Expectations, lags, and the transmission of monetary policy - speech by Catherine L. Mann

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Speech

1. Introduction

Economists often reference the ‘long and variable’ lags of monetary policy, first introduced by Milton Friedman in 1961. In the central banking world, 18 to 24 months is often quoted as how long it takes for changes in monetary policy to feed through to inflation, even as certainly this effect accumulates over that timeframe. Although this has by now become a sort of folk wisdom, the economic and policy environment over the past few years has prompted me to re-examine these long and variable lags.

As I’ve noted in numerous previous speeches[1], the speed and magnitude of monetary transmission depends on the underlying structure of the economy, shocks the economy faces, and on the behaviour of financial markets, firms and households. Monetary transmission will change when the economy and the economic environment changes. Empirical estimates of the effect of monetary policy on macroeconomic aggregates are strictly speaking only valid in-sample – unless we believe that the structure of the economy has not changed in a way that would invalidate our estimates.

We have been raising Bank Rate for more than a year now and by 390 basis points in total. Should we have seen more of an effect on the real economy and inflation already? Perhaps the ‘long and variable’ lags are influenced by how monetary policy is transmitted through financial markets or via the expectations of participants in the real economy. Certainly the sequence of shocks that we have encountered must also matter.

In the following examination of the a) data and research, b) presentation of a new financial conditions index, and c) modelling of sequential shocks and expectations in a theoretical model, I will argue that 1) financial markets have absorbed a substantial degree of the tightening to date; 2) that the sequence of shocks and embedding of inflation risks a troubling change in expectations formation via an increase in the share of backward-looking participants in the real economy; which 3) risks a worse inflation *and* output outcome in the longer term. This leads me to my conclusion that further tightening and sooner rather than later likely is needed to ensure the effectiveness of monetary policy to achieve the objective of 2% sustainably in the medium term.

[1] See Mann, 2022a and 2022b.

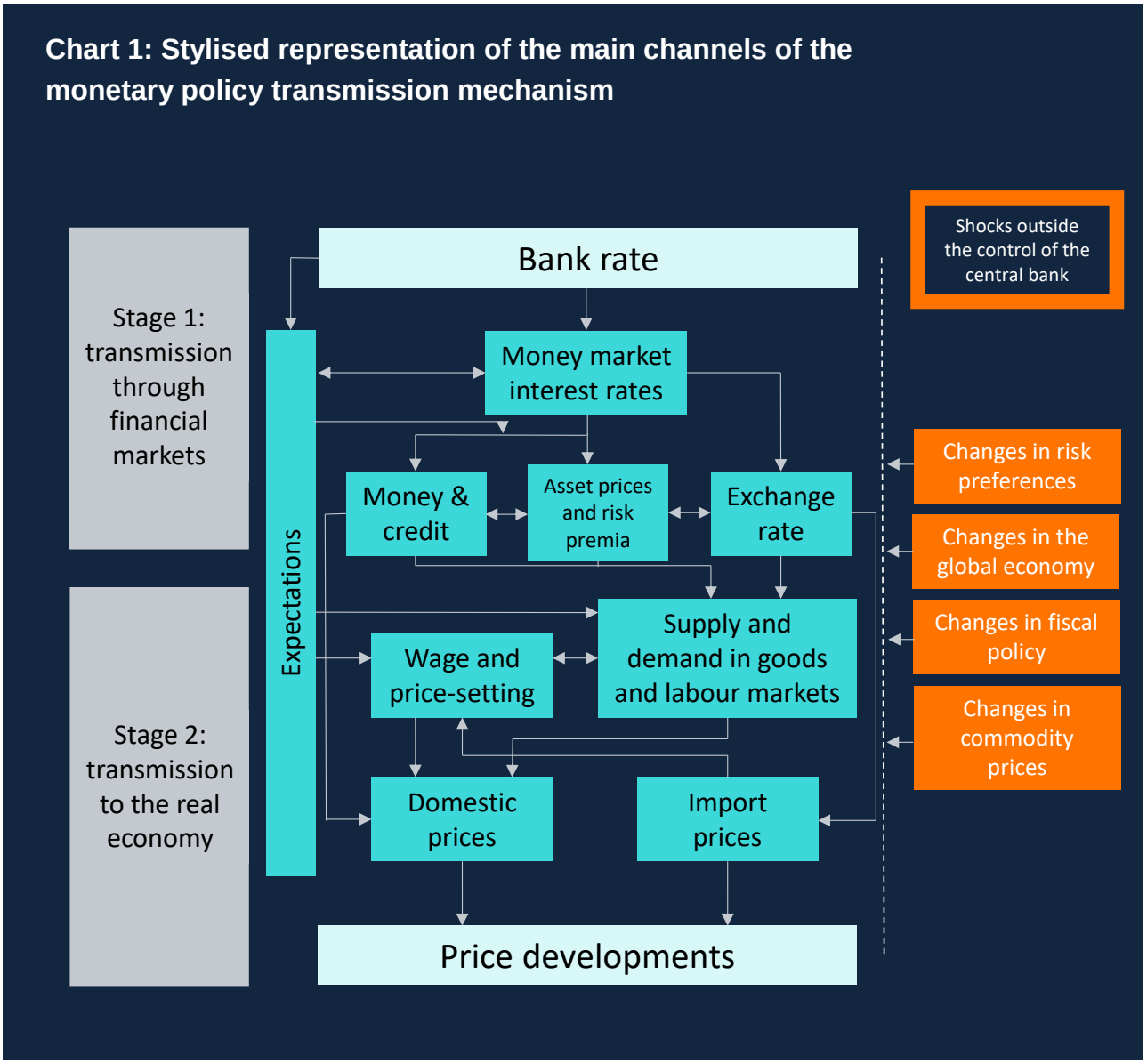
2. What is the transmission mechanism?

To structure the content of this speech, let me start with 'the monetary transmission mechanism'. The Bank's Monetary Policy Committee uses a single interest rate – Bank Rate – that affects only a narrow set of financial institutions.[2] How does that narrow conduit affect the behaviour of households and firms, and ultimately output and prices in the economy? Central banks rely on financial markets to pass through their policy choices in a way that is consistent with their intended consequences, alongside the role for expectations. Households and firms then react to these changed financial conditions and in light of their own expectations, which subsequently affects output and prices.

Chart 1 shows a stylised representation of the main channels through which monetary policymakers expect changes in policy rates to transmit through the economy. The effectiveness of monetary policy is influenced by the functioning of these individual channels, and the interactions between them, denoted by the arrows.

