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Speech

Mensch tracht, und Gott lacht: Giving guidance on future monetary policy

Speech given by

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1. Introduction

"Mensch tracht, und Gott lacht" is a Yiddish proverb – men plan and God laughs. Woody Allen puts the same thought this way: "If you want to make God laugh tell him about your plans".[1] Some people might see these as a fitting epitaph for forward guidance on monetary policy. The Bank of England has certainly faced a good deal of criticism for the guidance that it has recently been giving, as has the Federal Reserve in the US. In both cases the nature of the guidance has evolved, though I think it is rather harsh to assume that God has been laughing at how things have gone; anyway it is hard to know. Yet there is a real question here that is worth thinking about and it is this: What is the most useful way for a central bank to provide information about the way in which it will set monetary policy?

Consider a spectrum of choices a central bank might face about what it says about its future policies[2]: at one end of the spectrum (the minimalist end, which we might call the Montagu Norman side[3]) is just a statement that the central bank will continue to do what it sees as most appropriate over time. In the absence of a more precise statement about what constitutes "appropriate" this is probably about as vague as one can imagine. At the other end of the spectrum is an explicit commitment that policy will be set in a specific way at each point into the future – not just a rule that might be followed but a commitment to a particular policy setting. If we think of policy as being about the level of an interest rate set by the central bank (Bank Rate for the Bank of England) this second extreme end of the spectrum means a promise to set the interest rate along a specific path into the future. Between these two are a great many intermediate points: nearer the vague end – though meaningfully different from it – is an explicit statement of the goal of policy (e.g. an inflation target) but with little indication of how the central bank sees the link between its policy instrument and that goal or about what the current economic outlook is. Somewhere in the middle of the spectrum would be a fairly precise statement of the aim of policy (the targets) along with an assessment of the state of the economy and a (probabilistic) assessment of how the economy might evolve for a particular (fixed and perhaps arbitrary) setting of the policy instruments. Further along again might be an assessment of how the policy set by the central bank might evolve for different outcomes of some of the main forces driving the economy. That would tell you something about the central bank's reaction function and also its assessment of the nature of the economic environment and how it might evolve.

Forward guidance can mean many things. I think it is helpful to think about forward guidance as being a choice about which point to settle on along the spectrum I have described.

That is the question I want to address today.

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[1] Mike Tyson made a related - but different – point when he said "Everyone has a plan until they get punched in the mouth".
[2] In talking about a spectrum I am talking somewhat loosely. A spectrum suggests that there is just one dimension in which communication about policy can be varied. In practice there is more than one dimension.
[3] In recognition of his reputed dictum "never apologise, never explain"

Let me start by making two simple points.

My first point is that on this issue there is not a lot of generally agreed upon and directly applicable economic theory to help. To a large extent this is because in many standard economic models this is really a non-question – it simply does not arise. Suppose we assume that everyone in an economy is completely rational, has unlimited computational powers, has the same information and understands the processes driving the economic outcomes. They all share a common understanding about the links between monetary policy and economic outcomes and they share common (but imperfect) information about where the economy is today and the sorts of shocks that will buffet it over time. (They do not know what those shocks will be but understand the risks). In this idealised world then so long as the central bank can credibly commit to pursue an explicit and completely specified objective[4] then there is not much more to be said. People outside the central bank will work out what the optimal policy the central bank will follow given how the economy seems to be evolving. They will form the same expectations about the course of future policy as the central bank itself because they share a common view about how the economy works and make the same assessment about the probabilities of different future outcomes. All the central bank needs to do is say what its aims are. If these are precise and seen as something the central bank will pursue then people can figure out what it will do, depending on how the shocks that hit the economy play out.

There are a few wrinkles to this. Under some circumstances optimal policy might be time inconsistent – that is a situation when the central bank plan which is optimal today is no longer optimal at some point in the future simply because of the (entirely predictable) passage of time and not because of some news. And it might be that such time-inconsistency could be more likely if interest rates are stuck at the zero lower bound. But time inconsistency is a slightly tangential issue[5]. The main point is that when everyone shares common information and understanding (and that is the default assumption in many economic models) the central bank just needs to say what its aims are, which must involve not only some medium term targets but also how it will trade-off deviations from the targets. In the idealised world of many economic models people can then just go figure out the rest. Giving guidance on future policy is generally irrelevant here[6]. So in terms of the spectrum of points described above there just isn't one. When everyone has the same information – including about the objectives of the central bank – there is nothing else to talk about[7].

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[4] An example of a specific objective would be to make as small as possible a weighted average of deviations of inflation and output from specified levels over some horizon stretching into the future. An objective that was just to hit a target "over the medium term" would be too vague to allow people to figure out what the central bank would do in various circumstances.

[5] Woodford (2013) has an extensive discussion of the conditions under which the optimal monetary policy of a central bank might be time inconsistent. This depends upon the nature of the goals of the central bank which need to be precise enough to determine a policy path. The key condition is that "…the sequence of target criteria for different horizons are of the same form (i.e., if the target criterion is independent of the horizon)… then the forecast-targeting procedure will be inter-temporally consistent." I believe that the way the MPC interprets its goals satisfies this condition.

[6] Generally but not always. In cases where the central bank's credibility over a future path of interest rates is in doubt, guidance could be seen as a commitment device, creating costs from deviating from a pre-announced plan which can help avoid inferior outcomes that can arise if optimal monetary policy is time inconsistent. I believe that the aims of the Bank of England make the time inconsistency problem unlikely to be very relevant (see footnote 5).

[7] This may be rather too negative a conclusion to draw about the use of theories that assume common knowledge. Idealised models without information frictions might still have a message about guidance because they suggest that central banks should do all they can to remove information problems by being transparent about their objectives, about possible shocks and likely policy responses to them.

Of course this is very unrealistic – it requires common understanding between the central bank and everyone else about the structure of the economy, the current state it is in and also perfect clarity about the precise objectives of the central bank (including how it sees trade-offs between objectives). So it is not a very good guide to the practical policy issue about what guidance the central bank should give. Real world complexities – differences in information and the resources to interpret it; uncertainty about what the right model of the economy is; the possibility that information might be misinterpreted; different views amongst policy makers within the central banks – are just that: real.

The second simple point I want to make is that much of the most vocal recent criticism of guidance given by central banks really reflects a seeming preference to take one of the extreme ends of my spectrum. And that extreme end is very unlikely to be a good place to be. So for example in the UK the Bank of England (and more specifically its Monetary Policy Committee) is very often criticised for " flip-flopping"; for giving different signals about policy at different times; for seeming to change its mind on the right path for policy; in short for not providing certainty about policy. I think in many cases this boils down to the criticism that while the Bank of England now claims to be giving guidance on policy it is not saying what policy will be – it is not giving a specific path for interest rates, and not even saying when it is going to start raising rates. The criticism is also that what the MPC is saying seems to change over time so that the chances of interest rates moving along different paths seem to shift. So one frequently hears that the MPC's message is confusing, and that it should communicate more clearly. One version of this criticism is that the Bank lacks transparency – a criticism that is open to many interpretations, one of which is that the Bank refuses to say what it is going to do to interest rates, even though it could.

I do not take this criticism lightly. The Bank is accountable to the public, and it needs to clearly communicate the reasons behind its policy decisions. The MPC goes to some lengths to explain its thinking and decisions. The minutes of the MPC meetings are published two weeks after the interest rate decision; those minutes give a full account of the policy discussion, including differences of view. They show the votes of the individual members of the Committee. Committee members have to explain their decisions regularly to parliamentary committees. The evidence is transmitted live. And MPC members also speak to audiences throughout the country, explaining the MPC's policy decisions. These speeches are available on the Bank's website.

In addition to the monthly MPC minutes, the Bank publishes its Inflation Report every quarter. This report gives an analysis of the UK economy and the factors influencing policy decisions. The Inflation Report also includes the MPC's latest forecasts for key economic variables, and shows the assumptions under which these forecasts were made. And the Bank publishes details of the main economic models that its staff use to help the Committee make its forecasts.

I do not think the criticism that the MPC does not give much information about how it sets policy really stacks up. Nonetheless a case can be made that the MPC should provide additional information – for example that

it should say more about its reaction function[8]. And indeed the forward guidance that the MPC has been giving is, in part, a response to that. But I think a great deal of the loudest criticism is not so much that the MPC doesn't say much about how it sets policy, but rather that the MPC is providing less certainty than it could about interest rates.

And it is true that the MPC could commit to a certain path for future interest rates, and stick to it whatever economic circumstances materialise. Indeed the more uncertain the economic environment, the more valuable might people find it to have certainty about where interest rates are heading. Yet the greater the uncertainty the greater are the chances that the economic environment will turn out to be very different from what the MPC expected at the time they committed to an interest rate path. And this means that sticking to that path can be very costly. In many models sticking to a particular path for interest rates over a specific horizon can mean that at the end of that horizon interest rate may need to move dramatically to prevent serious instability in the economy. If the certainty about the path of rates for some near horizon comes at the cost of far higher uncertainty a bit down the road that hardly looks ideal.

