UK inflation: What's done and what's to come – speech by Jonathan Haskel

Given at King's College London with the Economic Statistics Centre of Excellence (ESCoE)

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Speech

I am delighted to be at the Economic Statistics Centre of Excellence (ESCoE) today. Economic measurement is central to good decision-making. But it's difficult and I applaud the key contributions that ESCoE continues to make in this very challenging area.

As I'm in the last eight weeks of my time on the Monetary Policy Committee, I want to talk about our key concern: UK inflation. I'll try to look at the past and future of inflation: what's done, and what's to come.

To address these questions, we will need a model. Now, economic models get a bad press and the Bank recently commissioned a **review of economic forecasting from Ben Bernanke**. So why am I using a model? We'll need to measure lots of concepts and understand their inter-relationships. Economic models, and the measurement that underpins them, can help us map this complicated system and make real-time decisions.

In this speech I draw on ongoing research work to implement for the UK the model of inflation, wages and expectations developed by Olivier Blanchard and Ben Bernanke (unrelated to the Bernanke review, on which more later) which was also applied by various central banks to study post-pandemic inflation.[1] This is joint work with Josh Martin and Lennart Brandt that I spoke about in **November 2023**, and today will update those results and develop them.

As I reflect on six years on the MPC, and the current situation, I find I have a lot to say! So, with apologies for a long speech, let me try to be up front about my two main points.

First, on the inflation outlook: there are considerable encouraging signs, most notably from normalising inflation expectations and a (spoiler: temporary) return of headline inflation to target in May 2024. However, the wage-price system in the UK has been subject to a sequence of enormous shocks over recent years. The playing out of those shocks through the economy, and the continued tight and impaired labour market, means that inflation will remain above target for quite some time. I would rather hold rates until there is more certainty that underlying inflationary pressures have subsided sustainably.

Second, on Central Bank credibility: learning from history, the upward burst of inflation in the 1970s and post-pandemic were caused by broadly the same factors: massive, unexpected rises in imported commodity prices. But the post-peak trajectories were very

[1] The initial paper for the US is **Bernanke and Blanchard (2023)** and the subsequent paper comparing across countries is **Bernanke and Blanchard (2024)**. The application of their model to the UK is set out in **Haskel, Martin and Brandt (2023)** and we were thereby able to contribute to the international work. I am very grateful to Olivier Blanchard and Ben Bernanke and research teams in other central banks for the chance to work together.

different: inflation was much more persistent in the 1970s, due to unanchored price expectations and inflexible labour markets, than it has been so far for the recent inflation. The lesson of this comparison is, in my view, that Central Bank credibility is an incredibly valuable (intangible) asset. The independence of the Central Bank is important, but assets need investment to maintain their value. The way the Bank of England invests in credibility is by doing and communicating good economics.

Along the way, I'll try to answer some other questions.

1. **What caused the pandemic-era inflation?** There is little consensus on this question, and commentators hold diametrically opposed views. Some say the Bank did "too little" and were "behind the curve" in 2021. Others say the Bank has done "too much", and CPI inflation of 2.0% in May 2024 proves it. Still others blame "greedflation". Rather than conjecture, I'll use the Bernanke-Blanchard model to try to answer this debate.
2. **Why was the 1970s so different?** Those interested in the more technical aspects will know that the Bernanke-Blanchard model has been applied successfully in a range of countries, as summarised in Bernanke and Blanchard (2024). Another test of the model is to apply it to the past. I'll show some initial results from applying the Bernanke-Blanchard model to the UK since the 1970s. These will help understand changes in the inflation process in the UK over time.
3. **How do you make policy in real-time?** I will reflect on the challenges of making policy in real time, in the presence of uncertainty. Recent revisions to the data on unemployment from the Labour Force Survey provide a case study about the importance of economic measurement for policymaking. I remain concerned about an impaired labour market, albeit less so than before following data revisions.

