

Inflation Models and Research: Distilling dynamics for monetary policy decision- making - speech by Catherine L. Mann

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Speech

Introduction

Central banks have come under fire for missing their inflation targets, but at least as much because their inflation forecasts have really missed outturns. It is reasonable for people to wonder: How can monetary policy be set correctly if the forecast misses are so large? But, this has been an unprecedented time with a series of shocks and subsequent evolution of the macroeconomy that present significant challenges to forecasting inflation. Our toolbox for economic assessment includes multiple models, but some have been estimated over time periods without major shocks or surges in inflation, and those forecasts effectively assume that quiescent conditions will re-emerge. Most are linear and symmetric and skimp on price-setting or wage-setting fundamentals, which may be reflected as time-varying and state-dependency in inflation dynamics. Some implicitly assume, and others are agnostic about, the stability of monetary policy transmission through financial markets, even as inflation rates and central bank hikes have been the most dramatic in a generation.

No single model can incorporate all these important questions about the inflation process today. But, central bank researchers have risen to the challenge of producing research that does address many of these issues. The key for monetary policy decision-making is how to weight information and predictions from existing models along with innovative new research, to distil a reasonable picture for how inflation might evolve under different economic and monetary policy scenarios.

Inevitably, and unfortunately, the inflation forecast and therefore the monetary policy maker likely will make a mistake; after all, we don't have a perfect crystal ball! Ex-post, either policy will tighten too much, in that the activity costs of monetary tightening are larger than warranted to achieve a deceleration in inflation to target. Or policy will be inappropriately loose, such that inflation will remain above target for an even longer period, risking expectations becoming unanchored. Which mistake would I rather make and do the data and analysis help me in that judgment?

At issue in the current conjuncture, and speaking just for myself, the risk of tightening too little is more salient. I make this judgment for the UK based on a variety of information. For instance data on inflation in core and services persisting at over 6% for over a year by now. Econometric analysis of the decomposition of inflation dynamics into components of expectations and inertia reveals an increasing role for these, which is supportive of continued inflation persistence. Worrying to me, is that a statistically-derived time-varying trend of inflation has drifted above 2%.

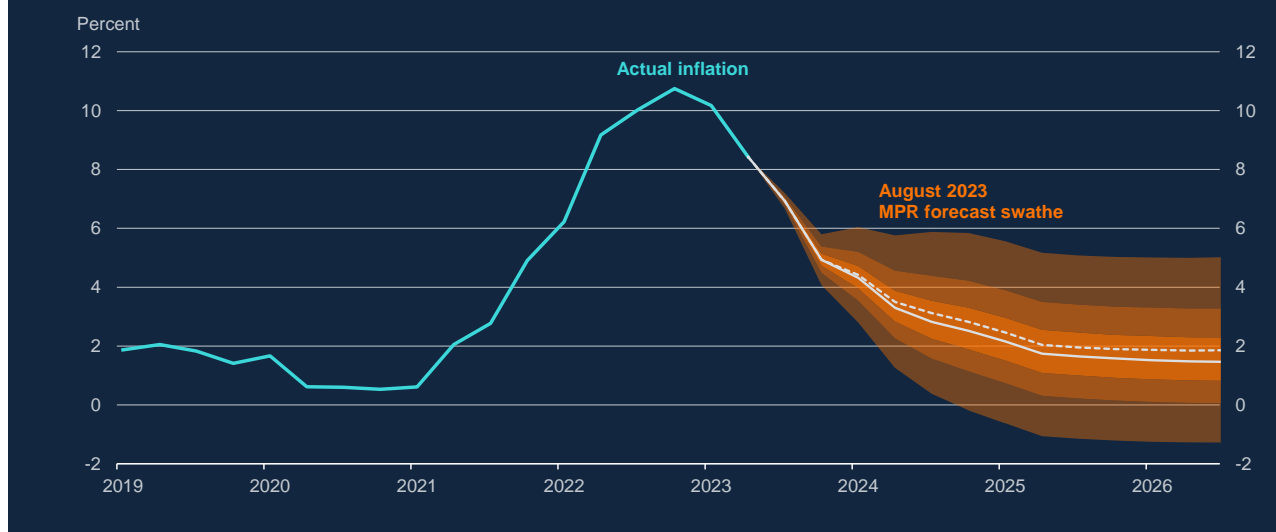
As I've discussed before, monetary policy transmits through financial markets to price setting and the real economy explicitly via an expectations channel. Therefore, duration above target matters for policy risk assessment: the longer inflation remains way above target, the more difficult it will be and the activity costs greater to ultimately get inflation to target. To pause or to hold the policy rate lower for longer risks inflation becoming more deeply embedded, which would then require more tightening in total, to both change inflation itself and to wring-out the embedded inflation that comes from the sustained duration above target. This is why I would rather err on the side of over-tightening. But, if I am wrong, and inflation decelerates more quickly and activity deteriorates more significantly, I will not hesitate to cut rates.

On the MPC forecast

First, let me say a couple of things about the nature of the MPC's forecast as I understand and interpret it. Over the course of a forecast round, it develops with staff assessments and key technical assumptions. Importantly, it is a process of incorporating and distilling from multiple inputs a short-term data-driven and then longer-term models-driven inflation trajectory. But, ultimately, it represents the 'best collective judgment' of the Monetary Policy Committee ([Burgess et al., 2013](#)).

Judgment is key – of particular importance when large and sequential shocks hit an economy. This judgment applies not only to the lines that you see in **Chart 1** but also to the choice of data to augment statistical outputs, which models to pay attention to in the first place and how to weight their conclusions. The data, the models and the judgments are reflected not only in the central tendency in the fan chart of the Monetary Policy Report but also reflected in the skew (and indeed the overall fan). The difference between the modal and mean inflation trajectories has been abnormally large over the last year. In this speech I will consider some of the research that has been particularly informative for my judgments which in turn underpin my risk assessment and monetary policy decisions.

Chart 1: Inflation forecast from the August 2023 MPR
Percent growth over same-quarter average the year prior



Source: [August 2023 Monetary Policy Report](#). Notes: Solid line in the chart shows the modal forecast for inflation, that is the most likely path, the dashed line the mean, or risk-weighted path ([Britton et al., 1998](#)). Latest observation: 2023 Q2 (actual), 2026 Q3 (A23 forecast).

Conditioning assumptions, especially the market curve

Along with judgments, the inflation trajectory depends on a range of conditioning assumptions. They are assumptions about the near-term outlook, future energy prices, exchange rates, fiscal stance, and a particular future path for interest rates. These market expectations of the future path of short-rates is not necessarily the path that the MPC collectively or any member individually would prefer. Neither is it an optimal path in a welfare-maximising sense¹, nor the unconditional prediction of any model. By convention, we condition on the future path of short rates implied by financial markets, which in theory should reflect both the MPC's actions to date, as well as participants' expectations of its current plans, and its likely reaction to future data outturns. However, it will also reflect market participants aggregated assumptions over underlying macroeconomic trends which can make things complicated when these assumptions differ from those embodied in our forecast process. But I'll come back to that later.

