26.02.15

RECOMMENDED READING

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From

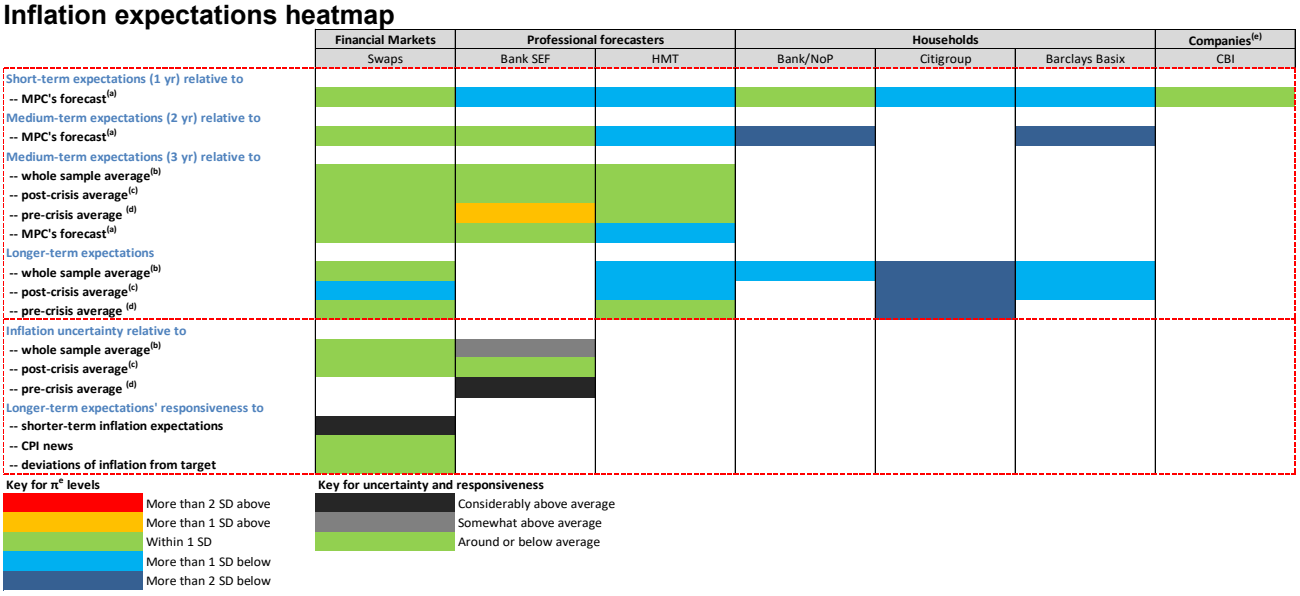
HOW SHOULD WE INTERPRET THE LEVEL OF LONGER-TERM UK INFLATION EXPECTATIONS?

Main message After a period of relative stability, we've seen relatively large moves in both financial market and household survey measures of UK long-term inflation expectations in recent months. The signal you take from these moves depends, in part, on what level of inflation expectations is consistent with the MPC's 2% CPI target for each measure. This note tries to assess what level of financial market and household inflation expectations are consistent with inflation being on target. It concludes that long-term financial market expectations are likely to be broadly consistent with inflation at target, but that households in particular expect inflation to take longer to return to target than is consistent with the February *IR* – although there are obvious uncertainties around these conclusions.

Key Points

- The change in 5-year, 5-year inflation swap rates over the past three months has been large compared to historic movements. But it is uncertain what level of inflation swap rates is consistent with expectations of 2% CPI inflation.
- Four factors hinder our ability to cleanly infer inflation expectations from the level of inflation swap rates: (i) time-varying risk premia; (ii) time-varying inflation hedging by liability-driven investors; (iii) changes in the expected RPI-CPI wedge; and (iv) volatility during the crisis.
- In particular, changes in inflation hedging and expectations of the RPI-CPI wedge mean that using the pre-crisis level of inflation swap rates or breakevens is likely to understate the downside risks to inflation expectations. But it is uncertain by exactly how much.
- Surveys of household inflation expectations do not reference an explicit inflation index and often have a short back-run. This makes it difficult to infer whether household expectations are consistent with the 2% CPI inflation target.
- For all three surveys, long-term expectations are below their series averages. And the survey with the longest back-run – Citigroup – is the one that is most below its pre-crisis average.
- The Bank/NOP survey allows us to adjust for the gap between respondents' perceptions of inflation and actual CPI inflation. These perceptions-adjusted long-term inflation expectations are below 2%. The adjusted level of 2-year expectations, however, is much lower at 1.14%.

