How much do UK market interest rates respond to macroeconomic data news?

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- Macroeconomic data releases receive considerable attention in financial market commentary, suggesting they are an important source of information that investors use to form their views about the economic outlook. This article quantifies the role played by these data releases in explaining observed changes in market interest rates in the United Kingdom.
- It looks at which data releases — both domestic and foreign — tend to have most effect on UK interest rates. It also examines how the importance of data releases can change over time and considers the factors that may explain changes in the sensitivity of interest rates to data news.

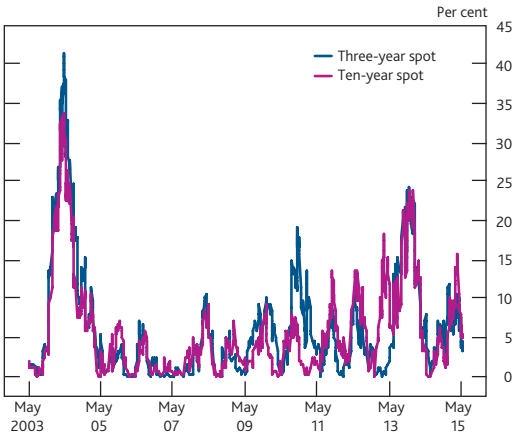
Overview

When new information comes to light, investors may reassess their views about the future, causing interest rates on government bonds to change. The signal central bank policymakers and market participants take from these changes in market interest rates will depend on what has driven them. One important source of new information is macroeconomic data releases, such as official estimates of GDP and inflation. In order to better understand the role played by these releases, this article explores their relationship with changes in market interest rates.

In this article new information or 'news' is measured as the difference between the actual release of official or survey data and market participants' expectations prior to the release. As data for any one macroeconomic variable is only released monthly or quarterly, the approach used in this article is to combine news from a number of different releases into an aggregate economic surprise index (ESI).

Both short and long-term interest rates in the United Kingdom are found to respond to changes in this ESI, although their sensitivity to data news varies considerably over time. In part reflecting these changes in sensitivity, **the importance of data news in explaining changes in interest rates varies. During certain periods it can explain up to 40% of the variation in short and long-term interest rates. But on average data news only accounts for a relatively small proportion of the total variation** (**summary chart**). This is consistent with previous research which suggests that the volatility of asset prices cannot be explained by changes in underlying economic fundamentals alone.

Summary chart Estimated proportion of the variation in short-term and long-term UK interest rates explained by a historically weighted ESI[a]



Sources: Bloomberg and Bank calculations.

(a) The economic surprise index (ESI) is constructed by aggregating the news component of several macroeconomic data releases. The plot depicts the R-squared statistic from 90-day rolling regressions of daily changes in UK interest rates on this ESI. See main text for more details.

There appears to be an important role for both domestic and foreign data news, from the United States and the euro area. Indeed, for both short and long-term interest rates, foreign news is as important as domestic news. This is consistent with the United Kingdom being a small open economy and with an important role for spillovers from international financial markets to UK asset prices.

(1) The authors would like to thank Lu Liu and Sheheryar Malik for their help in producing this article.

Financial assets are held because of the returns they yield in the future. Therefore financial investors are forward looking, and asset prices change as investors reassess their views about the future. This can occur when new information affects investors' expectations or, since the future is uncertain, the extent to which they wish to insure themselves against unexpected events. Asset prices therefore respond to a range of news events, including economic data releases, policy communications and geopolitical developments.

This article examines how one particular type of news — macroeconomic data releases — affects asset prices, and in particular market interest rates on UK government bonds. This provides an insight into which data releases tend to have the largest impact on UK interest rates, considering both domestic and foreign data releases. It is also possible to assess whether the sensitivity of interest rates to data news varies over time. Relatedly, one can explore how much of the observed variation in interest rates can be attributed to macroeconomic data news. Although data news is found to be an important driver of interest rates during certain periods, it only explains a relatively small proportion of the variation in UK interest rates on average over time.

The article first sets out why macroeconomic data releases and interest rates are expected to be related, and briefly outlines past research conducted on these issues. It then presents the analytical approach, which is based on analysing the relationship between changes in interest rates and the aggregation of news across a wide range of different data releases. Next, the findings on the role of macroeconomic data news in driving interest rates are summarised, including how this has varied over time. A box applies the same method to investigate the sensitivity of sterling exchange rates to data news. The article then illustrates how the approach can be applied to help central bank policymakers and market commentators to understand the drivers of changes in interest rates, using market reaction to data news during the summer of 2013 as an example. Finally, the potential drivers of the changing sensitivity of interest rates to macroeconomic data news over time are discussed briefly.

The link between macroeconomic data news and market interest rates

Market interest rates on assets such as government bonds are a natural focus for this article since there is expected to be a close link between investors' outlook for the economy and their expectations of future interest rates. In a UK context, one reason for this is because the Monetary Policy Committee (MPC) sets a short-term nominal interest rate ('Bank Rate') as part of its toolkit for conducting policy in order to achieve its inflation target.(1) Therefore if data news affects market participants' views about the prospects for future growth and inflation then this may also alter their expectations for the path of Bank Rate. Market interest rates, in part, reflect the future path of Bank Rate that investors expect, and so would also be expected to change.

Beyond a certain horizon, when short-term shocks are likely to have died away, it is unlikely that data news would affect expectations of Bank Rate. Therefore, for longer-term interest rates the effect of data news is more likely to come through the 'term premium'. This is the difference between market interest rates of a given maturity and the expected future path of interest rates over that horizon. This difference reflects the fact that the future is uncertain, and so investors must be compensated for the risk that interest rates turn out to be different from their central expectation. Previous research has found that estimates of the term premium tend to be related to domestic and foreign macroeconomic developments, suggesting they may be responsive to data news.

In addition, between 2009 and 2012 the MPC purchased assets such as government bonds to achieve their inflation target. These asset purchases, often referred to as quantitative easing (QE), affected the term premium and hence the interest rates on government bonds at a range of maturities.(2) Therefore, if macroeconomic data news affects the perceived probability of future changes in the stock of assets held by the Bank, this could lead to changes in market interest rates.

As well as interest rates, macroeconomic data news could also affect the prices of a variety of other assets. The box on pages 266–67 provides one example, examining the sensitivity of exchange rates to macroeconomic data news.

Understanding what is driving changes in asset prices, and the role played by macroeconomic data news, is important for policymakers such as the MPC for a number of reasons. The extent to which interest rates respond to data news can shed light on how macroeconomic developments have affected financial market participants' expectations of the future. These expectations can have important implications for household and business behaviour, and so affect the outlook and hence the required stance of policy. In addition, changes in asset prices themselves can affect the economy, by affecting the cost of borrowing faced by companies and households. But the overall impact these changes have on the economy will depend, in part, on what has driven those changes. For instance, if interest rates have fallen due to a weaker outlook for the future, then there may be less of a

(1) Monetary policy in the United Kingdom is set in order to meet the MPC's objective to deliver price stability — a target of 2% consumer price inflation set by the Government — and, subject to that, to support the Government's economic objectives including those for growth and employment.

