

# Understanding the MPC's forecast performance since mid-2010

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- Macroeconomic performance in the United Kingdom has been disappointing in recent years: for most of the post-crisis period, GDP growth has been unexpectedly weak, and inflation unexpectedly strong.
- That unexpected weakness in GDP reflects a combination of weaker growth in the United Kingdom's trading partners, tighter domestic credit conditions and slower dissipation of uncertainty.
- Unanticipated rises in energy and other imported costs can broadly account for the surprising strength in inflation since mid-2010.
- Weak effective supply is likely to have counteracted the impact of weak demand on inflation.

## Overview

The Monetary Policy Committee's (MPC's) macroeconomic forecasts play an important role in the setting of monetary policy. They are underpinned by a number of key judgements and conditioning assumptions. Among other things, these key judgements are informed by the MPC's understanding of its past forecast performance.

In mid-2010, the MPC's central expectation was for sustained recovery both domestically and abroad as the effects of the 2007–09 financial crisis, and of external price pressures, faded. GDP growth was expected to pick up to a little above historical average rates, and inflation was expected to fall to the target within two years.

But since mid-2010, growth has been closer to 1% on average, leaving the level of GDP in 2013 Q2 almost 7% below the central expectation in the August 2010 *Inflation Report*. A key reason for that weakness was that the effects of the financial crisis did not fade as anticipated. In particular, world trade, credit conditions and uncertainty dragged on growth by more than anticipated.

Despite unexpectedly weak GDP, inflation did not fall back towards the 2% target as expected, but picked up sharply, reaching around 5% in 2011 Q3. Unexpected increases in energy and other imported costs can broadly account for the strength in inflation relative to mid-2010 expectations. However, had the MPC correctly anticipated the weakness in GDP, it would have probably lowered its inflation projection. This suggests that other factors — in particular, the weakness of effective supply — have counteracted the impact of weak demand on inflation in recent years.

The key judgements underpinning the latest set of projections reflect the experience of the past few years. In particular, the consequences of the financial crisis have proved more severe and longer lasting than expected. In its November 2013 projections, the MPC's central expectation was for GDP to grow at around its average historical rate over the forecast period; in contrast, in August 2010, the recovery was assumed to involve a period of above-trend growth, in line with the experience of previous cyclical upswings.

The Monetary Policy Committee's (MPC's) macroeconomic forecasts, communicated through the *Inflation Report* each quarter, are a key input to the setting of monetary policy. The MPC regularly assesses macroeconomic developments against the judgements underpinning those forecasts. In this way, the MPC improves its understanding of the influences driving the economy, which should result in improved forecasts. As part of that process, this article explores the reasons why GDP and inflation have evolved differently from the MPC's forecasts since mid-2010.<sup>(1)</sup>

Since the start of the financial crisis, GDP growth and CPI inflation have repeatedly disappointed relative to the MPC's central expectation. Following the sharp falls in output in 2008–09, the MPC's central expectation had been for growth to pick up to above historical average rates, and for inflation to fall to the 2% target within two years. But four-quarter GDP growth has averaged around 1% since 2010 Q1, and inflation has remained above target. As discussed in the box on page 338, the MPC's forecast performance since the crisis has been similar to that of many external forecasters.

The article begins by providing some historical context, comparing GDP and inflation outturns since the crisis to the MPC's forecast distributions, as illustrated by the fan charts. The rest of the article focuses on the MPC's forecasting performance since the nascent recovery faltered from mid-2010. It has been over this period that the MPC has learned the most, and is still learning, about the repercussions of the financial crisis. Specifically, this article compares outturns between 2010 Q2 and 2013 Q2 with the projections in the August 2010 *Inflation Report*, which were typical of others around that time. The article quantifies, using Bank staff models, the importance of different developments in explaining why GDP growth and inflation outturns have been different from MPC projections. As part of that quantification, the article uses internal Bank staff projections for a range of variables that were broadly consistent with the MPC's published projections and underlying judgements.<sup>(2)</sup>

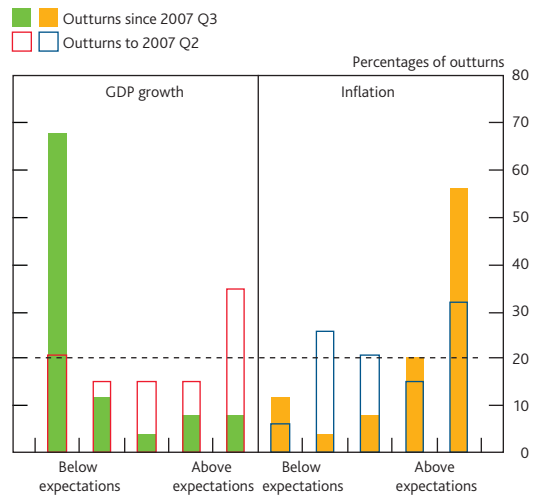
## GDP and inflation outturns relative to the MPC's fan charts

The MPC's forecasts are always presented as a distribution of outturns, conveying a range of possible outcomes and their likelihood. This approach is intended to reflect the inherent uncertainty about the future evolution of the economy.

One way to assess the MPC's forecasts is to examine the dispersion of outturns across the probability distributions. **Chart 1** shows, for four-quarter GDP growth on the left and annual CPI inflation on the right, the proportion of outturns in each quintile of the probability distributions at the one-year horizon. If the fan charts accurately described the uncertainty

faced by the MPC and the sample were sufficiently large, then outturns would be expected to lie evenly across the fan chart distributions; 20% of outturns would be expected to lie within each quintile of the distribution — illustrated by the black dashed line.

**Chart 1** Dispersion of GDP growth and inflation outturns, one year ahead, across the quintiles of the fan chart distributions<sup>(a)(b)</sup>



(a) Calculated for the fan charts based on market interest rate expectations published from February 1998 to August 2012. The outturns for GDP growth and inflation are allocated to one of five buckets representing the quintiles of the fan chart from a year earlier.  
 (b) The modes of the fan chart distributions for GDP growth up to the August 2011 forecasts have been adjusted up by 0.3 percentage points, to reflect the effects of methodological changes implemented in the 2011 edition of the *Blue Book*. Inflation fan charts refer to RPIX inflation up to November 2003 and CPI inflation thereafter.

Prior to the onset of the financial crisis in 2007 Q3, GDP growth and inflation outturns were fairly evenly distributed across the five quintiles (shown by the hollow red and blue bars in **Chart 1**), although growth had tended to be a little stronger than expected. Since then, however, the MPC's forecasts have tended to overpredict growth and underpredict inflation. Four fifths of GDP growth outturns since 2007 Q3 have been in the bottom half of the forecast distribution (shown by the solid green bars in **Chart 1**). In contrast, four fifths of inflation outturns have been in the top half of the distribution over the same period (shown by the solid orange bars in **Chart 1**). A similar pattern is seen for two year ahead GDP and inflation outturns.

(1) An enhanced forecast evaluation exercise is one aspect of the Bank's response to the 'Review of the Monetary Policy Committee's forecasting capability' by David Stockton; see Stockton (2012).  
 (2) Key findings from this analysis were set out in a box on pages 47–49 of the November 2013 *Inflation Report*.

## How does the MPC’s forecasting performance compare with external forecasters?

One way to assess the MPC’s forecasting performance is to compare it with equivalent projections made by external forecasters. In the ‘Review of the Monetary Policy Committee’s forecasting capability’, David Stockton, formerly of the US Federal Reserve, noted that ‘since the crisis commenced, the MPC have made somewhat larger forecast errors for growth than the average errors of external forecasters, though the differences are not striking’.<sup>(1)</sup>

This box examines how the MPC’s forecasting performance compares with that of external forecasters for four-quarter GDP growth and inflation outturns since the start of the financial crisis in 2007 Q3. If external forecasters’ expectations were closer to outturns than those of the MPC, that could indicate that the MPC was too cautious in incorporating all the available information into its forecasts. The results in this box suggest that differences between the MPC’s mean forecasts and outturns were similar to those of the average external forecaster on both GDP growth and inflation.

This box draws on the quarterly survey of external forecasters conducted by the Bank. Every three months, in preparation for the *Inflation Report*, the Bank asks a sample of external forecasters, including commercial banks and economic consultancies, for their economic projections, with around 20 to 25 institutions responding each quarter. The analysis in this box only includes forecasters that have both been in the sample and responded to at least two thirds of the surveys since the August 2006 *Inflation Report*.

### GDP

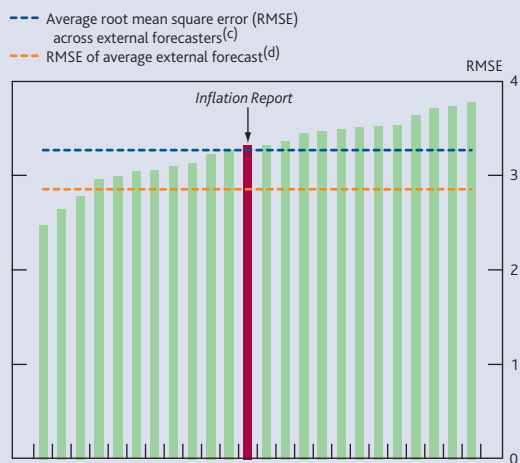
The MPC’s GDP growth forecasting performance has been similar to that of many external forecasters since 2007 Q3 (**Chart A**). Some external forecasts had a smaller root mean square error (RMSE), but the average of individual RMSEs across all external forecasters was the same as the MPC.