Inflation expectations heatmap



Financial market measures of inflation expectations

Update on changes since last MPC

UK 5-year, 5 years forward inflation swap rates fell by 40bps between the November and February *Inflation Reports*.[1] Since February MPC, however, inflation swap rates have increased by 7bps (**Charts 1 and 2**). As with the fall between November and February, the rise since February MPC has been across the forward curve (**Chart 2**). Although the US 5-year, 5 year forward inflation swap rate has increased by a similar amount, the rise has been less sharp than in the UK. The analogous measure in the euro area has fallen 5bps.

Chart 1: UK, US and euro area 5y5y inflation swaps: cumulative change since Jan 2014

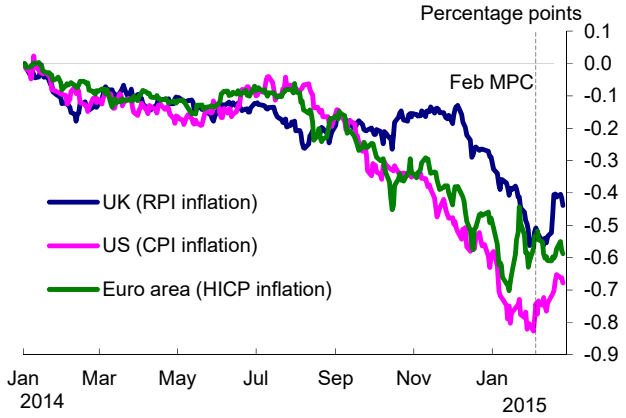
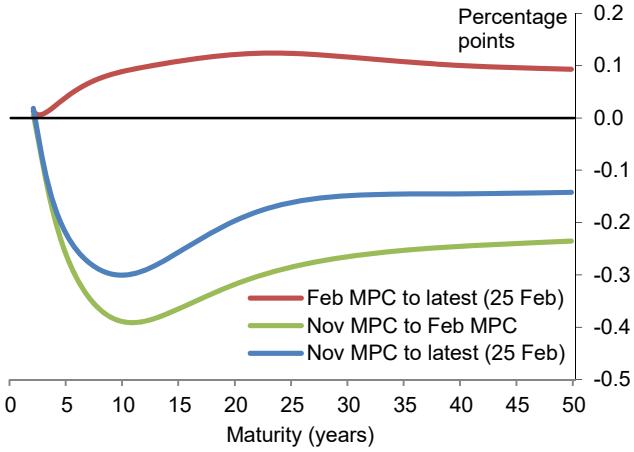


Chart 2: Changes in UK inflation swap forward curve



In 2014 Q4, the resilience of UK inflation swap rates relative to the US was thought to be the result of unusually strong liability-driven investment. Consistent with this, the subsequent fall in swap rates at the start of 2015 reflected both an easing in this demand and an increase in the supply of index-linked gilts by the DMO. Some thought that this lower level of inflation swaps in January might have reflected the pricing of increased risks of period of low inflation in the short and medium term. The initial MI on the 7bps increase in swap rates in February puts most weight on a return of LDI demand. But contacts are cautious about making a firm interpretation of the moves at this stage.