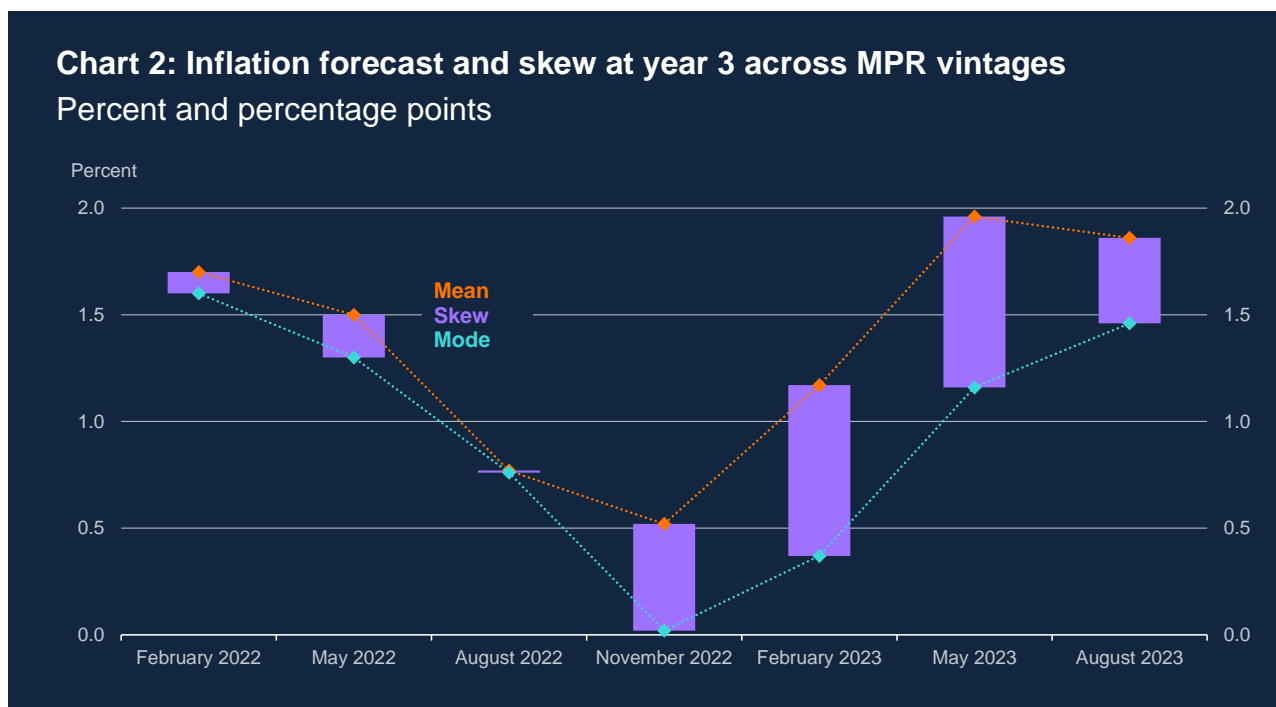
In general, I believe it is not a good idea to over-interpret the line, which is the modal forecast generated by the models and data, as well as judgments. At least as important, especially these days, is to consider the balance of risks embodied in the fan. The width of the fan measures the average expected forecast error, which uses as a starting point the

¹ See, for example, Chapter 4 of [Galí \(2015\)](#) for an overview over optimal monetary policy in macroeconomic models.

analysis of actual past forecast errors at the different horizons, so that's a statistical assessment of past model, data, judgmental inputs relative to actual outturns. On the other hand, the skew going forward is fully judgmental, albeit also based on models, statistical analysis, and data. The MPC will collectively agree on a skew which gives rise to the mean forecast.

The evolving mean and mode

Over the recent past, the mode and the mean inflation projections have differed substantially. The collective MPC judgment in August moved about half of the skew from previous forecasts into the mode (**Chart 2**), noting that some risks of persistence, previously reflected in the skew had indeed begun to 'crystallize'.² Even in the August forecast, the MPC judgment is that it is more likely for future shocks to be inflationary, such that, on an average, risk-weighted basis, the expected inflation rate at the end of the forecast horizon is just about 2% while the modal case is that inflation will fall below target.



Source: Bank calculations. Notes: Diamonds in aqua show the modal CPI inflation forecast at year 3 of successive MPR vintages, purple bars the (un-normalized) skewness, and orange diamonds the resulting mean forecast.

Should policy be set on the basis of either the mean or modal path? One problem with this question is that these paths are created under the assumption that we can model future economic outcomes as draws from a continuous and uni-modal distribution. That may not be how the world actually works, and no single outcome path from the true distribution

² See Paragraph 24 of the [minutes to the MPC's August 2023 meeting](#).

may even look like the pointwise mode or mean.³ It is also key to recognize that ex-post, more likely than not, we will have made errors. Thus, I consider it more useful, in this unprecedented environment, to think about discrete potential outcomes and associated errors.

Over the past year I have often said that I am in the upper part of the fan. That is because I believe that the MPR forecast, for a long time, has been telling a story fundamentally different from the one that I consider likely. My story has been one of more resilient domestic demand and more persistent price pressures which therefore requires a more restrictive monetary policy stance. The data that we have seen over the past half year or so has led me to believe that this was and is a useful story. And my policy votes have reflected this.

Of course, 'past performance does not guarantee future results'. Each policy round, I ask myself: Which error would I rather make? Based on the data and research so far, I would rather make the error of over-estimating the persistence of inflation than be continually surprised on the upside.

Explaining past errors and avoiding repeat misses

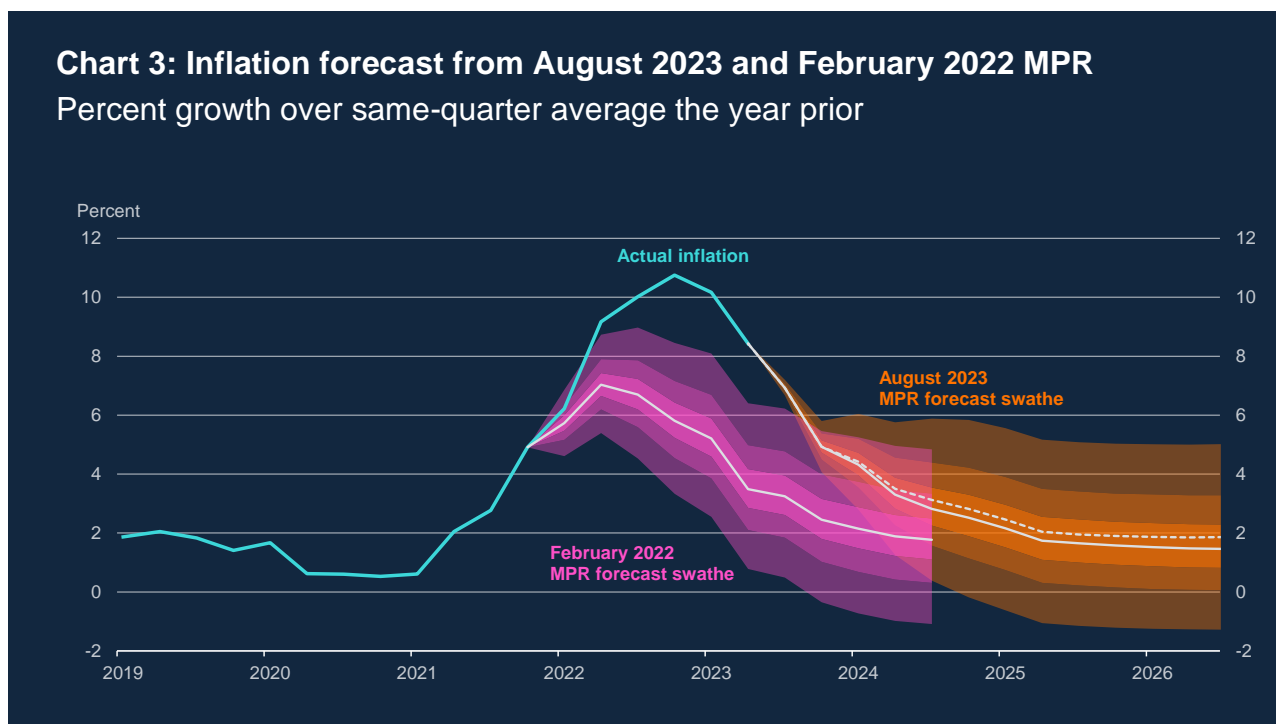
A dissection of the inflation forecast relative to outturns is a first strategy to help inform policy judgments. Fundamentally, the forecast depends on the economic environment, which is beset by shocks, other policies, but also behavioral changes. Whereas we can't predict shocks (although scenario analysis might be informative), and we can make assessments of the implications of policies (as and when they are official), the key area for research is the nature, extent, and longevity of behavioral changes. If these are all small or dissipate quickly, then assuming that future economic relationships will be the same as the past is a good working underpinning to the inflation forecast and associated monetary policy decision.

However, an increasing body of research from Bank staff points to behavioral changes that yield strong persistence in core inflation, even after the shocks that precipitated the surge have dissipated. Persistence in behavioral changes can also be revealed as structural changes in the underlying relationships. Incorporating this research into forecast judgments and decision-making is key, because they point to continued inflation persistence.

³ This point is related to the multiple-models problem described by [Fry and Pagan \(2011\)](#). If there is uncertainty about the properties of the correct model, then pointwise moments of the posterior density, such as means and modes, may not represent the behavior of the economy under any single possible model.

A sequence of shocks

Why have we been continually surprised by inflation over the past couple of years? On top of the first chart, let me now layer on a second fan (**Chart 3**). It shows the modal forecast and associated uncertainty bands made in February 2022, prior to Russia's invasion of Ukraine. Following this large and unforeseen shock, actual inflation accelerated to be far above the fan, something that should only happen with 5% probability – at most!⁴



Source: [August 2023](#) and [February 2022](#) Monetary Policy Report. Latest observation: 2023 Q2 (actual), 2024 Q3 (F22 forecast), 2026 Q3 (A23 forecast).