For GDP, taking the RMSE of the average across external forecasts is somewhat lower than the RMSE of the MPC and of most individual external forecasters. This consensus forecast would be expected to perform better than any individual forecast. For example, if one forecaster consistently overpredicted growth, and a second consistently underpredicted growth by the same amount, the average of their forecasts would be an accurate forecast, even though the individual forecasts would not. Only three external forecasters have had a smaller RMSE than this consensus forecast since late 2007.

### Inflation

MPC inflation forecasts have differed from outturns by a similar amount to external forecasts (**Chart B**). The RMSE of the MPC’s one year ahead inflation forecasts has been the same as the average RMSE across external forecasters. Unlike forecasts for GDP, the RMSE of the consensus external forecast is very similar to that of the MPC, and most external forecasters. This reflects less dispersion across individual external forecasts for inflation than for GDP.

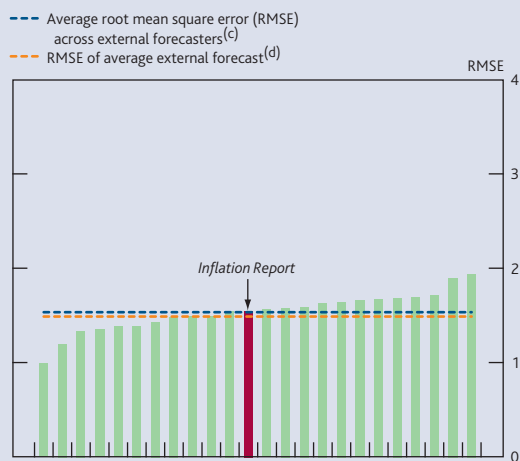
**Chart A** One year ahead GDP growth forecast RMSEs<sup>(a)(b)</sup>



Sources: Projections of outside forecasters provided for *Inflation Reports* between August 2006 and August 2012 and Bank calculations.

- (a) This chart covers outturns from 2007 Q3 to 2013 Q3 for four-quarter growth in GDP.
- (b) Each green bar shows the root mean square error of an external forecaster, based on their responses to the Bank’s survey of external forecasters.
- (c) This is the average RMSE across forecasters in the sample.
- (d) This is the RMSE of the average external forecaster’s projection for GDP growth.

**Chart B** One year ahead inflation forecast RMSEs<sup>(a)(b)</sup>



Sources: Projections of outside forecasters provided for *Inflation Reports* between August 2006 and August 2012 and Bank calculations.

- (a) This chart covers outturns from 2007 Q3 to 2013 Q3 for annual CPI inflation.
- (b) Each green bar shows the root mean square error of an external forecaster, based on their responses to the Bank’s survey of external forecasters.
- (c) This is the average RMSE across forecasters in the sample.
- (d) This is the RMSE of the average external forecaster’s projection for inflation.

(1) See page 17 of Stockton (2012).

## How the economy has evolved relative to the MPC's central expectations in August 2010

At the time of the August 2010 *Inflation Report*, the MPC's central expectation was for the economy to continue to recover from the 2008/09 recession as the effects of the financial crisis and external price pressures faded. That central view rested upon a number of key judgements:

- UK trade was expected to benefit from a global recovery and improved competitiveness following the large depreciation of sterling in 2007–08, such that the UK export share would rise;
- an easing in credit conditions and uncertainty was thought likely to support domestic demand;
- a temporary boost to inflation from import and energy prices was expected to wane;
- rising demand was expected to be associated with rising labour productivity; and
- an increase in unemployment was expected to weigh on wages and prices.

Based on those judgements, the MPC's central view was for four-quarter GDP growth to recover to a little above its pre-crisis average, and for inflation to fall back to below the 2% target by 2012.

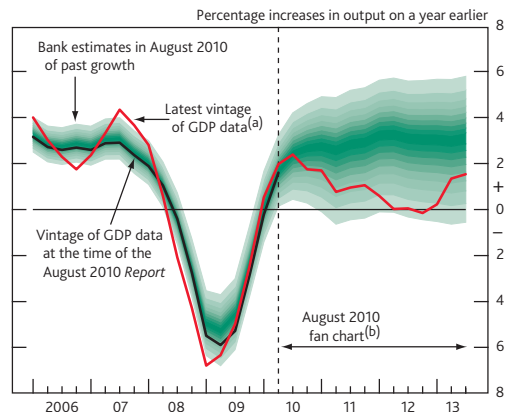
But, according to ONS estimates, growth has been closer to 1% on average (**Chart 2**), leaving the level of GDP in 2013 Q2 almost 7% weaker than the central expectation in the August 2010 *Inflation Report*. That unexpected weakness was disproportionately accounted for by exports and business investment, with consumption also playing a role (**Chart 3**). There was a partial offset from lower imports.

Despite weaker GDP, inflation did not, as expected, fall back towards the target, but picked up sharply, reaching around 5% in 2011 Q3 (**Chart 4**). Compared with the August 2010 projection, annual inflation has been, on average, around 1½ percentage points higher than expected.

The unexpected weakness in GDP and strength in inflation reflected underlying drivers of the economy evolving differently to the key judgements underpinning the August 2010 *Inflation Report* (**Table A**). In particular, global activity was weaker than expected — especially in the euro area — and UK exporters did not gain market share as anticipated. Credit conditions remained tight, and uncertainty dissipated more slowly than expected. Import and energy prices continued to rise. And labour productivity fell. Other unexpected developments include stronger labour supply and rises in tuition fees.

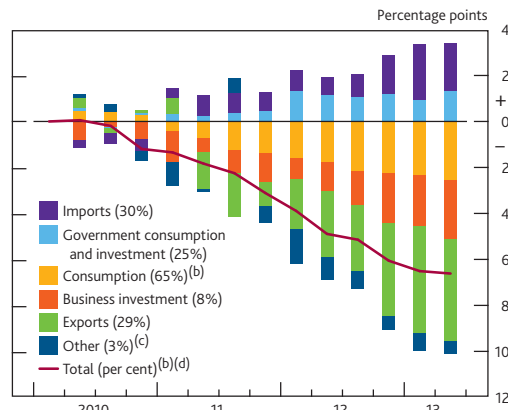
In response to the deteriorating outlook, the MPC provided more stimulus by increasing its stock of asset purchases by

**Chart 2** GDP outturns and projection in the August 2010 *Inflation Report*



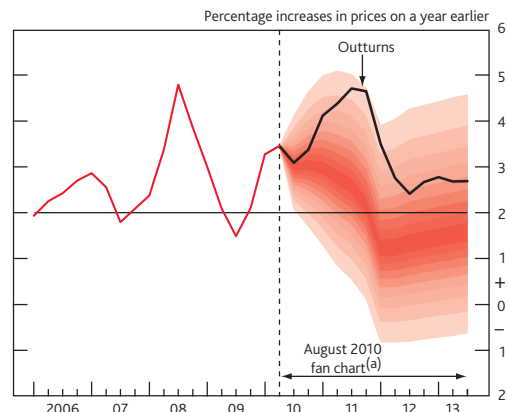
(a) Revisions, including methodological changes, account for the gap between the red and black lines prior to the vertical dashed line.  
 (b) Based on market interest rate expectations and the assumption that the stock of purchased assets remained at £200 billion throughout the forecast period. See footnote to Chart 5.1 in the August 2010 *Inflation Report* for information on how to interpret the fan chart. No adjustment has been made to the fan chart to reflect the effects of methodological changes implemented in the 2011 edition of the *Blue Book*.

**Chart 3** Contributions to the news in the level of real GDP since the August 2010 *Inflation Report*<sup>(a)</sup>



(a) Chained-volume measures. News calculated between 2010 Q1 and 2013 Q2 based on Bank staff projections made in August 2010 that were broadly consistent with the key judgements underlying the MPC's GDP and inflation forecasts. Those forecasts have been adjusted to be at 2010 prices. Figures in parentheses show 2009 weights in real GDP, which sum to more than 100% because imports detract from GDP.  
 (b) August 2010 projection adjusted to reflect the effects of methodological changes implemented in the 2011 edition of the *Blue Book*.  
 (c) Includes housing investment, stockbuilding, statistical adjustments and news from unexpected revisions to GDP.  
 (d) News in the MPC's GDP backcast at the time of the November 2013 *Inflation Report* relative to the August 2010 modal GDP projection.

**Chart 4** CPI inflation outturns and projection in the August 2010 *Inflation Report*



(a) Based on market interest rate expectations and the assumption that the stock of purchased assets remained at £200 billion throughout the forecast period. See footnote to Chart 5.6 in the August 2010 *Inflation Report* for information on how to interpret the fan chart.