To explore this issue of the effects of committing to a specific path for interest rates I will use a simple model of the economy which accounts for uncertainty and explores how that should affect monetary policy.

2.   A model of monetary policy under uncertainty

I want to use a simple model of the economy which takes account of uncertainty about the economic environment and makes explicit assumptions about the aims of monetary policy. My aim is to assess how much of a difference it would make if the central bank fixed the path for policy over the next few years rather than making it conditional upon the way the economy actually pans out.

The model is reduced to the bare minimum (see the Annex for details). It has three parts, summarised in three equations, which describe the evolution of output, inflation and supply capacity. Demand and output are assumed to grow faster if interest rates, adjusted for inflation (i.e. real interest rates), are below average. This is a standard demand relation – sometimes called the IS equation. Inflation is assumed to rise when firms produce above their long-run level of supply – in other words there is a link between slack (or spare capacity) and inflation. Finally I assume that supply capacity (more specifically, productivity growth) may respond positively to output growth; this is a simple way of taking account of possible hysteresis effects. I will assume that unless the central bank has committed to a specific path for interest rates it will vary them as it learns about how inflation and output evolve. I assume that the way in which the interest rate responds to inflation and production will be chosen by the central bank optimally in order to achieve its goals (goals which are described below and set out explicitly in the annex).

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[8] Though this assumes there is a single, simple reaction function for a Committee of 9 members each of whom is responsible for their own decisions.

This simple model allows me to incorporate a number of uncertainties that I think are particularly relevant for the UK right now. The first is uncertainty about the degree of spare capacity in the economy. The second is about the impact of monetary policy: since interest rates have been at such exceptionally low levels for so long there is unusual uncertainty about how the return towards more usual levels will affect the economy. The third source of uncertainty is how fast the economy grows in the absence of monetary stimulus (i.e. at a neutral setting for policy). And the fourth source of uncertainty is about the extent to which productivity growth responds positively to output growth. I believe that uncertainty about these four factors – slack, the transmission mechanism of monetary policy, current momentum in the economy, and the endogeneity of productive potential – is substantial and economically significant.

I calibrate the model in a fairly crude way to reflect what I think is a plausible view of how these economic relationships operate, and of how large the associated uncertainties are. The appendix gives details.

I specify the aim of the central bank as being to try to keep inflation close to a target and output close to its estimate of the supply capacity of the economy. More specifically, I assume that the central bank sets policy to minimise the expected value of the weighted sum of squared deviations from the inflation target and from supply capacity over a horizon stretching many years into the future. (Again the annex gives details). We can then compute an optimal policy rule showing how the interest rate should respond to the (uncertain) evolution of actual inflation and output so as to best achieve the aims of policy. What we are doing here is finding that interest rate rule which best achieves the aims of policy and where the rule is chosen at the outset when there is uncertainty about the economic environment. Using this rule we can then show how policy would evolve for any specific realisation of the uncertain parameters which affect the path that inflation and output actually take. This yields a range of paths for output, inflation and interest rates; each path is the outcome for a specific constellation of the uncertain factors incorporated in the model.

Figures 1-3 show the probabilities of paths for the output gap, output growth and inflation generated by the model over a period of 4 years (16 quarters) and where the central bank follows its optimally chosen policy rule. I assume we start from a position roughly like the UK today. The figures for growth and inflation are conceptually similar to the so-called fan charts showing the MPC's best collective judgement about how output and inflation might evolve. (For comparison with figures 2 and 3 the fan charts 2b and 3b are those from the August 2014 Inflation Report). In producing those fan charts the MPC takes into account vastly more information than in the stylised model used here. An important difference is that the fan charts in the Inflation Report are constructed around a central forecast that is conditioned on a specific path for interest rates whereas the paths in figures 1 and 2a and 3a take account of how interest rates would themselves vary over time. That is one reason why the uncertainty around the most likely path for inflation is very much lower in 3a, in which interest rates react to different inflation and output outcomes, than in chart 3b from the Inflation Report showing inflation outcomes based on assuming that interest rates evolve in line with market expectations at August 2014.
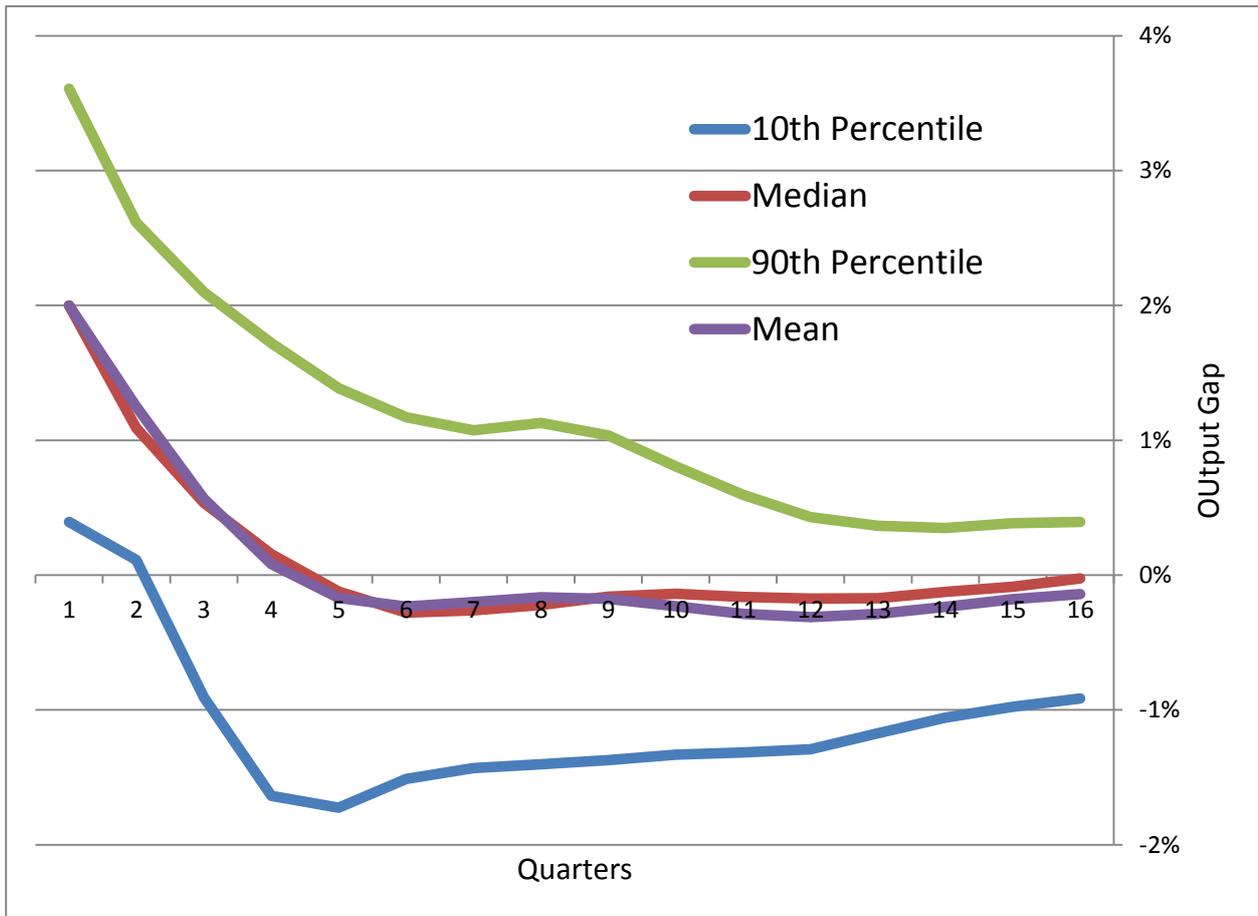
Figure 1: Output gap, simulation
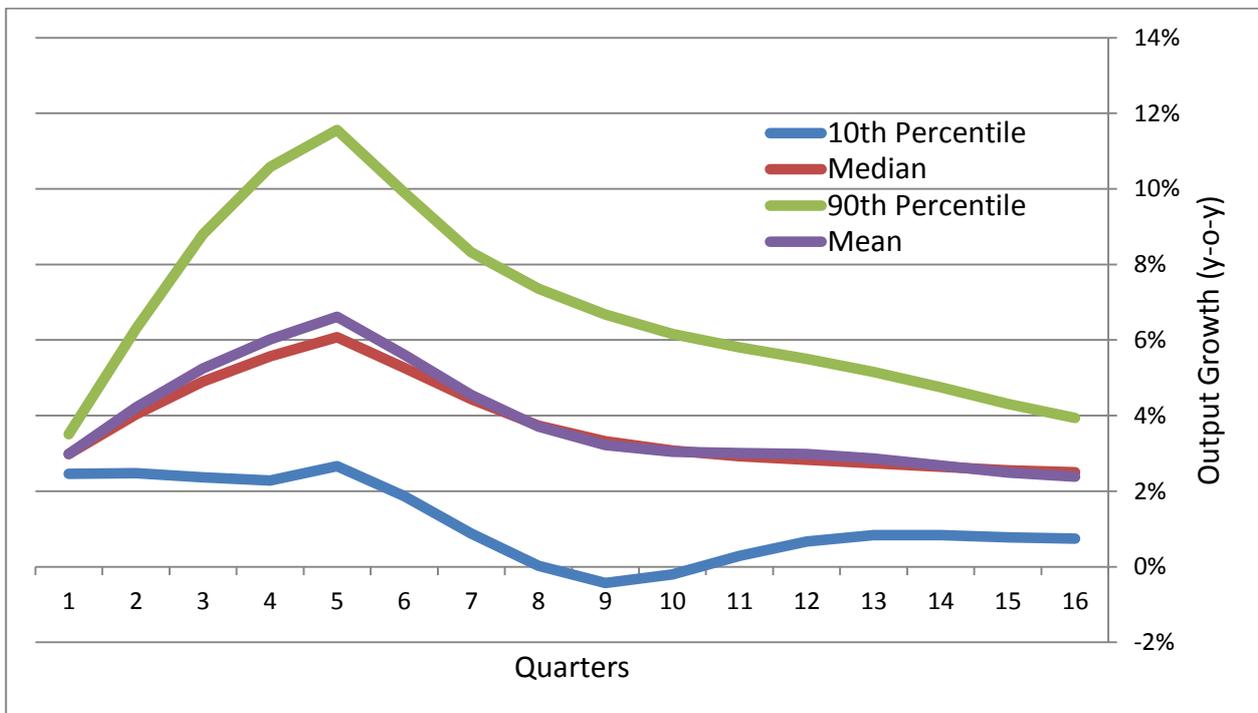