Thus, one reason for our forecast misses has simply been that it is impossible to predict shocks.⁵ This is by definition: If they were predictable, they would not be shocks anymore. However, I believe that another reason for our misses was that, after we had observed the shock, we under-estimated the potential for changes in the behavior of consumers and firms in response to the shock and to the associated fiscal response.

⁴ The outer band of the fan chart is calibrated to cover 90% of possible outcomes, so we should see surprises entirely to the upside or entirely to the downside with 5% probability each. See ['The Inflation Report projections: understanding the fan chart'](#) for more detail. At the time, a major land war in Europe appeared to be sufficiently unlikely such that a surprise relative to the fan is appropriate.

⁵ See Annex 2 of the [August 2023 Monetary Policy Report](#) for analysis of the MPC's forecast errors with a focus on the role of energy and food prices.

Changing behaviors

If the behaviors we knew from the low-inflation, low-volatility pre-Covid era have changed, then models which reflect aggregate behavior from this time, and performed well during it, would no longer be suitable for the current period. In general, models that have fixed parameters and are linear in variables, or log-linearized around a deterministic steady state, may perform poorly in times of large shocks and changing behaviors. And behavioral change patterns such as these are hard to identify in real-time. But, since the issue of model instability is, in all practicality, an unavoidable feature of economic forecasting, what should we do? I suggest, as Bank staff have done, to focus research efforts on questions of those behavioral changes or regime changes using new data and new methodologies and what they might imply for inflation dynamics and persistence.

Non-linearities and asymmetries

The issue of non-linearities in the inflation process is one that I have flagged multiple times.⁶ In general, it is difficult to estimate non-linear models on actual data since we rarely experience large shocks and more flexible models are prone to over-fitting. One way to confront these challenges is to tightly constrain the type of non-linearity to, for example, allow for asymmetric behavior in the run-up of an inflationary shock versus the subsequent come-down. Bank staff have undertaken research to investigate the existence, prevalence, and stickiness of inflation persistence through a variety of approaches. No one of these carries the day, but collectively, they strongly support the notion that behaviors have changed sufficiently to yield continued inflation persistence.

Asymmetries

Bank of England staff, in a recent blog post ([Mrabet and Page, 2023](#)), explore the effects of energy and food price shocks through the supply chain. They find that compared to a benchmark of complete and symmetric pass-through, inflationary shocks tend to linger for much longer, exerting upward pressure on consumer price inflation over the MPC's entire 3-year forecast horizon. The prevalence of this asymmetry is widespread in manufacturing sectors.

In the MPR forecast, on the other hand, this pass-through is assumed to be symmetric which shortens the time it takes for shocks to wash out. Additional staff analysis of the autocorrelation function of forecast errors reveals that once inflation crosses the 3-4% threshold, the errors become much more sticky. This is consistent with an inflation

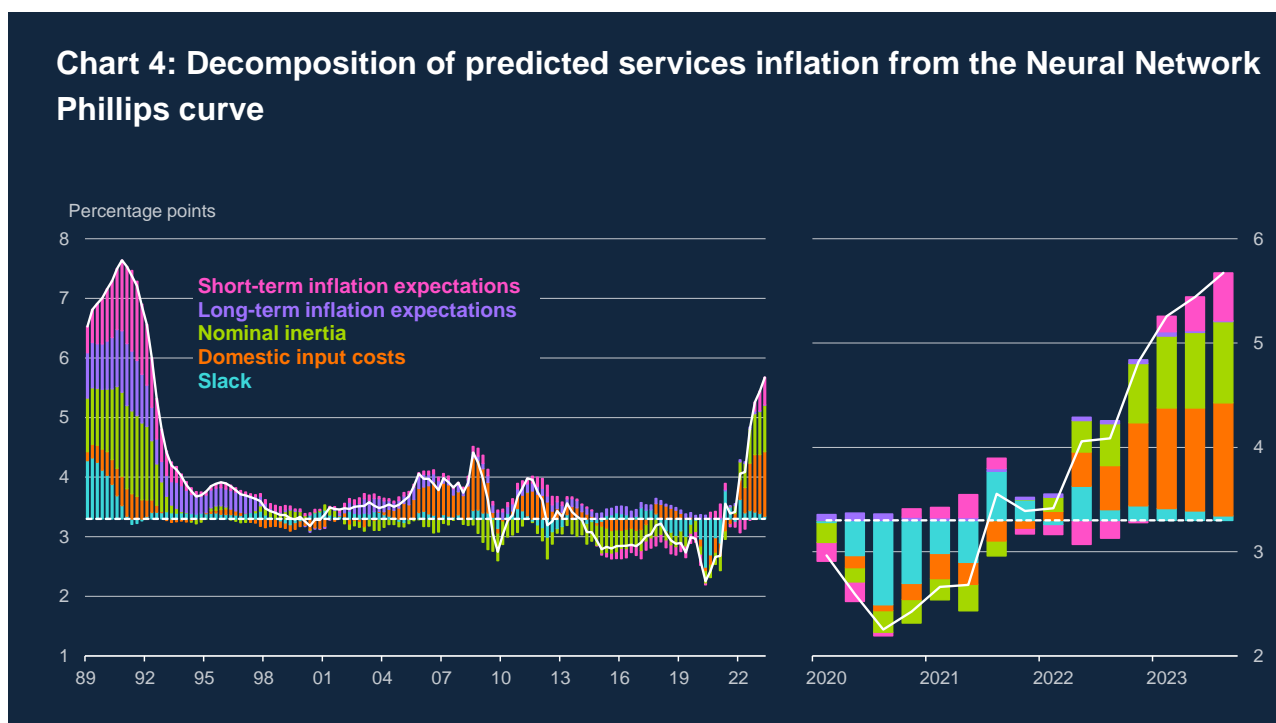
⁶ See [Mann \(2022\) 'Inflation expectations, inflation persistence, and monetary policy strategy'](#) for the role of non-linearities in the Phillips curve and [Mann \(2023\) 'Expectations, lags, and the transmission of monetary policy'](#) for a discussion about the non-linear effects of backward-looking expectations formation on the monetary transmission mechanism.

outcome that would be more persistent and where degree and duration above target can matter for inflation dynamics.

A Neural Network Phillips Curve

In another investigation of non-linearities and inflation persistence, Bank researchers developed a new model of the inflation process using novel machine learning techniques.⁷ It focuses on the services component of CPI which has been a recent source of surprisingly persistent inflation, remaining sticky at over 6% for more than an entire year.

They find that inflation since Russia's invasion of Ukraine can be explained in large part by input costs such as food and gas prices. But, importantly, there is an inertial component that includes wages and other compensation measures (**Chart 4**). The outsized role for nominal inertia, and its jointly positive contribution with inputs costs now, is what is different in this inflationary episode relative to those before and after the Global Financial Crisis when input costs dominated.



Source: [Buckmann, Potjagailo, and Schnattinger \(2023\)](#). Notes: The dashed line at 3.3% represents average services price inflation over the pre-Covid sample (1997-2019). Latest observation: 2023 Q3.

⁷ See [Buckmann, Potjagailo, and Schnattinger \(2023\)](#) 'Dissecting UK service inflation via a neural network Phillips curve' for details. The model is a neural network, following [Goulet Coulombe \(2022\)](#), enhanced with an economically intuitive structure to yield a decomposition in line with an expectations-augmented open-economy Phillips curve for UK services inflation. The authors discipline the model by using out-of-bag cross-validation to prevent over-fitting.

Another concern derived from this analysis is the increasing importance of inflation expectations, a type of data and behavior that I have addressed in my speeches before. In the current nowcast for the third quarter, inflation expectations add about half a percentage point to the explained variation of services inflation relative to its in-sample mean. As headline inflation falls back, and is concentrated especially in salient goods prices, we would expect this short-term expectations component to begin to drag on realized services inflation. However, as of now, this short-term expectations contribution is still rising. I worry that with a long duration of inflation well above target, persistence of target-inconsistent long-term expectations could emerge and support target-inconsistent services inflation.

Consider the experience of the late 1980s and early 90s as an example for when this happened. High inflation expectations created a gap between inflation outturns and economic fundamentals which required significant policy interventions to get it under control.⁸ As I flagged in a speech last year, rising inflation expectations shift the Phillips curve ([Mann, 2022](#)), thus making it necessary for monetary policy to work harder to bring down both inflation and inflation expectations – at a greater cost to output and unemployment.

Structural change

The predictive ability of models can break down when underlying trends change as a result of economic turmoil. To confront this issue, we can try to estimate models with time-varying parameters which typically discount observations that are in the more distant past. But that does not help when we are right now switching to a new, yet-unknown regime. We can only really know ex-post whether there was a regime change, but in real time we need to have a prior to interpret the emerging but uncertain evidence.