**Table A** Assessing key judgements in the August 2010 *Inflation Report*

August 2010 key judgements	Indicators of key judgements	Cumulative changes from 2010 Q1 to 2013 Q2 (per cent unless otherwise stated)	
		Aug. 2010 projections <sup>(a)</sup>	Nov. 2013 estimate
<b>Consequences of the financial crisis gradually fade</b>			
Sustained recovery in world demand growth.	UK-weighted world trade <sup>(b)</sup>	24.1	14.6
Uncertainty expected to dissipate and credit conditions to ease gradually.	Weighted average of household and corporate lending and deposit rates relative to reference rates (basis points) <sup>(c)</sup>	-175	-20
<b>Limited further imported inflationary pressure</b>			
Import prices expected to be fairly stable.	Import prices (excluding fuels)	0.2	3.9
Energy prices expected to move in line with futures curves.	Sterling oil prices <sup>(d)</sup>	13	36
<b>Rising productivity</b>			
Labour productivity expected to rise.	Whole-economy output per hour <sup>(e)</sup>	10.4	-1.2

Sources: Bank of England, Bloomberg, BofA Merrill Lynch Global Research, used with permission, British Household Panel Survey, IMF *World Economic Outlook (WEO)* October 2013, ONS, Thomson Reuters Datastream and Bank calculations.

(a) Bank staff projections made in August 2010 that were broadly consistent with the key judgements underlying the MPC's GDP and inflation forecasts.

(b) World trade is constructed using data for import volumes of 143 countries weighted according to their shares in UK exports.

(c) For a full description of this measure see Burgess *et al* (2013), pages 84–86.

(d) Brent forward prices for delivery in 10–21 days' time converted into sterling.

(e) Calculated using the MPC's GDP backcast instead of published ONS GDP data.

£175 billion. In addition, Bank Rate remained at 0.5% compared with the rise to 2% implied by the market curve at the time. Were it not for that more stimulative policy stance, it is likely that GDP and inflation would have been markedly weaker.

## Unexpected price pressures and demand headwinds

This section uses the Bank's suite of economic models to assess how far the MPC's forecast performance since mid-2010 can be explained by the key factors highlighted above, focusing on price pressures (energy and non-energy import costs and tuition fees) and demand headwinds (global demand for UK exports, credit conditions and uncertainty). The role of other factors, including supply, is discussed in the penultimate section.

Quantifying the precise impact of economic developments is not straightforward. There is no single model that accurately captures the impact of all the various factors affecting the economy. The MPC therefore uses a range of models and judgements to produce its forecasts. In that spirit, the estimates presented in the remainder of this article are based on a range of approaches, including the Bank's central forecasting model COMPASS, its wider suite of economic

models and other staff analysis.<sup>(1)</sup> All of those estimates are uncertain and necessarily specific to the models used.

### Impact on inflation

In August 2010, the MPC's central expectation was for upwards pressure on inflation from imported costs to fade. Instead, rises in these costs continued to boost inflation, as did an unanticipated increase in tuition fees that occurred in late 2012. **Overall, the direct impact of unanticipated rises in energy costs, non-energy import costs and tuition fees can broadly account for the news in inflation from mid-2010 to mid-2013.**

### Energy prices

**Just over a third of the 1½ percentage points a year news in inflation can, on average, be accounted for by the direct effect of unexpected rises in energy costs.**

CPI inflation has been boosted since mid-2010 by unexpectedly large rises in energy costs, reflecting both higher oil and gas prices, and increases in other costs faced by energy suppliers, such as the amounts that they have had to pay towards the maintenance of distribution networks.

MPC forecasts are conditioned on futures curves for oil and wholesale gas prices, expressed in sterling terms, which at the time of the August 2010 *Inflation Report* implied only a small rise in oil prices and some increase in gas prices (**Chart 5**).<sup>(2)</sup> But oil prices rose sharply through the latter part of 2010 and first half of 2011, such that they were around 25% higher on average than assumed between 2010 Q2 and 2013 Q2, while gas prices were on average 15% higher than assumed.

Higher energy prices reflected both demand and supply factors. Despite unexpectedly weak growth in the United Kingdom's trading partners, especially in the euro area, world oil demand has been stronger than expected, in part reflecting strong demand from emerging economies. Supply disruptions, such as those associated with geopolitical tensions in the Middle East, also raised the price of oil.

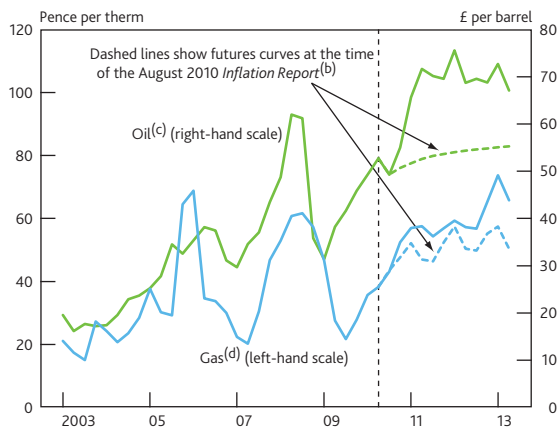
Rising wholesale energy prices typically affect inflation directly through petrol prices and domestic energy bills. The direct effect of unexpected rises in energy costs on inflation has averaged half a percentage point a year since mid-2010. Higher energy costs are also likely to have had indirect effects on consumer prices, in particular through higher costs of production for non-energy goods and services, such as manufacturing and distribution costs. These indirect effects are difficult to quantify. Based on the energy content of production, indirect effects could double the contribution of higher energy costs to inflation. But in time they are likely to

(1) For more on economic models at the Bank of England, see Burgess *et al* (2013).

(2) Nixon and Smith (2012) discuss how the MPC's assumptions about the evolution of oil prices relate to its forecasts.



**Chart 5 Sterling oil and wholesale gas prices<sup>(a)</sup>**



Sources: Bank of England, Bloomberg, Thomson Reuters Datastream and Bank calculations.

- (a) Data are quarterly averages. Vertical dashed line is at 2010 Q2, the last full quarter of oil and gas price data available at the time of the August 2010 *Inflation Report*.
- (b) The futures prices shown are averages during the fifteen working days to 4 August 2010. The sterling oil futures curve was calculated by assuming that the sterling-dollar exchange rate remained at its average level during that fifteen-day period.
- (c) Brent forward prices for delivery in 10–21 days' time converted into sterling.
- (d) One-day forward price of UK natural gas.

be largely offset by lower domestic costs — as discussed below, higher energy costs will squeeze household real incomes, reducing demand for other goods and services.<sup>(1)(2)</sup>

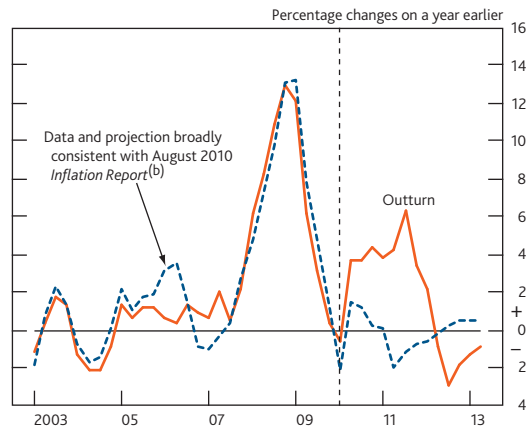
**Import prices (excluding energy)**

Import prices have risen by more than expected. And the impact on inflation from a given rise in import prices is now estimated to have been larger than previously assumed. **Taking these influences together, import prices can account for around three quarters of a percentage point per year of the news in inflation since mid-2010.**

Between 2010 Q1 and 2013 Q2, non-energy UK import prices increased by 4%, rather than remaining broadly unchanged as assumed in the August 2010 *Inflation Report* (Chart 6). These increases partly reflected strong demand from commodity-intensive emerging economies. Supply disruptions also raised the prices of some non-energy commodities. For example, wholesale agricultural prices were boosted by adverse weather conditions in Australia, Brazil and Russia in late 2010.

The impact of higher import prices on CPI inflation depends on three factors: the import intensity of consumer prices; the extent to which companies adjust to higher import costs by raising prices or reducing other costs; and how long that adjustment takes. Bank staff currently assume that import intensity is close to 30% and that higher import prices will eventually be fully passed through into higher consumer prices.<sup>(3)</sup> The timing of that pass-through is, however, uncertain. One way to judge how long it takes for higher import prices to be passed through to consumer prices is to look at the contribution to inflation of the import-intensive CPI components relative to those components that are less

**Chart 6 UK non-energy import prices<sup>(a)</sup>**



Sources: ONS and Bank calculations.

- (a) Goods and services import price deflator excluding fuels and the impact of missing trader intra-community (MTIC) fraud. Revisions account for the gap between the dashed and solid lines prior to the vertical dashed line. Vertical dashed line is at 2010 Q1, the last full quarter of non-energy import price data available at the time of the August 2010 *Inflation Report*.
- (b) Bank staff projection made in August 2010 that was broadly consistent with the key judgements underlying the MPC's GDP and inflation forecasts.

import-intensive.<sup>(4)</sup> Overall, Bank staff estimate that unexpected rises in import prices since mid-2010 can account for around half a percentage point per year of the news in inflation, on average.

In addition to the impact of unexpected rises in import prices since mid-2010, Bank staff estimate that CPI inflation since then has been unexpectedly boosted by rises in import prices prior to mid-2010. These previous rises in import prices, following the large depreciation of sterling in 2007–08, were known about at the time of the August 2010 *Inflation Report* (Chart 6). But the assumed impact of those rises has been revised upwards, as Bank staff have revised up their estimates of both import intensity and the degree of pass-through. Those two changes in judgement, applied to the rises in import prices prior to mid-2010, can account for a further third of a percentage point per year of the news in inflation, on average.