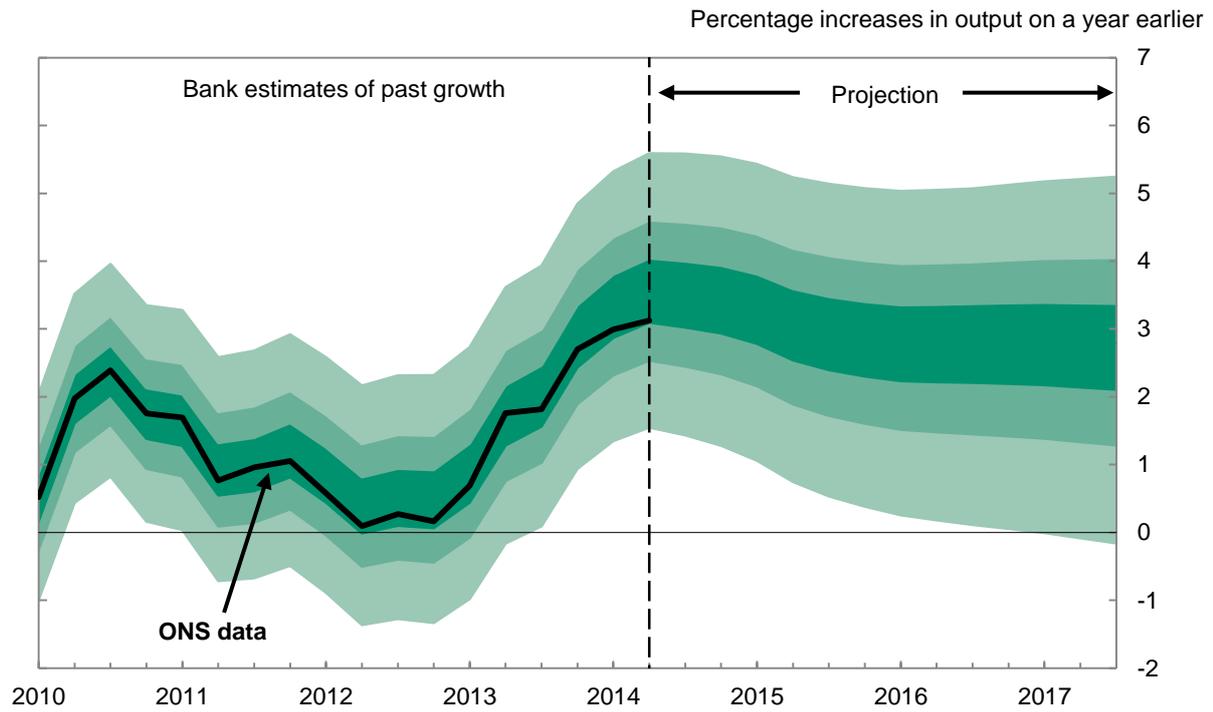**Figure 2a**: Output growth (year on year) simulation

Figure 2b: GDP projection based on market interest rate expectations and £375 billion purchased assets

Percentage increases in output on a year earlier

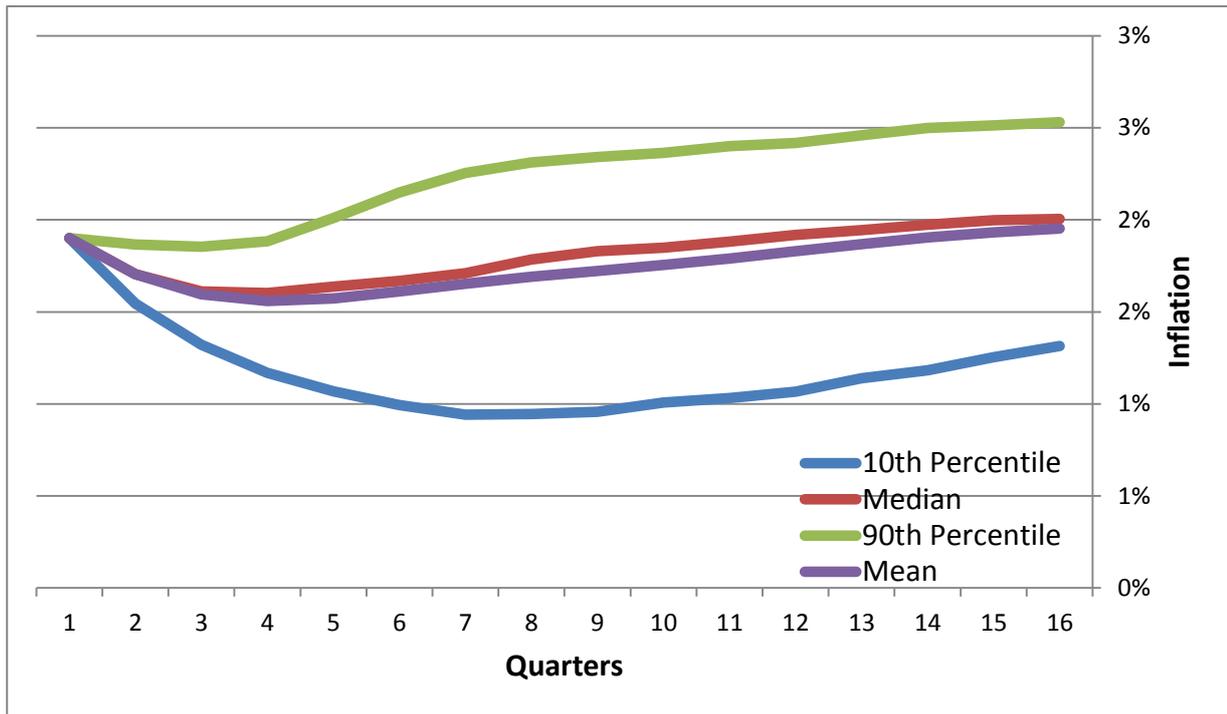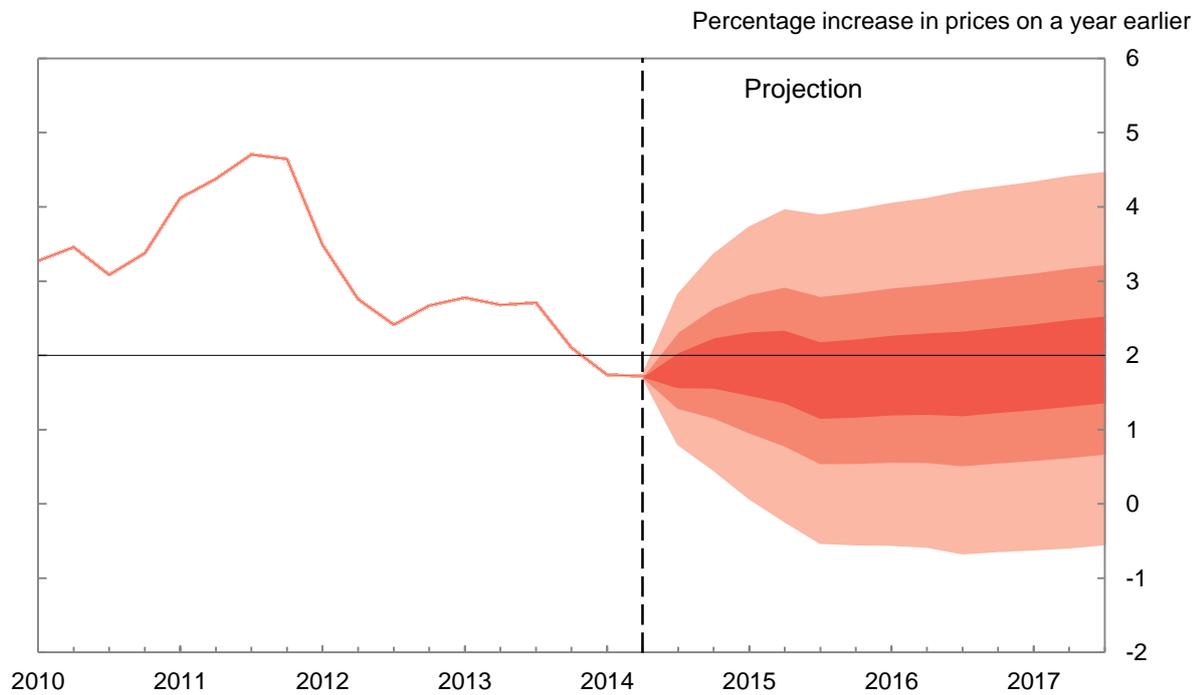Source: Bank of England August 2014 *Inflation Report*.