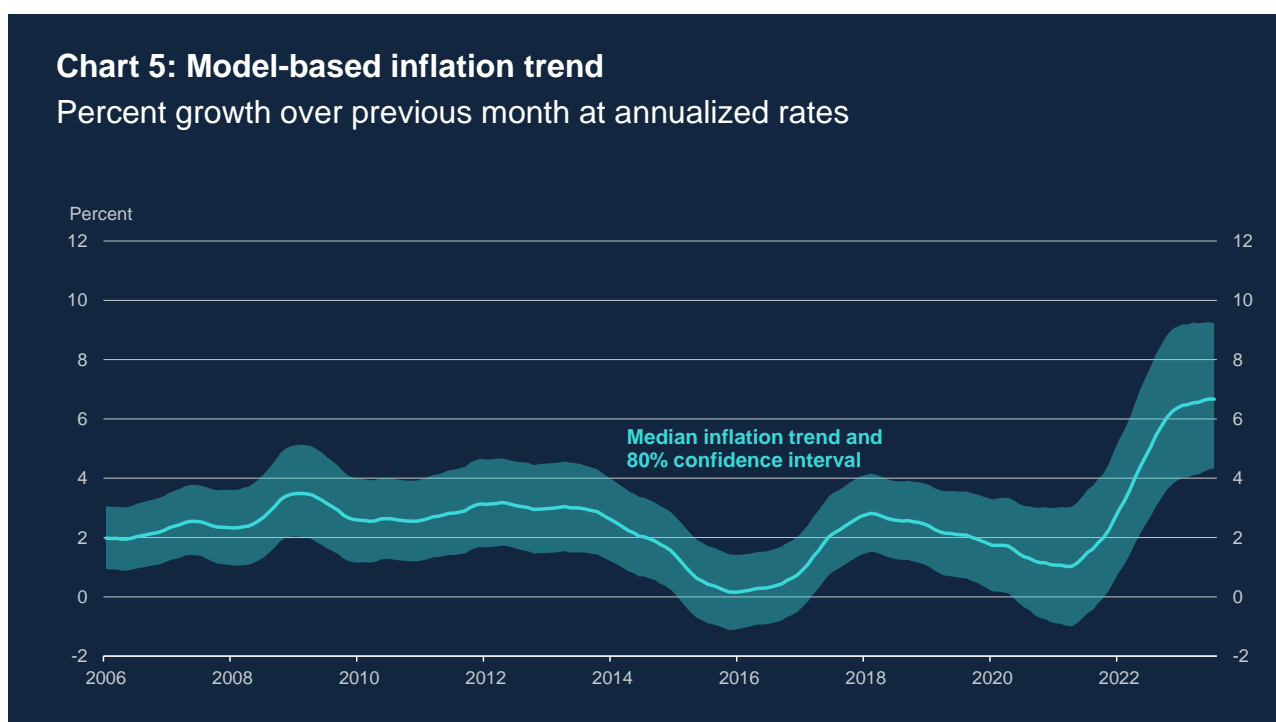
It may be less helpful to just estimate parameters on data in the distant past and apply them to the present. For example, while indeed the 1970s were a time of large supply shocks they were also a time of fundamentally different institutional regimes for UK monetary policy. There was no inflation-targeting, no independent MPC, and less integrated international trade and financial systems. To the extent that the pass-through of shocks depends on these institutions, we should pay attention to these periods while being careful about the conclusions that we can and cannot draw.

⁸ In the 1990s, high inflation ultimately led to the UK leaving the European Exchange Rate Mechanism and moving to an inflation targeting framework – two very dramatic changes in macroeconomic policy. See Mann (2023), 'The ERM crisis: A teachable episode for international macro' and other chapters in [Corsetti and Hale \(2023\)](#) for a detailed review of causes and effects of the ERM crisis.

A time-varying inflation trend

If underlying inflationary pressures rise, that is, the trend component of inflation increases, models that assume an equilibrium consistent with calm periods will likely over-estimate the pace of normalization. In technical jargon, they will overstate the importance of the error correction term. As it turns out, we do have evidence of a time-varying inflation trend, which has implications for how to interpret the inflation forecast.

In order to improve our short-term inflation forecasting toolkit, Bank staff are working with a flexible statistical framework, so-called ‘unobserved component models with stochastic volatility’.⁹ These models are designed to capture the time-varying trend and time-varying importance of seasonality in every component of the inflation basket, specifically with the aim of maximising forecast performance. **Chart 5** shows the resulting underlying trend in headline inflation. We see how, before 2021, the inflation trend was more or less indistinguishable from 2%, supporting the choice of fixed-trend model. Since then, however, the trend has risen markedly.



Source: Esady and Mate (mimeo). Latest observation: July 2023.

⁹ See Esady and Mate, ‘Component Level Short-Term Inflation Forecasting for the UK’ (mimeo), who use the methodology of [Stock and Watson \(2016\)](#) to robustly forecast UK CPI components and create a bottom-up forecast of UK inflation consistent with the predictions for these individual components. In [February](#), my colleague Huw Pill highlighted the results of a forecast evaluation exercise using this research to show how they can improve the Bank’s traditional forecasting toolkit.

One does not need to interpret this as a drifting nominal anchor (as suggested by [Ascari and Sbordone, 2014](#)). More agnostically, it is simply the persistent and thus predictable component of a statistical decomposition ([Stock and Watson, 2007](#)). In the short term, however, this is the centre of gravity for inflation and it suggests a drifting Phillips curve.

The MPR forecast imposes that, once all shocks have dissipated and the output gap is closed, inflation will be at 2%. This is a sensible assumption for the long run: After all, monetary policy, i.e. the MPC, will ensure that inflation returns to target sustainably in the medium-term.

Suppose the time-*invariant* trend is assumed throughout, how do the forecast mechanics work? In this case, the more realized inflation overshoots its target, the more the error correction mechanics drag on inflation in the near-term forecast, so as to bring the inflation forecast back to the assumed 2% mean. Unfortunately, I believe that in the real world right now the dynamics do not work this way. The more and the longer inflation is allowed to overshoot the target, the weaker the attractor of 2%, and the more persistent inflation strays away from target. The charts and previous research cited suggest that is the case. The rationale behind this alternative story includes consumers and firms that are, to some degree, backward-looking, not forward-looking rational, a scenario that I have worked through before ([Mann, 2023](#)).

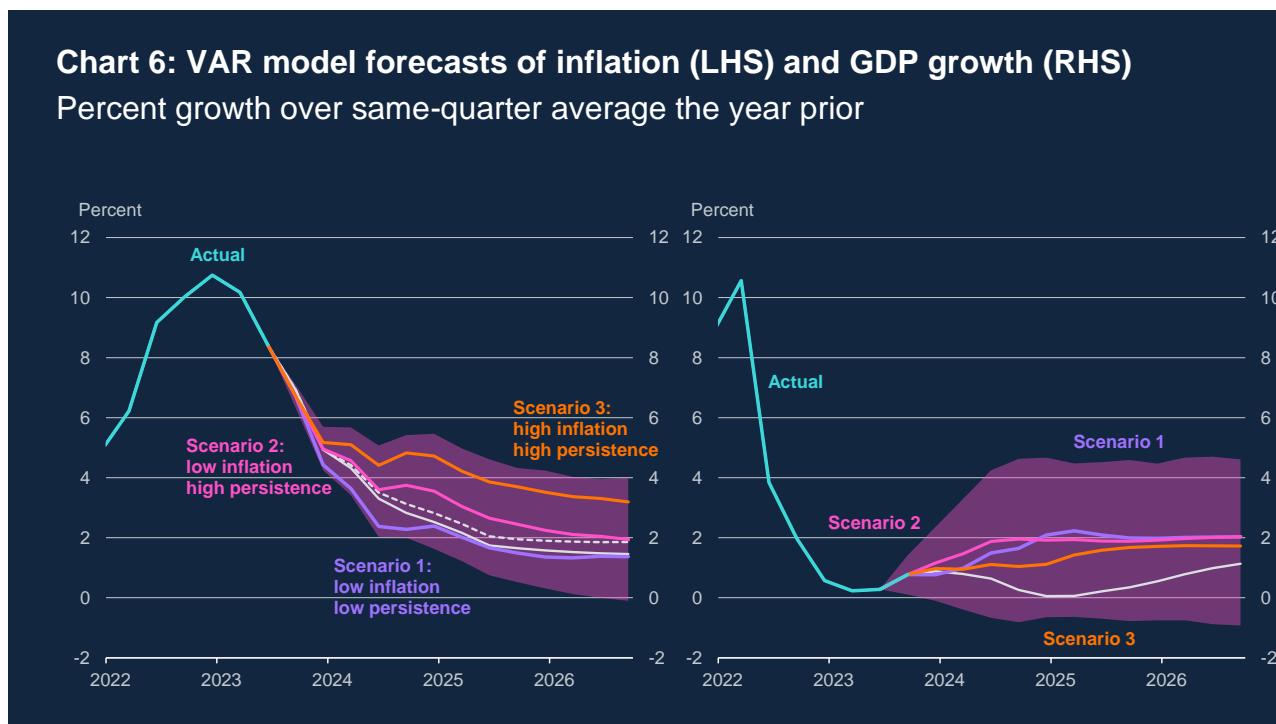
Time varying trend and inflation persistence

