Too Good to be True? The (In)credibility of the UK Inflation Fan Charts

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By

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This paper presents some simple methods to estimate the probability that realized inflation will breach a given inflation target range over a specified period, based on the Bank of England’s RPIX inflation forecasting model and the Monetary Policy Committee’s forecasts of the parameters on which this model is built. Illustrative results for plausible target ranges over the period up to 04Q1 indicate that these probabilities are low, if not very low, and strongly suggest that the Bank’s model over-estimates inflation risk.

Key words: Inflation, inflation risk, fan charts

JEL Classification Numbers: C53, E47, E52

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1. INTRODUCTION

Over the period from May 1997 to December 2003, the principal objective of UK monetary policy was to achieve a target RPIX inflation rate of 2.5% a year. The inflation target was set by the Government, and the newly established Monetary Policy Committee (MPC) of the Bank of England was given operational independence to achieve this target. At the same time, the Government also stipulated that in the event of inflation missing the target by more than 1 percentage point, the Bank would be required to write an open letter to the Government explaining why the deviation occurred and indicating the measures it was taking to bring inflation back on target. However, in the years since, UK monetary policy has been very successful and quarterly inflation has always remained well within this range. Consequently, the Bank has been spared the embarrassment of having to write an open letter to the Government.

Another feature of the new regime was the publication of ‘fan charts’ – projections of probable future inflation – in the Bank’s quarterly Inflation Report. The first published fan chart appeared in the February 1996 Inflation Report, but the Bank did not start to publish the parameters on which the inflation fan charts were based until August 1997. These fan charts are representations of forecast inflation probability density functions over
horizons of up to 8 quarters ahead, based on the assumption that every such pdf takes a particular form, known as a two-piece normal (2PN), and taking as its inputs the MPC’s forecasts of the parameters involved. Each fan chart shows the inflation central projection surrounded by a series of prediction intervals at various levels of probability.\textsuperscript{4} The fan charts were to reveal the MPC’s views on prospective future inflation, and as such were the forecasts on which monetary policy decisions were made: if the fan chart projections indicated that future inflation was likely to be too high, then the MPC would be inclined to raise interest rates, and so forth. The fan charts were a key feature of the monetary policy decision-making process, and the publication of the fan charts – together with the parameter forecasts on which they were based, which enables independent researchers to reproduce the Bank’s inflation-pdf forecasts – was a major step forward in monetary policy transparency.

The 97Q3 fan chart is reproduced as Figure 1. This chart gives prediction intervals for RPIX inflation for each of the 9 quarters from 97Q3 to 99Q3, and the intervals – the mischievously nicknamed ‘rivers of blood’ – tend to fan out as the horizon increases. For example, given that inflation at the end of 97Q2 was 2.60\%, the broadest interval, the 90\% interval, fans out to the range $[1.01\%, 5.08\%]$ for the end of the horizon period, indicating that the MPC was 90\% confident that inflation for 99Q3 would be in this range.
The fan chart also suggests a corresponding 80% prediction interval of [1.34%, 4.51%], a 70% prediction interval of [1.56%, 4.13%], and so on.

**Insert Figure 1 here**

However, what is most striking about the prediction intervals is their width: the wideness of the intervals in Figure 1 clearly shows that the MPC thought that there was a significant probability that inflation would *not* remain within its target range over the horizon to 99Q3. Yet inflation remained within this range in every quarter over that horizon period, and on every subsequent quarter, despite the fact that the later fan charts also suggested significant probabilities that that range would be missed. There is thus an uneasy tension between the inflation risk model, which seems to suggest a significant risk of inflation breaching this range, and the subsequent behavior of inflation, which, *ex post*, looks as though there was never any serious danger of a breach occurring.

There are two possible explanations: either the Bank’s risk model and the MPC were right and the Bank was just lucky (and maybe very lucky) that no breach actually occurred, or else the Bank’s model and the MPC over-estimated inflation risk. To choose between these two explanations, we need to get some idea of their empirical plausibility. In particular, is it plausible to maintain that the Bank’s model was right but that the Bank was simply lucky
in terms of how inflation turned out? Or is the balance of evidence so strong that a reasonable person would have to conclude that the Bank’s model has clearly over-estimated inflation risk?