Figure 3a: Inflation, simulation

Figure 3b: CPI inflation projection based on market interest rate expectations and £375 billion purchased assets

Percentage increase in prices on a year earlier

Source: Bank of England August 2014 *Inflation Report*.

Figure 4 shows probability distributions for the path of Bank Rate[9]. Along the central path (that is the median where 50% of the outcomes are with lower interest rates and 50% have higher rates) the level of Bank Rate rises gradually. But it remains materially below its pre-crisis average of around 5% even after four years. Figure 4 also shows that things may turn out quite differently from the central path. This simple model suggests that there is a 10% chance that the appropriate level of Bank Rate increases to above 5% within 18 months (the line labelled "90th percentile"). It also shows that there is a 10% chance that the appropriate level of Bank Rate is around zero for two years to come and is only just over 1% even four years ahead (the line labelled "10th percentile").

Figure 4: Optimal Bank Rate, simulation
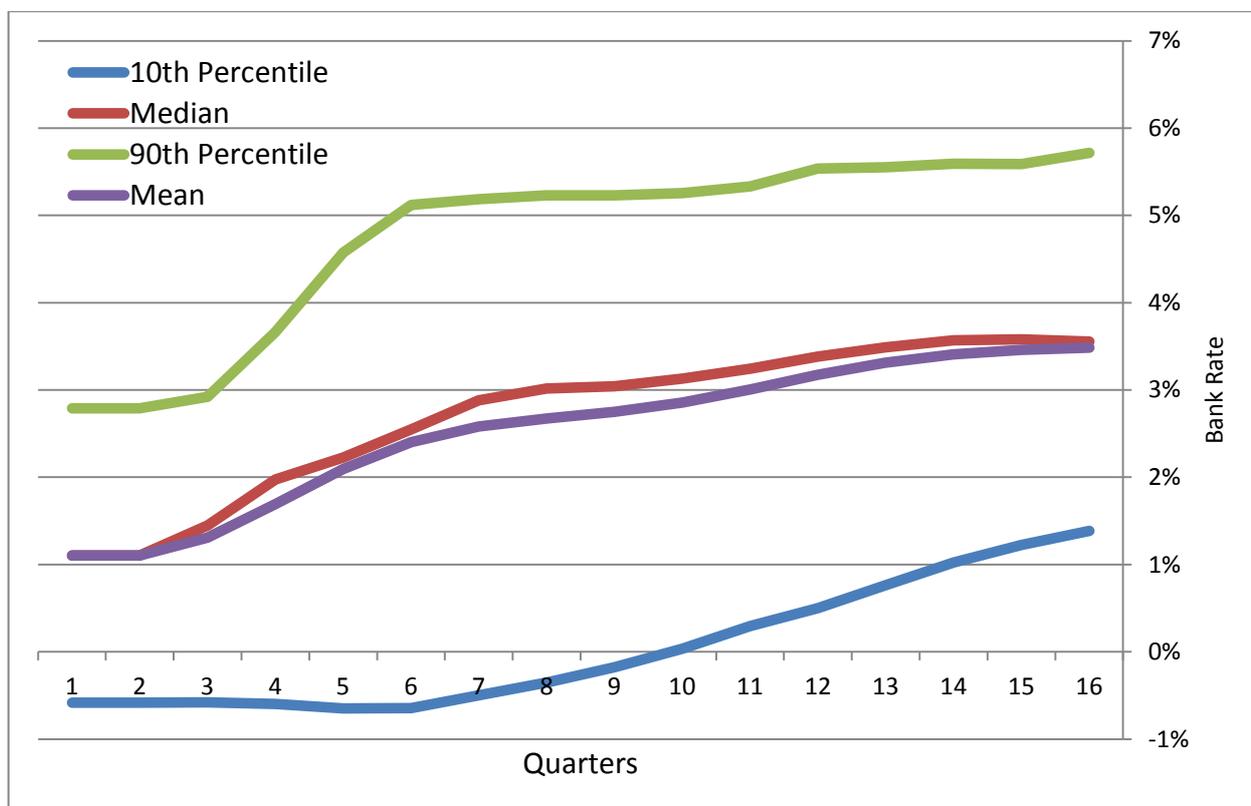
In this simple model, which path for interest rates is taken among the wide swathe shown in figure 4 depends on the values taken by the uncertain (random) parameters of the simple model. This is not meant to be a precise guide to the possible variability in interest rates in the UK over the next four years. While the model allows for some uncertainty about the quantitative relationships between key economic variables, it assumes that these relationships take a specific form – linear in this case – and that they do not change over time. The model also misses key aspects of the economic environment, such as the state of the banking sector, demand for British exports, commodity prices, and the stance of fiscal policy. I also assume that the

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[9] I generate an appropriate path of Bank Rate for each realisation of the set of uncertain parameters. There are 1000 such realisations, or scenarios, in all. Each path is that from following an optimal interest rate rule that is derived ex-ante of the realisations (and thus takes into account the model uncertainties). In the context of this model, this path of Bank Rate could be interpreted as a composite of Bank Rate and asset purchases.

economy is not hit by any unpredictable events during the forecast horizon – we just get a realisation of the random factors (on initial slack, on the strength of interest rate effects and so on) and that determines how the economy then evolves. But in reality there is a real chance that we experience substantial changes in the prices of, for example, oil, financial assets, or exchange rates during this period, all of which can affect inflation and output and none of which I take account of here. So in practice outcomes may even be more variable than what is shown in the figures.

How does a policy of fixing the interest rate for a 3 or 4 year horizon look in the light of this model? Not very attractive I should say. Suppose that interest rates are set at the outset so that they follow the central (median) path. *On average* this is an appropriate policy – but in the light of how things actually evolve it could be very different from the interest rate that would be appropriate based on what actually happens to inflation and output. How wrong could it be? Well 4 years ahead the interest rate to which the central bank commits at the outset if it fixes policy at what is (ex ante) the average outcome could, with about 10% probability, **be at least** 2.5 percentage points too low and with 10% probability it could be **at least** 2 percentage points too high. Having interest rates that far from the right level, and for an extended period, seems to me a very high price to pay for the certainty of following a given path for interest rates. It would probably generate outcomes that were wildly unstable. In the Annex I show some specific examples of unstable outcomes from following a fixed interest rate path. Indeed across a wide range of economic models it is the case that outcomes can become completely unstable if the central bank does not vary the nominal interest rate in response to economic developments.

Suppose instead that the central bank accepts that it must respond to events as they unfold. Suppose in fact that the central bank calculates what the appropriate response is given the uncertainties and sees that the fan chart for interest rates is as in Figure 4 (based of course on our highly simplified model). How might it then give guidance on policy? A natural response might be to say it should just publish figure 4. I want to consider some practical issues with that in a moment. But setting those to one side for now, let me consider how you might describe in everyday language the message that figure 4 conveys. (And using everyday language is absolutely central to effective communication. The amount of training and time needed to really understand what figure 4 means is surprisingly large). One might try the following as guidance:

Interest rates are likely to rise gradually from their current exceptionally low point, but probably to a level that is meaningfully short of the level of around 5% that used to be thought normal. But the exact path that interest rates should follow cannot be known for certain since how the economy will evolve is not known in advance. There is inevitably substantial uncertainty about the precise level of interest rates that will be suitable in the future. So this guidance is more in the way of an expectation and certainly not a commitment.

I don't think that is a bad summary – in everyday language – of what figure 4 shows. It is also pretty much the message on policy that the MPC have been giving for some months.

Whether or not something more precise and quantified than this broad description is useful is the issue I want to turn to next. Before that let me just say again that the figures above are based on a highly simplified model and that the way it is calibrated is based on some fairly subjective, though I think reasonable, judgements. For all that, I think the central conclusion that I draw from it – which is that setting interest rates on a pre-committed path for several years ahead does not look like a very attractive strategy – is one we can be confident about. The key point is that things can happen in the economy that are very different from our current best guess, and that when they do, just leaving interest rates on an unchanged path is not sensible.