[2] Of course, we also have conducted Quantitative Easing and engaged in forward guidance in order to influence risk-free rates further along the yield curve but these are less direct policy tools. Our main monetary policy instrument at the moment is certainly Bank Rate.

Chart 1: Stylised representation of the main channels of the monetary policy transmission mechanism



Source: Adapted from **ECB (n.d.) 'Transmission mechanism of monetary policy'**.

Factors outside of the central bank's control and interactions among the channels can amplify or dampen the pass-through of any given policy choice. I'd like to highlight several stages through which the transmission mechanism works in each of the following sections of this speech.

The first stage comprises the transmission from a change in the policy rate through financial markets. The overall transmission mechanism is often summarised in a 'financial conditions index'. But, as with many other cases of aggregation, it is important to look under the bonnet for where changes in the policy rate feed through to specific financial market variables, such as the exchange rate, the interest rates that firms and households face, as well as other asset prices. Changes in the policy rate don't transmit

instantaneously though, but rather at different speeds to different financial market variables, which is one source of lags in monetary policy.

The second stage of the transmission mechanism describes the pass-through of changes in financial conditions to the real economy, through the price-setting decisions of firms, wage negotiation behaviour of firms and households, as well as their spending, saving, and investment decisions. This is the stage in the transmission mechanism where lags arguably are most obvious because of agents' partial attentiveness and the staggered nature of contracts, among other factors. Prices and wages are influenced by, and may spill back into demand and supply, and labour markets.

But to start the transmission process, a tightening in financial conditions should mean households cut back on consumption as the cost of borrowing rises, and the opportunity cost of spending increases as saving rates rise. Firms may reduce investment, both in response to rising borrowing costs, and in anticipation of worsening demand conditions. Conditional on their pricing power and debt conditions, they may reduce prices or hold off on increasing them in order to preserve their market share, or they may even increase them to try to preserve cash flow.

Expectations – that is expectations of everything: policy, prices, demand, supply – influence both financial and real-side channels but with different lags and with different degrees of forward- versus backward-looking assessments of the current data and the future. An often underappreciated feature of macroeconomics is that expectations about the future can influence the present.[3] Expectations can affect wages and prices directly, possibly before demand and supply conditions in goods and labour markets have changed (Mann, 2022b).

However, there are also shocks, illustrated on the right-hand side of this diagram, that are outside of the control of a central bank and can influence the key channels of the transmission mechanism. These include for instance changes in fiscal policy, trade linkages in the global economy, commodity prices, and risk preferences. In recent years, economies and central banks across the world have faced a series of these shocks, which most probably have influenced the long and variable lags – that is the effectiveness – of how changes in Bank Rate affect the real economy and inflation.

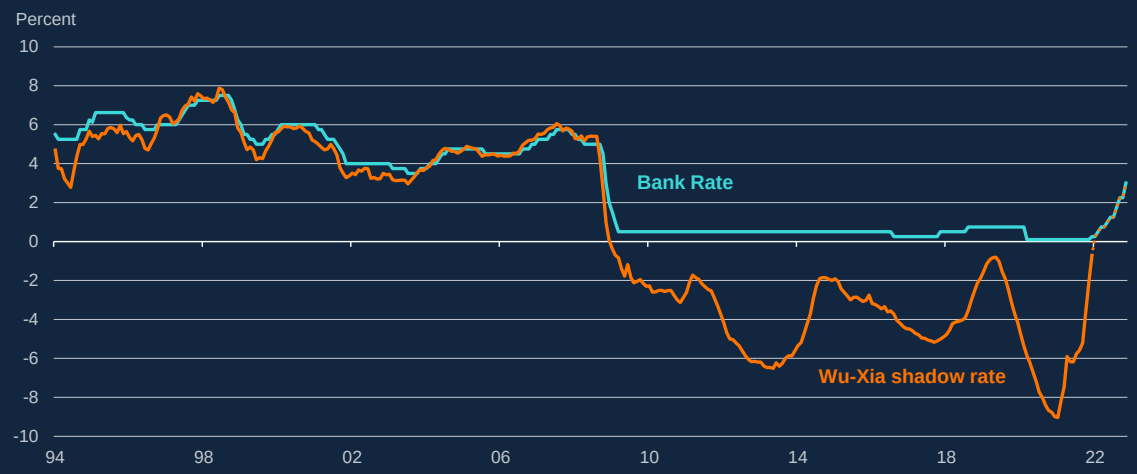
[3] In this current framework, in which central banks try to explain, as best as they can, the aim of and reasoning for their policy choices, the stance of monetary policy is as much about Bank Rate today as it is about Bank Rate tomorrow. Or even, as Woodford (2005) put it: "Not only do expectations about policy matter, but, at least under current conditions, very little *else* matters."

3. The transmission of monetary policy through financial markets

In the next few minutes, I would like to focus entirely on the first stage of the transmission mechanism, the transmission of monetary policy through financial markets.

Chart 2 shows the level of Bank Rate compared to a so-called "shadow rate" (Wu & Xia, 2016). This shadow rate can be thought of as showing the unobserved level of the short rate that could prevail, taking into account the effects of the policy rate as well as of unconventional monetary policy tools. Since the Global Financial Crisis (GFC), central banks have employed a range of conventional und unconventional monetary policy tools. So far, I have only focused on the transmission mechanism of Bank Rate, which has been the MPC's active policy tool. The use of forward guidance and quantitative easing (QE) are unconventional tools that were essential to the easing of the monetary stance while the policy rate was restricted by its effective lower bound, but these may work through different channels.[4]

Chart 2: Wu-Xia shadow rate and Bank Rate



Source: Wu and Xia (2020) and Bank of England. Notes: The orange dotted line constrains the shadow rate to the level of Bank Rate as suggested by the authors. Latest observation: February 2023.

[4] For more information on QE and its transmission channels, see Busetto et al. (2022).

As a first step to assess the effectiveness of the monetary transmission mechanism, a policymaker needs to understand how accommodative or tight the monetary stance is. This is not as straightforward to determine in light of the unconventional tools and the time-varying nature of r*. For a variety of reasons, the policy rate alone does not always provide an accurate read on the monetary policy stance.[5]

Over the last year and a half, monetary conditions have tightened significantly over a short period of time, in response to the MPC's Bank Rate increases. But, are the conditions tight? Not just the speed and size of tightening matter here, but the starting point does too. The MPC started tightening from what was a record-accommodative policy stance due to the Bank's response to the Covid-19 pandemic.