This paper sets out to answer these questions. The key is to estimate the probability that no breach would have occurred by the end of our sample period (i.e., the end of 04Q1) if the Bank’s model and the MPC’s parameter forecasts were correct. Our estimate of this no-breach probability must use the Bank’s own inflation pdf, and the MPC’s own forecasts of the parameters concerned, without imposing additional restrictions that the Bank and/or MPC did not make: in other words, the estimated probability must be a fair reflection of the Bank’s fan chart model and parameter forecasts.

This paper is organized as follows. Section 2 explains the density function used by the Bank to forecast inflation probabilities. Section 3 then sets out three simple ways to obtain a no-breach probability from the Bank’s published 2PN parameter forecasts. Section 4 presents some estimates of this probability, and these estimates indicate that the Bank has indeed been over-estimating inflation risk. Section 5 discusses possible explanations for this finding, and section 6 concludes.
2. THE TWO-PART NORMAL INFLATION DENSITY FUNCTION

The inflation fan charts are based on the assumption that the probability density function governing the RPIX inflation rate is a 2PN, which we can think of as a normal density function with an ad hoc adjustment for skewness. The 2PN pdf can be defined as:

\[
 f(x) = \begin{cases} 
 A \exp \left[ -\frac{(x-\mu)^2(1+\gamma)}{2\sigma^2} \right] & \text{if } x \leq \mu \\
 A \exp \left[ -\frac{(x-\mu)^2(1-\gamma)}{2\sigma^2} \right] & \text{if } x \geq \mu 
\end{cases}
\] (1)

where

\[
 A = \frac{2}{\sqrt{2\pi(\sigma_1 + \sigma_2)}} , \quad \sigma_1 = \frac{\sigma}{\sqrt{1+\gamma}} , \quad \text{and} \quad \sigma_2 = \frac{\sigma}{\sqrt{1-\gamma}}
\]

This density function has three parameters. The first is the most likely value, the mode, represented by \( \mu \). The second parameter, \( \gamma \), is a measure of the skew or asymmetry. The third parameter, \( \sigma \), describes the uncertainty or dispersion of the random variable. This parameter is closely related to the standard deviation, but is not the same as the standard deviation, except in the special case where the skew is zero.\(^7\) Hence, if \( \gamma = 0 \), the 2PN density is symmetric and equivalent to a normal with mean/mode \( \mu \) and standard
deviation $\sigma$. However, if $\gamma > 0$, the pdf is skewed towards higher values of inflation, as in the fan chart shown in Figure 1, and if $\gamma < 0$ the pdf is skewed towards lower values of inflation.

When it publishes a fan chart, the Bank also reports on its website the parameter values on which the fan chart is based. It publishes values for each of three parameters (i.e., $\mu$, $\sigma$, and a skew parameter equal to the difference between the mean and the mode) for each of 9 forecast horizons ranging from the current quarter to 8 quarters ahead. Once the MPC specifies the parameter values for each horizon period, then the forecasting model is complete and the information we need can be ascertained from it.

3. ESTIMATING THE PROBABILITY THAT INFLATION WILL NOT BREACH A CHOSEN RANGE OVER A HORIZON PERIOD

We now seek a means of estimating the probability that inflation will not breach a chosen range over a specified horizon. Let $F_{t,k}(x)$ be the cumulative density function, as viewed from quarter $t$, for the uncertain inflation rate for the quarter $t+k$, where $k=0,1,2,...$, up to a maximum of $n$ quarters ahead. Thus, $F_{t,0}(x)$ is the probability that current quarter inflation will be less than $x$, $F_{t,1}(x)$ is the probability that current quarter inflation will be less than $x$ for the next quarter, and so on.
\( F_{t,1}(x) \) is the probability that inflation 1 quarter ahead will be less than \( x \), and so on. We can estimate these cumulative probabilities because we know the form of the distribution and have estimates of the parameters on which each cumulative probability forecast is based.

Consider a target range \([x_L, x_U]\). The probability that inflation \( k \) quarters ahead will be less than \( x_L \) is equal to \( F_{t,k}(x_L) \), and the probability that inflation \( k \) quarters ahead will be less than \( x_U \) is equal to \( F_{t,k}(x_U) \). The probability that inflation \( k \) quarters ahead will lie between \( x_L \) and \( x_U \) – that is, the probability that inflation will not breach the \([x_L, x_U]\) range \( k \) quarters ahead – is therefore equal to \( F_{t,k}(x_U) - F_{t,k}(x_L) \).