A model of inflation, wages and price expectations

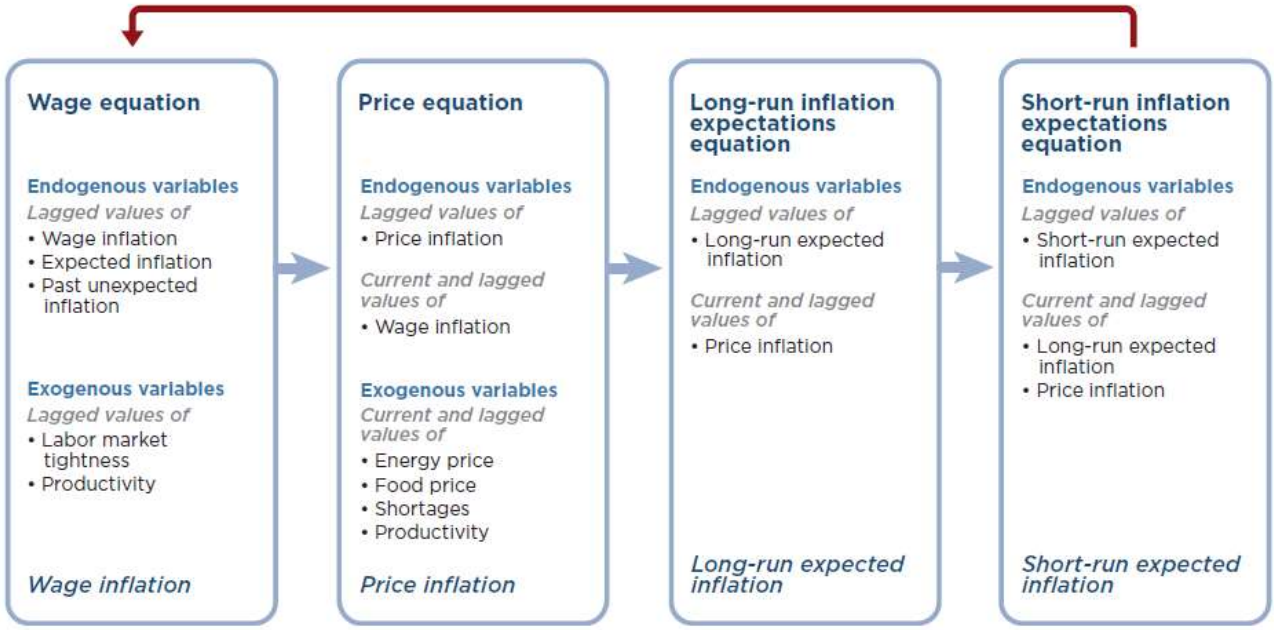
Let me start by summarising the model of inflation, wages and expectations developed in **Bernanke and Blanchard (2023)**, applied to the UK. This section draws heavily on a speech in **November 2023** and the accompanying paper **Haskel, Martin and Brandt (2023)**, those familiar with this might care to skip to the next section with updated results.[2]

The model consists of four equations, which can be conveniently thought about in sequence, as illustrated in **Chart 1**.[3] Following Chart 1 from left to right, the blocks show each of the four equations:

[2] The Bernanke and Blanchard framework is simple and transparent and follows a rich tradition of evidence on wage-price interactions. See footnote 9 for references.
[3] The model is a semi-structural model of wage and price determination which can be written as a structural VAR with additional theory-consistent parameter restrictions. The wage equation is identified by including only

1. **Wage inflation** is determined by past wage inflation, short-run inflation expectations, labour market tightness (measured by the vacancies-to-unemployment ratio in practice), productivity growth, and a "catch-up" term. The dependence on past wage inflation captures some inertia or "stickiness" in wage setting, while the "catch-up" term relates to real wage resistance and the desire of workers to recoup unexpected real wage losses.
2. **Price inflation** is determined by past price inflation, wage inflation, energy price growth, food price growth, shortages, and productivity. Energy and food prices are relative to wages (as a proxy for domestic price pressures).
3. **Long-run inflation expectations** depend on past long-run expectations and actual price inflation. If the role of actual inflation here is small, then it can be said that long-run expectations are well-anchored, since they will respond little to fluctuations in actual inflation.
4. **Short-run inflation expectations** depend on past short-run expectations, long-run inflation expectations, and actual price inflation. There is, in effect, a balance between anchoring to long-run expectations and deviations induced by actual inflation.