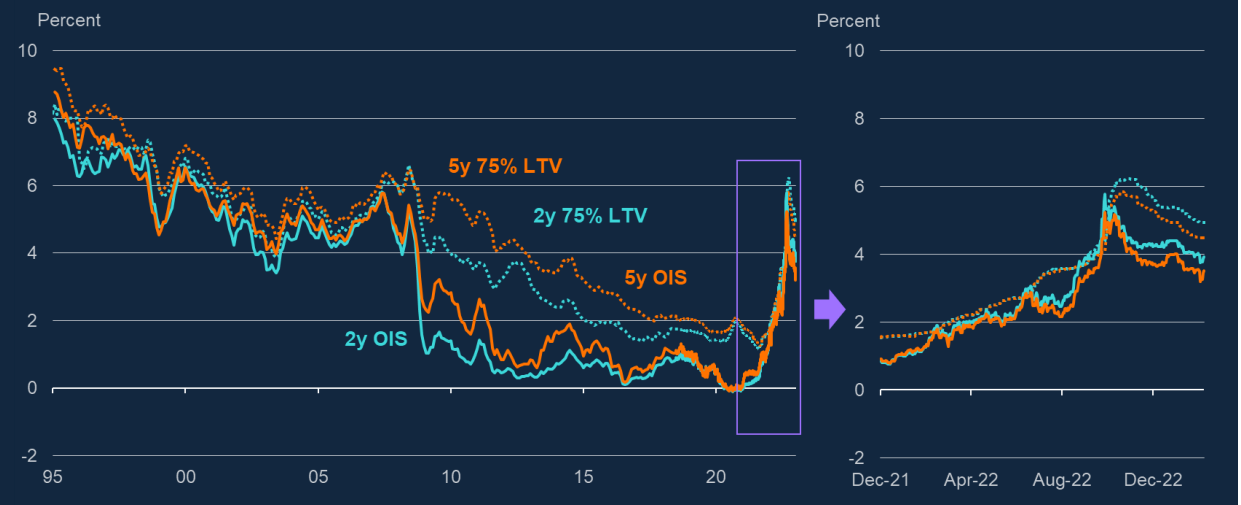
There is an obvious question on the interpretation of this shadow rate: Should monetary policy stance be judged by the level or the change? Which one (or both) matter for overall financial conditions and the real economy? To make an assessment on the level, you would need a relevant reference point. Is an historical average a good reference point, given the 'structural break' present in the data around the GFC? Compared to historical average, the monetary stance is still loose. Compared to a post-GFC period, monetary stance is tighter. But research also finds that the extent to which monetary policy affects inflation depends on thresholds: that is, tightening from a loose stance has less of an effect on inflation than tightening from a tight stance (Calza and Sousa, 2005).

Turning to a key part of the transmission mechanism – household debt-servicing costs. **Chart 3** shows the levels of mortgage rates at 2-year and 5-year horizons, alongside maturity-matched OIS reference rates. The difference between mortgage rates (in the dotted lines) and the maturity-matched OIS rate (in solid lines) is referred to as the mortgage spread. Up until the GFC, mortgage and reference rates co-moved closely – a relationship that broke down in the financial crisis. Spreads widened as reference rates fell in response to falling policy rates and QE. But mortgage rates fell only very slowly over the next decade, and never recovered the level of pre-crisis spreads. This is evidence, at least over the sample period we are looking at, of lagged pass-through from changes in policy rates to the rates households face on their mortgages.

[5] Typically, shadow rates in the literature are constrained to be near or equal to the level of the policy rate when it is above its effective lower bound (ELB). This made sense when the goal was to measure the easing effect of unconventional monetary policy. Arguably, however, also in times when the policy rate is far above the ELB, it is not a clean measure of the monetary policy stance. See for example Choi et al. (2022) who construct a less restrictive measure of the monetary policy stance for the US.

Chart 3: Mortgage rates and OIS rates

Solid lines show OIS rates, and dotted lines the maturity-matched 75% LTV mortgage rates



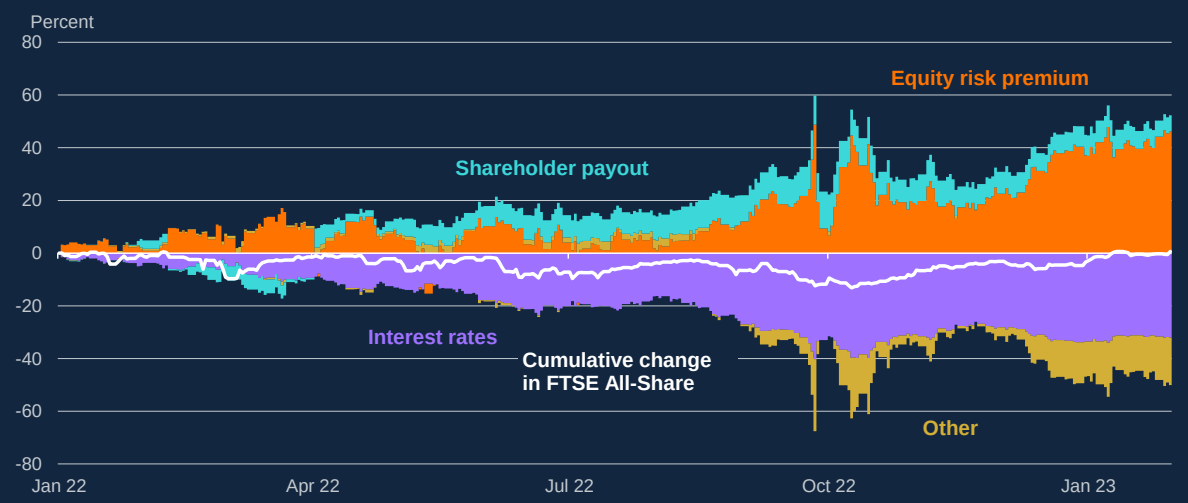
Source: Bank of England, Bloomberg Finance L.P, Moneyfacts and Bank calculations. Notes: For OIS data pre-2008, a Gilt-OIS spread is applied to the equivalent-maturity gilt yield data. Data is monthly until July 2018, and daily thereafter. Latest observation: 7th February 2023.

Zooming in on the time since we started increasing Bank Rate, we see that mortgage rates tracked reference rates quite closely, initially, on the way up. They have also somewhat retraced their recent spike around the mini-budget turmoil of September 2022 – but not as much as have reference rates. Interest rates spiked sooner than mortgage rates did, reflecting again the lag in the pass-through from changes in reference rates to mortgage rates.