We wish to estimate the probability of inflation remaining within a target range in each of periods 0, 1, \( \ldots \), \( n \). Let \( h_t \) be the occurrence of inflation in period \( t \) falling within the target range (i.e., \( h_t \) means there is no breach in \( t \)). The probability of no breach occurring in periods 0 and 1 is therefore equal to:

\[
p(h_0 \cap h_1) = p(h_0)p(h_1 | h_0)
\]  

(2)

where \( p(.) \) indicates the probability of the event specified in \( () \). More generally, the probability of no breach occurring over any of the periods 0, 1, \( \ldots \), \( n \) is equal to:
These probabilities can be estimated using Monte Carlo simulation.\textsuperscript{11} We simulate \(m\) ‘random’ paths, each of which consists of \(n+1\) drawings – one drawing for each quarter in our horizon period, including the current quarter – and where each of these drawings determines whether a breach occurs in the quarter concerned. To ensure accuracy, \(m\) needs to be large, so we set \(m=50000\). We then estimate \(p(h_0)\) as the proportion of period 0 simulated observations that do not involve a breach of the target range. We then throw away any simulation paths involving breaches in period 0, and estimate \(p(h_1 \mid h_0)\) as the proportion of remaining paths whose period 1 values do not involve breaches of the target range. After this, we throw away any simulation paths involving breaches in period 1, and estimate \(p(h_2 \mid h_0, h_1)\) as the proportion of remaining paths whose period 2 values do not involve breaches of the target range. We carry on in the same way for the remaining conditional probabilities. We now have estimates of the probabilities on the right-hand side of (3), and can then use (3) to estimate the probability of no breach occurring at any time on or between periods 0 and \(n\).

One issue remains: at the start of the horizon period we only have parameter forecasts going out 8 quarters ahead. This means that as of some
initial period $t$ (e.g., 97Q3), $F_{t,k}(x)$ are only known up to $k=8$. If we are to estimate the probability of no breach occurring by the end of 04Q4 (i.e., up to a horizon of 27 quarters, if we start in 97Q3) we need to use some proxies for probability forecasts beyond the first 8-quarter ahead forecast horizon. To obtain these, we need to use proxy parameter forecasts, and if the results are to be fair to the Bank, we must obtain these parameter proxies using only information provided by the Bank itself.\footnote{12}

**Extrapolation method**

Three such methods suggest themselves. The first and simplest is to estimate the probability of no breach occurring by the end of the fan chart period using only the parameter forecasts from the first fan chart. Thus, for the first 9 quarters, we use the ‘correct’ parameter forecasts. We then use these same forecasts for the next 9 quarters, and then use them again for the final set of quarters. This ‘extrapolation’ method only requires information on the MPC’s first set of parameter forecasts (e.g., those published in 97Q3 if we are dealing with the constant-rate version). This method has the attraction that it would have enabled the Bank (or anyone else) back in 97Q3 to predict no-breach probabilities out to the end of any future horizon period, using information already available then. This method also provides a useful and simple-to-implement yardstick, even if the extrapolation procedure itself is somewhat simplistic.
**Rollover method**

An alternative is to estimate the longer-horizon no-breach probabilities by ‘rolling over’ fan charts: we use the first fan chart to get the first set of parameter forecasts, as before; but instead of re-using that same set of parameter forecasts for the next set of 9 quarters, we take the second set of parameter forecasts from the fan chart forecasts for quarter $t+9$; we then proceed in like manner and take the third set of parameter forecasts from the fan chart forecasts for quarter $t+18$. This ‘rollover’ method requires estimates of the MPC’s parameter forecasts for three sets of fan charts spaced nine quarters apart. However, if the MPC’s forecasts are fairly stable over time and if the parameters in the first fan chart are not too untypical of the rest – and casual inspections suggest that both conditions are plausible – then the extrapolation and rollover methods ought to (and in fact do) give broadly similar answers.