**Tuition fees**

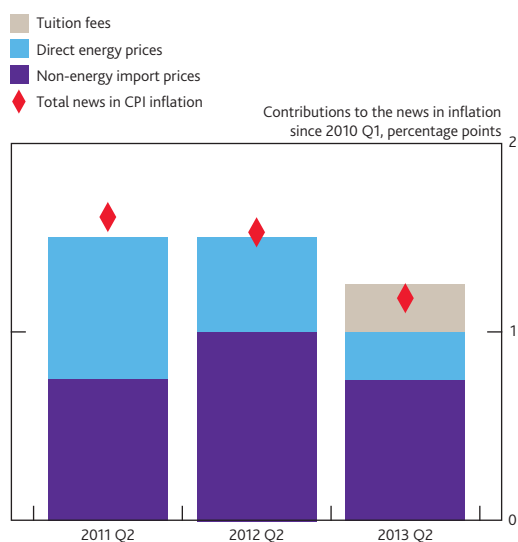
**Unanticipated rises in tuition fees are likely to have raised inflation since late 2012, contributing around a quarter of a percentage point to the news in inflation since then.** From 1 September 2012, the government cap on undergraduate fees charged by universities increased to £9,000 from £3,375. The subsequent increase in fees is estimated to have increased annual CPI inflation by around a quarter of a percentage point, relative to historical average rates.

**Chart 7 summarises the direct impact of unanticipated rises in energy costs, non-energy import costs and tuition fees on**

(1) This is based on a simulation using a version of COMPASS that incorporates energy as a complement to the production process. See section 5.2.1 on pages 40–41 of Burgess *et al* (2013).  
 (2) For a detailed discussion of how higher energy prices transmit through the economy, see Barwell, Thomas and Turnbull (2007).  
 (3) Bank staff estimate import intensity using ONS Supply and Use tables.  
 (4) See Section 4 of the November 2013 *Inflation Report* for more information.

CPI inflation from mid-2010 to mid-2013. As can be seen from Chart 7, these factors can broadly account for the unexpected strength in inflation over that period.

**Chart 7** Contributions to the news in CPI inflation since the August 2010 *Inflation Report*<sup>(a)</sup>



(a) The news in inflation is defined as ONS estimates of CPI twelve-month inflation relative to the modal inflation projection in the August 2010 *Inflation Report*. That news is decomposed into the contributions from various factors, using the Bank staff estimates detailed in this article.

## Impact on GDP

Using Bank staff models, the squeeze on real income from higher imported and energy costs, together with unexpectedly weak world demand, a falling export share, tighter credit conditions, and elevated uncertainty can broadly account for the weakness in GDP.<sup>(1)</sup>

### Demand impact from price pressures

As well as raising inflation, external price pressures are likely to have weighed on demand by squeezing households' real incomes. Between mid-2010 and mid-2013, unexpectedly strong inflation, driven by higher energy and import costs, was not accompanied by a commensurate rise in households' money wages, meaning that households' real incomes were squeezed. Indeed, over that period, annual money wage growth was around 1 percentage point weaker than anticipated, on average. In principle, households could have responded to the real income squeeze in one of three ways: by running down saving in order to maintain the amount of goods and services that they consume; by switching their spending towards goods and services that are less energy and import-intensive, thus mitigating the income squeeze; or by reducing their overall spending. Since the increases in energy and import costs were persistent, and because close substitutes for energy and non-energy imports are not readily available, households are likely to have responded to the real income squeeze by reducing their spending on a range of goods and services. So the unexpected strength in energy and import costs is therefore likely to have been associated with weaker growth in overall demand.

Overall, unanticipated external price pressures have been an important factor contributing to weak GDP, accounting for around a third of the shortfall in GDP by 2013 Q2.

In addition to the drag on GDP from unanticipated external price pressures, a number of headwinds to demand proved greater, or more persistent, than was anticipated in August 2010. Together, unexpectedly weak global demand, a falling export share, tight credit conditions and elevated uncertainty have weighed significantly on UK demand since mid-2010, accounting for around two thirds of the shortfall in GDP.

### Global demand and UK export performance

A significant increase in exports was a key judgement underlying the MPC's August 2010 GDP projection. Sustained growth in world trade was expected as the global economy continued to recover and, following a long period of decline, the UK export share was expected to rise. Instead, world demand growth turned out weaker than expected, while the UK export share continued to decline. The unexpected weakness in UK exports can account for around half of the almost 7% shortfall in GDP, with broadly equal contributions from unexpectedly weak world trade and the failure of UK companies to increase their trade share.

The August 2010 GDP projection assumed a sustained global recovery: UK-weighted world trade was expected to increase by around 25%, but it actually increased by just 15% (Chart 8). Around two thirds of that news in world trade can be directly attributed to renewed weakness in euro-area growth from mid-2011 following an intensification of sovereign debt concerns and banking sector strains.

Exports grew by only 13% between 2010 Q1 and 2013 Q2, compared with an expectation of around 30%. Based on the Bank's central forecasting model, COMPASS, unexpectedly weak world trade can account for around half of the news in exports.<sup>(2)</sup> The remaining half of the news in exports is likely to reflect the unexpected fall in the share of world trade captured by UK companies since mid-2010.

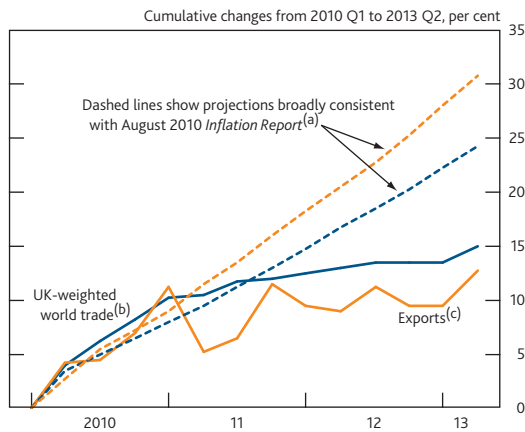
Prior to the financial crisis, the UK export share had been declining since 1996, reflecting, at least in part, greater competition from lower-cost emerging economies, as well as the sharp appreciation of sterling in the mid-to-late 1990s.<sup>(3)</sup> In August 2010, the MPC expected that secular decline to be arrested, as exporters benefited from the large depreciation of sterling in 2007–08, leading to a rise in the UK export share.

(1) These estimated impacts include some offset from lower imports.

(2) In COMPASS, changes in UK-weighted world trade result in a broadly one-for-one change in exports, within one to two quarters. See pages 19–20 of Burgess *et al* (2013) for a fuller discussion of the interaction between the United Kingdom and the rest of the world in COMPASS.

(3) For a discussion of the sources of the decline in the United Kingdom's share of world demand, see Buisán, Learmonth and Sebastián-Barriol (2006).

**Chart 8** News in UK-weighted world trade and UK exports since mid-2010



Sources: IMF WEO October 2013, OECD, ONS, Thomson Reuters Datastream and Bank calculations.

- (a) Bank staff projections made in August 2010 that were broadly consistent with the key judgements underlying the MPC's GDP and inflation forecasts.
- (b) Constructed using data for import volumes of 143 countries weighted according to their shares in UK exports. The observation for 2013 Q2 is an estimate. For those countries where national accounts data for 2013 Q2 were not available, data were assumed to be consistent with projections in the IMF WEO October 2013.
- (c) Excluding the impact of MTIC fraud. Official MTIC-adjusted data are not available for exports, so the headline exports data have been adjusted by Bank staff for MTIC fraud by an amount equal to the ONS import adjustment.

The extent of that anticipated improvement was informed by past experience of large movements in sterling. But it did not materialise: the export share continued to decline, driven by unexpected weakness in services exports, in particular. As discussed in past *Inflation Reports*, this is likely to have reflected, to some extent, both weaker demand for, and lower supply of, UK financial services.<sup>(1)</sup>

### Credit conditions

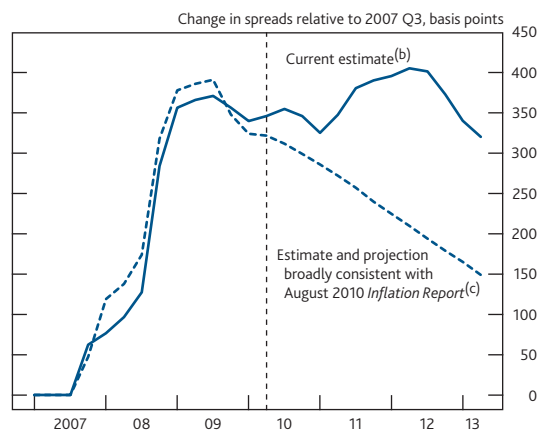
The MPC had expected credit conditions to ease as the banking sector recovered from the financial crisis. But, partly reflecting the intensification of the euro-area crisis, that did not materialise. **Bank staff models suggest that the lack of improvement in credit conditions can account for nearly 1 percentage point of the almost 7% news in GDP. But it is likely that these models underestimate the effects of credit conditions on the wider economy.**

In mid-2010, with the economy recovering and bank balance sheets improving, the MPC's central expectation was for substantial improvements in credit conditions, supporting household and business spending. In fact, the intensification of the euro-area crisis led to a renewed tightening in credit conditions in 2011 as banks faced higher funding costs. Credit spreads have fallen back more recently following international policy initiatives that reduced pressure on bank funding costs, including the European Central Bank's announcement of Outright Monetary Transactions and the Bank's Funding for Lending Scheme.