(2) There are a number of ways in which central bank asset purchases could affect market interest rates. For instance purchasing large quantities of government bonds may push up the price of the bonds remaining in the private sector, reducing their interest rates. For more details on the Bank's asset purchases and evidence on their impact, see Joyce, Tong and Woods (2011).

reaction in people's desire to increase their borrowing and spending. Quantifying the role of data news can, therefore, help policymakers to understand what signal to take from observed changes in interest rates.

Variation in the sensitivity of interest rates to data news over time could also be informative for the Bank's Financial Policy Committee. For instance, it could help them to understand whether changes in market microstructure have affected the sensitivity of interest rates to shocks, such as macroeconomic data news. That might be particularly important to the extent that there are financial stability risks from sharp increases in interest rates. And these techniques could also be of more general interest to private sector economists and market commentators who seek to understand the links between macroeconomic news and financial markets.

Measuring the sensitivity of interest rates to data news

To measure the 'news' or 'surprise' contained in each data release, surveys of financial market participants can be used to compare the release with what was expected beforehand. For instance, as an arbitrary example, on 23 July 2010, the median expectation for the annualised quarterly growth rate of UK GDP in Q2 was 1.1%, as measured by the Bloomberg survey of market participants prior to the data release. The actual growth rate announced that day was 1.6%. That news of 0.5 percentage points was equivalent to 1.9 standard deviations relative to the distribution of UK GDP news.

The change in market interest rates on the day of the data release can be used to estimate the reaction of interest rates to this data news. For instance, on the day of that positive GDP news, the interest rate of three-year maturity UK government bonds rose by 8 basis points.

In principle, this reaction can be compared to the change in interest rates on the days of subsequent GDP releases to determine whether the sensitivity of interest rates to data news has changed. As releases of most data series are monthly/quarterly in frequency, however, it is difficult to assess whether the reaction to a particular type of data release has changed over relatively short periods of time.

Therefore, the approach used in this article is to combine news from over a hundred different types of official and survey releases into an aggregate 'economic surprise index' (ESI). The fact that the ESI has many more observations than individual data releases allows for a better understanding of the relationship between data news and changes in interest rates. The construction of the ESI is described in more detail in the next section.

Existing research

A number of studies have investigated the role of macroeconomic data releases in driving changes in asset prices. Initially these papers — such as Ederington and Lee (1993), ap Gwilym *et al* (1998) and Clare and Courtenay (2001) — did not measure market expectations directly, but looked simply at changes in asset prices on the day of the data release. As a long backrun of surveys of financial market participants became available for a wide set of releases, a number of papers began to quantify the news component of data releases and to assess the response of asset prices. Brooke, Danton and Moessner (1999) and Joyce and Read (1999) were among the first ones to do this exercise focusing on sterling asset prices, while Balduzzi, Elton and Clifton Green (2001), Andersen *et al* (2003) and Gürkaynak, Sack and Swanson (2005) look at a much wider set of data releases and focus on US dollar asset prices.

More recently a number of studies, such as Faust *et al* (2007), have begun to examine how these effects have varied over time, using a range of alternative techniques. Goldberg and Grisse (2013) investigate the causes of this variation (this is discussed briefly in the final section of the article). The approach used in this article is based on the method developed and outlined in Swanson and Williams (2014a, 2014b), which accounts for the historical importance of different macroeconomic data news when constructing an ESI. Where appropriate the results discussed in this article are compared to the findings of the existing literature.

The approach: using an 'economic surprise index'

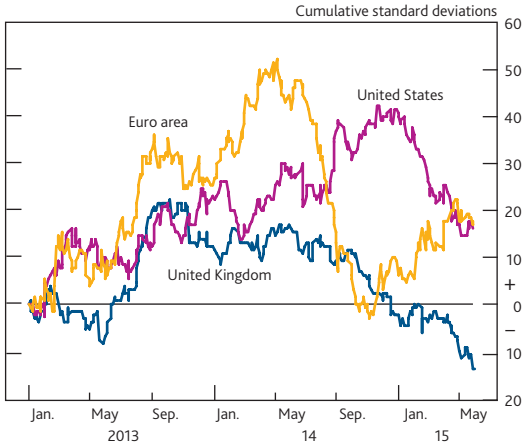
In principle, there are a number of different ways of aggregating the news component across different data releases. This article compares the results from two different approaches: first an 'equally weighted' ESI that treats every data series equally; and second a 'historically weighted' ESI that weights releases from each data series differently based on the extent to which interest rates have responded to the news component in each release on average over the sample.

The 'equally weighted' ESI is constructed as the sum of all data news on a given day. These include activity indicators (such as GDP or retail sales), inflation estimates (such as CPI inflation), labour market indicators (such as the unemployment rate) and business surveys (such as the purchasing managers' index (PMI)). Over a hundred different types of releases from the United Kingdom, United States and euro area are considered each quarter. The sample period is from January 2003 to May 2015.

To allow comparison across different data series, each piece of news is measured relative to the standard deviation of news

for that data series over the full sample period.(1) **Chart 1** shows how this measure has evolved since 2013 for UK, US and euro-area data releases.(2) In the analysis below, the data news from each country is combined into one aggregate ESI.

Chart 1 Equally weighted ESIs since 2013(a)



Sources: Bloomberg and Bank calculations.

(a) The economic surprise indices are constructed by aggregating the news component of several macroeconomic data releases. See main text for more details.

Some types of data releases, however, receive more attention in financial market commentary than others. It may not, therefore, be appropriate to treat all data releases as equally important in affecting interest rates.

The historically weighted ESI, developed by Swanson and Williams (2014a, 2014b), tries to account for this by weighting different data series according to the magnitude of the effect news has had on market interest rates over the sample. Data series that do not have a statistically significant effect on interest rates are excluded. This approach is described in more detail in the appendix.

This weighting scheme has some shortcomings too. The weights attached to each series in the historically weighted ESI are fixed throughout the sample period. This means that the ESI includes only those types of data releases that are consistently important across the entire sample period. In reality, it may be that particular types of releases become more or less important at different points in time.

We use a regression to estimate how changes in the ESI affect market interest rates, and how this has changed over time. This analysis is based on equation **(1)** below.

$$\triangle i_t = \alpha + \beta ESI_t + \varepsilon_t \qquad (1)$$

where Δi_t represents the daily change in market interest rates and ESI_t is the ESI index described above. β is the 'sensitivity' coefficient which is the focus of the analysis.

The effect of data news on both short and long-term interest rates is examined.(3) The appendix contains more details on the data used and the econometric approach.

The sensitivity of market interest rates to data news

This section starts by outlining the weights used in the historically weighted ESI. These weights themselves are informative, as they provide an indication of which data releases market participants pay most attention to. The section then turns to consider, for both approaches, the estimated sensitivity of interest rates to the ESI measures, and how this has changed over time. The section ends by examining how much of the observed variation in interest rates can be explained by macroeconomic data news.