Chart 1: Structure of the Bernanke-Blanchard (2023) empirical model



Source: **Bernanke and Blanchard (2024)**, Figure 1.

To illustrate the model, imagine an energy price shock which pushes up price inflation – that is, a permanent rise in the price *level* of energy, but a one-off rise in inflation. This

lagged independent variables, and the other endogenous variables (price inflation, and inflation expectations) can be written in a causal chain starting with wages. The equations are estimated separately, and the model is solved recursively.

affects short-run and long-run price expectations, which in turn affect wage growth in two ways – first, if workers now have higher inflation expectations they may push for higher wages; second, workers may try to recoup the real income losses brought on by the unexpectedly high price inflation. If wages are higher, that pushes up inflation, and so the cycle continues.

The long-run consequences of a price shock in the model depend on the various parameters in the equations. Two types of economy can be described using **Chart 2**, which is drawn from **Bernanke and Blanchard (2023)**, and based on a stylised version of the model. The left-hand panel describes the response of inflation to a permanent increase in the price level (or one-period upward shock to inflation), and the right-hand panel to a permanent increase in labour market tightness. Imagine that inflation starts at steady-state (which might be at target) and these shocks move inflation away from steady-state – the chart plots the *response* of inflation to the shock, rather than the resultant level of inflation.

Chart 2: Theoretical model response to shocks in two types of economy

Source: **Bernanke and Blanchard (2023)**, Figures 1 and 2.
Notes: The chart shows the response of quarterly inflation to a permanent shock to the price level (left panel) and a permanent increase in labour market tightness (right panel), under alternative parameter choices. The blue lines show an economy characterised as "Weak feedback", which has well-anchored inflation expectations and little 'catch-up' (α=0.2, δ=0.9, γ=0.95). The red lines show an economy characterised as "Strong feedback", which has weakly-anchored inflation expectations and strong 'catch-up' (α=0.6, δ=0.7, γ=0.9). α=elasticity of wage growth to catch-up, δ=weight on long-run inflation expectations in short-run inflation expectations equation, γ=weight on long-run inflation expectations in long-run inflation expectations equation.

Starting with the left-hand panel, the blue economy is one with well-anchored inflation expectations and little real wage resistance (catch-up). While a price shock initially raises inflation, the effect wears off quickly, and after a year inflation is no higher than it was before (i.e. the graph is back to zero, so inflation is essentially back to its steady-state level). In the language of the model, the coefficients on current inflation in the expectations

equations are low (so expectations are well-anchored), and the coefficient on catch-up in the wage equation is low (so there is little real wage resistance).

The red economy is one with weakly-anchored inflation expectations and high real wage resistance. In this economy, a price shock leads to an initial burst of inflation directly, but persistently higher inflation forever (assuming no other changes in the exogenous variables). This is because expectations become de-anchored (are permanently higher), which leads to permanently higher wage growth and so permanently higher price inflation. In the red economy, the coefficients on current inflation in the expectations equations are high, and the coefficient on catch-up in the wage equation is high, so the degree of second-round effects is large. Of course, an inflation-targeting central bank would likely respond by increasing rates, cooling the economy, and returning inflation to target. Chart 2 suggests this job would be harder in a 'red' economy.

Turning to the right-hand panel, a similar result emerges. A permanent increase in labour market tightness leads to far higher inflation in the red economy (with weakly anchored expectations and strong real wage resistance) than in the blue economy (with well-anchored expectations and little real wage resistance). Note that in both cases, inflation continues to rise forever, since a permanently tighter labour market sets off a wage-price spiral of higher wage growth, higher inflation, higher expectations, higher wage growth, and so forth. The extent of this spiral is less severe in the blue economy than the red. Again, in reality, inflation-targeting central banks would not allow the labour market to be permanently tighter forever.

As the model shows, what then is crucial is both the extent of real wage resistance, captured here by the extent of "catch up", and the anchoring of inflation expectations. We may perhaps think of the first as related to labour market flexibility and/or the institutional arrangements within labour markets, most obviously indexation of wages. The second may be thought of as the institutional arrangements around monetary policy, most obviously the independence and reputation of the central bank, though independence alone is likely insufficient.[4] We may now apply this model to answer a number of questions.