To see how much this matters for inflation over the forecast horizon, we can look at the predictions of models which do not impose an inflation trend of exactly 2%. For example, the MPC has been presented with a purely empirical vector-autoregressive (VAR) model of the UK economy which was given the same conditioning assumptions as the main forecast and then allowed to generate predictions for inflation and output.¹⁰

Depending on the sample over which this model was estimated, it generates different paths for inflation. To illustrate, in **Chart 6** I show three paths for output and inflation implied by different estimates of the same model – versus the MPR forecast in light grey, solid line for the mode, dashed line for the mean. First, consider the purple line in the lower half of the swathe. It restricts the sample to the inflation-targeting period from 1992 onwards but cuts off the data after 2019. This was a period of overall low macroeconomic volatility and inflation at or relatively close to the target. This line, which I labelled ‘low

¹⁰ The model is a large-scale Bayesian VAR estimated over different subsamples between 1990 and 2023 with five lags in 20 endogenous variables. It is estimated in (log) levels thereby allowing for possible co-integrating relationships between variables. In order to account for pandemic-related outliers, time dummies are used following [Cascaldi-Garcia \(2022\)](#). The model is then constrained by the same conditioning assumptions as the MPR forecast. See [Angelini et al. \(2019\)](#) for a related model and conditional forecasting exercise.

inflation, low persistence', shows a profile not far off the MPR forecast, save for the added persistence judgment imposed in 2024. Given this set of parameters, inflation is predicted to fall below target in 2025 and remain there until the end of the horizon.



Source: Bank calculations. Notes: The lines are the conditional forecasts generated by estimating the same model on three different samples. The model underlying Scenario 1 is estimated on the sample spanning 1992-2019, Scenario 2 on 1992-2023, and Scenario 3 on 1990-2023. The swathe shows the 90% confidence region derived from the model of Scenario 2 which implies a low-inflation steady state but a relatively persistent inflation process. The grey lines are taken from the A23 MPR forecast. Latest observation: 2023 Q2.

To show the sensitivity of the inflation prediction to different assumptions about the properties of the steady state going forward, I have added two other versions of the same model, varying only by the time period of the sample. The pink line in the middle of the swathe now also includes the period all the way to the present (appropriately controlling for data issues during the Covid-induced lockdowns). I have labelled this the 'low inflation, high persistence' scenario because inflation is stickier in the near term while having similar convergence properties by the end of the horizon. In expectation, inflation does not return to target until 2026, but afterwards it is roughly in line with the mean MPR forecast.

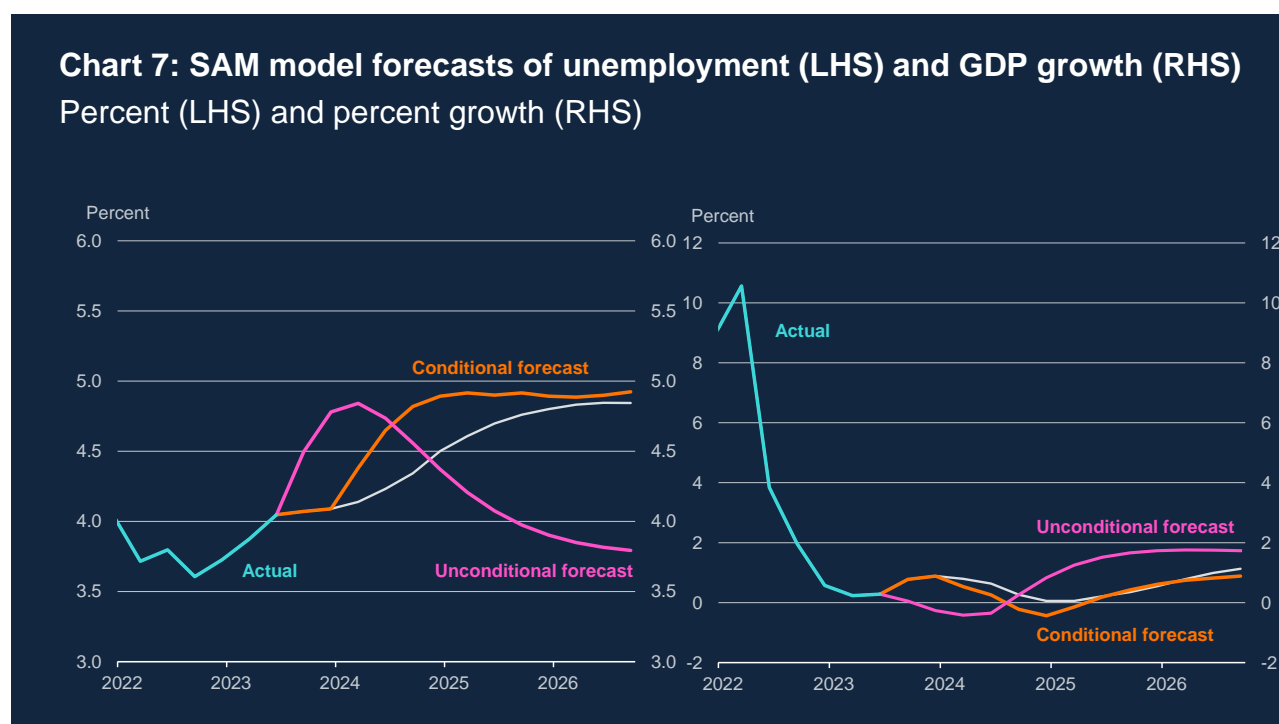
However, a third scenario which includes data from the high-inflation period at the beginning of the 1990s, yields a higher trend inflation rate, and a very different picture emerges. Under these parameter estimates, not only is inflation higher in the near term, it also remains above target for the entirety of the forecast horizon. Notably, this high inflation forecast is accompanied by slower output growth than under the alternatives, although still far above the MPR's. To me this corroborates a point I have made before:

when inflation is already very high, there is no inflation-output trade-off: the best way to generate real economic growth is to get inflation under control.

From the perspective of this model, the MPR forecast looks quite optimistic on inflation. How probable is it that behaviors and outturns will return to pre-Covid times of a low inflation, low stickiness steady-state? In a technical sense, these differences only mechanically reflect the different sub-sample averages of realized inflation. But they underline the importance of accurately capturing the time-varying inflation trend for the short-term dynamics of the forecast.

Revealing structural changes

Another source of model instability can arise because we have not correctly modelled deep structural relationships in the first place. Our approximations to the behavior of the economy by aggregate decision rules and correlations in the past may have been acceptable, but now are revealed to be wanting.



Source: Bank calculations. Notes: The pink line is the unconditional forecast of a DSGE model with search-and-matching frictions in the labor market estimated on UK data from 1997 to 2022. The orange line is the forecast conditional on the MPC's conditioning assumptions for the A23 MPR forecast. The grey lines are taken directly from the A23 MPR forecast. Latest observation: 2023 Q2.

An example includes the surprising resilience and persistent tightness of the labor market. Bank researchers have developed a structural model of the UK economy with an explicitly micro-founded search-and-matching process in the labor market. This model, in its latest update, indicates significant downside risks to the forecast. As the yield curve shifted up markedly in response to upside surprises in wage growth and inflation, the search-and-

matching (SAM) model predicts a significantly higher unemployment rate and lower GDP growth than is in the MPR (**Chart 7**).

Monetary transmission in VAR and SAM

Why do these two models, the VAR and the SAM, show such different outlooks for the economy even though they are estimated on roughly the same samples and conditioned on the same paths for energy prices, interest rates, etc.? It is because, under the hood, they rationalize these conditioning paths using different underlying shocks and, crucially, make different assumptions about the nature of the monetary transmission mechanism.