It appears that pass-through from changes in risk-free rates to mortgage rates is highly state-dependent, suggesting more rapid transmission as interest rates rise and slower transmission as interest rates fall. Whereas the level of mortgages rates is higher than the trough, they are about back to pre-GFC levels, and importantly, have loosened from last autumn. Is this a tight stance for 2-year and 5-year mortgage rates? Notably, mortgage rates are definitely looser than they were last autumn, even as Bank Rate has risen further since.

Turning now to the equity market, **Chart 4** shows a decomposition of moves in equity prices into underlying components through the lens of a Dividend Discount Model. The MPC's tightening in monetary policy has had a considerable downward effect on equity prices over the last twelve months. This is the direction monetary policy makers would expect the transmission mechanism to work in a hiking cycle: higher interest rates weigh on equity prices as future earnings and cash flows are discounted using a higher discount factor. It would also make sense that higher interest rates would signal a worsening economic outlook to financial markets, which should dampen expected shareholder payouts, and potentially increase risk premia.

Chart 4: Decomposition of equity price moves of the FTSE All-Share[6]
Cumulative percentage changes



Source: Bloomberg Finance L.P, Tradeweb, Refinitiv Eikon and I/B/E/S from LSEG, IMF WEO and Bank calculations. Latest observation: 1st February 2023.

But **Chart 4** shows that, in fact, shareholder payout and most notably the equity risk premium have made a positive contribution to equity prices since the beginning of last year. These have outweighed the effects of monetary policy tightening through interest rates. Shareholder payout, in aqua, captures a combination of realised cash flows to investors, and their expectations for future payout, and is often used as a proxy for market-implied views on the economic outlook. So, equity markets seem to have a reason to believe the outlook has improved since the beginning of 2022, or at least some

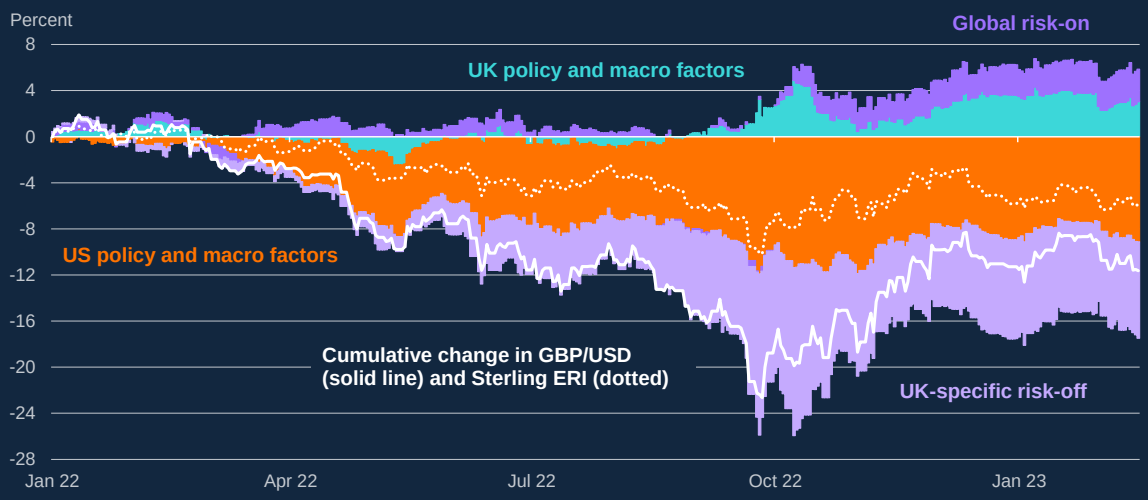
[6] The decomposition uses the Bank's Dividend Discount Model. For more information, see Dison and Rattan (2017).

remaining elevated tail risks from the Covid period seem to have receded. This could be a result of their forward-looking nature, that inflation is expected to fall steadily this year, or reflective of the fact that long term interest rates are expected to be lower than short term ones.

Either way, this chart tells an interesting story about the net effectiveness of the monetary tightening so far. The positive contribution of a falling equity risk premium implies that an improving outlook is not enough to explain equity performance. Indeed, it implies that equities have performed significantly better given what we know about interest rates and growth expectations. It seems that the MPC's tightening efforts have been in part offset by this risk premium.

Moving now to how global factors affect the transmission mechanism as measured by the exchange rate. **Chart 5** decomposes the moves in the Sterling-Dollar exchange rate into contributions by monetary policy, macroeconomic factors and risks. All other things being equal, a rise in UK interest rates should cause Sterling to appreciate relative to other currencies – but we see a marked depreciation instead.

Chart 5: Decomposition of bilateral Sterling-Dollar exchange rate
Cumulative percentage changes



Source: Bloomberg Finance L.P, Refinitiv Eikon from LSEG and Bank calculations. Notes: For more information on the model see Appendix A1. Latest observation: 17th February 2023.

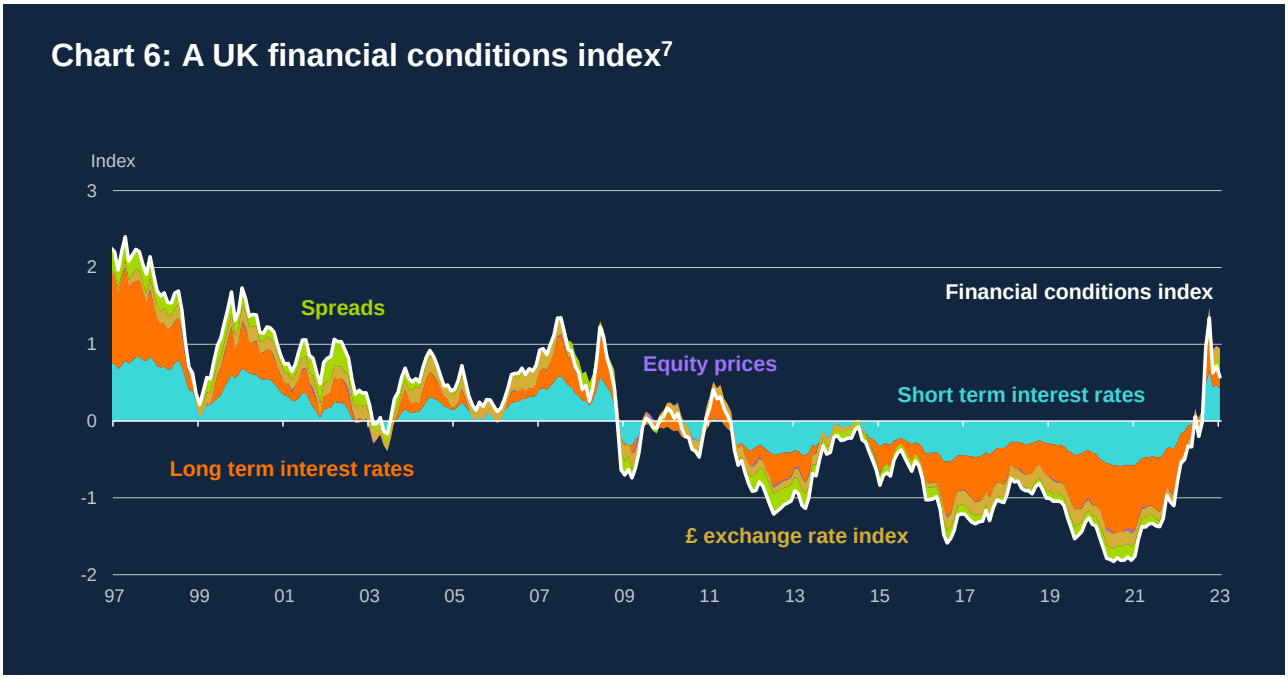
The chart covers the entire MPC tightening cycle, and Sterling has depreciated by 10% versus the Dollar. Up until the end of 2022, the contribution of US policy and macroeconomic factors have outweighed the MPC's tightening. This in part reflects the Federal Reserve tightening, particularly at a quicker pace than the MPC, but also a better