**Earliest forecast method**

A third possibility is to use the earliest available forecast for each quarter. This approach has a certain plausibility – if the ideal would have been to have had forecasts for all future horizons back in 97Q3, then this is the closest we can come to this ideal. So, for example, at $t$ we start with forecasts that go out to only $t+8$. The first forecasts for $t+9$ become available in $t+1$, the first
forecasts for \( t+10 \) become available in \( t+2 \), and so on. In each case, we use the earliest available forecasts for the quarter concerned. Being the earliest available, all bar the first 8 of these forecasts will be 8-quarter ahead forecasts. Since the density forecasts in the fan charts tend to fan out as the forecast horizon lengthens, these long horizon forecasts will be associated with relatively high breach-probability forecasts relative to the other two methods. We might then expect this method to give somewhat lower estimates of no-breach probabilities, and our results confirm this expectation.

4. RESULTS

No-breach probabilities

Some results are presented in Table 1. This Table shows our estimated probabilities of no breach occurring between the beginning of, or very early in, the MPC period up to 04Q1. If we start our calculations using the first fan chart for which we have the necessary input parameter forecasts, the 97Q3 constant-rate fan chart, we get no-breach probabilities of 0.122% using the ‘extrapolation’ method, 0.328% using the ‘rollover’ method, and 0.072% using the ‘earliest forecast’ method. The average of these estimates is 0.174%. If we start the calculations the next quarter, we get a corresponding average of 1.526%. If we start in 98Q1, we can also estimate the no-breach
probabilities using the market-rate model, which is first produced that quarter, thus giving us six instead of three ways of estimating the same probability, depending on the combination of fan chart type (constant rate or market rate) or method used (extrapolation, rollover or earliest forecast). The average of these six estimates for 98Q1 is 3.431%, and the corresponding average for 98Q2 is 2.471%.

\[\text{Insert Table 1 here}\]

Strictly speaking, each of these probabilities only refers to the probability of no breach occurring between the relevant starting quarter and the end of 04Q1. Hence, only the first of these actually refers to the probability of no breach between the publication of the 97Q3 fan chart and the end of 04Q1. In theory, our best estimates of the no-breach probability over the whole of our period should therefore be our first estimates, because estimates based on later starting quarters fail to take account of the possibility of breach very early on in that period. However, if we compare the various mean estimates, we also see that those based on 97Q3 are an order of magnitude lower than the others, which are all relatively close together. Hence, it would be prudent to regard the first estimate as something of an outlier, and to take our ‘best’ estimate of the no-breach probability over the
whole fan chart period to be in the region of the overall average, which is 1.901%.

In short: taking the Bank’s own model and using the MPC’s own parameter forecasts, I estimate that the probability of inflation not breaching a [1.5%, 3.5%] target range at some time during the 97Q4-04Q1 period was only about 1.9%. This result suggests that the Bank was fortunate, though by no means incredibly so, to have avoided missing its target range at some point.

Yet what is most curious is not so much that the realized inflation rate has never breached the Government’s target range over the fan chart period (and, indeed for a long period before), but that the realized quarterly inflation rate has *never even come close* to breaching this range. Instead, realized quarterly inflation has stayed within a much narrower range of [1.89%, 3.00%]. If the probability of the inflation rate breaching the [1.5%, 3.5%] range was small, the probability of inflation remaining within this narrower band was presumably much smaller still.

To investigate this issue further, Table 2 presents estimates of the probability that inflation would not breach the range [1.80%, 3.05%] – a range considerably narrower than the Government’s target range, but still unbreached over the fan chart period. These results are striking: nearly half of the estimated probabilities are 0.000%, estimated to three decimal places, and we get an overall mean estimate – which is arguably our ‘best’ estimate – of
0.006%. The Bank’s inflation risk forecasting model applied to this narrower range now implies a no-breach probability of around 6 in 100,000, and this would suggest that the Bank’s model is (seriously) over-estimating inflation risk.\(^{14}\)

Insert Table 2 here

5. DISCUSSION

Our results therefore point to the conclusion that the MPC has been persistently over-estimating inflation risk. Why might this be the case?

One possible response is that the world always looks uncertain when one tries to anticipate the future and subjective uncertainty often tends to increase, the further ahead one tries to forecast. So it might make sense for the MPC to be quite uncertain about future inflation, and to be more uncertain about future inflation over longer horizons. However, this ‘explanation’ is hardly adequate, because it fails to take into account the fact that inflation is largely determined by the MPC itself, or the fact that the MPC successfully operates to an inflation target. These facts suggest that any ‘reasonable’ density forecast would attach a high probability to the inflation rate coming in
close to target – assuming (as would seem reasonable) that the MPC continues to expect itself to deliver a successful monetary policy. What needs to be explained is the co-existence of two apparently incongruent phenomena – the high degree of inflation uncertainty shown by the MPC’s fan chart forecasts, on the one hand, and the low and stable inflation actually delivered by the MPC’s own monetary policy, on the other.