One indicator of credit conditions is the difference between the interest rate on a new loan and an appropriate risk-free rate — a 'credit spread'.<sup>(2)</sup> **Chart 9** shows one measure of

credit spreads derived from a weighted average of household and corporate deposit and loan rates.<sup>(3)</sup> Based on this measure, credit conditions tightened sharply in 2007 and 2008 as financial market participants reassessed the health of the banking sector and banks themselves reassessed the riskiness of new lending. By the time of the August 2010 *Inflation Report*, credit conditions had improved a little and were expected to improve further (**Chart 9**). But, instead, credit conditions tightened again. Overall, credit spreads fell by just 20 basis points between 2010 Q1 and 2013 Q2, around 150 basis points less than expected.

**Chart 9** Weighted average of household and corporate lending and deposit rates relative to reference rates<sup>(a)</sup>



Sources: Bank of England, Bloomberg, BofA Merrill Lynch Global Research, used with permission, British Household Panel Survey and Bank calculations.

- (a) Vertical dashed line is at 2010 Q2, the last full quarter of interest rate data available at the time of the August 2010 *Inflation Report*.
- (b) Methodological improvements to the way the measure is calculated account for the gap between the dashed and solid lines prior to the vertical dashed line. For a full description of this measure see Burgess *et al* (2013).
- (c) Bank staff projection made in August 2010 that was broadly consistent with the key judgements underlying the MPC's GDP and inflation forecasts.

The impact of credit conditions on the economy is highly uncertain. As noted by Burgess *et al* (2013), there is no canonical model in the academic literature articulating all of the effects of the financial sector on the wider economy. Bank staff have, therefore, adopted a range of approaches to quantify the effects of credit conditions. The central estimate used in this article assumes that higher interest rates facing households and companies that stem from banking sector impairment have a similar impact to increases in Bank Rate, but without an effect on the exchange rate.<sup>(4)</sup> Under that assumption, unexpectedly tight credit conditions are likely to have reduced the level of GDP by almost 1% by 2013 Q2.

(1) For more information, see the box on pages 24–25 of the February 2013 *Inflation Report*.  
 (2) Lenders are also likely to vary the supply of credit by changing terms other than the spread between the price of a loan and the relevant risk-free rate. For example, they may adjust the number or type of borrowers that they are willing to grant a loan to. Credit spreads are therefore an imperfect proxy for credit supply conditions.  
 (3) This indicator aggregates the marginal interest rate facing different groups of households and corporates using population shares. For a full description of this measure see Burgess *et al* (2013), pages 84–86. Bank staff projections of this measure of credit conditions inform the MPC's central forecast.  
 (4) A full discussion of the transmission mechanism for changes in Bank Rate is contained in Bank of England (1999).



Alternative estimates of the impact of the news in credit conditions on GDP can be obtained using the Bank's suite of economic models.<sup>(1)</sup> Barnett and Thomas (2013) estimate a structural vector autoregression model that identifies credit supply shocks as those that reduce loan volumes and increase credit spreads.<sup>(2)</sup> They find that credit supply shocks appear to have a much larger impact on lending than an equivalent change in monetary policy, perhaps because credit supply shocks have additional effects on loan volumes via non-price terms beyond those operating via loan rates. Using that model, news in credit conditions since mid-2010 can account for around 2% of the GDP news by 2013 Q2.

Another model in the Bank's suite is a version of the Gertler-Karadi model (Gertler and Karadi (2011)) estimated for the United Kingdom by Villa and Yang (2011). This model assumes that banks face financial frictions, which result in higher interest rates on new lending for non-financial companies. The model suggests a smaller peak impact on GDP of around half a percentage point. One reason for that smaller impact is that the model only captures the effects of credit spreads facing companies, and does not include any channels through which tighter credit conditions affect households.

The estimates from these three alternative models illustrate the uncertainty surrounding the impact of credit conditions on the real economy. But, overall, there are reasons to believe that the estimates presented here underestimate the impact of credit conditions. In particular, the models capture only some of the channels through which tight credit conditions are likely to affect demand and supply.

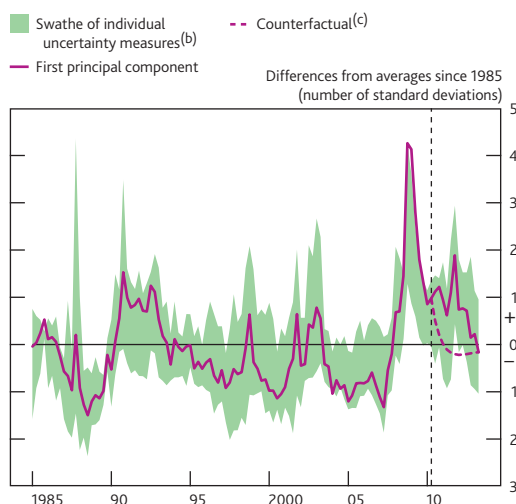
### Uncertainty

The intensification of the euro-area crisis, and weakness in global growth more generally, is likely to have made households and companies more uncertain about future income, adversely affecting spending. **Bank staff models suggest that news in uncertainty has reduced GDP by at least half a percentage point, but the impact of uncertainty on the economy is hard to quantify and could be larger.**

During the financial crisis, measures of economic uncertainty, including those derived from financial markets and from surveys, increased significantly (**Chart 10**).<sup>(3)</sup> That greater uncertainty is likely to have weighed on households' and companies' spending. In August 2010, the MPC expected uncertainty to dissipate, supporting demand growth. But uncertainty remained elevated and increased again as the euro-area crisis intensified.

The impact of uncertainty on the economy is difficult to quantify. Economic uncertainty itself is not directly observable and can only be imperfectly proxied. It is also challenging to disentangle the effects of uncertainty from other demand headwinds. For example, heightened uncertainty is likely to have contributed to weaker world growth, while weaker world

**Chart 10** Measures of economic uncertainty<sup>(a)</sup>



Sources: British Bankers' Association, CBI, CBI/PwC, Consensus Economics, GfK, Institutional Brokers' Estimate System, London Stock Exchange, New York Stock Exchange/London International Financial Futures and Options Exchange (NYSE Liffe), Nexis, ONS, Times Newspapers and Bank calculations.

- (a) Vertical dashed line is at 2010 Q2, the last full quarter of data available at the time of the August 2010 *Inflation Report*.  
 (b) For a full description of the series used in this swathe see Table B on page 103 of Haddow *et al* (2013).  
 (c) The dashed counterfactual line is constructed using the VAR model in Haddow *et al* (2013), assuming that there were no unexpected developments after 2010 Q2. For more details on this model see footnote (4) below.

growth is likely to have made UK companies more uncertain about future demand for their products.

Bank staff have attempted to estimate the impact of uncertainty using a vector autoregression (VAR) model, in which uncertainty is proxied using the first principal component shown in **Chart 10**.<sup>(4)(5)</sup> This measure suggests that uncertainty spiked during the financial crisis, before beginning to fall back. The VAR model implies that, in the absence of other unexpected developments after 2010 Q2, and given the historical relationship between the variables in the model, uncertainty would have fallen relatively sharply as shown by the dashed magenta line in **Chart 10**. That path is broadly consistent with the MPC's judgement in the August 2010 *Inflation Report* that uncertainty would continue to fall back towards more normal levels. Taking that line as a counterfactual, the news in uncertainty can account for around half a percentage point of the 7% shortfall in GDP by 2013 Q2, with a peak impact of nearly 1% in mid-2012.

- (1) Both of the models discussed here, and how they can be used to mimic the effects of financial frictions in COMPASS, are discussed in detail on pages 87–95 of Burgess *et al* (2013).  
 (2) This model uses corporate bond spreads as a measure of credit spreads, because a longer back-run of these data are available than for the household and business loan rate series used to construct the measure shown in **Chart 9**.  
 (3) See Haddow *et al* (2013) for a discussion of macroeconomic uncertainty and how to measure it.  
 (4) As well as an uncertainty indicator, the model includes GDP, employment (measured in hours worked), CPI, Bank Rate and a measure of credit conditions to control to some extent for the interdependencies between credit and uncertainty. The model does not control for world demand. See Haddow *et al* (2013) for more details.  
 (5) Principal components analysis is a statistical technique combining individual measures into a single summary uncertainty index. The method involves extracting from a set of related variables a smaller number of new variables, called principal components, which explain most of the variation in the original set. The first principal component accounts for the greatest amount of variation in the original set of variables.

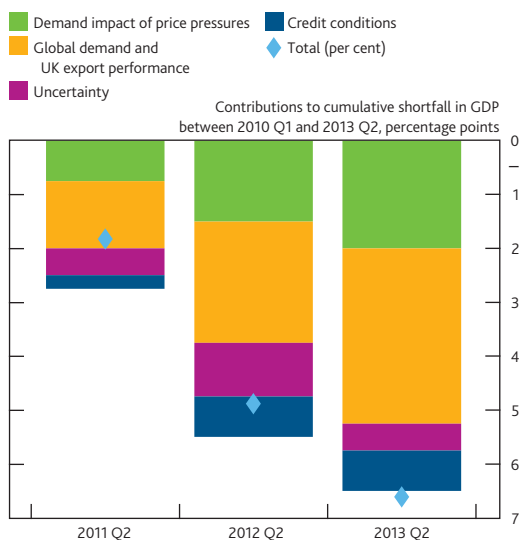
There are reasons to believe, however, that this approach underestimates the full impact of uncertainty. Higher uncertainty is narrowly defined in the VAR as increasing the range of likely outcomes faced by a household or business. The model does not capture the effects of an increased probability of very unlikely but very bad outcomes. It also does not capture the possibility that higher uncertainty amplifies the impact of other developments such as tight credit conditions.