On average it is found that data news only explains a relatively small proportion of the variation in UK interest rates. Although this may seem somewhat surprising, it is consistent with previous research which suggests that the volatility of asset prices cannot be explained by changes in underlying economic fundamentals alone. This would be consistent with a large share of the variation in asset prices being explained by changes in the risk premia required by investors, which may respond to a wide set of factors besides macro data news.

Which data releases have been associated with changes in market interest rates?

A range of both domestic and foreign data releases are important in explaining changes in short-term interest rates over our sample period (**Table A**). This might be because the United Kingdom is a small open economy, so the outlook — and thus the prospects for interest rates — is strongly affected by foreign as well as domestic shocks. It could also reflect a role for spillovers from international financial markets to UK asset prices. Swanson and Williams (2014b), Goldberg and Grisse (2013) and Brooke, Danton and Moessner (1999) also find a significant role for foreign data news in driving UK short-term interest rates.

The statistically significant data releases are those that often receive most attention in financial market commentary — for instance UK GDP, UK PMI and the change in US non-farm payrolls.

(1) If, for example, on a given day there is a one standard deviation positive GDP news and a one standard deviation positive retail sales news, the 'equally weighted' approach assigns a value of two to the ESI. If the retail sales news was negative and the GDP news was positive the 'equally weighted' approach assumes that the news in these releases 'cancels out' and assigns a value of zero to the ESI.
(2) A historically weighted version of the ESI is not shown as these are specific to the asset considered.
(3) We focus on changes in three-year spot interest rates for the short term (the interest rate to borrow for a period of three years from today), and the ten-year spot interest rates for the long term.

Table A Data releases included in the historically weighted ESI for short-term UK interest rates (three-year)[a]

Data release	Estimated impact on short rates (basis points per standard deviation news)	Estimated standard error
UK GDP — first estimate	2.6	0.6
US change in non-farm payrolls	2.5	0.4
UK retail sales including fuel	1.9	0.5
US ISM non-manufacturing	1.8	0.5
UK services PMI	1.4	0.5
UK net lending secured on dwellings	1.4	0.7
US ISM manufacturing	1.3	0.3
UK manufacturing production	1.2	0.2
US existing home sales	1.2	0.4

Sources: Bloomberg and Bank calculations.

(a) UK releases in blue, US releases in magenta. Data releases are ordered according to their impact on UK three-year spot interest rates. The impact is estimated from regressions of daily changes in three-year rates on macro news over January 2003–May 2015, and standard errors are robust to heteroskedasticity. See appendix for more details.

Table B Data releases included in the historically weighted ESI for long-term UK interest rates (ten-year)[a]

Data release	Estimated impact on long rates (basis points per standard deviation news)	Estimated standard error
US change in non-farm payrolls	3.0	0.4
UK retail sales including fuel	2.1	0.7
US ISM non-manufacturing	2.1	0.5
UK manufacturing PMI	1.7	0.8
Italy manufacturing PMI	1.6	0.6
UK manufacturing production	1.3	0.3
UK net lending secured on dwellings	1.3	0.5
US ISM manufacturing	1.3	0.3
Italy industrial production	1.3	0.4
US existing home sales	1.2	0.4

Sources: Bloomberg and Bank calculations.

(a) UK releases in blue, US releases in magenta and euro-area releases in orange. Data releases are ordered according to their impact on UK ten-year spot interest rates. The impact is estimated from regressions of daily changes in ten-year rates on macro news over January 2003–May 2015, and standard errors are robust to heteroskedasticity. See appendix for more details.

It is perhaps surprising that there are no significant euro-area releases, given that the euro area is the United Kingdom's largest trading partner.(1) One explanation could be the way in which euro-area data tends to be released. For many data series, such as GDP, individual releases for each country are often made in the days prior to the aggregate euro-area release. Therefore even if the joint news across each of the releases is important for UK interest rates, it may be that the individual country releases are not significant. And by the time the aggregate euro-area measure is released, there is often little additional news relative to the individual country releases.

International data releases also have an important effect on long-term interest rates (**Table B**). Some of the data releases that are significant are similar to those for short-term interest rates and in line with what might be intuitively expected — for instance the change in US non-farm payrolls. Other data releases are less intuitive. For instance, it is not clear why the Italian manufacturing PMI would be particularly important for the United Kingdom. Previous research — such as that by Swanson and Williams (2014b) — also finds some counterintuitive data releases to be significant.

As discussed above, part of the reason for the sensitivity of long-term interest rates to data news is likely to be because of the effect it has on the term premium. Consistent with this, past research has found that the term premium tends to vary with the economic cycle (Malik and Meldrum (2014)). This past research also finds an important role for common international factors in driving changes in the term premium, which result in a strong correlation between long-term interest rates across countries. That may be consistent with the finding in this article of the role of foreign data releases in explaining past movements in long-term UK interest rates.

How has the sensitivity of interest rates to data releases varied over time?

Both of the ESI approaches can be used to consider how the sensitivity of interest rates to data news has changed over time, by regressing interest rate changes on the ESIs over a rolling 90-day window.

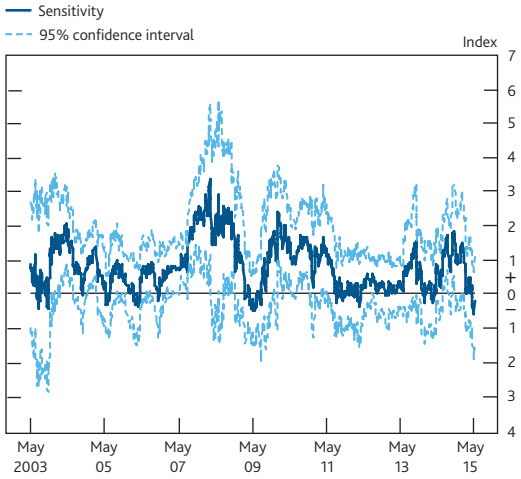
Short-term interest rates

Chart 2 and **Chart 3** illustrate how the sensitivity of UK short-term interest rates to data news has varied over time, for the equally weighted and historically weighted ESIs respectively. A regression coefficient close to one implies that the sensitivity of yields to the ESI is near the average over the benchmark period (2003–08). A coefficient greater than one indicates that yields are more sensitive to data news than in the benchmark period; while a coefficient close to zero means that yields have become unresponsive to data news.(2) Generally the estimated sensitivity has a positive value, which implies that interest rates increase in the face of positive news in variables such as GDP or inflation for example. This is consistent with the way expectations of monetary policy would be anticipated to change in response to such changes in the economic outlook.(3)

Both methods suggest that, rather than being stable, the extent to which interest rates respond to data news varies considerably over time.