This is not just a theoretical point. The scale of unexpected shocks that hit the UK – the difference between actual outcomes and prior best guesses – really is big. To illustrate, table 1 compares the annual GDP growth rates in the first quarters of 2008, 2009, and 2010 with predictions made in the first quarter of 2007. The Bank of England asked a group of private sector economists what they thought the likelihood was that the annual growth rate of GDP would be smaller than -1%, between -1% and 0%, between 0% and 1%, and so on, in the first quarter of 2008, 2009, and 2010. The probability distribution shows the average assessed likelihoods across all answers.

Table 1: Forecasters' probability distribution for GDP growth as of Q1 2007

| **GDP Growth** | Range: | | | | | | Growth |
Probability, per cent	< -1%	-1 - 0%	0 - 1%	1 - 2%	2 - 3%	>3%	Outturn
Q1 2008 (1 year ahead)	0	0	17	43	32	8	2.8%
Q2 2009 (2 years ahead)	6	12	21	27	21	13	-6.8%
Q1 2010 (3 years ahead)	3	7	12	22	34	24	0.5%

Source: Projections of forecasters as of Q1 2007. Outturn from ONS.

All economists interviewed thought there was only a remote possibility of a recession as deep as the one that subsequently occurred. On average people surveyed thought it 94% likely that growth in the year to 2009 Q2 would be above -1%. The outturn was for growth of -7%. Table 2 shows results for annual inflation forecasts as of 2007 Q1. Economists believed that the likelihood that the actual inflation rates for 2009 Q1 would be 3% or higher was around 6% and for 2010 that there was only a 10% chance that inflation would exceed 3%. In fact inflation was at 3% or more in both years. Two- and three-year ahead forecasts of annual inflation made in 2011 were not much better, as Table 3 shows.

Table 2: Forecasters' probability distribution for CPI inflation as of Q1 2007

CPI Inflation	Range:							CPI
Probability, per cent	<0%	0 - 1%	1 - 1.5%	1.5 - 2%	2 - 2.5	2.5 - 3	>3%	Outturn
Q1 2008 (1 year ahead)	0	5	14	28	30	16	8	2.4%
Q1 2009 (2 years ahead)	9	17	21	23	16	8	6	3.0%
Q1 2010 (3 years ahead)	3	8	14	25	26	15	10	3.3%

Source: Projections of forecasters as of Q1 2007. Outturn from ONS.

Table 3: Forecasters' probability distribution for CPI inflation as of Q1 2011

CPI Inflation	Range:							CPI
Probability, per cent	<0%	0 - 1%	1 - 1.5%	1.5 - 2%	2 - 2.5	2.5 - 3	>3%	Outturn
Q1 2012 (1 year ahead)	4	9	22	29	19	12	6	3.5%
Q1 2013 (2 years ahead)	3	7	12	21	26	19	12	2.8%
Q1 2014 (3 years ahead)	3	7	12	23	24	19	12	1.7%

Source: Projections of forecasters as of Q1 2011. Outturn from ONS.

What happened to the exchange rate and to oil prices between Autumn 2007 and early 2009 was also very far away from market expectations. This is illustrated in Tables 4, 5 and 6.

Table 4: Range of forecasts of the Exchange Rate Index as of Q1 2006

Exchange Rate Index	Min	10th Percentile	Median	90th Percentile	Max	Outturn
Q1 2007 (1 year ahead)	91.70	92.82	98.00	100.37	100.62	104.65
Q1 2008 (2 years ahead)	90.10	92.20	97.10	99.98	100.70	95.87
Q1 2009 (3 years ahead)	88.80	91.00	96.40	99.98	101.10	77.75

Jan 2005=100

Source: Projections of forecasters. Outturn from ONS.

Table 5: Range of forecasts of oil prices as of August 2007

Forecasts of WTI Oil Price (US$ per barrel)	Min	Mean	Max	Standard Deviation	Outturn	(Outturn-Mean)/S.D
End of Nov 2007 (1 qtr ahead)	59.0	69.3	75.0	3.7	**88.6**	**5.2**
End of Aug 2008 (1 year ahead)	51.4	68.2	80.0	6.1	**115.6**	**7.8**

Source: Projections of forecasters from Consensus Forecasts, Consensus Economics Inc. Outturn from Thomson Reuters.

**Table 6**: Range of forecasts of oil prices as of Feb 2008

Forecasts of WTI Oil Price (US$ per barrel)	Min	Mean	Max	Standard Deviation	Outturn	(Outturn-Mean)/S.D
End of May 2008 (1 quarter ahead)	66.0	84.6	100.0	6.1	**127.4**	**7.0**
End of Feb 2009 (1 year ahead)	65.0	82.0	102.0	8.1	**44.2**	**-4.7**

Source: Projections of forecasters from Consensus Forecasts, Consensus Economics Inc. Outturn from Thomson Reuters.

The implied chance that oil prices would fall in different ranges, derived from options prices[10], also suggest that what subsequently happened was thought to be extremely unlikely. Figures 5 and 6 show the outturns along with a probability distribution implied by option prices as they were in September 2007. Outcomes as high as they were in September 2008, or as low as they were in March 2009, were each given less than a 3% probability.
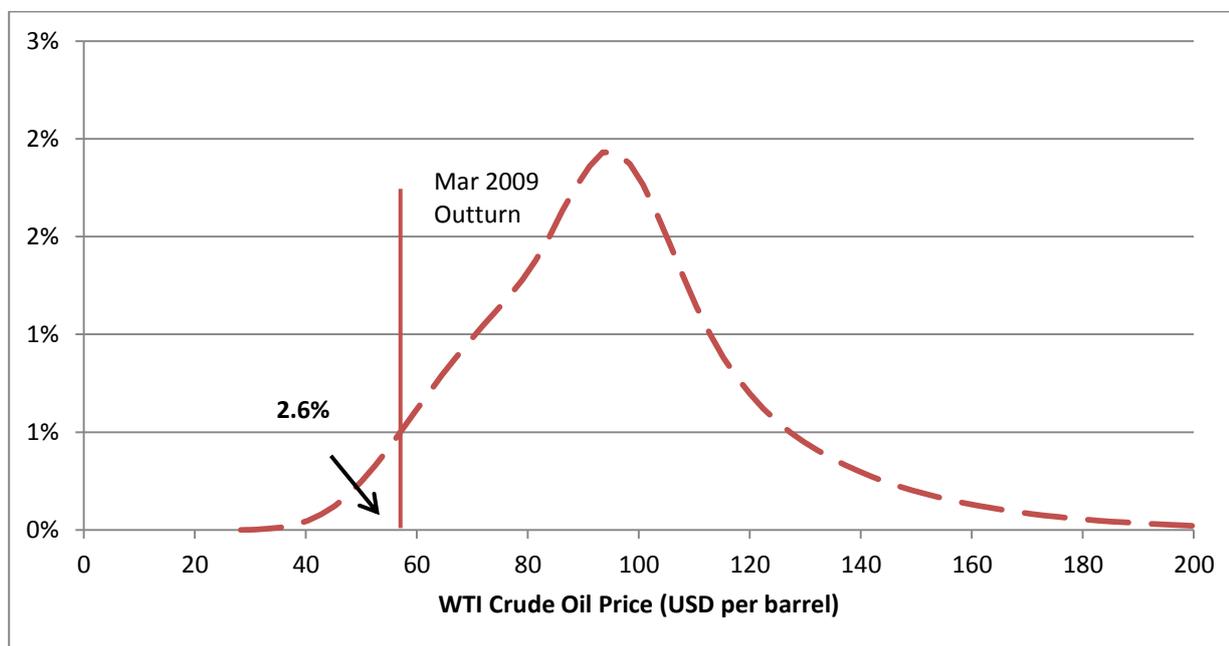
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[10] Note that these are risk-neutral probabilities.