### Fiscal policy

**The fiscal consolidation has been broadly in line with plans announced in 2010.** The MPC's projections are conditioned on the Government's tax and spending plans. These have remained broadly unchanged since the time of the August 2010 *Inflation Report* — in particular, the increase in VAT was announced before that *Inflation Report*.

**Taken together, the impacts from unexpected developments in price pressures and headwinds to demand — global demand for UK exports, credit conditions and uncertainty — can broadly account for the unexpected weakness in GDP from mid-2010 to mid-2013.** Chart 11 summarises the estimated impacts of these factors on GDP over that period.

**Chart 11** Contributions to the news in the level of real GDP since the August 2010 *Inflation Report*<sup>(a)</sup>



(a) The news in GDP is defined as the MPC's backcast, as published in the November 2013 *Inflation Report*, relative to the modal GDP projection in the August 2010 *Inflation Report*. That news is decomposed into the contributions from various factors, using the Bank staff estimates detailed in this article.

## Other unexpected developments affecting GDP and inflation since mid-2010

The MPC reacted as the outlook worsened by providing more stimulus: the stock of asset purchases was increased by £175 billion. In addition, Bank Rate remained at 0.5%. That stance of monetary policy contrasts with the conditioning assumptions underlying the August 2010 projections: the

market curve implied a rise in Bank Rate to around 2% by 2013 Q2; and the stock of asset purchases was assumed to remain at £200 billion. The sterling effective exchange rate has also been, on average, a little below that assumed in August 2010. A more stimulative stance of monetary policy has prevented GDP and inflation from being markedly weaker: Bank staff analysis suggests that the level of GDP would have been around 2% weaker, and inflation 1% lower, in 2013 Q2 had monetary conditions followed the path assumed in the August 2010 *Inflation Report*.<sup>(1)</sup>

Despite this additional stimulus, the shortfall in the level of GDP can be broadly accounted for by the unexpected price pressures and headwinds to demand as discussed in the previous section. And the unexpected strength in inflation can be largely accounted for by developments in imported and energy costs. That suggests that other developments have both weighed on demand, and counteracted the impact of weak demand on inflation in recent years. An obvious candidate, although not the only one, is unexpectedly weak effective supply.

### Effective supply

The effective supply capacity of the economy has been boosted by unanticipated rises in labour supply, but that has been more than offset by weak labour productivity since mid-2010. Unexpectedly weak effective supply can explain the resilience of inflation in the face of weak demand.

### Labour productivity

Productivity — output produced per hour worked — is a key indicator of the economy's effective supply capacity. Measured labour productivity has fallen since 2010 Q1, whereas in August 2010 it was expected to rise by around 10% by 2013 Q2 (Chart 12). That has reflected unusual resilience in employment over a period of weak GDP growth. In addition, surveys have pointed to relatively little spare capacity within companies during the post-crisis period despite the weakness in activity (Chart 13). Together with the weakness in measured productivity, that suggests that the effective supply capacity of the economy has been weaker than anticipated, offsetting some of the impact of weak demand on inflation.

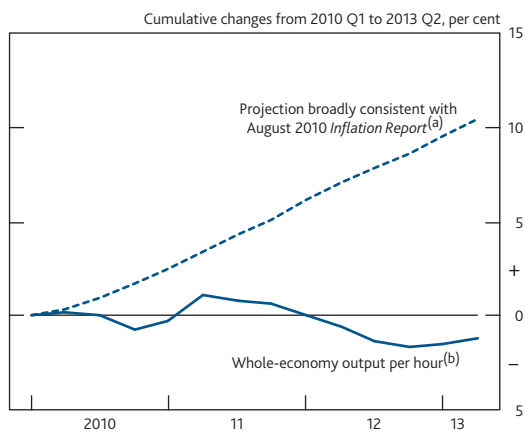
The source of the unanticipated weakness in productivity is not clear.<sup>(2)</sup> Some of the weakness in productivity has probably been directly related to the general weakness in demand, so that weak demand has not been associated with much additional downward pressure on inflation. Factors such

(1) The impacts of Bank Rate and the exchange rate on GDP and inflation are estimated using COMPASS, the Bank's central forecasting model, and are discussed in more detail on pages 34–35 of Burgess *et al* (2013). The impact of asset purchases is based on the estimates discussed in Joyce, Tong and Woods (2011) — see Table C on page 210. That paper includes a range of estimates for the impact of asset purchases, and the uncertainty around them.

(2) For a discussion of the possible drivers of weak productivity since the financial crisis see Section 3 of the November 2013 *Inflation Report*.

as tight credit conditions and elevated uncertainty have probably also weighed on both demand and supply growth. For example, tight credit conditions are likely to have reduced the effective supply capacity of the economy by impeding the reallocation of resources from less productive businesses towards more productive ones.<sup>(1)</sup> Weak productivity may also have augmented the adverse demand impact of factors such as tight credit conditions: if companies and households expect the weakness in incomes associated with weak productivity to persist for longer than they did prior to mid-2010, then that may have weighed on spending.

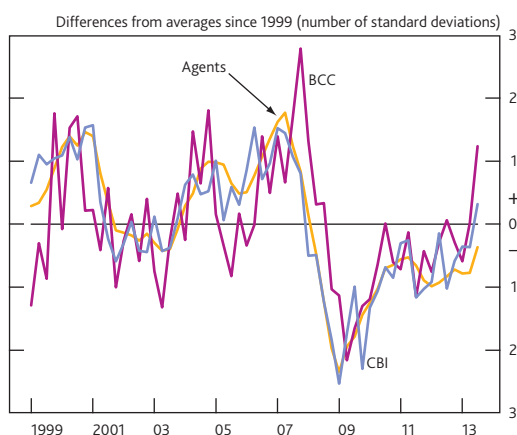
**Chart 12** News in labour productivity since mid-2010



Sources: ONS and Bank calculations.

- (a) Bank staff projection made in August 2010 that was broadly consistent with the key judgements underlying the MPC's GDP and inflation forecasts.  
 (b) Calculated using the MPC's GDP backcast published in the November 2013 *Inflation Report*.

**Chart 13** Survey indicators of capacity utilisation<sup>(a)</sup>



Sources: Bank of England, BCC, CBI, CBI/PwC and Bank calculations.

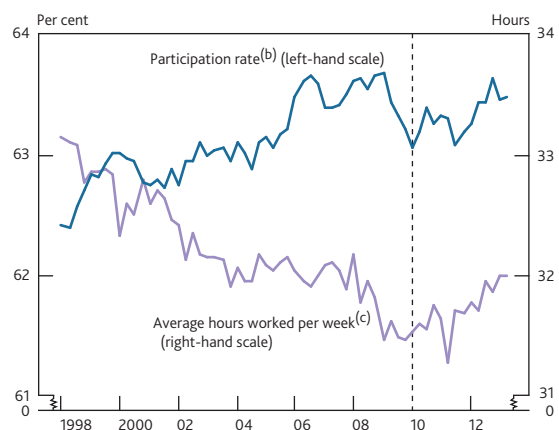
- (a) These measures are produced by weighting together survey results from the Bank's Agents (manufacturing and services), the BCC (non-services and services) and the CBI (manufacturing, financial services, business/consumer services and distributive trades) using nominal shares in value added. The BCC data are non seasonally adjusted.

## Labour supply

While unanticipated weakness in productivity has reduced the economy's effective supply capacity relative to expectations in August 2010, Bank staff believe that a greater willingness to work, and to work longer hours, has partially offset that weaker productivity.

In August 2010, the labour force participation rate — the proportion of the adult population in work, or actively looking for a job — was expected to decline further, as a rising proportion of the population approached normal retirement age. Instead, the participation rate has risen (**Chart 14**). That is likely to have been a response to the recent squeeze on household incomes; to lower expected future labour and pension income following the financial crisis; and to changes in government benefits in recent years.<sup>(2)</sup> In addition to greater labour market participation, employees have been working more hours per week than expected. Average weekly hours worked were expected to remain broadly flat, but since mid-2010 have increased by 1.5% (**Chart 14**). A willingness to work longer hours is likely to have been a response to similar factors as those raising participation.

**Chart 14** Participation rate and average hours worked per week<sup>(a)</sup>



Source: ONS (including the Labour Force Survey).

- (a) Vertical dashed line is at 2010 Q1, the last full quarter of labour market quantities data available at the time of the August 2010 *Inflation Report*.  
 (b) Percentage of the 16+ population. Three-month moving average.  
 (c) Average weekly hours in main job and second job for all workers.

That increase in supply should eventually lead to a proportionate increase in output, but it is not clear how long that will take. For example, businesses may need to invest in additional buildings or equipment before taking on additional workers or offering extra hours. During the adjustment period, the presence of those additional jobseekers, and workers wanting to work more hours, puts downward pressure on labour costs, and inflation. Overall, Bank staff analysis suggests that unexpectedly strong labour supply has raised GDP and reduced inflation since mid-2010. However, the impact of stronger labour supply is likely to have been more than offset by weaker productivity.