The search-and-matching model is a structural model of the DSGE type. It imposes a well-defined monetary transmission mechanism in which inflation is a function of the output gap and fully forward-looking, rational inflation expectations while the output gap in turn is a function of the deviation of interest rates from their natural level. A static monetary policy rule, known and accepted by all agents ‘closes the model’ by linking Bank Rate to deviations from the inflation target and the output gap.

As a result of assumptions about the structure of the economy, the SAM, and to some extent the forecast process, ascribes a large part of the reason for why the yield curve is so high to a series of contractionary monetary policy shocks – that is inexplicably tight monetary policy, an over-reaction. This drags on output and inflation such that we end up with weak growth and inflation below target.

This is indicated by the difference between the orange and the pink line in **Chart 7**. The former shows the forecast which is most comparable to the MPR and the VAR since it is conditioned on the same assumptions about future energy prices, fiscal policy, and interest rates. The latter, on the other hand, is the purely model-implied *unconditional* forecast. It makes no assumptions about future variables and simply unwinds the shocks that it has observed up to the current period according to their reaction functions. In this forecast, since Bank Rate already is far above what the SAM considers neutral, the unconditional forecast for Bank Rate is much shallower than implied by the current market curve. Therefore, because of the structure of the SAM model, monetary policy is the major driver of the forecast.

The VAR on the other hand is purely statistical. It does not explicitly impose a monetary policy rule or channels of transmission, it just reflects co-movements in the historical data. Without identifying restrictions, it is agnostic about causal relationships.¹¹ The VAR simply

¹¹ That does not mean that forecasting with these so-called reduced-form models is inferior or deficient. To the contrary, it’s a common finding in the literature that it is difficult to statistically outperform these types of models. On average, they are probably the best we can do for forecasting, but without identifying restrictions they cannot be used for story-telling or scenario analysis. See [Antolín-Díaz et al. \(2021\)](#) for an example on how to conduct conditional forecasting and scenario analysis in identified VAR models.

asks: “What are the economic conditions that are, on average, consistent with the given path for Bank Rate?” These economic conditions need not be driven by inexplicably tight monetary policy, but can be generated by any combination of supply, demand, monetary policy, or other shocks. It will statistically select a combination of underlying drivers that are most likely given the historical regularities embodied in its parameters.

So which of these characterizations *is* more likely to play out? If we look at the experience of the past two years, I am partial to one with more demand and less monetary policy tightness. There also is evidence on how much monetary tightening there has actually been relative to what would be assumed in the SAM. Staff analysis of past MPC decisions relative to policy rules shows that the MPC on average moved Bank Rate by less than expected under these rules. Considering the past two years of MPC decisions, and using high-frequency moves of asset prices around policy announcements as proxies¹² the evidence points towards an accumulation of *expansionary* monetary policy shocks over the past two years. Should economic agents update their assessment of the monetary policy reaction function in response to these surprises, it would increase the likelihood of a drifting inflation trend.¹³

In the end, what determines the stance of monetary policy is not just Bank Rate but the level and shape of the entire yield curve. So we need to consider both expectations of nominal rates and inflation over the forecast horizon against their neutral level in the short, medium, and long run.

What does it mean to be restrictive?

In the [minutes to the August MPC decision](#), the committee noted that monetary policy was now ‘restrictive’. This assessment is based on the likely output effect of the Bank Rate increases undertaken over the course of the past two years and expectations of the policy stance over the forecast horizon. The level of real rates, that is expected interest rates

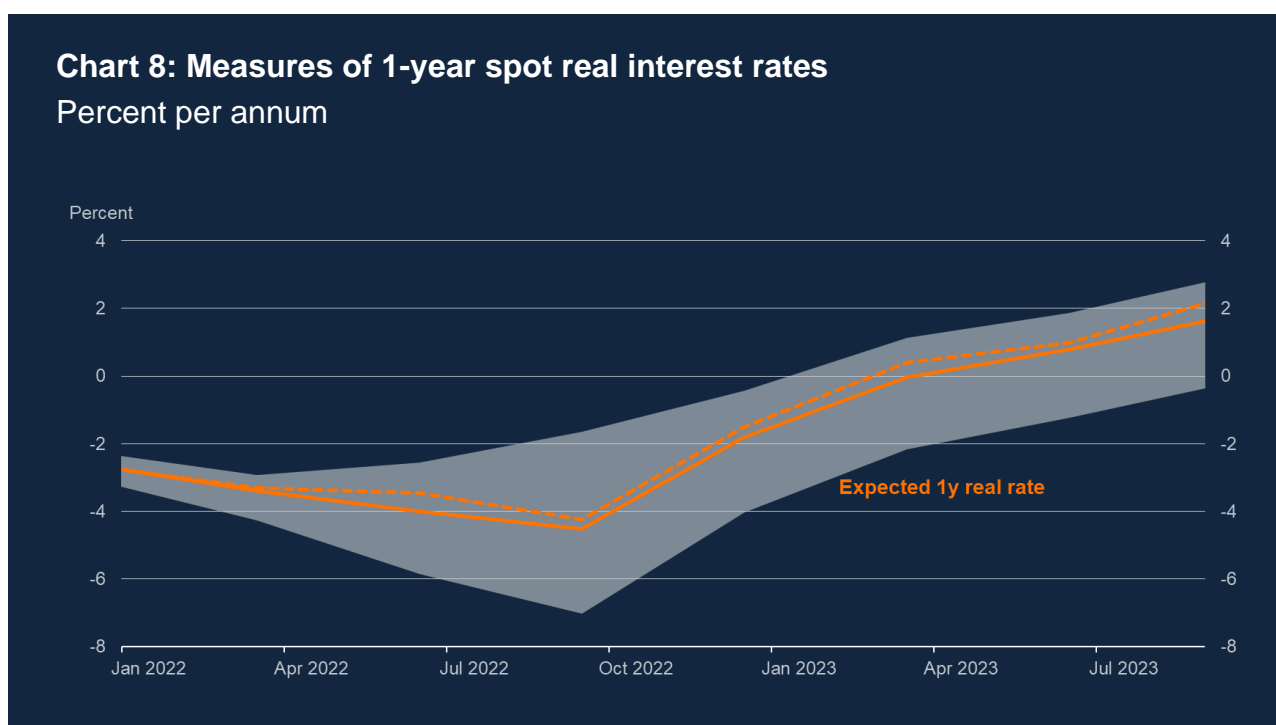
¹² In empirical macroeconomics we use these moves as proxies for exogenous changes in Bank Rate to estimate the causal effects of monetary policy. I have used these types of proxies in multiple speeches. First to estimate spillovers of US monetary policy on UK variables using the instruments of [Miranda-Agrippino and Nenova \(2022\)](#), and second to estimate the causal effect of UK monetary policy following [Cesa-Bianchi et al. \(2020\)](#) and Braun, Miranda-Agrippino, and Saha (mimeo).

¹³ This line of argument goes back to the Lucas critique which makes the point that systematic deviations from perceived decision rules will eventually lead agents to update their beliefs about the rules. This updating causes changes in the reaction of aggregate variables to economic shocks. Sequences of shocks as in [Bernanke \(1997\)](#) or [Sims and Zha \(1998\)](#) may not change behaviors if they are ‘modest’ ([Leeper & Zha, 2003](#)), but the longer-lasting and more pronounced these are, the more likely regime change becomes. For a more recent reference see [McKay and Wolf \(2022\)](#) who confront this issue by explicitly capturing news shocks.

adjusted for expected inflation over the same horizon, can give a first indication of the restrictiveness of monetary policy.

Real rates are now positive

In **Chart 8** I have plotted an estimate for the average real rate expected over the next twelve months derived by combining inflation expectations and 1-year risk-free rates from financial markets and surveys. This year, for the first time since the Global Financial Crisis¹⁴, most of these measures have now turned positive. As this rise in borrowing costs feeds through to households, firms, and the public sector, it will weigh on both inflation expectations and aggregate demand.