Figure 5: Option implied distribution of probabilities for WTI crude oil price 1 year ahead, as of end Sep 2007
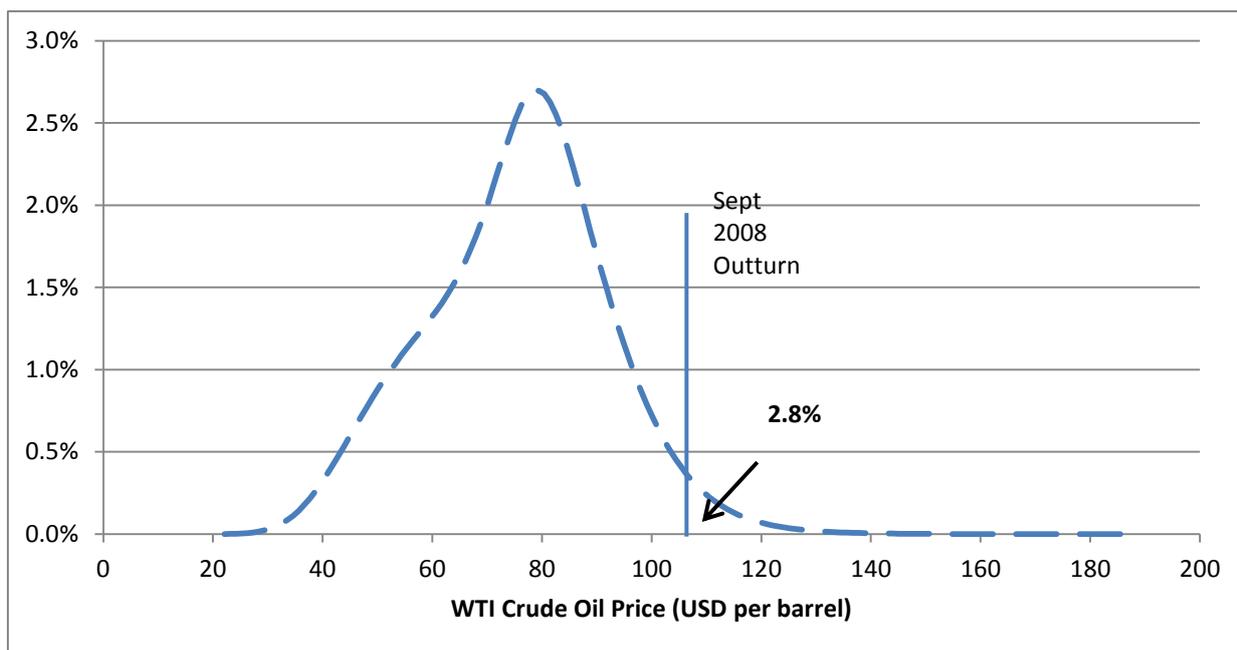
Source: Bloomberg, Chicago Mercantile Exchange and Bank calculations.

Figure 6: Option implied distribution of probabilities for WTI crude oil price 1 year ahead, as of end March 2008

Source: Bloomberg, Chicago Mercantile Exchange and Bank calculations.

Self-evidently uncertainty around the future economic environment is very significant. This is why the MPC meets regularly to assess the latest developments and, if necessary, to adjust the stance of monetary policy.

The commitment to a particular interest rate path is very unlikely to be the answer to the question of where on the spectrum of giving guidance on policy one should sit.

Yet people who ask what Bank Rate will be in a few years' time are likely to be disappointed if all they are told is that it might be not much different from today, but it could be around 5%, or somewhere between the two, or maybe even outside that range.

So what is the right sort of information – the right sort of guidance – to give?

3. What does economics tell us?

As I noted above, in stylised models of the economy where the central bank and the general public have exactly the same information about the structure of the economy – and make the same assessment of the nature of uncertainty – then everyone can work out what the central bank will do in various circumstances so long as the central bank explains what exactly the aim of policy is, including about how trade-offs between goals are evaluated. The central bank could specify some reaction function – that is a description (or rule) for how it would set interest rates depending on how the economy evolves. But in a model which assumes perfectly rational, computationally proficient and equally informed people, they could work out for themselves the rule the central bank would follow to best achieve its objectives. If one weakened that assumption on common knowledge then providing a monetary policy reaction function can be a useful form of guidance. But in practice the conclusion that the central bank needs to either simply be explicit about its aims or provide a policy reaction function is not very helpful because it ignores several very significant real world complications:

1. Central banks will have different information about the economy than other agents – not so much in terms of having more raw data (though that will certainly be a factor) but more in terms of the scope to analyse it in an institution that has a small army of people trained to interpret data

2. Central banks will use various models of the economy – all of them imperfect and none used as sole guide to policy. The use of such models in setting policy is part science and quantifiable (in the sense that an explicit policy rule could in principle be codified and shared) and part judgement – which is much more difficult to codify in a useful way. Coming up with a reaction function that is a good approximation to the actual decision making procedure and can also be understood is in practice very difficult. (This is made more complicated if people on the policy Committee don't all agree and if those people change over time).

3. Even if models could all be codified and some policy rules specified, then if they were to be even an approximate guide to actual decisions they would probably be complicated. They might be of the form: "if X, Y and Z happen, and none of A, B or C happen, then policy will be set according to the following (non-linear,

dynamic, regularly re-estimated) equation…." The number of people who could understand what that means and find it useful may be very small; the scope to misinterpret it is large[11].

So what are some other options for giving useful guidance?

One is to provide an expected path for the policy rate (for example the median path shown in figure 4 above). But without giving some idea about how likely it is that policy will be close to this path this may not be particularly useful. While making clear there is uncertainty around those paths is simple, quantifying that uncertainty is tricky. One might just draw on the volatility of past interest rates (around some previously expected path) as a guide to uncertainty in the future. Or a stochastic simulation using a monetary policy rule could be used to derive fan charts for the policy rate. The policy rule could be (an approximation) to an optimal rule – which is one way to interpret figure 4 above. What figure 4 showed was the probability distribution for the path of Bank Rate if the central bank were to follow a mechanically derived optimal rule taking into account the uncertainty of the parameters. It is worth stepping back though to consider what is needed to construct figure 4.

You need the following elements:

1. An assessment of all the random factors (or shocks) that can impinge on the economy and their probabilities
2. A model of how those shocks then impact on the outcome you care about – inflation, growth, output etc.
3. A model for how monetary policy affects those outcomes and can be used to offset the impact of shocks

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[11] You may think this is an exaggerated statement about what a policy rule might look like. But consider the rule that the MPC adopted in August 2013. This is how it was described:

The Committee intends at a minimum to maintain the current highly stimulative stance of monetary policy until economic slack has been substantially reduced, provided this does not entail material risks to either price stability or to financial stability.
In particular, the MPC intends not to raise Bank Rate from its current level of 0.5% at least until the Labour Force Survey headline measure of the unemployment rate has fallen to a threshold of 7%, subject to the conditions below.
The MPC stands ready to undertake further asset purchases while the unemployment rate remains above 7% if it judges that additional monetary stimulus is warranted. But until the unemployment threshold is reached, and subject to the conditions below, the MPC intends not to reduce the stock of asset purchases financed by the issuance of central bank reserves and, consistent with that, intends to reinvest the cash flows associated with all maturing gilts held in the Asset Purchase Facility.
The guidance linking Bank Rate and asset sales to the unemployment threshold would cease to hold if any of the following three 'knockouts' were breached:
- in the MPC's view, it is more likely than not, that CPI inflation 18 to 24 months ahead will be 0.5 percentage points or more above the 2% target;
- medium-term inflation expectations no longer remain sufficiently well anchored;
- the Financial Policy Committee (FPC) judges that the stance of monetary policy poses a significant threat to financial stability that cannot be contained by the substantial range of mitigating policy actions available to the FPC, the Financial Conduct Authority and the Prudential Regulation Authority in a way consistent with their objectives.
The Committee will continue to set the level of Bank Rate and the size of the asset purchase programme each month, taking these criteria into account. The action taken by the MPC if any of these knockouts were breached would depend upon its assessment at the time as to the appropriate setting of monetary policy in order to fulfil its remit to deliver price stability. There is therefore no presumption that breaching any of these knockouts would lead to an immediate increase in Bank Rate or sale of assets.

This policy rule runs to 360 words.

4. An assessment of what the optimal policy response to such shocks is (which means using 1-3 above to derive a policy rule that maximises some specified target function).

5. If policy is made by a committee you need to reach an agreement on 1-4; if it is a committee with members responsible for their own votes you somehow need to reconcile a unique path of rates (for given realisation of shocks) with individual accountability in an environment where people will take different views on the structure of the economy, its current state and the chances of various shocks hitting in the future.

This is a complex task. I could construct figure 4 but only with a very simplified and stylised model (which ignored a vast amount of information that any policy committee should certainly take account of) and where I chose the calibrations based on my own rather subjective assessment of the environment. For example I chose to calibrate uncertainty about slack by saying it was somewhere in the 0-4% range and that all outcomes in that range were equally likely. The MPC currently have a best collective view that slack is most likely to be around 1% – a rather different assessment. And the model I used to construct figure 4 had only four sources of uncertainty – in practice at MPC meetings we discuss many dozens of sources of uncertainty.

The MPC could nonetheless decide to use a mechanical procedure that is some sort of rough approximation to its decision making so as to produce a fan chart for interest rates. That might involve using a model with a similar structure to that used to construct figure 4; it would have embedded in it a policy rule for setting interest rates for any given state of the economy. This would be a (pretty crude) approximation to the decision making process of any one member of a Committee. Whether the resulting probability distribution of interest rates was a useful guide to the true chances of interest rates taking on different values is hard to judge. Whether any resulting fan chart of interest rates would be an improvement over a rougher sort of guidance – for example a statement that interest rates are expected to only increase gently from the current level over the next few years – is also unclear.

There is no getting around the fact that constructing fan charts of interest rates that represent the MPC's view of the probability of different paths present many problems. It involves, for example, the quantification of the chances of various events happening which may go beyond what can meaningfully be done. The apparent precision of probability statements in a world of uncertainty (not just risk) can be misleading[12].