- (1) Chari, Kehoe and McGrattan (2007) show that in a model where companies have to borrow in advance to pay for some of their inputs, and some firms face difficulties accessing credit, those difficulties can be thought of as equivalent to shocks to total factor productivity. As they note: 'an outside observer who attempted to fit the data generated by the detailed economy with input-financing frictions to the prototype economy would identify the fluctuations in relative distortions [ie credit frictions] with fluctuations in technology... In particular, periods in which the relative distortions increase would be misinterpreted as periods of technological regress'.  
 (2) Developments in the participation rate since the 2008/09 recession are discussed in more detail in the box on page 27 of the May 2013 *Inflation Report*.

## Inflation persistence

As well as unexpected weakness in productivity, it is possible that greater inflation persistence could have partially offset the disinflationary implications of weak demand growth. For example, successive rises in inflation through 2010 and 2011 may have led some households and companies to expect inflation to remain high, despite those rises being largely driven by temporary rises in imported costs. As a result, inflation may have remained persistently higher. One to three-year inflation expectations did rise through 2011, but then fell back, however, and the MPC's current assessment is that medium-term inflation expectations remain sufficiently well anchored.<sup>(1)</sup>

## Conclusions and implications for the MPC's forecasts

This article has discussed the MPC's forecasting performance from mid-2010 to mid-2013. Relative to the MPC's central expectation in August 2010, GDP has been weaker than anticipated and inflation higher. That primarily reflects: unexpectedly weak global activity; the impact of unexpectedly

tight credit conditions and heightened uncertainty; and unexpected rises in import and energy costs. Other factors — in particular unexpectedly weak effective supply — are also likely to have played a role in offsetting the impact of unexpectedly weak demand growth on inflation.

The key judgements underpinning the MPC's recent *Inflation Report* projections reflect the experience of the past few years. For example, in the November 2013 *Inflation Report*, global growth was projected to strengthen further, but only gradually. And the share of global demand growth captured by UK exporters was no longer projected to rise. The domestic recovery was seen as increasingly entrenched; nevertheless, GDP was only expected to grow at around its historical average rate over the forecast period, and the associated recovery in productivity growth was expected to occur only gradually. In contrast, GDP and productivity were both expected to grow at above-average rates in August 2010.

(1) For a discussion of the indicators that the MPC uses to monitor developments in inflation expectations, see the box on pages 34–35 of the November 2013 *Inflation Report*.

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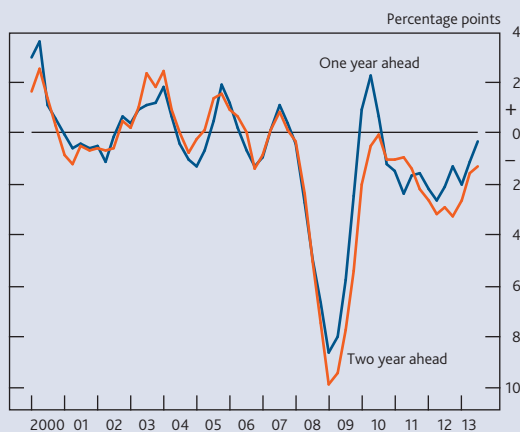
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## Statistical properties of the MPC's forecasts

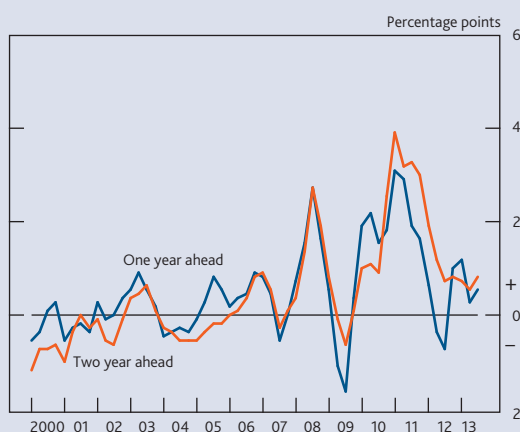
Since the start of the financial crisis, outturns have differed from the MPC's central forecasts by more than was the case pre-crisis. Relative to the MPC's mean forecasts, since 2007 outturns for four-quarter GDP growth have been disproportionately below expectations (**Chart A**), and inflation outturns above expectations (**Chart B**). This contrasts with the pre-crisis period when growth and inflation outturns were closer to expectations.

**Chart A** Four-quarter GDP growth forecast, outturn less MPC's mean forecast<sup>(a)</sup>



(a) Calculated for the market rate fan charts published since February 1998. The means of the fan chart distributions have been adjusted by 0.3 percentage points where applicable, to reflect the effects of methodological changes implemented in the 2011 edition of the *Blue Book*.

**Chart B** Inflation forecast, outturn less MPC's mean forecast<sup>(a)</sup>



(a) Calculated for the market rate fan charts published since February 1998. Inflation fan charts refer to RPIX inflation up to November 2003 and CPI inflation thereafter.

This box considers whether the MPC has systematically over or underpredicted GDP growth and inflation since the Bank received operational independence for monetary policy in 1997. It draws heavily on previous Bank work.<sup>(1)</sup> As discussed in a recent speech by Ben Broadbent (an external member of the MPC), this sample may be too small to draw strong conclusions from, given economic uncertainty.<sup>(2)</sup> But if there is evidence of outturns differing systematically from the MPC's

forecasts, that could suggest that judgements underpinning those forecasts have been repeatedly too optimistic or pessimistic.

This box considers forecasts at both one quarter and longer horizons. One quarter ahead forecasts are informed by leading GDP and inflation indicators. Forecasts at longer horizons depend far more on MPC judgements about how the economy is likely to develop.<sup>(3)</sup>

### Assessing the mean projection

This section assesses one quarter and one year ahead MPC forecasts for GDP and inflation against outturns. GDP outturns are defined as the first time a quarter is released in the Quarterly National Accounts.<sup>(4)</sup> Forecasting performance is evaluated using the following, well-established criteria:<sup>(5)</sup>

- The forecast should be in line with outturns, on average (implying no bias).
- It should not be possible to improve the accuracy of the forecasts by rescaling them (called 'weak efficiency').
- Nor should it be possible systematically to use other information, available to the forecaster at the time, to improve forecast accuracy (called 'strong efficiency').

MPC forecasts can be assessed against these criteria by estimating various regression equations.  $Y_t$  is defined as the variable being forecast and  $Y_t^{t-i}$  represents the mean projection of that variable,  $i$  quarters ahead of time  $t$ . We define the difference between an  $i$  quarter ahead forecast and outturn as  $e_t^{t-i} = Y_t - Y_t^{t-i}$ , and  $u_t$  is a zero-mean error term.

To test for bias, (a), we estimate the regression:

$$e_t^{t-i} = \alpha + u_t \quad (1)$$

unbiasedness requires  $\alpha = 0$ .

For (b), a joint test of bias and weak efficiency we estimate:

$$Y_t = \alpha + \beta Y_t^{t-i} + u_t \quad (2)$$

unbiasedness requires  $\alpha = 0$  and weak efficiency requires  $\beta = 1$ .

For a joint test of bias and strong efficiency, (c), we estimate:

$$Y_t = \alpha + \beta Y_t^{t-i} + \gamma Z_t + u_t \quad (3)$$

where  $Z_t$  is a single additional indicator available to the forecaster at time  $t$ . Strong efficiency implies that  $\alpha = 0$ ,  $\beta = 1$  and  $\gamma = 0$ .

### One quarter ahead mean projections

In forming its policy decision, the MPC places most weight on forecasts for medium-term growth and inflation. But the one



quarter ahead forecast is important for helping the MPC assess the shocks affecting the economy. If data outturns for a given quarter differ starkly from the MPC's expectations one quarter earlier, this could change how the MPC thinks about its medium-term projections. And if data outturns are repeatedly higher or repeatedly lower than forecast — that is, appear serially correlated — that could imply that the MPC has not altered the way it forms forecast judgements sufficiently quickly.

The results of these tests, using the 64 independent one quarter ahead forecasts published by the MPC, are reported in **Table 1**. The probability of not rejecting the tested hypothesis is reported in parentheses. A higher probability is associated with there being less statistically significant evidence to reject the hypothesis. Figures are presented in bold if we find no statistically significant evidence, at the 5% level, for bias or forecasts being weakly or strongly inefficient.

**Table 1** Regression results on one quarter ahead projections<sup>(a)(b)(c)</sup>

	Hypothesis	Inflation	Quarterly GDP growth <sup>(d)</sup>
Bias	$\alpha = 0$	<b>0.0 (0.58)</b>	-0.1 (0.13)
Weak efficiency	$\alpha = 0$	0.2 (0.01)	<b>-0.1 (0.12)</b>
	$\beta = 1$	0.9 (0.01)	<b>1.0 (0.52)</b>
Strong efficiency <sup>(e)</sup>	$\gamma = 0$		
(i) Previous outturn less expectation		<b>-0.1 (0.26)</b>	0.4 (0.00)
(ii) Previous outturn		<b>0.0 (0.94)</b>	-0.2 (0.04)
(iii) Change in exchange rate		<b>0.0 (0.30)</b>	<b>0.0 (0.26)</b>
(iv) CIPS business activity index			1.2 (0.00)
(v) Import prices		<b>0.0 (0.41)</b>	

(a) For mean projection based on market expectations for interest rates. RPIX forecasts made between August 1997 and November 2003, CPI forecasts made between February 2004 and May 2013. GDP forecasts made between August 1997 and May 2013.  
 (b) Figures are in bold if the p-value associated with each test (in parentheses) is greater than 0.05, or in other words if at the 95% confidence level, there is no significant evidence that projections are biased or inefficient.  
 (c) Each indicator is included in a separate regression. We do not report the constant and coefficient on expectations in this table, for brevity. Where the indicator shows evidence for statistical significance, the significance of the estimates for  $\alpha$  and  $\beta$  are the same as for weak efficiency.  
 (d) Using real-time GDP data, including the Bank's estimates for past growth since November 2007, as these most closely relate to forecasts made at that time.  
 (e) Using real-time data for previous outturn, forecast and import price inflation, as these were available at the time the forecast was made.