A more plausible explanation might be the following.\textsuperscript{15} To begin with, let us accept that the underlying objective of UK monetary policy is to deliver low and stable inflation over the longer term, and not just from one year to the next. This is highly plausible, and there is evidence to support it.\textsuperscript{16} There is, in effect, a long run inflation target, which would mean that unexpectedly high or low inflation in one period would be offset in future periods. The inflation targeting regime then comes to resemble a price-level targeting regime. It is well-known that a price-level targeting regime delivers lower inflation forecast errors than an inflation targeting regime in which ‘bygones are bygones’ and nothing is done to correct excessively high or low past inflation (see, e.g., Balke and Emery (1994)). It is also well-known that if the central bank in a hybrid (i.e., part price-level targeting, part inflation targeting) regime places even a small weight on the past price level path, then the inflation rate will be considerably more stable than it would have been had the central bank followed a ‘pure’ inflation target alone and let past inflation bygones be bygones.\textsuperscript{17} So we might reasonably believe that the
Bank of England operates to a long-term inflation target, and such a target might lead us to expect a high degree of inflation stability.

But how then do we explain the degree of *ex ante* uncertainty in the MPC’s density forecasts? One superficial but still plausible possibility is simply that the MPC might have surprised itself and surpassed its own expectations of how much inflation stability it could deliver. A complementary but deeper possibility is that the MPC’s forecasts were based, at least in part, on econometric models that failed to take account of the Bank’s concern to achieve long-term inflation stability: for example, the econometric models it used may have assumed – and most likely *did* assume – that the Bank was following a ‘pure’ inflation target in which inflation bygones are bygones. Such models would generate an excessive sense of *ex ante* uncertainty, the source of which might be far from obvious to policy makers. The nature of Bank deliberations might also contribute to policy makers’ overlooking this sort of problem. Even though everyone recognizes that models have their limitations, in group situations the results generated by models often acquire a certain sense of spurious objectivity that individuals are reluctant to challenge – models get treated ‘as if’ individuals had more confidence in them than they really do. In addition, the sheer volume of data considered in the course of a typical *Inflation Report* cycle might have the effect of distracting participants from less obvious issues, which might
otherwise have got more attention, and assumptions buried in the recesses of econometric models are rarely obvious.

A final contributory factor is the relative novelty of the regime. Had the regime been functioning for decades, the lack of congruence between the uncertainty forecast by the MPC and the high inflation stability actually delivered by the MPC would surely have been noticed a long time ago. One presumes that some effort would then have been made to ‘join up’ the MPC’s thinking, so that the inflation stability achieved by the MPC was fed through into its deliberation of future inflation uncertainty. That this has not yet happened must be due, at least in part, to the fact that the problems with the MPC’s inflation density forecasts have only come to light relatively recently. And they could hardly have come to light much earlier than they did, because the regime is still relatively new and it takes time to accumulate a forecast track record that can be evaluated.
This paper has presented some simple methods to estimate the probability that realized inflation would breach a given inflation target over a specified period, based on the Bank of England’s own inflation density forecasting model and the MPC’s forecasts of the parameters on which this model is built. The proposed methods were used to estimate the probabilities, as viewed from 97Q3 on, that inflation would breach each of two specified inflation target ranges at some point in the period up to 04Q1.

If the Bank’s model is sound and the MPC’s forecasts were ‘good’ ones, our results that imply it is highly likely that both target ranges should have been breached by now. Taking our target range to be the broader range of [1.5%, 3.5%], our estimates suggest that the probability of an unbreached target by 04Q1 is rather low. More precisely, our ‘best’ estimate suggests that the probability of the Bank’s model over-estimating inflation risk is around 98.1%, and the probability of the Bank’s model being sound but with inflation being unusually or unexpectedly stable over this period is about 1.9%. Results for the narrower target range are even stronger: these suggest that the probability of the Bank’s model over-estimating inflation risk is about 99.994%, and the probability of it being sound is only about 0.006%. Furthermore, these results are biased in favor of the Bank’s model, not least
because realized inflation was always comfortably within even the narrower of these two target ranges: we can therefore say with some confidence that the ‘true’ probability of the Bank’s model being correct is just about negligible.