Interpreting the level of market-based inflation expectations

Recent moves in UK 5-year, 5 year inflation swap rates have been large, especially compared to relative stability seen since early 2013. **Chart 3** compares these moves against the 90-day changes in 5-year, 5-year inflation swap rates from other major market events (breakevens are used for the change after BoE independence). The change in inflation swaps has been of similar size to other events that had a material impact on inflation markets. The volatility of the *level* of inflation swaps has picked up sharply over the last three months: the 90-day standard deviation of the level of 5-year, 5-year inflation swap rates is the highest since 2010 (**Chart 4**).

Chart 3: Putting the recent changes in 5y5y inflation rates in context – absolute changes

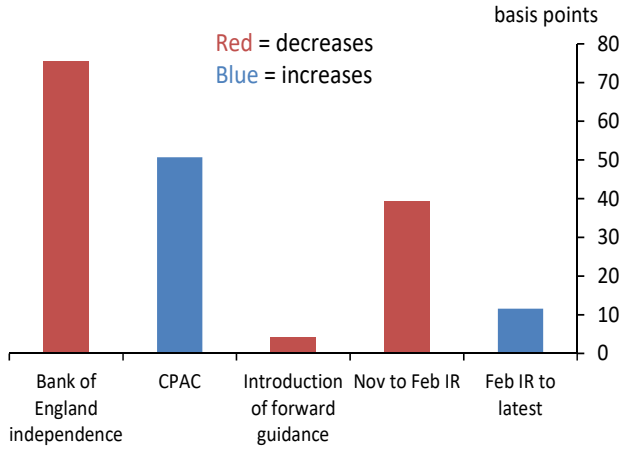
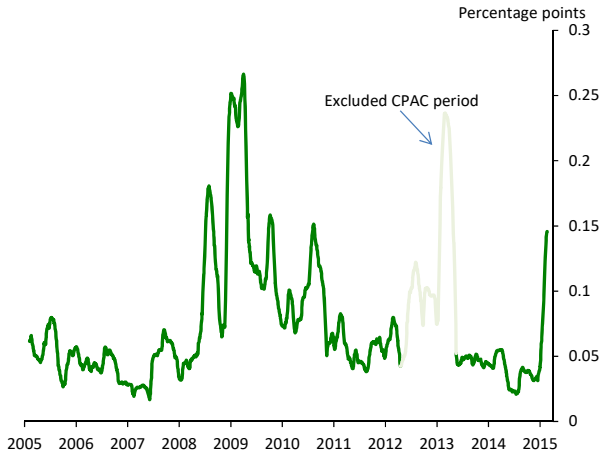


Chart 4: 90-day rolling standard deviation of the level of 5y5y



Given the magnitude of the recent changes, how should we interpret the current level of UK market-based measures of inflation expectations? There are at least four factors that hinder our ability to cleanly infer inflation expectations from inflation swaps and breakevens:

1) **Time-varying risk premia** – As discussed in the '5 questions on inflation markets' note[2] the level of inflation swap rates is affected by risk premia, including compensation for both inflation and liquidity risks, which vary over time and may be large.

2) **Time-varying inflation hedging** – There is strong demand for inflation hedging from liability driven investors, who have liabilities linked to RPI inflation. Increases in inflation hedging activity – particularly at medium- and long-term maturities – have tended to push up on inflation swaps and breakevens over time.[3]

3) **Changing RPI-CPI wedge expectations** – UK inflation-linked instruments reference RPI rather than CPI inflation. Therefore inflation swap rates reflect expectations about not only CPI inflation but also the average wedge between RPI and CPI inflation. Changes in the expected wedge can have a big impact on inflation swaps and breakevens. Most notably, inflation swap rates were last as low as 3% during the CPAC consultation on RPI, which reportedly reflected market participants pricing in around 40 basis points reduction in RPI expectations in anticipation of the ONS announcing a change to the RPI formula. Aside from the changes in expectations around the CPAC consultation, it is likely that expectations of the RPI/CPI wedge have increased slightly over time. SEAD's forecast of the average long-run wedge has risen from 80bps to 130bps[4]. And whilst MI suggests market forecasts have changed by less, it seems likely that wedge expectations are now perhaps around 20bps higher than before 2010. Contacts' current estimate of the wedge priced into inflation swaps is 100bps.[5]

4) **High volatility during the crisis** – As with other financial markets, inflation markets were volatile during the crisis and disruptions to the functioning of this market through 2009 and part of 2010 impairs the signal we can take from inflation swaps and breakevens over this period (**Chart 4**).