These results provide evidence that the one quarter ahead inflation forecasts have been weakly inefficient. This has become more apparent since the start of the crisis, based on an F-test for a structural break.<sup>(6)</sup> This could reflect the especially large movements in oil and utility prices since 2007, which have tended to be reflected in consumer prices quickly.

The tests for bias in quarterly GDP growth one quarter ahead do not show statistically significant evidence for bias or weak inefficiency. There is evidence that including the previous quarter's information on outturns, or placing greater weight on the business output survey, would have improved the accuracy of the forecasts. An F-test does not show significant evidence of a deterioration in the one quarter ahead forecast since the start of the crisis period.

### One year ahead mean projections

Forecasts at longer horizons are underpinned by sets of forecast judgements. Where outturns differ from the forecast at these longer horizons it could reflect either one or more of these judgements evolving differently to expected.

When testing for the bias and efficiency of medium-term forecasts, it is important to control for serial correlation. This is because a difference in any given quarter will affect four consecutive quarters of one year ahead forecasts: individual forecasts are not independent. In order to control for this, lagged differences between expectations and outturns for the previous three quarters are included in regressions **(1)**, **(2)** and **(3)**.

As with the one quarter ahead forecasts, there is statistically significant evidence for bias and weak inefficiency in the one year ahead inflation forecasts. But this is not the case for the GDP forecasts. The evidence does not suggest that including business activity index outturns for the exchange rate or import price inflation at the time of making the forecasts would have improved forecasting performance. Therefore, these results do not suggest that the one year ahead forecasts are strongly inefficient.

**Table 2** Regression results on one year ahead projections<sup>(a)(b)(c)</sup>

	Hypothesis	Inflation	GDP growth <sup>(d)</sup>
Bias	$\alpha = 0$	<b>0.2 (0.06)</b>	<b>-0.2 (0.09)</b>
Weak efficiency	$\alpha = 0$	1.6 (0.00)	<b>0.6 (0.21)</b>
	$\beta = 1$	0.3 (0.0)	<b>0.7 (0.08)</b>
Strong efficiency <sup>(e)</sup>	$\gamma = 0$		
(i) Change in exchange rate		<b>0.0 (0.91)</b>	<b>0.0 (0.93)</b>
(ii) CIPS business activity index			<b>0.62 (0.44)</b>
(iii) Import prices		<b>0.0 (0.19)</b>	

(a) For mean projection based on market expectations for interest rates. RPIX forecasts made between August 1997 and November 2003, CPI forecasts made between February 2004 and May 2012. GDP forecasts made between August 1997 and May 2012.  
 (b)–(e) See footnotes (b) to (e) of **Table 1**.

One reason why outturns may differ repeatedly from expectations is if the MPC is uncertain about the nature of a shock: in this case it may adjust its forecasts only gradually in response to changes in economic indicators. After the series of shocks affecting the economy, and their impact, are fully appreciated, central forecasts may appear consistently too optimistic or pessimistic. But, *ex ante*, based on a small number of data outturns, to revise dramatically key judgements might have been too reactive.

### Assessing forecast revisions

An alternative approach to test for the efficiency of a forecast is to examine the revision properties of GDP growth and inflation forecasts. Forecast revisions are changes made to the forecast for a given quarter, so unlike differences between

outturns and forecast, should not be susceptible to serial correlation.

The information on forecast revisions is used to test for efficiency in two ways. First, we test whether, for a given quarter, previous revisions to the MPC forecast for that quarter can be used to predict subsequent revisions. Intuitively, if the final revision to a forecast is predictable, it could be argued that the MPC could have improved its forecast for that quarter sooner.

To test whether earlier revisions to a projection for a given quarter contain information about the final revision, we estimate:

$$Y_t^{t-1} - Y_t^{t-2} = \alpha + \sum_{i=1}^6 \beta_i (Y_t^{t-i} - Y_t^{t-i-1}) + \varepsilon_t \quad (4)$$

There is little significant evidence of predictability in the revisions for a given quarter's inflation or GDP forecast (Table 3). As an example, for GDP growth in 2013 Q3, which was released in October, the change made to that quarter's forecast between the May and August 2013 *Inflation Reports* was not significantly related to the revision made between the February and May *Inflation Reports*.

**Table 3** Tests for predictability of forecast revisions<sup>(a)(b)</sup>

Forecast horizon	Inflation	GDP growth
Constant $\alpha$	0.1 (0.16)	0.0 (0.50)
Two quarters ahead revision $\beta_1$	0.2 (0.24)	0.2 (0.06)
Three quarters ahead revision $\beta_2$	-0.2 (0.18)	0.0 (0.87)
Four quarters ahead revision $\beta_3$	0.0 (0.75)	0.1 (0.44)
Five quarters ahead revision $\beta_4$	-0.2 (0.11)	0.1 (0.59)
Six quarters ahead revision $\beta_5$	-0.1 (0.34)	0.0 (0.97)

(a) Mean projection based on market expectations for interest rates published between August 1998 and May 2013. For inflation, we adjust RPIX forecasts covering the period 2004 Q1 to 2005 Q4 down by  $\frac{3}{4}$  of a percentage point in order to make the inflation measures comparable.  $\frac{3}{4}$  of a percentage point was the assumed wedge between the RPIX and CPI inflation measures at the time of the change in the inflation target — see the box on page 36 of the February 2004 *Inflation Report*.

(b) Figures are in bold if the p-value associated with each test (in parentheses) is greater than 0.05.

Second, we test whether past forecast revisions  $i$  quarters ahead of the first publication of the outturn can explain revisions to subsequent quarters. To test  $i$  quarter ahead forecast revisions, we estimate:

$$Y_t^{t-1} - Y_t^{t-2} = \alpha + \beta_1 (Y_{t-1}^{t-i} - Y_{t-1}^{t-i-1}) + \beta_2 (Y_{t-2}^{t-i} - Y_{t-2}^{t-i-1}) + \varepsilon_t \quad (5)$$

for  $i = 1, 2, \dots, 6$ .

Table 4 reports the joint significance of the coefficients in the regressions using an F-test, with a higher test statistic indicating less evidence of predictability of forecast revisions.

**Table 4** F-tests for predictability of forecast revisions<sup>(a)(b)(c)</sup>

Forecast horizon	Inflation	GDP growth
Six quarters ahead	0.30	0.28
Five quarters ahead	0.24	0.09
Four quarters ahead	0.0	0.06
Three quarters ahead	0.02	0.14
Two quarters ahead	0.05	0.03
One quarter ahead	0.41	0.07

(a) Mean projection based on market expectations for interest rates published between August 1998 and May 2013. For inflation, we adjust RPIX forecasts covering the period 2004 Q1 to 2005 Q4 down by  $\frac{3}{4}$  of a percentage point so that they are on a comparable inflation measure.  $\frac{3}{4}$  of a percentage point was the assumed wedge between the RPIX and CPI inflation measures at the time of the change in target. See the box on page 36 of the February 2004 *Inflation Report*.

(b) Figures are in bold if the p-value associated with each test is greater than 0.05.

(c) We stop at six quarters ahead as we require three earlier forecasts of the same event. Forecasts made up to February 2004 had only eight forecast quarters.

The results suggest that, for both GDP and inflation there is no strong evidence suggesting serial correlation in forecast revisions. In other words, MPC forecasts have not tended to be revised in a predictable way.

## Conclusions

Since the onset of the financial crisis, outturns for GDP growth and inflation have been further from the MPC's mean expectations than in the pre-crisis period. In general, the results presented in this box suggest that, since 1997, the MPC's forecasts did not systematically miss the insights from widely available economic indicators. This is true both in the near term and at longer horizons. But there is some evidence that the MPC has been slow to incorporate new information, and that this has become more acute since the start of the financial crisis. One quarter ahead inflation forecasts show some evidence of being inefficient. But this probably reflects large changes in commodity prices over the crisis period, which feed through quickly to inflation.

(1) The analysis in this box draws heavily on the work in Elder *et al* (2005).

(2) See Broadbent (2013).

(3) The MPC's latest key judgements are set out on page 38 of the November 2013 *Inflation Report*.

(4) We use the Quarterly National Accounts (QNA) vintage of data, because the ONS receives a substantial amount of information between the first time a data point is released and QNA, so the QNA is likely to be more comparable with our forecast.

(5) The criteria are set out on page 333 of the Autumn 2005 *Bulletin*.

(6) For this test, we estimate equation (b) over the sample up to and including 2007 Q2, and then over the sample from 2007 Q3 to 2013 Q2. We use a Chow test to identify structural breaks in the relationship.