(1) The only exception is French consumer confidence news, which was found to be significant for both short and long-term interest rates. However this series is not included in the ESIs as it entered with the opposite sign to what would be expected, suggesting this was likely to be a spurious result rather than a genuine reflection of the impact of news about French consumer confidence on UK interest rates.
(2) In the case of the historically weighted ESI, a normalisation of the sensitivity coefficient is needed for technical reasons, which are explained in the appendix. In order to allow for an easier comparison, the sensitivity coefficient for the equally weighted ESI was also normalised, such that it averages one over 2003–08.
(3) At times the coefficient is close to zero, suggesting that interest rates are unresponsive to such data news. In other periods, the coefficient even becomes negative. It is likely that this reflects other news on the day of the data releases which is distorting the reaction to the data news themselves.

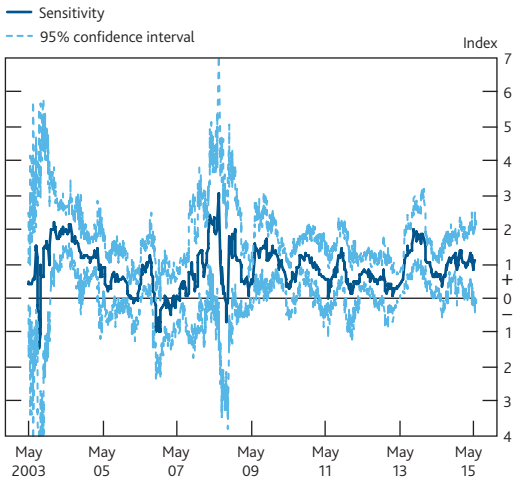
Chart 2 Estimated sensitivity of short-term UK interest rates (three-year) to an equally weighted ESI[a]



Sources: Bloomberg and Bank calculations.

(a) Based on 90-day rolling regressions of daily changes in three-year rates on an equally weighted ESI. The estimated coefficient is normalised to average one over 2003–08 so as to facilitate the comparison with **Chart 3**. Standard errors are robust to heteroskedasticity. See main text for more details.

Chart 3 Estimated sensitivity of short-term UK interest rates (three-year) to a historically weighted ESI[a]



Sources: Bloomberg and Bank calculations.

(a) Based on 90-day rolling regressions of daily changes in three-year rates on a historically weighted ESI. The estimated coefficient is normalised so intuitively it can broadly be thought of as averaging one over 2003–08. See appendix for more details. Standard errors are bootstrapped to account for the fact that the ESI is a generated regressor. The y-axis scale is restricted to show variation in the coefficient estimate more clearly. As a result, the 95% confidence interval is not fully captured in the chart when the standard errors spike in 2003 and 2008.

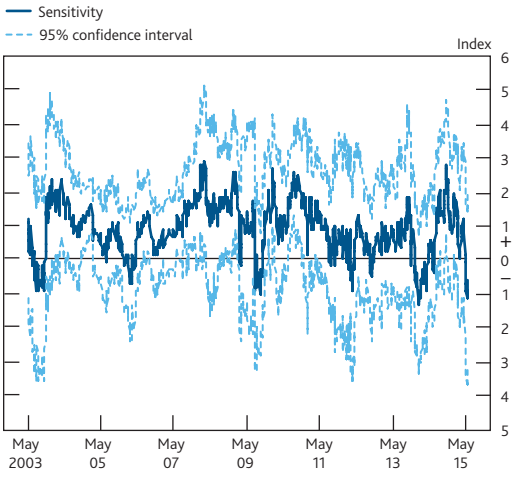
The broad pattern of moves in sensitivity is similar according to both estimates. Short-term interest rates were particularly sensitive to data news at the beginning of the financial crisis. Over the period since then, sensitivity has frequently been low. This may be consistent with the low level of interest rates and their proximity to their 'lower bound' over this period. Since there is a limit to how low nominal interest rates can be, then as they approach this level they will be unable to fall further in response to negative data news, which would reduce the sensitivity of interest rates to data news. Swanson and Williams (2014a, 2014b) put particular emphasis on this explanation for recent variation in sensitivity.

Even during this period, however, there have also been periods of elevated sensitivity, such as the spike upwards during the summer of 2013. This coincided with an increased focus on the prospects for monetary policy in the United States, an episode that is considered in more detail in the next section. The final section of the article considers more broadly some of the potential reasons why the sensitivity may vary over time. These include factors such as changes in market microstructure, as well as changes in central bank communication.

Long-term interest rates

Chart 4 and **Chart 5** illustrate how the sensitivity of long-term UK interest rates to data news has varied over time, for the equally weighted and historically weighted ESIs respectively.

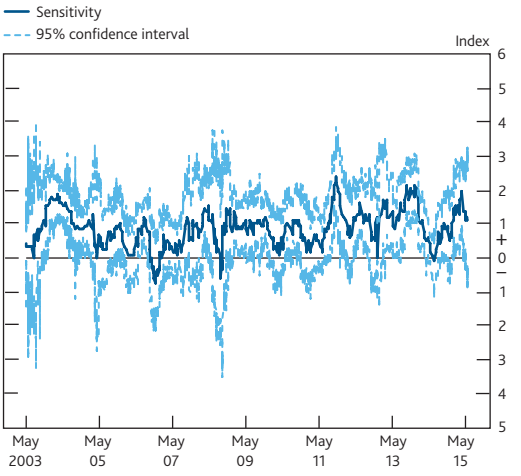
Chart 4 Estimated sensitivity of long-term UK interest rates (ten-year) to an equally weighted ESI[a]



Sources: Bloomberg and Bank calculations.

(a) Based on 90-day rolling regressions of daily changes in ten-year rates on an equally weighted ESI. The estimated coefficient is normalised to average one over 2003–08 so as to facilitate the comparison with **Chart 5**. Standard errors are robust to heteroskedasticity. See main text for more details.

Chart 5 Estimated sensitivity of long-term UK interest rates (ten-year) to a historically weighted ESI[a]



Sources: Bloomberg and Bank calculations.

(a) Based on 90-day rolling regressions of daily changes in ten-year rates on a historically weighted ESI. The estimated coefficient is normalised so intuitively it can broadly be thought of as averaging one over 2003–08. See appendix for more details. Standard errors are bootstrapped to account for the fact that the ESI is a generated regressor.

As with short-term interest rates there is a high degree of variation over time. The standard errors around the coefficient estimates are larger, so sensitivity of long-term interest rates is less precisely estimated and, perhaps reflecting this, there is less similarity in the dynamics of the two measures of the sensitivity of long rates than in those for short-term rates. Despite displaying different dynamics over some periods, however, changes in the sensitivity of long-term interest rates tend to be positively correlated with those of short-term interest rates, maybe as a result of having common drivers.

These results are broadly similar to those for the United Kingdom of Swanson and Williams (2014b), and those for the United States of Goldberg and Grisse (2013), Faust *et al* (2007) and Swanson and Williams (2014a), who also find evidence that the sensitivity of short and long-term interest rates to data news varies significantly over time.