In short, the odds strongly suggest (i.e., suggest beyond a reasonable doubt) that the Bank’s model is inadequate: the Bank’s inflation ‘luck’ is almost beyond belief – and whatever remaining credibility the fan chart model still has diminishes further with each new inflation ‘success’. If the fan chart model is to restore its credibility, an embarrassing letter to the UK Government is well overdue.
REFERENCES


FOOTNOTES

1 In December 2003, the target RPIX rate of 2.5% was changed to a CPI target rate of 2.0%. However, this change was largely a housekeeping exercise that did not signal any significant change in the underlying monetary policy stance.

2 This has been a surprise to many, including some at the Bank itself. For example, Haldane and Salmon (1995) presented results suggesting that breaches of the [1.5%, 3.5%] range would be very common. Sgherri and Wallis (1997) and Bean (1998) reached similar conclusions.

3 The RPIX fan charts – and the forecast density functions on which they were based – refer to the ‘headline’ inflation targeted by the Bank, which was the quarterly average of monthly observations of RPIX inflation over the previous 12 months.

4 The Bank published two different types of RPIX fan chart. The first, the constant-rate version, was based on the assumption that short-term market interest rates would remain constant over the horizon period. In February 1998, a second type of RPIX fan chart was introduced, the market-rate version, based on the assumption that short-term interest rates would follow market expectations over the horizon period.

5 The sample period ends in 04Q1 because later Inflation Reports do not publish RPIX inflation fan charts. Since then, the Bank only publishes CPI
inflation fan charts, which are not directly comparable for our purposes. Our sample period therefore covers 27 quarters in total.

6 Naturally, it would have been very convenient if the Bank had produced forecasts in 97Q3 that went out to the end of our forecast horizon (i.e., 04Q1). However, we have to live with the constraint that the MPC’s forecasts only go out 8 quarters ahead. Consequently, if we want parameters for later periods (i.e., after 99Q3), we have to use parameter forecasts only made after 97Q3. Since these latter forecasts have the benefit of news coming in post 97Q3, we can only suppose that using these parameter forecasts produces a bias in favor of the Bank’s fan chart model, relative to an ‘ideal’ framework that uses only information available in 97Q3.

7 For more on the 2PN and on the Bank’s parameterization of it, see Wallis (1999, 2004).

8 Parameter values can be obtained from the Bank’s website at http://www.bankofengland.co.uk/inflationreport/rpixinternet.xls.

9 Note that the skew parameter reported by the Bank is not in general the same as the $\gamma$ given in (1). Instead, the latter has to be inferred from the parameters given by the Bank, as explained by Wallis (2004).

10 For our purposes, we are particularly interested in the 2PN cumulative density function (cdf). Given the Bank’s forecasts of the input parameters, cdf values are easily obtainable from the pdf formula (1) using numerical methods. These and other calculations reported in this paper were carried out
using MATLAB, and the programs written for this purpose are obtainable from the author.

11 There is no straightforward analytical solution for the probability of no breach occurring throughout the horizon period, because we have no right to assume that the period-by-period breach probabilities are independent. I thank a referee for pointing this out. Any analytical approach then requires us to grapple with conditional densities, and the easiest way to do so is by means of a Monte Carlo approach such as the one in the text.

12 This requirement rules out the possibility of taking the 97Q3 fan chart and then extrapolating its parameters over a longer period. However, it is interesting to note that the MPC’s volatility forecasts broadly follow a square-root-of-time rule, by which the volatility forecast over an $h$-period horizon can be taken as the square root of $h$ times the one-period ahead volatility forecast. This suggests that the MPC’s implicit model takes inflation to be a diffusion process. Were one to make this assumption, we could extrapolate parameter forecasts for horizons longer than 8 quarters ahead, and we would get much lower no-breach probabilities than those reported in section 5.

13 By ‘best’, I merely mean an estimate that seems to be robust to alternative specifications and/or auxiliary assumptions. Any estimates we make are inevitably subject to considerable model and parameter risk: as the
old saying goes, it is better to approximate and right, than to be precise and wrong.