More useful can be the assessment of different scenarios and the use of model to (in a rather mechanical way) find a path for interest rates which in that particular scenario delivers a path for output and inflation with particular features. This gives an indication of the sort of policy response that might be appropriate in a

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[12] The distinction between uncertainty and risk is one that Knight and Keynes both made. In a famous passage Keynes described what he meant by "uncertain knowledge":
"By 'uncertain' knowledge, let me explain, I do not mean merely to distinguish what is known for certain from what is only probable. The game of roulette is not subject, in this sense, to uncertainty...The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of copper and the rate of interest twenty years hence...About these matters there is no scientific basis on which to form any calculable probability whatever. We simply do not know." Keynes (1937).

specific eventuality. One possibility is something along the lines of the Riksbank's 'four-panel graphs' as illustrated in their February 2012 minutes (Sveriges Riksbank 2012), or the 'three policy paths' used by Yellen (Yellen 2012). (See also Svensson (2013)).

So what do some of the world's major central banks do today?

4.   Communication strategies of other central banks

At the Bank of England the MPC does produce forecasts of inflation and GDP with assessments of the probability of different paths over a 3 year horizon. These are conditional forecasts based on specific paths for interest rates – so do **not** take account of the likely response of the MPC to different outcomes. And the specific interest rate paths are not a view of the MPC or its most likely (or expected) future policy[13]; they are either for a constant interest rate path or the prevailing market curve. These conditioning assumptions raise well-known problems – well described by Woodford (2013).

The Fed provides different information. The members of the Federal Open Market Committee (FOMC) each provide their central projection of the appropriate Federal Funds rate target at the end of each of the next several years, as well as in the longer run. (These views are represented as individual points on a 'dot chart'). FOMC members also provide forecasts for key economic variables – such as output growth, unemployment and inflation – based on their own individual assessment of appropriate monetary policy.

The range of dots in the FOMC's 'dot chart' represents the range of committee members' central projections for interest rates. The FOMC's dot chart may be useful at conveying the heterogeneity of views amongst its participants; but by focusing on only central estimates, it does not reflect the uncertainty each policy-maker attach to their own assessments.

It might seem clear that to condition forecasts on policymakers' views on what would be their own future monetary policy response is a better alternative than the Bank of England approach and that if risks around that preferred path can be quantified it provides more useful information than the FOMC dot chart. In rather different ways The Reserve Bank of New Zealand, the Norges Bank, and the Riksbank attempt to do just this. If the path of interest rates used is a reasonable approximation to the true expectation based on how the Committee will actually make decisions in the future, then this would seem a better option than using a market implied path for interest rates and would avoid some well-known problems of consistency and interpretation.

There is still the issue of how to provide probability assessments of interest rates being away from the "preferred" path. The Riksbank uses uncertainty bands based on historical forecast errors for implied

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[13] A policy that will in practice be voted on by a committee whose membership will not be constant.

forward rates, which are adjusted to take into account the corresponding risk premium[14]; the Norges Bank uses fans that depend in part on model-based density forecast and in part on judgment[15]. For the Reserve Bank of New Zealand (RBNZ), the fan chart represents the uncertainty around the magnitude of the main drivers of the economy. The RBNZ fans summarise the projected path of interest rate for a collection of a thousand scenarios[16]. (It is worthwhile noting that the RBNZ's fan chart does not need to reflect the heterogeneity in views across policy makers, because in New Zealand the Governor is personally responsible for all the monetary policy decisions taken by the Bank[17].) There are different ways the future paths and uncertainty bands around them can be generated, and there is no clear right way. The precise way to generate these fan charts, and what type of uncertainty could, or should, be incorporated is likely to continue to be the subject of research.

5. Guidance about the future path of policy in the UK

In different ways the MPC has for a long time provided guidance about the likely future path of policy in its publications, in speeches, interviews and evidence at the Treasury Committee. Some guidance about the future path of policy was provided in an indirect way. The Inflation Report has for many years contained forecasts for GDP and inflation that are derived under the assumption that Bank Rate would follow the profile implied by market rates. If inflation was then expected to rise above target, it was an (imperfect) indication that many on the MPC believed it would probably have to raise rates above what was implied by market rates. And vice versa, if inflation was expected to fall below target conditional on market interest rates.

This may seem to be a roundabout way of communicating the likely future path of interest rates. And as I said earlier, there are known problems of internal consistency with the conditioning path assumption behind those charts, summarised clearly in Woodford (2013). But in the years preceding the financial crisis, a period that has been described as the great moderation, it seemed to most people that the fan charts gave them a reasonable guide to what the MPC was up to and how policy might evolve. In large part this was because the path of Bank Rate implied by market interest rates usually generated a fan chart for inflation whose central path was close to the target and was fairly symmetric around it. And if market interest rates deviated materially from what the MPC thought would appropriately reflect their likely future policy stance, MPC members had plenty of opportunities in addition to producing fan charts to influence market expectations: there has never been a shortage of MPC speeches and interviews.

August 2013 saw the introduction of more explicit guidance about policy. Monetary policy had gone through a phase of exceptionally low interest rates and unprecedented asset purchases. With the economy starting to pick up speed again, uncertainty about how the MPC would respond to signs of a gradual economic recovery appeared particularly great. So it seemed to the MPC right to give more guidance than had been

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[14] Sveriges Riksbank (2007)
[15] Gerdrup and Nicolaisen (2011)
[16] For details, please refer to the Reserve Bank of New Zealand's Monetary Policy Statement.
[17] See: http://www.rbnz.govt.nz/monetary_policy/about_monetary_policy/2851362.html

given in the past. The combination of unprecedented shocks and exceptional policy meant that past actions might not be giving much information about how policy might be set. For me there was one specific risk in mid-2013. This was that at the emerging signs that the growth of GDP might be returning to levels that were closer to the long run trend for the UK, people might assume that with inflation also fairly close to target that monetary policy might quickly be returned to something that looked more normal. "Normal" might well be thought of as a level for Bank Rate of around 5% (which is the average Bank Rate since 1694 and also the average in the 10 year period between the formation of the MPC and the onset of the financial crisis – a period when inflation was close to target and growth close to the long run average for the UK).

Now the MPC is giving some qualitative judgements on most likely outcomes – saying that interest rate rises are expected to be gradual and probably to a level lower than had been seen as normal pre-crisis.

Is this guidance too vague and imprecise (more vague than is optimal)? Is it open to misinterpretation?

The MPC could try to give more information on how it will set policy; it could give some approximation to its future reaction function. But I have argued that an easy to understand reaction function will likely be too crude to accurately reflect how decisions will actually be made – so runs the risk of being more misleading than informative. It is not self-evident that some approximation to a collective reaction function (even ignoring such issues as different members having different reaction functions) is really helpful to ordinary people in understanding what the prospects are for interest rates. It is very likely that any reaction function the central bank gives will at best be a rough approximation; and the more precise you make it the more people may see it as a rule which will absolutely be followed. This is one aspect of a broader problem with guidance which is the danger that people confuse guidance with commitment.

The MPC has been at pains to stress that the guidance it gives is more an expectation than a promise. This has been true since we provided the assessment of the uses of guidance in August 2013. And yet it has been very common in the media to describe guidance in the language of promises (or time-contingent guidance):

- "New Governor Mark Carney announced the bank was unlikely to raise rates until the end of 2016, at the earliest." Mirror, 7 August 2013[18]

- "Bank on good times rolling" – "The Bank of England aims to keep interest rates at record low for as long as three years". The Sun, 8 August 2013

- "I will keep rates low for 3 years says Bank of England boss". The Daily Express, 29 August 2013 [19]

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[18] http://www.mirror.co.uk/money/city-news/bank-england-interest-rates-could-2137614#ixzz3DfexGCLM
[19] http://www.express.co.uk/news/uk/425331/I-will-keep-rates-low-for-3-years-says-Bank-of-England-boss

The risks of interpreting guidance meant to convey expectations as commitments is not just hypothetical.

6. Conclusions

In an ideal world (and in idealised models) the Central Bank can just explain its objectives; maybe it would also need to describe its reaction function. No more is needed.

But unless outsiders have as good information on the economic outlook – and can plug that into the reaction function – then they may be left floundering in attempting to assess the prospects for interest rates.

 Any reasonable approximation to a reaction function might be very complex. (Indeed it is very likely that it is; otherwise MPC meetings would be mechanical affairs lasting 5 minutes).

In light of this I believe that the central bank directly giving some assessment of the likelihood of interest rates following different paths is likely to be helpful, particularly in situations in which past action and communication is not enough to describe new trade-offs in an unusual environment.

Constructing an explicit probability distribution for the central bank's own policy rate that is based on the realities of how policy is made and gets across a message that can be widely understood is a major challenge.

Attempting to provide a specific central path with fans around it is a complex task, and may go beyond what is feasible and useful. Spurious accuracy is unhelpful. So while I am open minded about whether the MPC should provide fan charts for interest rates, I am not convinced that is clearly a step forward.[20]

Currently, it might be just as useful – and probably less misleading and possibly even more accurate – to give forms of guidance which are more qualitative, such as: "interest rate rises will probably be gradual and likely to be to a level below the old normal".

That says something substantive; **and** most people can understand it.