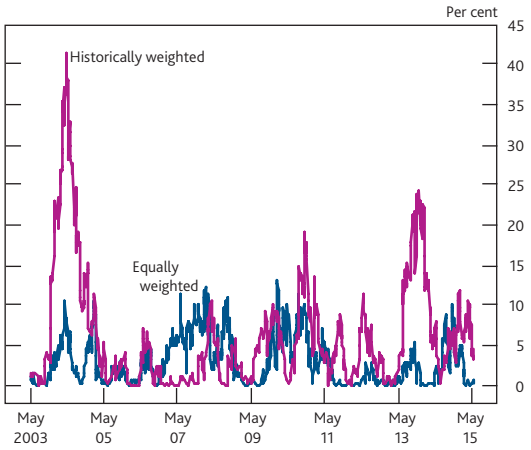
How much of the observed variation in interest rates can be attributed to data news?

The estimates of sensitivity of interest rates to data news show the extent to which interest rates respond to a given amount of news. The approach can also be used to investigate how much of the variation in interest rates can be explained by economic data news, using the 'R-squared' statistic of the estimated regressions. The R-squared captures the proportion of the variation in the dependent variable (daily changes in interest rates) that can be explained by the explanatory variable (the ESI).

Given that macro data releases receive considerable attention from market participants, it is perhaps surprising to see that they can only account for a relatively small proportion of the variation in short-term interest rates (**Chart 6**). The impact of data news has, however, varied over time. During certain subperiods, data news explains up to 40% of the total variation in short-term interest rates; but these periods are infrequent. The findings are similar for long-term interest rates (**Chart 7**).(1) Swanson and Williams (2014b) find similar results for the United Kingdom using a slightly different sample period.

These findings suggest that while macroeconomic data news does affect market interest rates systematically, there are a number of other important factors. These may include policy communications, geopolitical developments, movements in other asset prices, and technical factors in the bond market. Although this may appear surprising given the attention data news receive, this result is actually broadly consistent with the findings of a range of research on financial markets, which suggests that the volatility of asset prices cannot be explained by changes in underlying economic fundamentals alone. Much of this research gives prominence to changes in the risk premia required by investors to explain variation in asset prices.

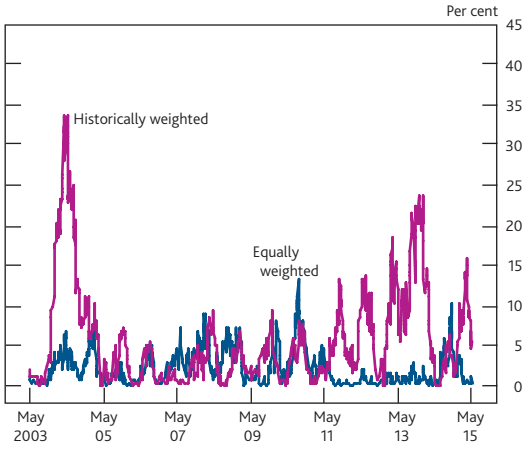
Chart 6 Estimated proportion of the observed variation in short-term UK interest rates (three-year) explained by the ESIs(a)



Sources: Bloomberg and Bank calculations.

(a) The plot depicts the R-squared statistic from 90-day rolling regressions of daily changes in three-year interest rates on two alternative ESIs. See main text for more details.

Chart 7 Estimated proportion of the observed variation in long-term UK interest rates (ten-year) explained by the ESIs(a)



Sources: Bloomberg and Bank calculations.

(a) The plot depicts the R-squared statistic from 90-day rolling regressions of daily changes in ten-year interest rates on two alternative ESIs. See main text for more details.

Although economic fundamentals can affect risk premia, these risk premia are also likely to depend on a broad range of other potential drivers.

It is also possible that the low R-squared values can also partly be explained by the drawbacks of the approach used. The fact that the impact of data releases is identified using daily data means that the measure of interest rate changes could also be capturing the effects of other events on the same day as the releases, which results in the impact of data news being mismeasured.(2) Perhaps consistent with that, there is

(1) These estimates include days in which there are no data releases. If the estimation is repeated only considering days in which there are non-zero ESI values, the share of explained variation of short and long-term interest rate increases, but it still typically remains low.

(2) A number of papers, such as Faust *et al* (2007) and Goldberg and Grisse (2013) have tackled this issue by relying on high-frequency intraday data to study time variation in the sensitivity of interest rates to macroeconomic data news.

The sensitivity of other asset prices to data news

The impact of macroeconomic data on financial markets is not limited to interest rates, and a similar approach to that used in this article can be applied to a range of other asset prices. This box illustrates this by examining the sensitivity to macro data news of the sterling-US dollar exchange rate.(1)

A historically weighted ESI is constructed using the same technique as that applied to interest rates in the main text (see the appendix for more details). This involves combining the data releases found to significantly affect the sterling-US dollar exchange rate,(2) weighting each release according to its past impact on the exchange rate.

The exchange rate is expected to respond to data releases to the extent that these contain news about the outlook of one country relative to the other. Consistent with this, both UK and US data releases are found to be significant (**Table 1**). Typically, positive data news on UK activity causes sterling to appreciate (resulting in a positive coefficient in **Table 1**), while positive data news on US activity causes the US dollar to appreciate (and sterling to depreciate, resulting in a negative coefficient in **Table 1**).(3) This could be consistent with the impact of these releases on UK/US interest rates, to the extent that changes in exchange rates reflect changes in interest rate differentials across countries.(4)

Table 1 Data releases included in the historically weighted ESI for the US dollar-sterling bilateral exchange rate (US$ per £)(a)

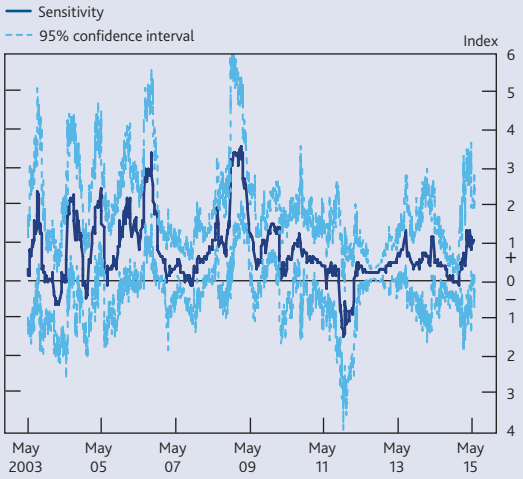
Data release	Estimated impact on US$ per £ (percentage change per standard deviation news)	Estimated standard error
UK GDP — first estimate	0.32	0.08
UK manufacturing PMI	0.28	0.07
UK net lending secured on dwellings	0.25	0.10
UK GDP — third estimate	0.25	0.09
UK manufacturing production	0.19	0.03
UK PPI input prices	0.17	0.06
US ISM non-manufacturing composite	0.14	0.06
US change in non-farm payrolls	-0.13	0.06
US factory orders	-0.11	0.06
US advance retail sales	-0.11	0.04
US GDP	-0.11	0.05

Sources: Bloomberg and Bank calculations.