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[4] See the Box on page 34 of the May 2014 Inflation Report.

[5]

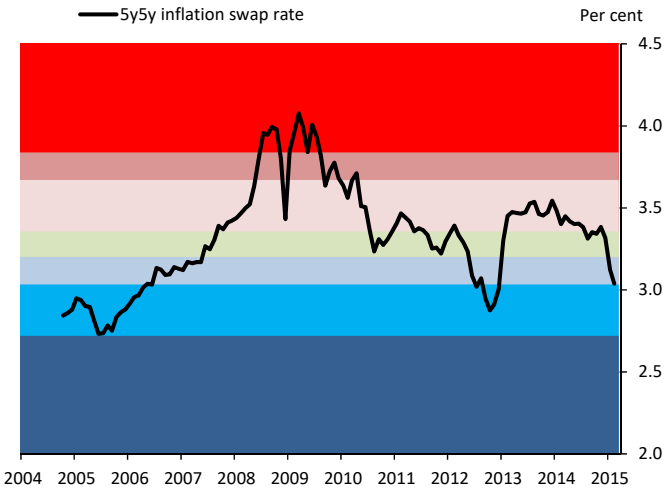
The factors described above mean that it is difficult to understand market CPI expectations by looking at the level of inflation swap data alone. It is important to use MI and other tools (such as term structure models) to try to decipher what signal should we take from the moves. But the factors above also suggest there is a large amount of uncertainty about what is the most appropriate historical average to compare with the current level of inflation swaps. The inflation expectation heatmap tries to deal with this uncertainty by comparing the level of inflation swaps to the average over three different periods: i) pre-crisis, ii) post-crisis and iii) the whole sample (**Table 1**). But the difference between these levels is large – around 1.5 standard deviations. This means that (a) any change in inflation swap rates has to be very large to trigger all three cells in the heatmap, and (b) it is likely that at least one measure is triggered at any one time (**Chart 5**).

Table 1: 5-year, 5-year inflation swap rates and their historical averages[(a)(b)]

		Average	Heatmap
Latest	25 Feb 2015	3.10	-
Feb 2015 MPC	4 Feb 2015	3.03	-
Pre-crisis	Oct 2004 – Dec 2007	3.04	
Post-crisis	Jan 2009 – Aug 2013	3.52	
Whole sample	Oct 2004 – Aug 2013	3.35	
Standard deviation	Oct 2004 - present	0.32	

(a) Excludes CPAC period between 18 May 2012 and 9 January 2013
(b) The heatmap was originally developed to monitor the MPC's inflation expectations knockout during forward guidance. The averages therefore stop when forward guidance begins. Extending these averages to the end of 2014 reduces them slightly.

Chart 5: 5-year, 5-year inflation swaps and the inflation expectations heatmap[(a)(b)]