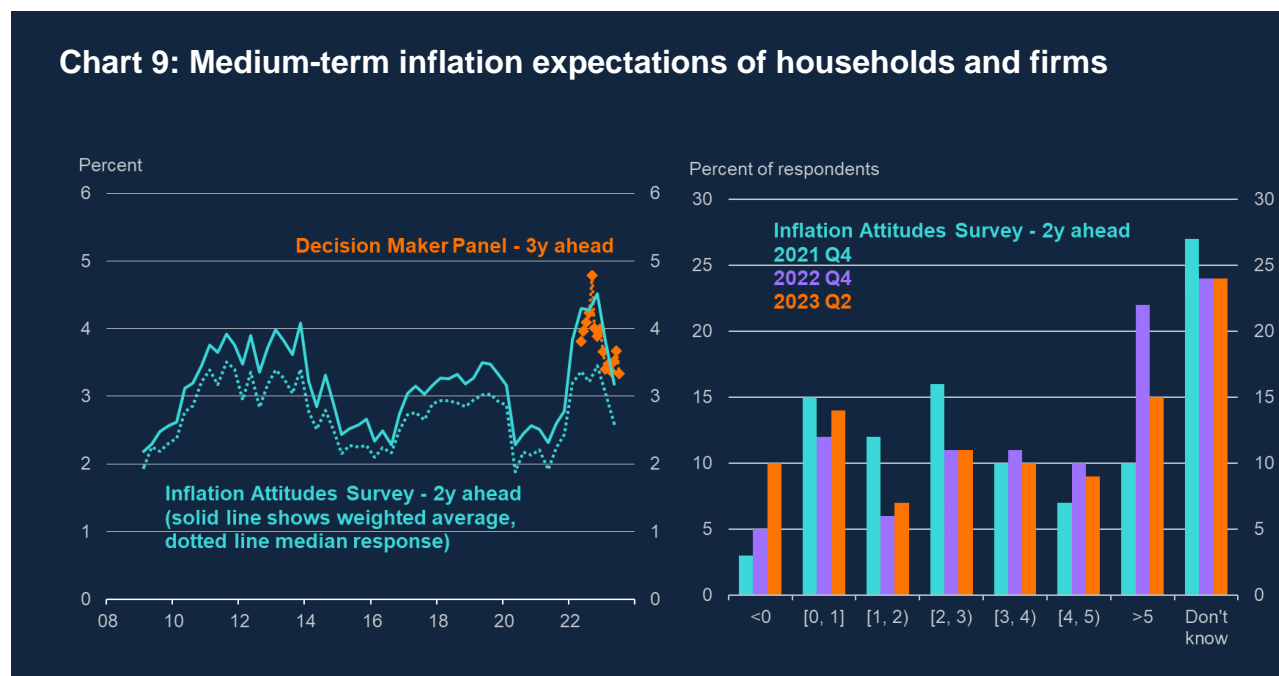
Source: Bank of England and Bank calculations. Notes: The grey swathe represents the range of estimates of 1-year expected real interest rates derived by combining information from financial market measures, as well as surveys of households, firms, and professional forecasters. The solid line represents the mean, the dashed line the median across these estimates. Latest observation: August 2023.

Inflation expectations have moderated but still a concern

Part of the recent increase in expected real rates can be attributed to the fall in measures of inflation expectations off their highs last year (**Chart 9**). These charts (which I have shown before) show the time series of medium-term expectations of households and firms on the left-hand side as well the distribution from the household survey on the right. For households, their central tendency is back in line with the historical series mainly from the

¹⁴ See Chart 10 in [Mann \(2023\), 'Turning Points and Monetary Policy Strategy'](#) for a longer time series of one of the measures in the swathe.

upper tail decreasing, reducing what Ricardo Reis and co-authors call the likelihood of inflation disasters ([Hilscher et al., 2022](#)). But still, almost 25 percent of respondents expect inflation above 4% in two years' time, even as 10% now expect prices to fall. For firms, the stickiness in 3-year ahead expectations should be a concern.



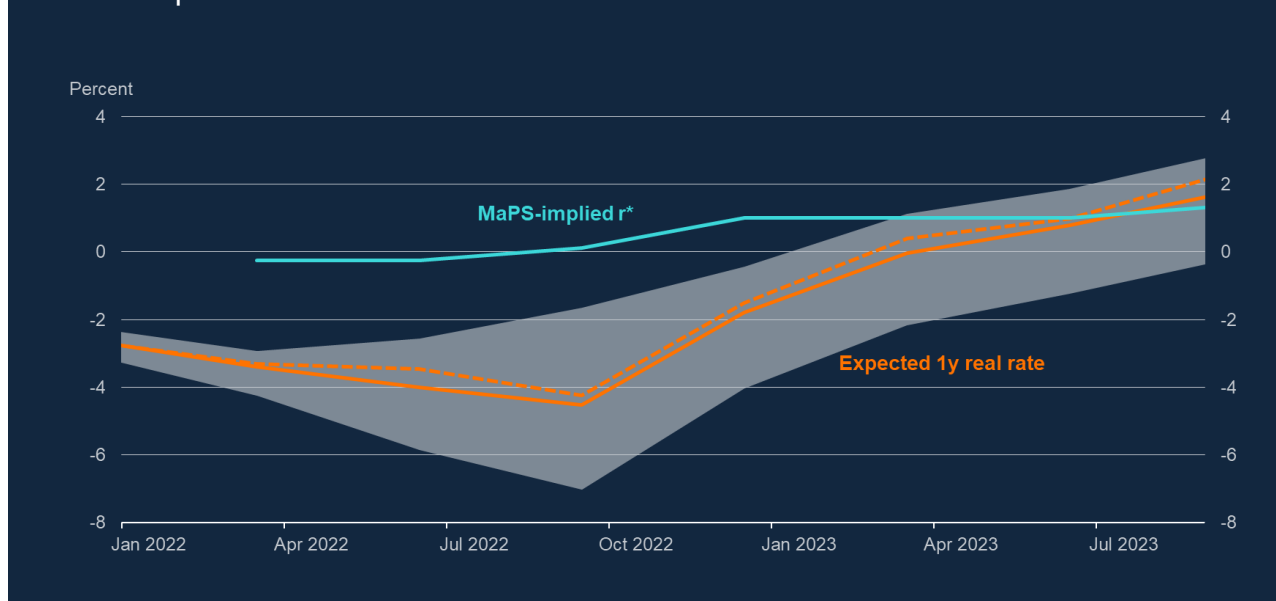
Source: Bank of England [Inflation Attitudes Survey](#) and [Decision Maker Panel](#). Latest observation: 2023 Q2 (IAS), August 2023 (DMP).

Monetary stance and stars

The level of interest rates alone, even after controlling for expected inflation, is not a sufficient measure of the stance of monetary policy. We have to always keep in mind that there exists a neutral level of interest rates which is consistent with the economy being in equilibrium – r^* . There is some evidence that this might have risen in the aftermath of Covid.¹⁵ In **Chart 10** I have added a survey measure of r^* to the swathe of observed real rates from the Bank's [Market Participants Survey](#). Theoretically, if expected real rates are below r^* , monetary policy is accommodative. This was the case for most of the past two years (a point noted above, but using very different techniques). Only very recently has the swathe moved in line with or above this particular estimate of the neutral level.

¹⁵ See the update of [Lubik and Matthes \(2015\)](#) as well as [Baker et al. \(2023\)](#) for prominent examples for the US. For the purposes of this speech, I am talking about a short-term notion of r^* here, not the long-term version pinned down by slow-moving trends in productivity and demographics – which at the Bank would be called big- R^* . See Box 6 of the [August 2018 Inflation Report](#) in which the MPC laid out their argument for assuming a real neutral rate of 0.25% in the long term. However, splitting just short and long-term neutral rates is a simplification as there exists a whole term structure of r^* . And the stance of monetary policy will depend on this entire term structure of r^* , of expectations about nominal rates, and of expectations about inflation.

Chart 10: Measures of real 1y spot rates and the neutral real rate
Percent per annum



Source: Bank of England and Bank calculations. Notes: The grey swathe represents the range of estimates of 1-year expected real interest rates derived by combining information from financial market measures, as well as surveys of households, firms, and professional forecasters. The solid line represents the mean, the dashed line the median across these estimates. The measure of r^* is from the Bank's [Market Participants Survey](#). Latest observation: August 2023.

Considering both real rates and r^* , monetary policy was tightening from two directions: one by raising nominal interest rates, one by lowering inflation expectations. However, this tightening was being offset, in part, by a rise in the neutral level of interest rates. If we take the perceptions of MaPS respondents as given, then more than 100 basis points of Bank Rate tightening over the past year was just chasing a rising neutral rate – and therefore was not actually restrictive.