macroeconomic outlook in the US. More recently, the orange US bars have come off as the Fed had been expected to reduce their pace of tightening.

On the other hand, the aqua bars, reflecting the pricing of UK policy and domestic macroeconomic factors, have increased, suggesting that had the MPC not tightened, the exchange rate likely would have been even weaker. Another factor weighing on Sterling, as seen through the lens of this model, is a persistent UK-specific risk premium which captures the reduced appetite for Sterling assets more broadly, that is, apparently, unrelated to direct pricing of monetary policy and future macroeconomic conditions.

To summarise this section on the first stage of the transmission mechanism, **Chart 6** shows a new measure of aggregate financial conditions in the UK. There are numerous such indices which all emphasise different aspects of the transmission mechanism. In my view, this measure is particularly useful as it was constructed by explicitly controlling for the non-stationarity in many underlying series, so for example should not be affected by a falling r*. Its average level should, therefore, be able to better capture a notion of "neutral". That said, the distinctions among the transmission channels in the decomposition should not be considered so bright-lined given the endogeneity among the components.

Chart 6: A UK financial conditions index[7]



Source: Bloomberg Finance L.P, ICE, Moneyfacts, Refinitiv Eikon from LSEG, Tradeweb and Bank calculations. Latest observation: January 2023.

[7] More information can be obtained in a forthcoming Bank Underground post and in Appendix A2.

This new financial conditions index implies that UK financial conditions are, at the moment, not much tighter than on average, relative to historical standards. But, coming out of an entire decade of short rates at the effective lower bound, and relatively loose financial conditions, we have had to come a long way. We are left with the conundrum of to what extent *tightening* or *tightness* matters for the transmission to the real economy and inflation.

In my view, we have more to do. Because, as markets have looked forward to the soon-to-be expected peak in policy rates, financial conditions have again begun to loosen. Financial conditions are looser relative to what they might be otherwise, due to the depreciation of Sterling and a falling equity risk premium, which have global factors embedded in them. To me, as both the level as well as the delta matter in assessing the effectiveness of transmission of monetary policy, this implies that the forward-looking nature of financial markets has been absorbing some of the intended tightening, which impact the long and variable lags of folk wisdom. Even more important is the apparently premature loosening of conditions, given prospects for inflation formation. A topic to which I now will turn.

4. The transmission of monetary policy to the real economy and inflation

Now that I have outlined some of the ways in which the transmission through financial markets can be assessed, I would like to turn the focus to the second stage. The transmission to the real economy, specifically, inflation.

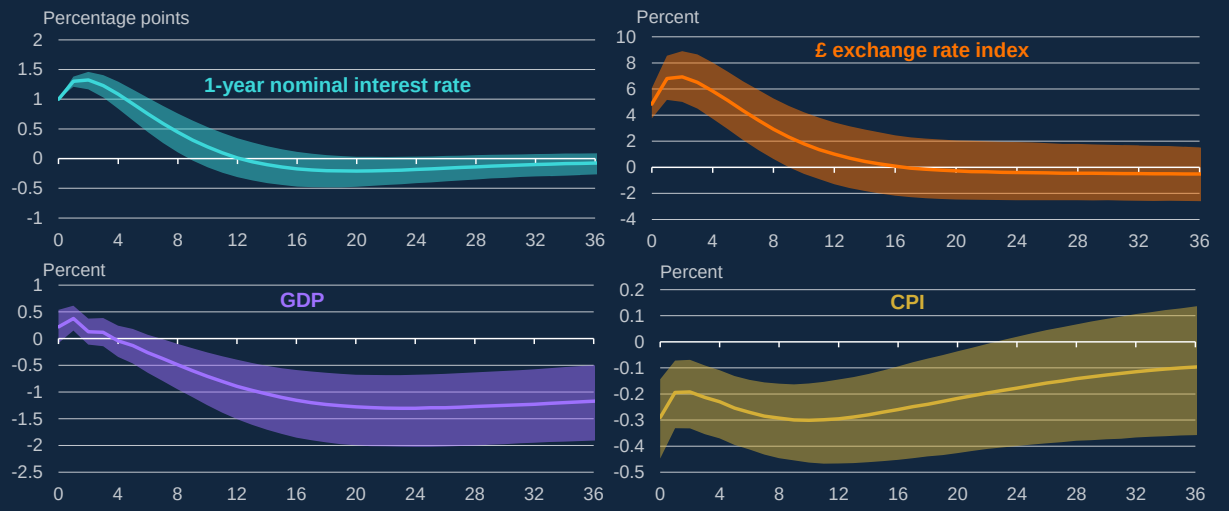
Measuring the effects of the transmission of monetary policy, or more importantly the causal effect of monetary policy on the macroeconomy and the price level is challenging. Not least because the causality runs both ways. Monetary policy can affect the state of the macroeconomy by changing the interest rate, changing borrowing costs in the economy, and thereby influencing spending, investment and saving behaviour, including expectations, wage and price setting. But through the reaction function, monetary policy will be affected by developments in the macroeconomy: if a central bank observes high inflation, policymakers should react by setting tighter monetary policy.