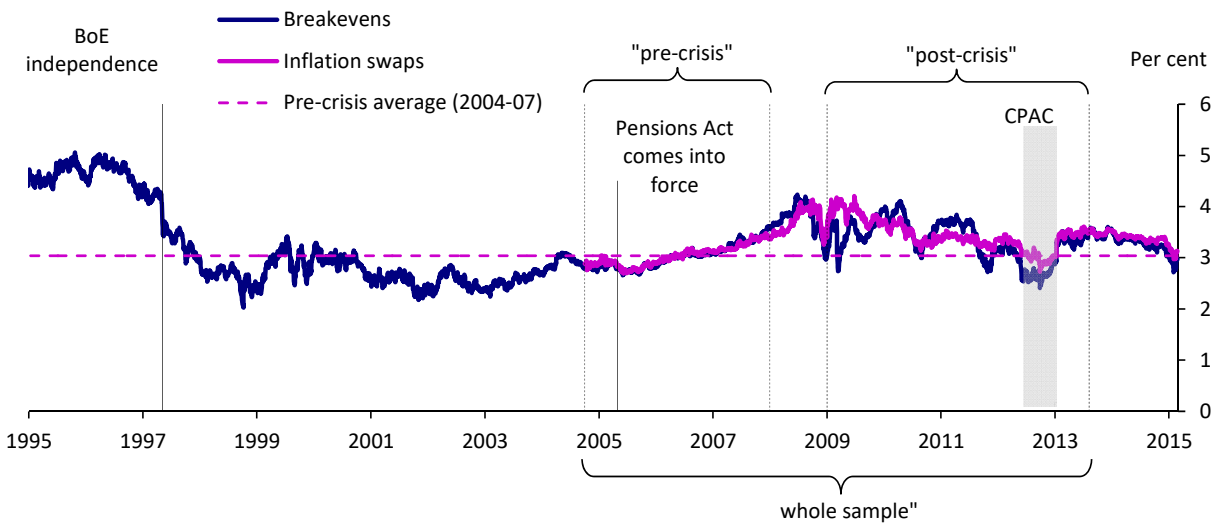


(a) Monthly average of 5y5y inflation swap rate.
(b) The darkest shades indicate that three cells have been triggered; the lighest indicate one has been triggered. Green space indicates no cell is triggered.

Most problematic is the "pre-crisis" average, which is between October 2004, when inflation swaps data are first available, and end of 2007. We use inflation swaps because these tend to be more liquid than breakevens[6]. **Chart 6** shows that this period covers an upwards trend in inflation swap rates, from a level of 2.7-2.9% at the start of the period to 3.4% by the end. As discussed in McGrath and Windle (2006)[7], the increase in inflation swap rates is likely to reflect a structural increase in demand for inflation hedging following the Pension Fund Act 2004 coming into force in April 2005. The new regulation introduced market-based valuation for private pensions' accounting standards and required those valuations to be published on companies' balance sheets.[8] Contacts argued that company boards' aversion to the volatility of these deficits – as they were valued using current market prices – drove pension funds to increase their hedging of interest rate and inflation risk and "lock in" narrower deficits.[9]

[6]
[7] McGrath and Windle (2006), 'Recent developments in sterling inflation-linked markets'
[8] The Pensions Act 2004 required pension fund trustees to value their funds on the basis of FRS 17. It gave trustees 18 months from the end of 2005 to complete the valuation of their funds on this new basis.
[9]

Chart 6 – 5-year, 5-year inflation swaps and breakevens



Although there is a great deal of uncertainty about what average level of inflation swap is consistent with expectations of 2% CPI inflation in the medium or long run, we can make some crude adjustments to make past levels of inflation swaps more comparable with the current level. We estimate an average level of inflation swap rates and breakevens between 1997 and 2007, controlling for past changes in two things:

(a) **Changes in the expected RPI-CPI wedge** – we add 20bps to inflation swap rates before 2010 to account for an increase in expectations of the RPI-CPI wedge, reflecting the changes in clothing and footwear data.

(b) **Changes in risk premia and the role of liability-driven investors** – we add 20bps to account for the higher risk premia on account of the increase in the role of liability driven investors after 2004. Using MFAD's inflation term structure model,[10] this is the increase in the average inflation risk premium between 1997-2004 and 2007-2014.