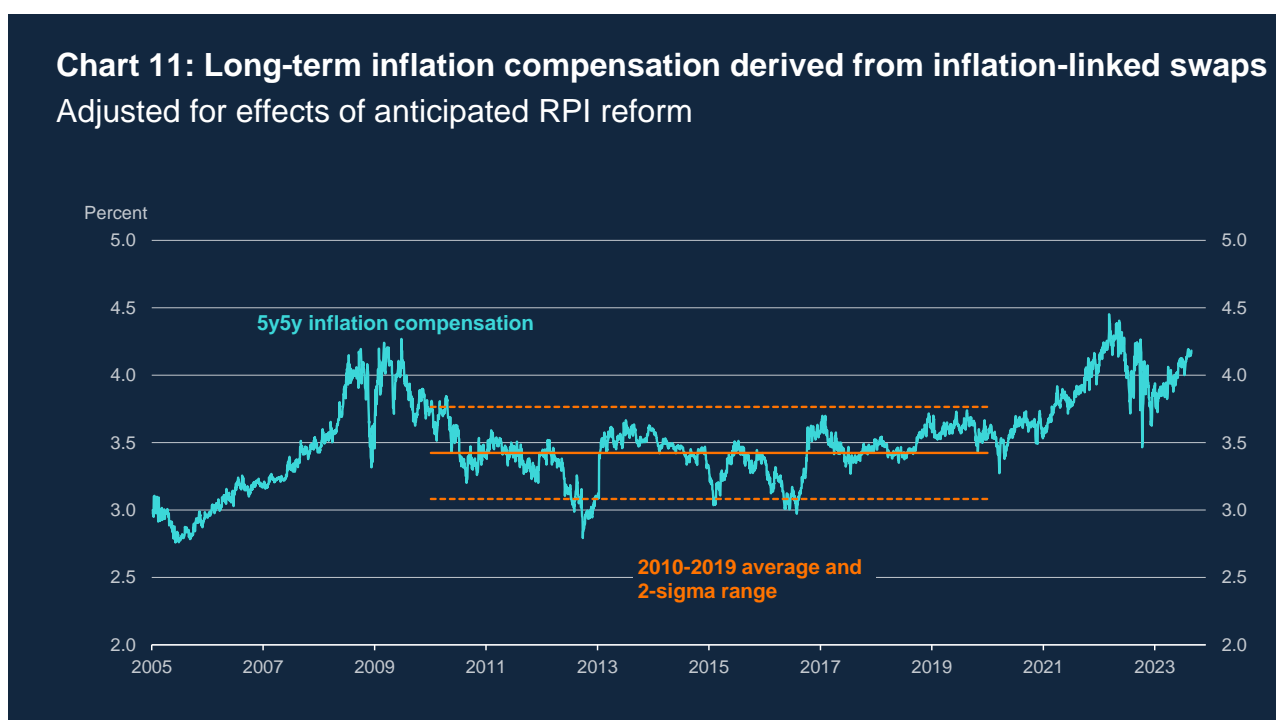
Bottom line: Monetary policy definitely has been *tightening*; all the Bank Rate increases are tightening. But whether or not the current condition is *restrictive* is a statement about levels relative to r^* , and this is more difficult to assess, given that r^* is unobserved. In any case, the question of restrictiveness, to me, is one about the relationship between interest rates and economic activity, about the IS curve if you will.

An inflation risk premium

However, our remit of course is inflation. And I worry that there is an increasing inflation risk premium being priced into the UK's macroeconomic prospects.

The good news first: the MPC is credible that it will bring inflation down to target sustainably in the medium-term. Virtually all measures of long-term inflation expectations are close to target-consistent, be it from households, financial market participants, or professional forecasters. However, when asked about the interest rate that would be consistent with achieving the target in the long run, this rate has risen, and with significant uncertainty around it. Surveys now have the long-term level of Bank Rate at about 3 percent or even a little above that, versus between 1 and 2 percent pre-Covid. If the world on average has become more inflationary and if inflation will tend to over-shoot rather than under-shoot over the next decade or so, then nominal rates will need to be permanently higher.¹⁶

This seems to be observed for the UK. Although, based on survey evidence, pure expectations are roughly at target in the long term, inflation compensation implied by financial markets, which explicitly includes an inflation risk premium, has been volatile and high over the past two years. **Chart 11** shows the evolution of inflation compensation derived from inflation-linked swaps over the past 20 years. After falling back from the highs during 2021 and 2022, this measure is again drifting up since the turn of the year and is currently at the very upper edge of its pre-Covid distribution.



Source: Bloomberg Finance L.P. and Bank calculations. Notes: See Chart 2.26 of the [August 2023 Monetary Policy Report](#) for details on the adjustment of the series. Latest observation: 29 August 2023.

¹⁶ I am talking about medium to long-term inflation risk here. [Schnabel \(2023\)](#) showed a model-based measure of the inflation risk premium in short-term inflation swaps for the euro area. At the same conference Ricardo Reis presented findings from a Bank of England Staff working paper ([Bahaj et al., 2023](#)) highlighting the importance of liquidity premia and intermediation frictions for short-dated UK inflation swaps.

The inflation risk premium is that part of the return on nominal assets which compensates investors, for example those saving for retirement, for the possibility of inflation surprises over the length of the obligation. Thus, it will tend to rise if people expect inflation to be overall more volatile in the future, or to be skewed to the upside.

Subtracting survey-based expectations of inflation from the above series can give us a first indication of this premium component. If we take responses from Consensus survey as given, the gap between fundamental inflation expectations and required compensation has risen from 0.2 in 2014 to 0.4 in 2019 to currently 0.9 percentage points. This increase underlines a point that I have made previously about the interaction between inflation uncertainty and monetary policy strategy.¹⁷ If there is fundamental uncertainty about the inflation process, monetary policy should tighten more forcefully and earlier in order to rule out long periods above target.

The existence of an inflation risk premium matters since this affects the long-run neutral rate. Our forecast assumes a long-run nominal neutral rate of 2¼%, which is a real neutral rate of 0.25% with inflation at the 2% target. As discussed above, a higher real rate would be restrictive, generate a negative output gap and below-target inflation. Right now the long-run market-implied path for Bank Rate (at 3%, see above) is inconsistent with the MPC's assumption about the long-term equilibrium of the economy; and this is because financial markets may have a different perceived level of the neutral rate. In my view, this inconsistency is one of the reasons for why our forecast is relatively weak and still under-estimates the stickiness of inflation. The forecast over-estimates what the amount of monetary tightening that is in the curve further out means for the real economy and inflation.¹⁸

The relevance of the Lucas critique

The past conjuncture of relatively low and stable inflation and generally little macroeconomic volatility¹⁹ was conditional on prevailing policy rules and choices made at the time, importantly with a backdrop of global economic conditions—the Great Moderation. The Lucas critique teaches us that trying to exploit historical regularities carries the risk of invalidating those exact regularities. To be specific, to exploit the fact that inflation expectations are firmly anchored by looking through or under-reacting to inflationary shocks may lead us to lose the anchor we try to exploit in the first place. We need to validate the anchor at every step to make it stay in place ([Cogley and Sargent, 2005](#)).

¹⁷ See [Mann \(2022\)](#), '[A monetary policymaker faces uncertainty](#)' and references therein.

¹⁸ See also [Mann \(2023\)](#), '[Expectations, lags, and the transmission of monetary policy](#)'.

¹⁹ See for example [Haskel \(2022\)](#), '[Current monetary policy](#)'.

Policy judgment

At the start of this speech I asked: Which error would I rather make? Would I rather assume that, with the current monetary policy stance and standard models, inflation is forecast to undershoot the target? Or that, given what we have learned about time-variation and non-linearities, we need to position ourselves accordingly and raise rates by more. I believe it would be prudent to risk an error that can be more easily rectified. Right now, that is to err on the side of tightening further in order to prevent the risks of further inflation persistence from crystalizing. If I am wrong, and there are excess negative effects to the real economy, it is an easier task to rectify as compared to regaining control over inflation.²⁰

In my view, holding rates constant at the current level risks enabling further inflation persistence which will have to be unwound eventually with a worse trade-off. If we underestimate the rise in the persistent component of inflation and set policy consistent with a world that may no longer exist we will ourselves contribute to the persistent overshoot of the target. And the longer this overshoot is allowed to continue, the more likely a departure from the old ‘low inflation, low volatility’ steady state.

It’s a risky bet that inflation expectations are sufficiently well-anchored and to wait for core inflation to ease down, as this extends the duration way above the target-consistent rate. We need to prepare for a world where inflation is more likely to be volatile in the future, and the neutral nominal rate is likely to be higher than in the past. While these might support a “3% inflation is close enough”, popular in some circles, it cannot be *our* guide. We need to communicate and act on our commitment to do what is necessary to achieve the 2% target, sooner rather than later.

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²⁰ Recent research from the San Francisco Fed ([Jorda et al., 2023](#)) has shown that monetary tightening can have large and lasting effects on output, exacerbating the risks from over-tightening monetary policy. However, if a too cautious monetary reaction leads to a loss of credibility or drifting inflation expectations, the costs of reversal increase by more down the line. See for example [Beaudry et al. \(2023\)](#) who in their Bank of Canada working paper show that a forceful monetary policy reaction is desirable in response to large supply shocks.