Failing to properly account for this empirical modelling challenge resulted in the famous ‘price puzzle’: Empirical models predicted that tightening monetary policy resulted in an increase, not a decrease in inflation, at least in the short run. Sims (1992) argued this was because policy shocks used to identify the causal effects also included the endogenous policy responses to forecasts of future inflation. Ramey (2016) showed that identifying monetary policy *shocks* to measure the transmission to macroeconomic outcomes is

essential in order to estimate causal effects – we require deviations from the monetary rule to identify the response of the economy to monetary policy.

To confront this endogeneity, we need structural models to estimate the transmission of monetary policy to the real economy and inflation. Using the results of just one empirical model as an example, **Chart 7** shows the impulse response functions to a 1 percentage point monetary policy shock, replicated using a method adapted and extended from Cesa-Bianchi, Thwaites and Vicondoa (2020)[8]. The authors – one of whom is now at the Resolution Foundation – use a high-frequency identification approach to measure UK monetary policy surprises, which they use as instruments to identify the transmission to the real economy. The model is estimated over the entire period of inflation targeting in the UK excluding the Covid period.

Chart 7: Impulse response functions to a 100 basis point monetary policy shock



Source: Cesa-Bianchi, Thwaites and Vicondoa (2020) and Bank calculations. Notes: sample period 1992-2019, monthly. The solid lines and shaded areas report the median and the 68% confidence intervals, computed using moving block bootstrap with 5000 replications. For the full set of impulse responses, see Appendix A3.

Starting by looking at the top left panel, a 100 basis point monetary policy shock has a persistent effect on the 1-year nominal interest rate, lasting for around twelve months after the shock hits. The top right-hand panel shows the monetary policy shock also appreciates the Sterling exchange rate index, with a peak effect at two to three months

[8] More information on methodology, and robustness checks can be obtained in Appendix A3.

following the shock, consistent with the effect on the 1-year nominal interest rate. This follows from the standard theory of interest rate differentials explaining exchange rate movements when only the home central bank tightens.

The monetary policy shock also has a significant, delayed response on the level of real GDP, which is consistent with the story on monetary policy lags, but also New Keynesian theory that GDP lags inflation. Real GDP barely moves on impact, and slowly falls with a statistically significant peak response of -1.25% after around two years – consistent with the 18 to 24 months of the long and variable lags story. The results also suggest a permanently negative effect of contractionary monetary policy on the *level* of output relative to trend. This shouldn't be interpreted as monetary policy scarring activity forever, as in growth rate space, GDP recovers.

However, the lags on inflation are quite different in this simple set-up. Turning now to the bottom right panel, the effect on the level of CPI is not only statistically significant and negative, but also instantaneous. In the model, the fast pass-through of the monetary tightening likely relies on the exchange rate appreciating on impact.

Of course, this is a simplified version of the world, as the impulse response functions show the impact of a single monetary policy surprise, and only by UK policymakers, as indicated by the role for the exchange rate in financial conditions. In reality, the economy has faced a sequence of these shocks in the past year which have overlapped before we have seen the full effect of any of them. And, other central banks have also been tightening policy.

Further, the period over which the model was estimated had generally low and stable inflation. Might these results be affected a period of surging and persistently high inflation such as we have experienced over the last 18 months? Could high inflation itself affect the monetary transmission mechanism? Using an event study, Bank researchers show some evidence for a direct expectations channel of monetary policy which could affect price setting already within the period of the shock.[9] To examine these questions, I need to turn to a different kind of model that allows us to control and vary deep parameters about expectations formation.

[9] See Di Pace et al. (2023) who analyse firm expectations in particular, and find that announced changes in the monetary policy rate induce firms to revise their price expectations, with rate hikes inducing a decrease in price expectations and uncertainty surrounding them.

5. A stylised example of forward- versus backward-looking expectations formation and the monetary policy transmission mechanism

This section presents a so-called "toy model" in which we can vary the share of backward-looking price-setters in the economy. At its core, it is a very simple, calibrated, textbook New Keynesian model.[10] It is designed to capture a certain mechanism that we are interested in but, as these models tend to do, it disregards many other features of the real world. It shouldn't be thought of as quantifying the behaviour of any particular real-life economy. For example, it is not COMPASS, the Bank's large and complex structural model that is used, among others, in our forecasting exercise every quarter (Burgess et al, 2013). Although, as a dynamic and stochastic general equilibrium model, it does share the underlying modelling paradigm.

This model focuses and formalises a concern that I flagged in a previous speech (Mann, 2022b): What happens to the behaviour of macroeconomic aggregates if people begin to form backward-looking inflation expectations? In this model, I find that, indeed, a higher degree of "backward-lookingness" generates more inflation persistence even if the underlying shock is the same. But, crucially, it also changes the effectiveness of monetary policy to control inflation. A given monetary tightening has less of an effect on inflation if expectations formation is mainly backward-looking, detached from demand and supply conditions, which thereby worsens any inflation-activity trade-off in the face of a shock.

Stepping back from the model exercise, is there evidence that the degree of forward- and backward-lookingness changes? In a previous speech (Mann, 2022b), I cited research which estimated the share of forward- versus backward-looking agents using switching forecast rules. Cornea-Madeira and Madeira (2022) show empirically that for the UK the share of backward-looking agents has varied significantly over time, in particular being higher when energy prices surge.[11]

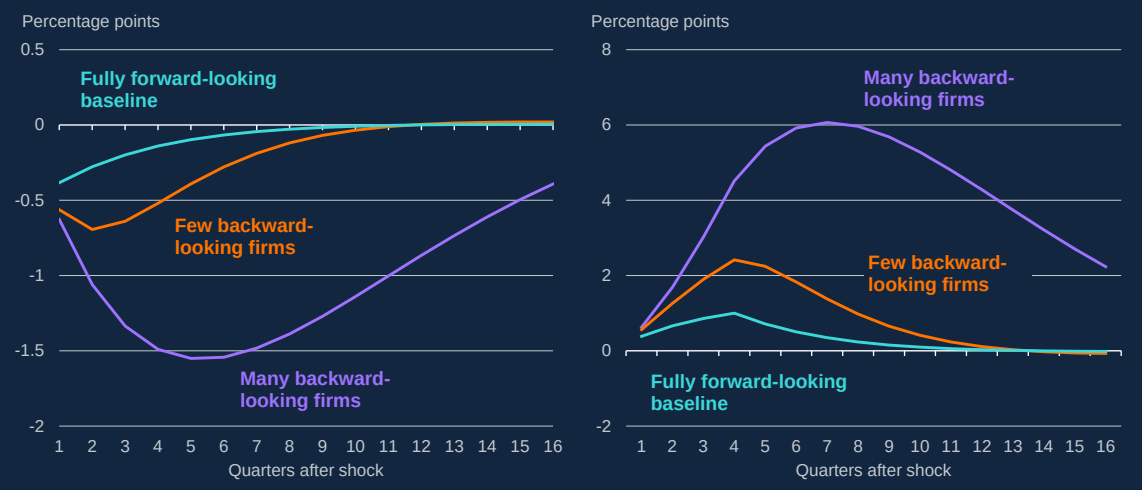
Returning to the model, we can trace out the response of our model economy to the same underlying shock: a so-called cost-push shock which exogenously increases prices over and above what would be implied by domestic demand conditions. It is, of course, intended to stand in for the global goods price shock of 2021 or the energy price shock of 2022.