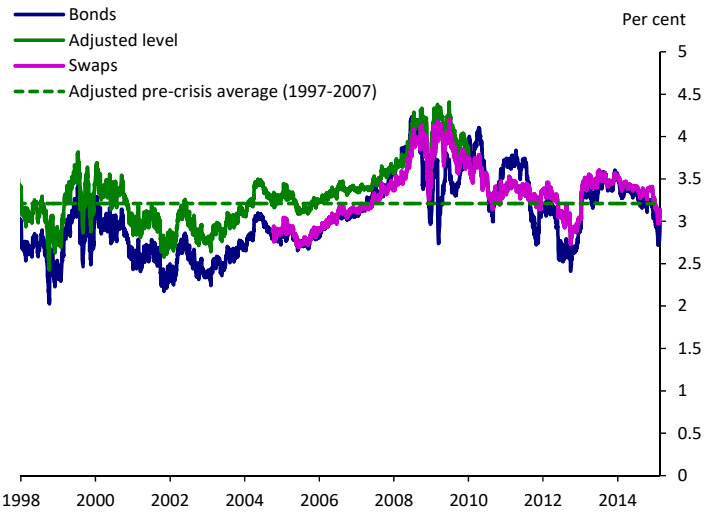
Chart 7 plots this adjusted series (the green line) against the 5-year, 5-year inflation swap and breakeven rates (pink and blue lines). The series before 2004 uses breakeven inflation rates and afterwards uses inflation swaps, reflecting the fact that the latter tends to be more liquid. The higher level of this series before the crisis relative to swaps and bonds reflects the upwards adjustment to account for lower RPI-CPI wedge expectations and a lower average risk premium. The pre-crisis average of this series between 1997 and 2007 is around 3.2%, which is around 20bps higher than that unadjusted pre-crisis average in the heatmap, and 30bps below the post-crisis average. If we used only data from inflation swaps such that the series began in 2004 (analogous to the time period in the heatmap), the adjusted pre-crisis average would be 3.34%.

These adjustments are crude and there is a high degree of uncertainty about what is the appropriate level against which to compare current inflation swap rates. But this adjusted series suggests that looking at only the pre-crisis average of inflation swaps may understate downside risks from the current level of inflation swaps. While we do not place a large amount of weight on the precise numbers, the combination of structural

[10] This uses a modelled recently developed by MFAD and the DMO based on RPI swaps, RPI index-linked bonds and Consensus surveys of RPI and CPI expectations.

changes to the market suggest that the level of inflation swaps consistent with expectations of 2% CPI inflation is likely to be higher than before the crisis.

Chart 7 – An adjusted measure of pre-crisis inflation swaps/brekaevens



The current level of inflation swaps, however, is not significantly below this adjusted pre-crisis average. In the inflation expectations heatmap, the cell for either the 1997-2007 or 2004-07 average would currently be green using the adjusted pre-crisis series. The balance of risks, however, is different. Using the unadjusted pre-crisis average indicates that inflation swap rates may fall some way below 3% before causing concern, as shown in **Chart 5**. Using the adjusted pre-crisis average, however, the dark blue zone in **Chart 5** would now start at 2.9% (consistent with all three cells in the heatmap turning blue).

In addition, the change in inflation swap rates over the last few months has been large and it is likely that this contains some signal about a change in market participants' inflation expectations. While the level of inflation swaps may be broadly consistent with CPI inflation being around 2% in the medium term, the large change in swap rates – which captures *mean* expectations – may indicate that market participants are placing more probability on inflation staying low for a prolonged period.

Household survey measures of inflation expectations

We have three main surveys of household inflation expectations. None of these surveys references a specific price index; two refer to changes in prices while the other refers to a non-specific rate of inflation (see **Table 2**). The level of these measures of household long-term inflation expectation is therefore not directly comparable with expectations of CPI inflation.

This makes it difficult to assess whether the levels are consistent with the MPC's inflation target. In particular, the level of inflation expectations from these measures has usually been higher than CPI or the MPC's 2% inflation target. For example, the average of 5-10 year ahead expectations from Citigroup survey between 2005 and 2007 is 3.2% (**Chart 9**).

One reason that households' inflation expectations tend to be higher than the MPC's inflation target is that respondents may report expectations of prices of goods and services they use frequently. These prices may tend to grow faster than other components of the CPI basket or faster growing prices may be more noticeable.[11] Research by the Federal Reserve has found that the phrasing of the question can also influence responses.[12] Expectations of "prices in general" tend to be more dispersed than expectations of the "rate of inflation". One reason for this was because respondents interpreted questions about "prices in general" as a

[11] Cavallo, Cruces and Perez-Truglia (2014) find evidence that individuals tend to assign significant weight to the prices (and incorrect memories of prices) of a few specific products as well as to official inflation statistics.

reference to prices they themselves had recently paid, whereas they interpreted the "rate of inflation" as more about price changes across a broader set of items or about changes in the cost of living. The Bank/NOP and Citigroup surveys ask about prices, whereas the Basix survey asks about a non-specific inflation rate.