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[20] As Gilboa has stressed a probabilistic approach is quite useful in illustrating a broad sense of subjective uncertainty, but can be counter-productive if it forces the practitioner to impose an arbitrary degree of precision to that uncertainty. In a case where we want to communicate that interest rates are likely to rise gradually whilst also emphasising there is a significant degree of uncertainty around this expected path, a model based fan chart forces us to address the question: 'Exactly how uncertain are you? By 1% or 2%?' It can be difficult to provide an answer without imposing some spurious level of precision. The reality is that not all types of uncertainty can be meaningfully quantified. As Gilboa says: "The Bayesian approach is quite successful at representing knowledge, but rather poor when it comes to representing ignorance. When I try to say, within the Bayesian language, 'I do not know', the model asks me, 'How much do you not know? Do you not know to degree 0.6 or to degree 0.7?' " Gilboa (2014).

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Annex: The Model

The model presented below is reduced to the bare minimum. It has three parts, summarised in three equations, which describe the evolution of output, inflation and supply capacity. We aim to describe the economic environment – and crucially the uncertainty about it – in a way that is roughly consistent with the assessment made by the MPC in its latest *Inflation Report* and which allows an explicit calculation of optimal monetary policy.

1. The growth rate of output ($\dot{y}_t$) depends on the deviation of the real interest rate from its natural level (r^*). The real interest rate is the nominal rate, set by the central bank and denoted (i), minus inflation (π). (We assume that this dependence is linear but allow both the constant and the slope coefficient to be uncertain.

$$\dot{y}_t = \beta_0 + \beta_1(i_{t-1} - \pi_{t-1} - r^*) \tag{1}$$

2. Inflation depends on the output gap via a Phillips curve. We constrain the constant such that inflation remains at target when the output gap is zero.

$$\pi_t = \pi^*(1 - \alpha_1) + \alpha_1\pi_{t-1} + \alpha_2(Gap_{t-1}) \tag{2}$$

Gap_{t-1} stands for the output gap in the economy in quarter t-1, defined as output (y) relative to supply capacity (y^s).

3. The growth of the economy's supply capacity is a weighted average of the mean growth rate of output and its actual growth rate: above-average demand growth stimulates supply growth, and vice versa. We allow the extent to which supply growth responds to output growth to be uncertain.

$$\dot{y}_t^S = \delta_1\dot{y}_t + (1 - \delta_1)E[\beta_0] \tag{3}$$

The central bank's objectives are summarised by a standard loss function, according to which the central bank would like to avoid deviations of inflation from its inflation target, and deviations of output from supply:

$$L = \sum_{t=0}^{T}\beta^t[(\pi_t - \pi^*)^2 + (Gap_t)^2] \tag{4}$$

It sets monetary policy according to a linear Taylor rule:

$$i_t = \tau_0 + \tau_1(\pi_{t-1} - \pi^*) + \tau_2(Gap_{t-1}) \tag{5}$$

We assume that the central bank chooses the parameters τ_1, τ_2 of this rule ex ante, before knowing the realisation of the uncertain parameters, in order to minimise the expected value of the loss function (4). (For ease of interpretation of the results, we constrain the constant, τ_0, to be equal to the sum of the inflation

target π^* and the neutral real rate (r^*); this is close to the optimum that an unconditional minimisation delivers.) We solve this minimisation problem numerically by computing the evolution of the economy over 50 quarters for each of 20000 different realisations of each random variable, and then taking averages over the associated losses. We assume that the economy is not hit by any shocks. The endogenous variables are uncertain only because the values of some parameters and of the initial output gap are uncertain.

Table 1: Calibration of the model

Uncertain parameters	
Quarterly growth rate of output at unchanged policy (β_0)	Distributed uniformly in [0 ; 1.3%]
Impact of changes in monetary policy on the quarterly growth rate of output (β_1)	Distributed uniformly in [-1 ; -0.1]
Impact of the deviation of the growth rate of demand from its expected value on supply capacity (δ_1)	Distributed uniformly in [0 ; 0.8]
Initial output gap (Gap_0)	Distributed uniformly in [0 ; 4%]
Certain parameters	
Quarterly growth rate of supply capacity (δ_0)	0.65%
Inflation inertia coefficient (α_1)	0.95 (quarterly)
Inflation in period t=0 (π_0)	1.9% p.a.
Slope of the Phillips curve (α_2)	-0.1
Neutral level of the real interest rate (r^*)	1.5% p.a.

Scenario analysis: Commitment vs rule-based policy making

In Figure A1 and A2 below I illustrate the economic outcomes that would prevail under specific scenarios if the central bank were to commit to the median path of Bank Rates illustrated in Figure 4. This is contrasted with the case where the central bank can respond in each period according to the mechanically derived optimal policy rule, taking into account the uncertainty around the parameters.

Figure A1: Commitment to a specific policy path vs rule-based policy making under scenario of robust growth and low output gap

Scenario 1: $\beta_0 = 0.625\%$; $\beta_1 = -0.4$; $\delta_1 = 0.5$; $Gap_0 = 0.5\%$ [Commitment leads to rising inflation]
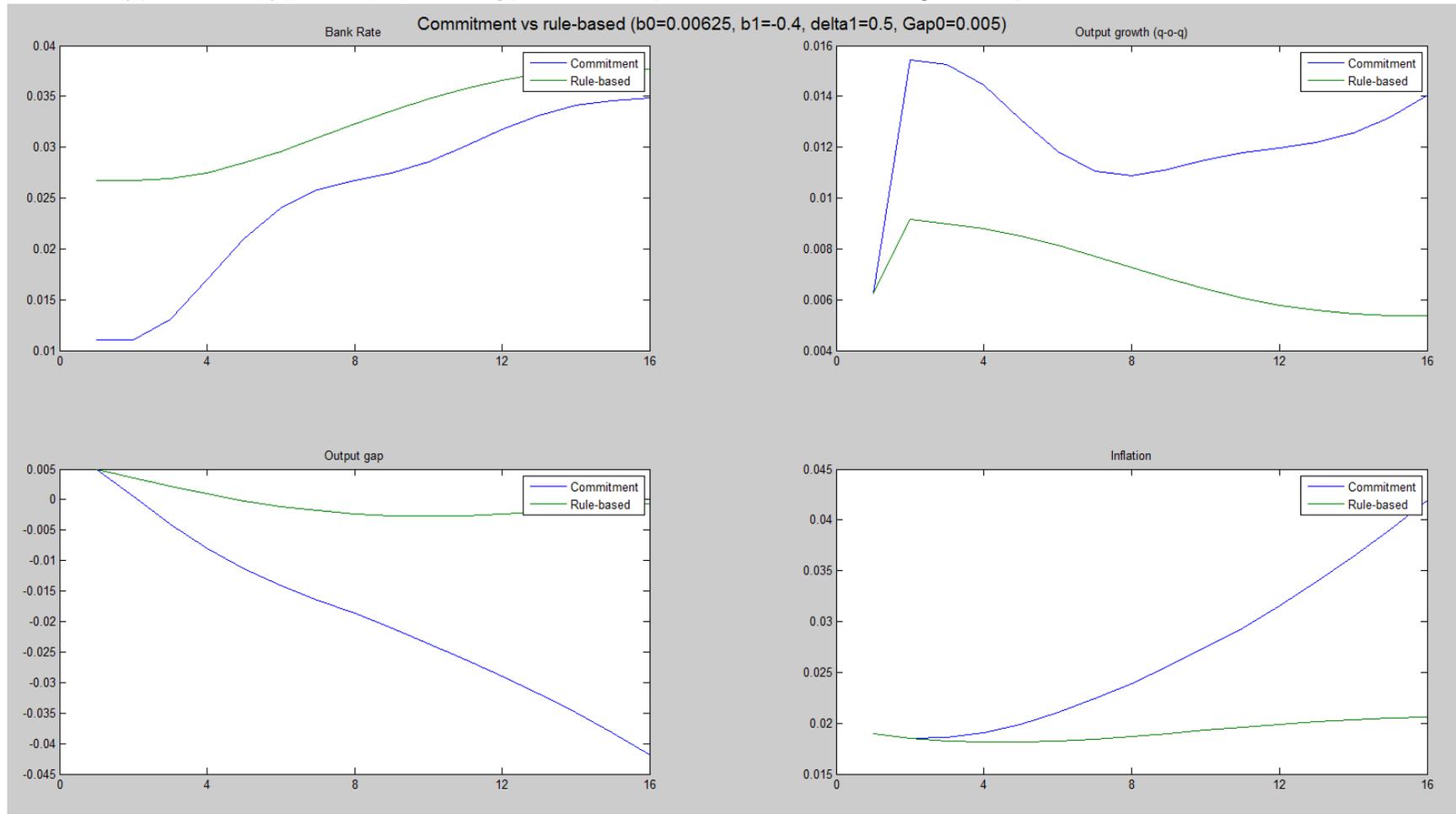
Figure A2: Commitment to a specific policy path vs rule-based policy making under scenario of slow growth and high output gap

Scenario 2: $\beta_0 = 0.2\%$; $\beta_1 = -0.4$; δ_1=0.5; $Gap_0 = 3\%$ [Commitment leads to deflation]