(a) UK releases in blue, US releases in magenta. Data releases are ordered according to their impact on the US$ per £ exchange rate. The impact is estimated from regressions of daily changes in the US$ per £ exchange rate on macro news over January 2003–May 2015, and standard errors are robust to heteroskedasticity. See appendix for more details.

Following the same process as for interest rates, rolling regressions can then be estimated of changes in the spot exchange rate on this historically weighted ESI. **Chart A** shows that the sensitivity of the sterling-US dollar exchange rate to data news also varies considerably over time. In

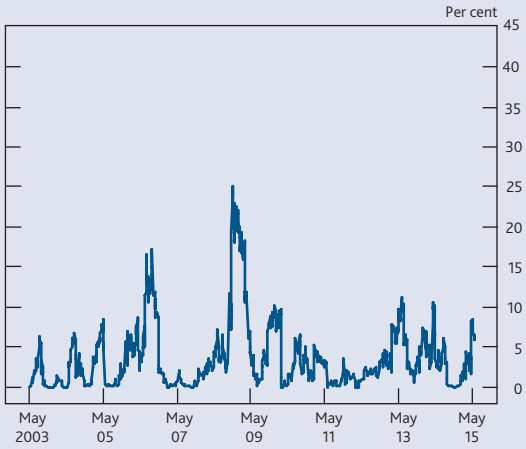
Chart A Estimated sensitivity of the US dollar-sterling bilateral exchange rate to a historically weighted ESI(a)



Sources: Bloomberg and Bank calculations.

(a) Based on 90-day rolling regressions of daily changes in US$ per £ exchange rate on a historically weighted ESI. The estimated coefficient is normalised so intuitively it can broadly be thought of as averaging one over 2003–08. See appendix for more details. Standard errors are bootstrapped to account for the fact that the ESI is a generated regressor. The y-axis scale is restricted to show variation in the coefficient estimate more clearly. As a result, the 95% confidence interval is not fully captured in the chart when the standard errors spike in 2008.

Chart B Estimated proportion of the observed variation in the US dollar-sterling bilateral exchange rate explained by a historically weighted ESI(a)



Sources: Bloomberg and Bank calculations.

(a) The plot depicts the R-squared statistic from 90-day rolling regressions of daily changes in US$ per £ exchange rate on a historically weighted ESI. See main text for more details.

(1) For an examination of the reaction to data news in equity markets see Andersen *et al* (2007).
(2) In this case, only UK and US releases were considered.
(3) In **Table 1** the coefficient on the US ISM non-manufacturing composite index is positive suggesting that positive news in this data release caused the dollar to depreciate. It is possible this reflects measurement error (due to other news taking place on the same day) rather than a well-identified impact of the release on the US dollar.
(4) This can be explained according to the uncovered interest parity (UIP) framework. Positive data news in the United Kingdom, which results in an increase in UK interest rates, will increase the expected return for an investor in the United Kingdom relative to the United States. This will encourage investors to shift their investments from the United States to the United Kingdom, increasing demand for sterling, causing it to appreciate. Technically, this assumes that there is no change in either the exchange rate risk premium or the expected long-run level of the exchange rate. If data news were to affect either of these components, the direction of the impact of data news on the exchange rate could be positive or negative.

particular, the sensitivity has been at very low levels since UK and US short-term interest rates moved close to their effective lower bounds following the financial crisis. The sensitivity estimate has increased back towards average levels over the past year.

For exchange rates, data news generally explains even less of the observed variation in the asset price than was the case for interest rates (**Chart B**). Again, this is consistent with the results of Swanson and Williams (2014b) and, more generally, with other research which finds that it is particularly difficult to explain exchange rate dynamics solely on the basis of the reaction to changes in macroeconomic fundamentals.(1)

(1) For a brief survey of this literature see Evans and Lyons (2008).

evidence that data news can explain a greater proportion of the variation in interest rates at lower frequencies, when the short-lived 'noise' affecting interest rates on a day-to-day basis is more likely to have washed out. Altavilla, Giannone and Modugno (2014) find that the power of ESIs for explaining changes in bond and equity prices increases significantly when looking at monthly or quarterly changes in the case of the United States. A final shortcoming of the approach could be that the survey measure of expectations used might not fully reflect the expectations of market participants — for instance because it is not representative of all the active investors within the government bond market.

Case study: heightened sensitivity of interest rates to data news during the summer of 2013

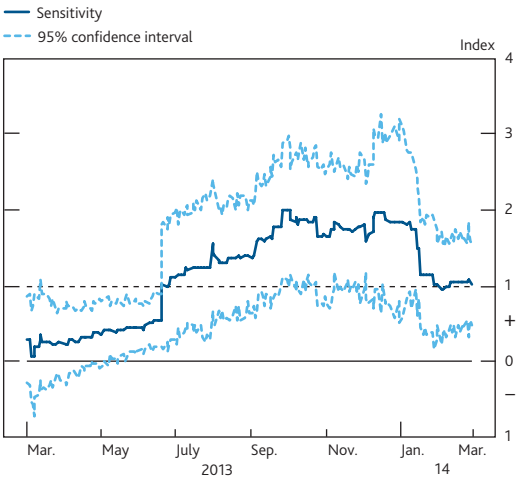
To illustrate how this approach can be used to help understand the drivers of changes in market interest rates, this section examines the changes in the sensitivity of interest rates to data news during the summer of 2013. During this period there was a sustained increase in short and long-term interest rates, in both the United Kingdom and the United States. From their low point in May 2013, short-term rates increased by around 75 basis points by mid-September, in both the United Kingdom and the United States. Over a similar period long-term rates increased by around 145 basis points in the United States and by 130 basis points in the United Kingdom.

A relevant question for conjunctural analysis within central banks at the time was to understand what was driving these increases in UK and US interest rates. One aspect of that was the extent to which it reflected the reaction of interest rates to data news.

Chart 1 shows that over this period there was an accumulation of upside data news in both the United Kingdom and the United States, which would be consistent with an increase in interest rates in both countries.

Focusing on the reaction of UK interest rates, **Chart 8** shows that the sensitivity of short-term UK interest rates to data news rose sharply around that time, becoming statistically higher than average at times during the second half of 2013. The sensitivity of long-term UK interest rates also increased markedly. Hence, it appears that interest rates were responding by more than usual to the positive data news over this period, contributing to the increase in interest rates observed.