[10] It is a generalisation of the model described in Chapter 3 of Galí (2015), enriched with backwards- and forward-looking price-setters as in Galí and Gertler (1999). For more information, please see Appendix 4.
[11] For a fully structural model with endogenous forecast switching, see Fischer (2022).

Consider **Chart 8**: it shows the reactions for a model economy which differs only by the share of backward-looking price-setters.[12] The baseline, where all firms form fully forward-looking and model-consistent expectations, is shown in the aqua line. In this economy, the cost-push shock has a very limited and short-lived impact on activity and prices. The output gap jumps on impact but quickly returns to zero. Because of the lagged nature of year-on-year inflation (Mann, 2023), it peaks after four quarters and then reverts towards target.

Chart 8: Responses to an inflationary cost-push shock, given a central bank using a balanced Taylor Rule

Output gap (LHS) and year-on-year inflation (RHS)



Source: Bank calculations. Notes: Responses are generated using a New Keynesian model with varying degrees of backward-looking expectations formation. For more information, see Appendix A4.

The behaviours of the output gap and inflation change dramatically when we introduce a modest degree of backward-looking inflation expectations formation. The output gap is more negative for longer which is mirrored in inflation peaking higher and remaining above target for an extended period of time.

Increasing the share of backward-looking agents even more takes this pattern to the extreme. Both output and inflation display a pronounced hump-shaped pattern and are away from equilibrium for the entirety of the plotted period (4 years). Remember that I

[12] The three lines refer to models in which the share of backward-looking firms is calibrated to be zero, 40, and 80 percent respectively. The choice of these values, away from the fully forward-looking baseline, is motivated by the range of the share of fundamental agents in Cornea-Madeira and Madeira (2022) which find that for most of the last 50 years, this share has fluctuated between 20 and 80 percent with a median of about half.

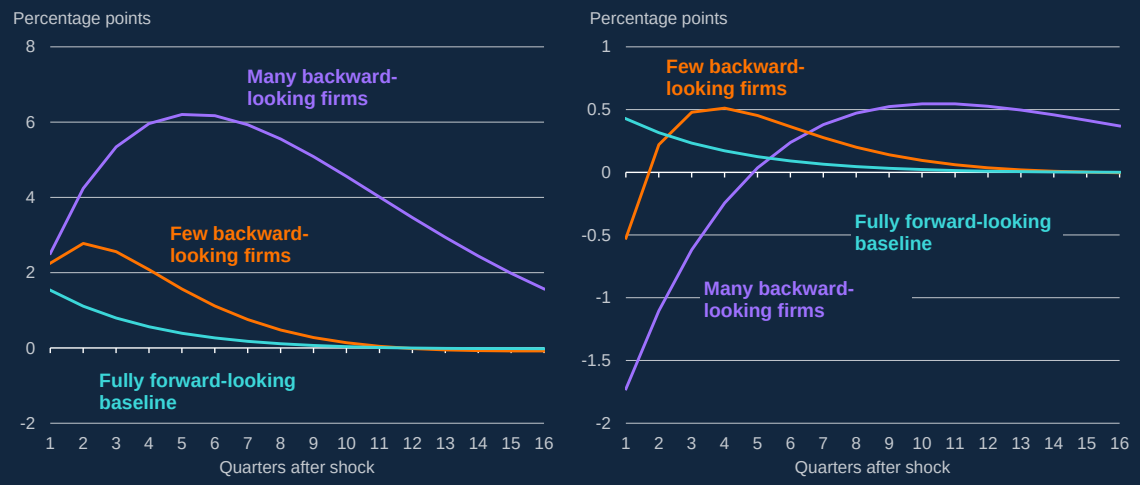
have not changed the size of the shock – just the degree of backward-lookingness of the firms in the economy.

These pictures also reveal an important non-linearity generated by changes in the formation of inflation expectations. Even though I have increased the share of backward-looking firms by equally sized increments step-by-step from aqua to orange to purple, the change in behaviour is increasingly stark. Not only does more backward-lookingness worsen the trade-off between inflation and output, every additional step worsens the trade-off by more than the last.

The outcomes in the previous charts are determined also by what central banks are doing. **Chart 9** shows the nominal (left side) and real interest (right side) rates associated with the central bank that follows a Taylor rule balanced between output and inflation deviations from target. In the model, this trade-off is reflected in the reaction of interest rates to the shock.

Chart 9: Responses to an inflationary cost-push shock, given a central bank using a balanced Taylor Rule

Annualised nominal (LHS) and real interest rates (RHS)



Source: Bank calculations. Notes: Responses are generated using a New Keynesian model with varying degrees of backward-looking expectations formation. For more information, see Appendix A4.

In the baseline case with fully forward-looking agents, the central bank raises nominal rates on impact which, due to benign inflation dynamics is sufficient to raise the real rate, which dampens inflation, and quickly both interest rates (and the real economy and

inflation) return to baseline. In the two less benign cases, however, despite the central bank raising the nominal rate sharply and persistently, the real rate actually falls initially. Since it is the real rate that determines output in this model, the falling real rate adds to inflation persistence so that, in the latter half of the simulation, the central bank must keep restrictive real rates longer in order to stabilise the economy. In the case of many backward-looking firms, the nominal interest rate rises even more and the restrictive real rates last for much longer.

