparison against all days in sample.

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