Chart 8 Estimated sensitivity of short-term interest rates (three-year) to a historically weighted ESI over 2013 and early 2014(a)



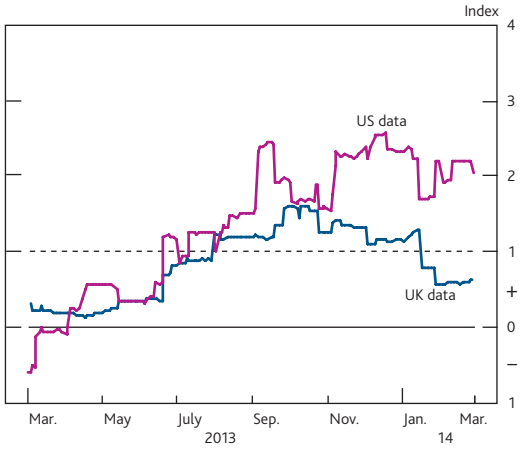
Sources: Bloomberg and Bank calculations.

(a) Based on 90-day rolling regressions of daily changes in three-year interest rates on a historically weighted ESI. The estimated coefficient is normalised so intuitively it can broadly be thought of as averaging one over 2003–08. See appendix for more details. Standard errors are bootstrapped to account for the fact that the ESI is a generated regressor.

Using the approach discussed in the previous section, the estimated R-squared values from this period can be used to quantify the extent to which the combination of this positive data news and increased sensitivity of interest rates to data news can explain the changes in interest rates during 2013. **Chart 6** and **Chart 7** show that, for the historically weighted ESI, data news can account for around a quarter of the moves in short and long-term interest rates over certain periods of 2013. This suggests an important role for data news. Although, this also means that, even during this period of heightened sensitivity, it still only accounted for a relatively small proportion of the variation in interest rates.

There are a number of possible explanations for this increase in the sensitivity of interest rates to data news. To better understand the drivers of this in the case of UK interest rates, the sensitivity can be estimated separately for the UK and US data releases included in the historically weighted ESI. **Chart 9** shows that for short-term UK interest rates there was an increase in the sensitivity to both UK and particularly US data news. The sensitivity to UK data news picked up to around its past average level, while the sensitivity to US data news increased more markedly to above its past average. The separate estimates for UK and US data news are based on fewer observations, and so are less precisely estimated. Nonetheless, combined with the fact that interest rates increased in both the United Kingdom and the United States, this suggests an important role for international developments.

Chart 9 Estimated sensitivity of short-term interest rates (three-year) to two historically weighted ESIs over 2013 and early 2014, separating UK and US data news(a)



Sources: Bloomberg and Bank calculations.

(a) Based on 90-day rolling regressions of daily changes in three-year interest rates on a historically weighted ESI. The estimated coefficient is normalised so intuitively it can broadly be thought of as averaging one over 2003–08. See appendix for more details. Each line corresponds to a separate regression which considers UK and US data releases separately.

In the United States, beginning in May 2013 there was increased speculation about the future prospects for monetary policy. In particular, communication by the Federal Reserve Board Open Market Committee (FOMC, responsible for setting monetary policy in the United States) suggested it was considering reducing the pace at which it was purchasing assets from the private sector as part of its QE policy (this came to be known as 'tapering' the pace of purchases). Changes in the stock of assets expected to be purchased by the Federal Reserve could have had a direct impact on US interest rates. In addition, as this communication by the FOMC was interpreted as signalling a turning point in the stance of US monetary policy, it could also have resulted in market participants paying closer attention to macroeconomic data news, as they formed their expectations for the future path of monetary policy.

That could explain an increase in the sensitivity of US interest rates to US data news. And given the close correlation between market interest rates internationally, this could also have increased the sensitivity of UK interest rates to US data news, as investors assessed the implications of changes in the United States for UK interest rates.

One potential reason for the less marked increase in the sensitivity of UK interest rates to UK data news, relative to US data news, is the introduction of forward guidance by the MPC in August 2013.(1) It is difficult, however, to draw strong conclusions about the effect of forward guidance on the sensitivity of UK interest rates to data news using the techniques outlined in this article. This is because it is hard to know what might have happened to the sensitivity of interest rates to UK data news in the absence of the MPC's forward guidance, particularly given the other developments in global markets around this time. Moreover, the MPC specifically referred to an unemployment threshold when it first introduced forward guidance.(2) But since UK labour market data news has not on average had a significant effect on UK interest rates over the full sample period, they are not included in the historically weighted ESI. Therefore any impact on the sensitivity of interest rates to these labour market releases will not be captured by this method.

The sensitivity of interest rates to data news could also have been affected by a number of other factors. For instance, changes in government bond market conditions following the financial crisis could have made periods of sharp increases in market volatility around key events more likely. The next section considers some of the potential drivers of the changing sensitivity of interest rates to macroeconomic data news over time, drawing on existing research where possible.

Potential drivers of the time variation in sensitivity

While it appears that the sensitivity of interest rates to data news varies considerably over time, the technique used in this article cannot be used to identify the reasons for this variation.

One factor frequently cited in the literature as potentially affecting the sensitivity of interest rates to data news is the degree of uncertainty and risk aversion in financial markets. Goldberg and Grisse (2013) find that the sensitivity of

(1) The Chancellor had asked the MPC to consider the case for adopting some form of forward guidance when setting the MPC's remit in March 2013. For more detail on the forward guidance policy adopted by the MPC in August 2013, see www.bankofengland.co.uk/publications/Documents/inflationreport/2013/ir13augforwardguidance.pdf.

(2) The MPC stated that it intended, at a minimum, to maintain the exceptionally accommodative stance of monetary policy until economic slack had been substantially reduced, provided that this did not put at risk either price stability or financial stability. In particular, and subject to those conditions, the MPC stated it intended not to raise Bank Rate from 0.5% at least until the Labour Force Survey headline measure of the unemployment rate had fallen to a threshold of 7%.

US interest rates to key US data releases (such as non-farm payrolls, GDP and CPI) is lower when uncertainty and risk conditions are elevated. They suggest that market participants are less likely to take strong signals from data news when the relationship between these and the economic outlook is more uncertain.(1)

Other papers have found that asset price sensitivity depends on the magnitude and direction of data news. Looking at exchange rates, Andersen *et al* (2003) and Ehrmann and Fratzscher (2005) find that negative data news has a larger effect than positive news of the same magnitude, and that larger news (in absolute terms) seems to have a more than proportional impact.

As discussed earlier, in recent years the sensitivity of interest rates could also have been affected by the fact that interest rates have been closer to their lower bound. Given that there is a limit to how low nominal interest rates can fall, at very low levels it is likely interest rates will respond less to (particularly negative) data news. Swanson and Williams (2014a, 2014b) find this to be an important factor for the sensitivity of interest rates to data releases in the United States, United Kingdom and Germany at different points in time since the beginning of the financial crisis.

It is possible that changes in central bank communications could also have an effect on interest rate sensitivity, as described in the previous section.