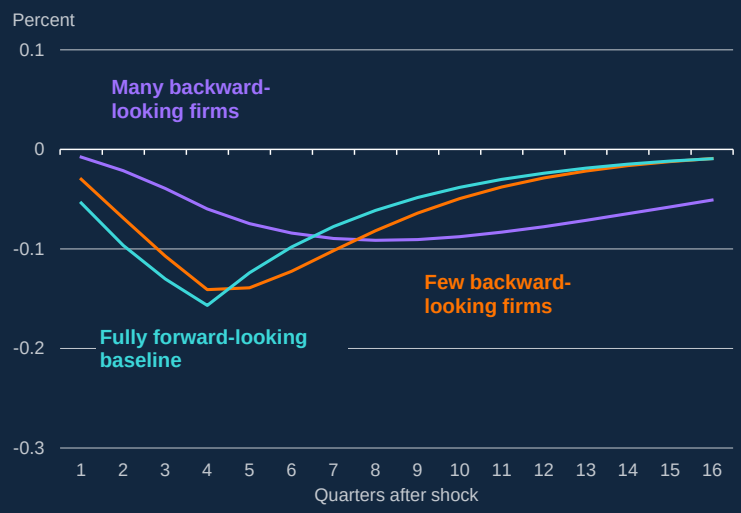
However, the problems of the central bank in the orange or the purple economy do not stop there. As a result of the increased share of backward-looking firms, the speed at which monetary policy can affect realised inflation also changes. In other words, the lags of the monetary transmission mechanism lengthen as shown by the increasingly long period away from the neutral line in the charts, which is particularly dramatic for the purple economy. The share of backward-looking firms in the purple economy is 80%, which is what Cornea-Madeira and Madeira (2022) find in their work for years when energy prices surged.[13]

Finally, given the monetary response, what happens to inflation? **Chart 10** plots the inflation response to a monetary policy shock in the three types of economies. All three lines are indexed to yield the same amount of output losses. As shown in the appendix (**Chart A4.2**), the path for output and the nominal interest rate is very similar for each case, which implies that the monetary transmission mechanism into economic activity is not meaningfully affected by backward-looking inflation expectations.

[13] In this simple model, we abstract from the behaviour of financial conditions discussed above. In that sense, the model here simplifies away the challenges of transmitting monetary policy through financial markets, the focus of the first half of the speech.

Chart 10: Inflation responses to a contractionary monetary policy shock, given same output costs

Year-on-year inflation



Source: Bank calculations. Notes: Responses are generated using a New Keynesian model with varying degrees of backward-looking expectations formation. For more information, see Appendix A4.

However, what does change is the transmission of monetary policy into prices. By construction, in the chart, the tightening yields the same outcome in activity, so we can read the lines as a dynamic slope of the Phillips curve under conditions of changing expectations formation.[14] An increasing degree of backward-lookingness implies a shrinking share of price-setters in the economy that consider supply and demand conditions when making decisions. Therefore, their importance for aggregate inflation falls. Inflation becomes persistent because firms that set prices and generate inflation expect it to be persistent. With a high share of backward-looking agents, monetary policy effectiveness – whether directly on expectations or through the output gap channel – is greatly diminished.

What does the central banker need to do when faced with these different types of expectations formation? The model in **Chart 9** shows the extent to which monetary policy needs to be increasingly restrictive to return the inflation rate to target when agents increasingly are backward-looking.

We have to remember that the world has been hit by a sequence of large inflationary shocks, which have increased the risk of being in the purple world in which troubling

[14] It is also related to the Phillips multiplier of Barnichon & Meesters (2021) in that it attempts to capture the trade-off between inflation and economic activity over time.

non-linearities are evident. I am not saying we are at that point yet or that we will necessarily get there given what we know now. However we need to be aware of how important the expectations formation process is for the effectiveness of monetary policy, and position ourselves accordingly. To reduce the risk of ending up in the 'purple' world, we should weigh inflation more highly in our reaction function.[15]

6. What does this all mean for monetary policy?

So, what does this all mean for monetary policy? Typically, we assume that the world is sufficiently stable such that the estimated relationships between, for example Bank Rate and inflation also are stable and we can look to these when deliberating monetary policy stance – the folk wisdom of 18 to 24 months.

In this speech, I have presented state-of-the-art evidence which shows that, in normal times, the monetary transmission into inflation is in fact faster, peaking within the first year. But, I have also reviewed factors that may change these relationships – change the long and variable lags – including a) that there has been a sequence of shocks, b) that the transmission from monetary policy to financial markets has been quick, but not all in the direction of tightening, and c) that the degree of backward- or forward-lookingness in expectations formation influences the effectiveness of monetary policy. Going forward, how should this reassessment of lags determine the appropriate monetary policy strategy?

Looking back to my speech from just under a year ago (Mann, 2022a), in the face of two shocks, and given what was already in-train regarding inflation expectations and the collected research on policy effectiveness in the face of inflation uncertainties, a greater degree of front-loading would have reduced the risk of an increasing share of backward-looking households and firms.

In the end, monetary policy has taken a path which has been historically aggressive, but perhaps insufficiently so relative to the multiple shocks, the behaviours pushing up inflation, and the initial accommodative starting point. The stage was set for a transmission of monetary policy to financial markets that has been quick, but also has been partially absorbed. And also, having a shorter horizon and being more

[15] Indeed, in an exercise of explicitly considering overlapping shocks and monetary reaction, I evaluate the implied paths of inflation and the output gap according to the loss function of Mark Carney's "Lambda" speech of 2017. In that speech, he shows how this loss function can embody society's preferred trade-off. Given the shocks hitting our model economy, the inflation-biased policy rule delivers a combination of output and inflation which is superior to those of the balanced policy rule.

forward-looking than households and firms, markets are already incorporating the expected future inflection in monetary stance.

Collectively, all this adds up to financial conditions that are now looser than what likely will be needed to moderate the embedding of on-going inflation into the wage- and price-setting paths. I worry that this constellation could yield extended persistence of inflation into this year and the next. The resulting long period of time above the 2% target could increase the degree of backward-lookingness, or catch-up behaviour, in the system. Given that the risk of increasingly persistent inflation rises disproportionately with the share of backward-lookingness, I believe that more tightening is needed, and caution that a pivot is not imminent. In my view, a preponderance of turning points (Mann, 2023) is not yet in the data.

We have an inflation remit, and we will achieve it one way or another. Failing to do enough now risks the worst of both worlds – the higher inflation and lower activity of the ‘purple’ regime – as monetary policy will have to stay tighter for longer to ensure that inflation returns sustainably back to the 2% target.

The views expressed in this speech are not necessarily those of the Bank of England or the Monetary Policy Committee.

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