Table 2 – Surveys of household inflation expectations

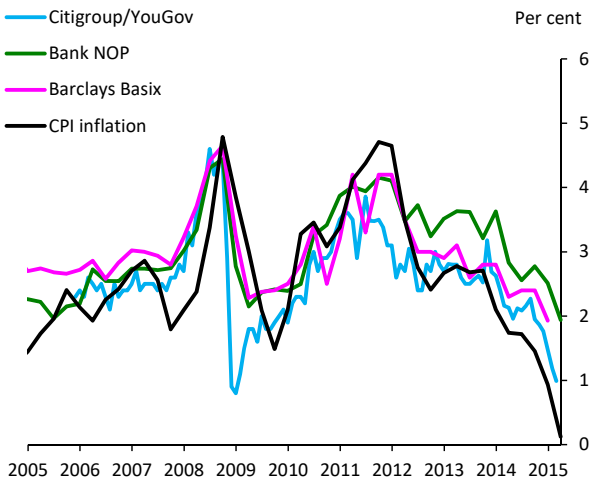
Survey	Frequency	Horizons	Start of data	Survey question
Bank/NOP	Quarterly	Past 12 months 1 year ahead 2 years ahead 5 years ahead	Q4 1999 Q1 2009	"How have **prices** changed over the past 12 months" "How much would you **expect prices in the shops generally** to change over the next…?"
Barclays Basix	Quarterly	1 year ahead 2 years ahead 5 years ahead	Q4 1986 Q3 2008	"What do you expect the **rate of inflation** to be over the next…?"
Citigroup	Monthly	1 year ahead 5-10 years ahead	Nov 2005	"How do you expect **consumer prices of goods and service**s will develop over the next…?"

Short-term household inflation expectations

We expect measures of short-term inflation expectations to fluctuate with economic news. And therefore the level of shorter-term measures may – on their own – not be informative about the credibility of the MPC's inflation target. However, one sign of a reduction in the credibility is if those short-term expectations deviate unusually far from the MPC's own forecasts. This test is shown in the first two lines of the inflation expectations heatmap.

Households' short-term expectations are currently unusually low relative to the MPC's CPI inflation forecast one and two years ahead, with [all but one] cell blue or dark blue. They are particularly low relative to the MPC's two-year forecast, suggesting that households may expect inflation to return to target more slowly than the MPC. It may also reflect the fact that households' short-term inflation expectations tend to be particularly sensitive to changes in energy and food prices and to media references about these.[13]

Chart 7 – Households' 1-year ahead inflation expectations



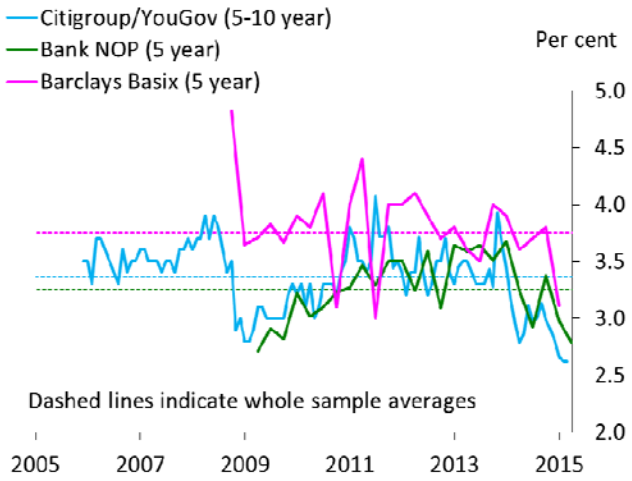
Long-term household inflation expectations

If households' inflation expectations are well anchored, we would expect them to be relatively stable at levels consistent with the MPC's inflation target. But as the level of household survey measures are not directly comparable with CPI inflation, we tend to assess how well anchored households' expectations are by assessing the level against their historical averages.