14 Moreover, this estimate almost certainly over-states the probability that inflation would have remained within its actual range of [1.83%, 3.00%], because it is based on the somewhat wider target range of [1.80%, 3.05%]. Any bias in our estimates is therefore in favor of the Bank’s model, rather than against it.

15 I thank a referee for suggesting this possible explanation.

16 To give an example, in his letter to the Bank of December 10, 2003, the Chancellor of the Exchequer, Gordon Brown, wrote that his intention was “lock into our policy making system a commitment to consistently low inflation in the long term. The real stability that we need will be achieved …when we can confidently expect inflation to remain low and stable for a long period of time.” The context of his letter and the reaction to it suggest that Brown is merely confirming what was already understood, rather than establishing a new policy objective. One could also find numerous other statements by leading UK policymakers to confirm this impression.

17 This result is a robust one that emerges from a wide variety of models, such as those of Cover and Pecorino (2001), Dittmar et alia (1999), Nessin and Vestin (2000), Reifschneider and Williams (2003), and Williams (2003).

18 These problems first came to light when Wallis (2003) reported that the Bank seemed to be over-estimating inflation risk over a horizon of 1 year
ahead. However, he did not examine horizons longer than a year. A subsequent study by Dowd (2004) looked at the Bank’s density forecasting over all horizons from current quarter to 8 quarters ahead, and found evidence that the performance of the Bank’s forecasts clearly deteriorated as the forecast horizon got longer. The estimates reported in the present study are consistent with their conclusions, but arise from a very different methodology that focuses on no-breach probabilities rather than formal forecast evaluation tests. This means that the main conclusion reported here – that the Bank almost certainly over-estimates inflation risk – is not dependent on any particular forecast evaluation test used in these studies. Hence, my study suggests that the conclusions of these earlier studies are robust.
FIGURES

Figure 1: The Fan Chart for August 1997

Note: This fan chart is based on the constant-rate model, and is equivalent to that published in the August 1997 Inflation Report. The fan chart is reproduced with permission from the Bank of England.
Table 1: Probabilities (in %) of an Unbreached [1.5%, 3.5%] Inflation Target Range Over Period to 04Q1

<table>
<thead>
<tr>
<th>Type of fan chart</th>
<th>Calculation method</th>
<th>Calculations start in quarter:</th>
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<td></td>
<td></td>
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<tr>
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<tr>
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<td>Rollover</td>
<td>0.328</td>
</tr>
<tr>
<td>CR</td>
<td>Earliest forecast</td>
<td>0.072</td>
</tr>
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</tr>
<tr>
<td>MR</td>
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<tr>
<td>Mean</td>
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Summary statistics over all results

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<tr>
<td>Standard deviation</td>
<td>2.485</td>
</tr>
</tbody>
</table>

Notes: CR and MR refer to the constant-rate and market-rate fan chart models. Results are based on 50000 Monte Carlo simulation trials.
Table 2: Probabilities (in %) of an Unbreached [1.8%, 3.05%] Inflation Target Range Over Period to 04Q1

<table>
<thead>
<tr>
<th>Type of fan chart</th>
<th>Calculation method</th>
<th>Calculations start in quarter:</th>
<th>97Q3</th>
<th>97Q4</th>
<th>98Q1</th>
<th>98Q2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>Extrapolation</td>
<td></td>
<td>0</td>
<td>0.006</td>
<td>0.016</td>
<td>0.002</td>
</tr>
<tr>
<td>CR</td>
<td>Rollover</td>
<td></td>
<td>0</td>
<td>0.004</td>
<td>0.012</td>
<td>0.032</td>
</tr>
<tr>
<td>CR</td>
<td>Earliest forecast</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MR</td>
<td>Extrapolation</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0.018</td>
<td>0.006</td>
</tr>
<tr>
<td>MR</td>
<td>Rollover</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0.012</td>
<td>0.034</td>
</tr>
<tr>
<td>MR</td>
<td>Earliest forecast</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td></td>
<td></td>
<td>0.000</td>
<td>0.000</td>
<td>0.003</td>
<td>0.010</td>
</tr>
</tbody>
</table>

**Summary statistics over all results**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.006</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.000</td>
</tr>
<tr>
<td>Maximum</td>
<td>0.034</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.011</td>
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</tbody>
</table>

Notes: CR and MR refer to the constant-rate and market-rate fan chart models. Results are based on 50000 Monte Carlo simulation trials.