Finally, it is possible that structural changes in financial markets following the financial crisis may have affected the sensitivity of interest rates to data news. For example, prior to the financial crisis, intermediaries in government bond markets tended to hold government bonds themselves after purchasing them from clients, waiting until they could find an appropriate buyer. More recently, the Bank's market contacts suggest that these intermediaries often try to directly match buyers and sellers rather than hold the bonds themselves. To the extent that intermediaries holding these bonds reduced some of the volatility in market prices, these changes in the way the market operates could have led to an increase in the sensitivity of market prices in the face of developments such as macroeconomic data news. Set against that, there is also some indication that these intermediaries are now less active in speculatively trading in these markets themselves. That reduced activity could act in the opposite direction, reducing the sensitivity of market prices to news more generally, including in response to data news. These hypotheses have not been widely explored in previous research, most likely due to the absence of data on these developments.

Conclusion

This article has explored the link between macroeconomic data releases and changes in market interest rates. It finds that both short and long-term interest rates in the United Kingdom respond to data releases that differ from market participants' expectations prior to the release, although their sensitivity to data news varies over time.

In part reflecting these changes in sensitivity, the importance of data news in explaining the variation in interest rates also varies considerably over time. During certain periods it can explain up to 40% of the variation in short and long-term interest rates. But on average data news can only account for a relatively small proportion of the total variation in UK interest rates. This is consistent with previous research which suggests that the volatility of asset prices cannot be explained by changes in underlying economic fundamentals alone.

That said, there appears to be an important role for both domestic and foreign data news. Indeed, for short and long-term interest rates, foreign news is as important as domestic news. This is consistent with the United Kingdom being a small open economy and with an important role for spillovers from international financial markets to UK asset prices.

The technique used in this article cannot be used to identify the drivers of variation over time in the sensitivity of interest rates to data news. But other research suggests it may be related to factors such as the degree of uncertainty and risk aversion, central bank communication, and the absolute size and direction of data news. In recent years, it could also have been affected by the low level of interest rates and their proximity to their 'lower bound', and changes in the structure of financial markets.

(1) Consistent with this, Pericoli and Veronese (2015) find that interest rates respond less to data news during periods when there is more disagreement among forecasters about upcoming macroeconomic releases.

Appendix

This appendix describes the data used throughout the article and explains in detail the econometric method underlying the analysis.

Data

The sample considered comprises daily data on market interest rates, exchange rates and macroeconomic data news. We consider 110 different types of macroeconomic data releases (24 UK series, 31 US series and 55 euro-area series). These include activity indicators (such as GDP or retail sales), inflation estimates (such as CPI inflation), labour market indicators (such as the unemployment rate) and business surveys (such as the purchasing managers' index (PMI)). The sample period is from January 2003 to May 2015.

Market interest rates are measured using the Bank of England's zero-coupon government bond yields. To capture the effect on both short and long-term interest rates, estimations are performed using both the three-year and ten-year spot government bond yields. Spot exchange rates are used as provided by Bloomberg.

The daily change in market interest rates and exchange rates is measured as the change from close of business on the day of the release relative to the rate at close of business on the day prior to the release.(1) A one-day window is used to try to isolate the effect of the data release. But it is possible that this window will also include a range of other events which can affect interest rates.(2)

Macroeconomic data news is constructed by comparing headline releases with market expectations, as measured by the Bloomberg survey of market participants.(3) This involves a survey of a panel of analysts from private institutions such as investment banks, which is conducted in the days prior to each data release. The number of respondents varies across data releases and over time. The news component is calculated as the difference between the headline data release and the median expectation from the survey. While this survey allows us to estimate the news component of data releases it is not perfect, not least because the pool of survey respondents might not be representative of the entire universe of investors participating in the market.

Method

The relatively low frequency of releases of individual macroeconomic data series is an obstacle to measuring the time variation in the sensitivity of market interest rates to particular series over short horizons. To overcome this issue an economic surprise index (ESI) is constructed. It aggregates different types of macroeconomic releases into a (higher-frequency) single indicator. In order to account for the relative importance of different types of releases, one of the approaches used to construct the ESI follows Swanson and Williams (2014a, 2014b) in weighting news in each data series according to its average importance in explaining daily changes in yields over the whole sample. Daily changes in this ESI are then compared to daily changes in the asset prices considered to measure the sensitivity of these asset prices to macroeconomic data news.

The weight placed on different data series and the sensitivity of the asset price to the ESI are estimated simultaneously from the following equation:

$$\triangle i_t = \alpha_\tau + \delta_\tau \sum_{i=1}^{n} w^i x_t^i + \varepsilon_t \qquad (1)$$

where Δi_t represents daily changes in the asset price considered, α_τ is an annual dummy variable used to pick up trends in the variation of asset prices, w^i represent the weights attached to different macroeconomic data news (x_t^i), and δ_τ is the aggregate sensitivity of the asset price in question to the ESI ($\Sigma_{i=1}^{n} w^i x_t^i$) which is allowed to vary in each calendar year. ε_t is a residual.

This non-linear specification is estimated using maximum likelihood. This allows joint estimation of the weights (w^i) and the aggregate sensitivity (δ_τ). However, to separately identify these two sets of coefficients, it is necessary to normalise the aggregate sensitivity in a benchmark period.(4) The benchmark period is chosen to be between the start of 2003 and the end of 2008, the part of our sample where Bank Rate was not near its lower bound.

In order to obtain estimates of how the sensitivity of asset prices to data news changes over shorter periods of time than captured by the annual change in δ_τ, 90-day rolling OLS regressions are run using the daily ESI constructed above ($\hat{W} = \Sigma_{i=1}^{n} \hat{w}^i x_t^i$).(5) The specification used is:

$$\triangle i_t = \alpha + \beta \hat{W} + v_t \qquad (2)$$

A variable selection process is conducted in order to obtain a more precise estimation when using the methodology that weights different macroeconomic series according to their historical impact on interest rates. This narrows down the sample of over 100 types of macroeconomic data news from the United Kingdom, United States and the euro area by only

(1) Special consideration is given to UK bank holidays, as US and euro-area data releases on those days are allowed to affect UK interest rates on the following day.
(2) As discussed, a potential extension to the work discussed in this article which might help to alleviate this problem would be to use intraday data to more accurately capture the change in interest rates around the precise time of the data release.
(3) For some of the data releases, the forecasts provided by Bloomberg are based on underlying data from Markit.
(4) In practice this means making δ_τ average 1 over 2003–08.
(5) Standard errors are obtained using a bootstrap to account for the sampling uncertainty derived from using a constructed regressor.

considering those that significantly affect the asset price in question. In the first stage, all data news from a given origin (United Kingdom, United States or euro area) are considered in turn in three separate regressions. Those variables found to be significant at the 5% level in this first stage are taken into account for a second stage, in which variables from different economies are considered together. This interaction renders some of these variables non-significant, and hence they are subsequently dropped before confirming a final set of significant releases.(1) This process is done separately for each asset price considered, as the set of significant data news might change depending on asset characteristics. Once the set of asset-specific significant data news is formed, the methodology described above can be applied.

(1) Data releases with less than 25 non-zero news observations throughout the sample are also dropped, as are those which have a negligible impact (an impact of less than 1 basis point in bonds and 0.1% in exchange rates per standard deviation of news).

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