[12] De Bruin, Potter, Rich, Topa and van der Klaauw (2010), 'Improving Survey Measures of Household Inflation Expectations'

The level of long-term inflation expectations has fallen sharply over 2014 and 2015. The levels of 5-year inflation expectations are currently more than one standard deviation below their pre- and post-crisis averages for all three surveys (**Chart 9**). The Bank/NOP and Basix surveys have relatively short back-runs, and so their average levels may be distorted by the crisis period. The Citigroup survey, however, has a reasonable pre-crisis back-run, starting in late 2005. The level of this measure is currently the lowest of all the surveys relative to its pre- and post-crisis averages. It is three standard deviations below its pre-crisis average and two below its post-crisis average.

Chart 9 – Measures of long-term household inflation expectations



Changes in households' reported inflation expectations may, however, reflect changes in households' perceptions of what is meant by inflation or a change in prices. The Bank/NOP asks respondents for their perception of changes in prices over the last year. While the correlation between changes in CPI and medium-term measures of inflation expectations is weak, the correlation between individuals' perception of past inflation and future inflation is reasonably high.[14] For instance, the recent cross-sectional correlation between perceived inflation and inflation expectations has been between 0.5 and 0.7 (**Chart 10**). Therefore shifts in inflation expectations may reflect changes in their perceptions of past inflation rather than changes in underlying CPI inflation expectations.

Chart 10 – Correlation between perceived inflation and inflation expectations

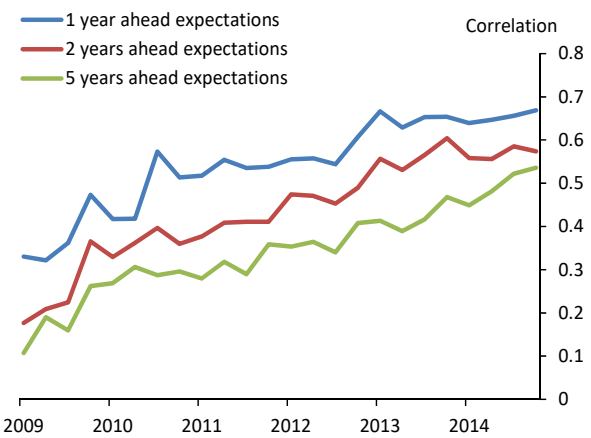


Chart 11 – Term structure of household inflation expectations (adjusted for the difference between perceived and actual inflation.

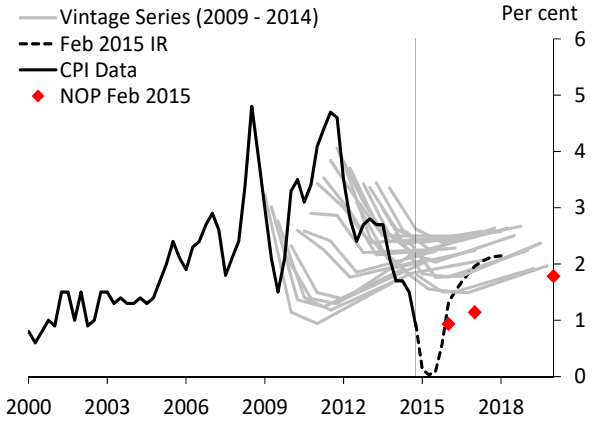


Chart 11 shows the term structure of households' inflation expectations from the Bank/NOP survey, adjusting down the level of these expectations for the average wedge between median past inflation and actual CPI inflation, which is around 1pp. While the adjusted 5-year inflation expectations are slightly below the 2% CPI inflation target, the 2-year measure is around 1pp below. The gap between perceived and actual inflation is not stable and has been widening in recent quarters.