Applying the model to the present

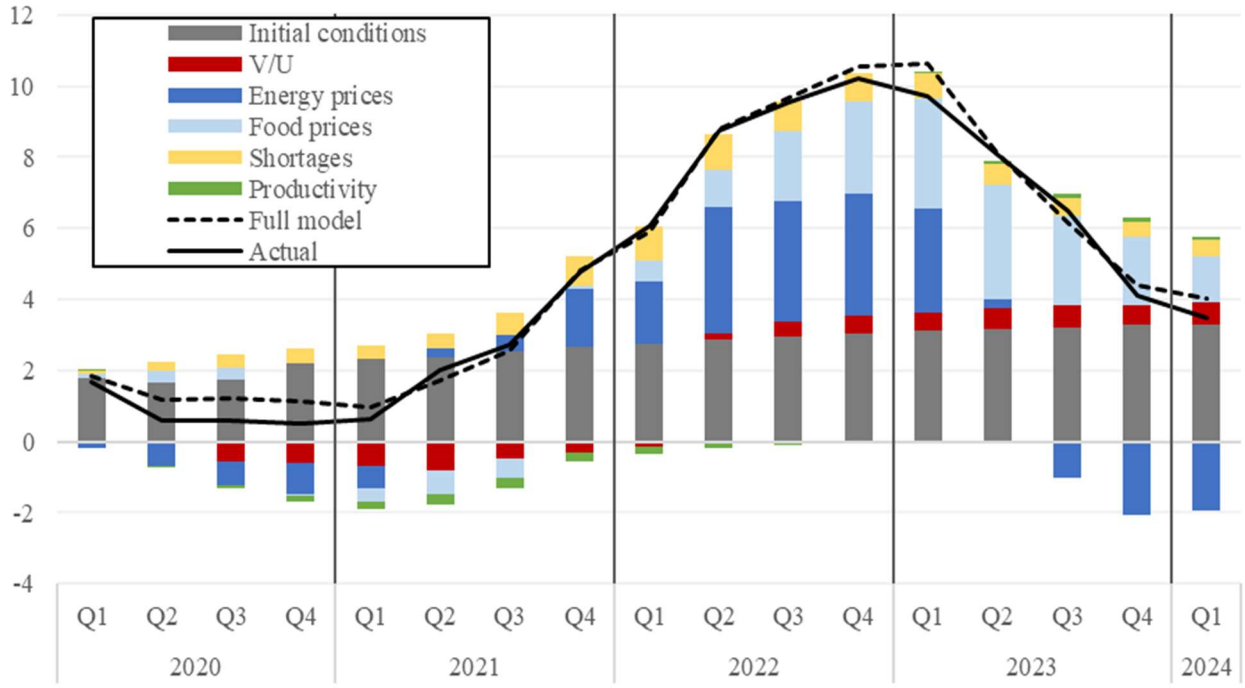
Chart 3 shows the results of this model applied to the latest data. The chart shows a decomposition of annual UK CPI inflation[5] (black line) into its proximate drivers identified in the Bernanke-Blanchard model (the various coloured bars). This is an update of the chart I

[4] An overview of theory and evidence on central bank independence and how it helps credibility, particularly over time, is to be found in **Bernanke (2010)** and a 2024 blog by the **White House Council of Economic Advisers**.

[5] The model is estimated on quarter-on-quarter annualised seasonally adjusted variables, but for easier interpretation I have converted the results into annual inflation. The quarterly equivalent of Chart 3 is in the Appendix. More detail of the data, model and methods can be found in **Haskel, Martin and Brandt (2023)**.

showed in a **speech in November 2023**, with the model now estimated on data up to 2024 Q1. The coefficients in the model are little changed.[6]

Chart 3: Decomposition of annual UK inflation, 2020 Q1 to 2024 Q1



Source: Author's calculations, update of **Haskel, Martin and Brandt (2023)**.
Notes: "Initial conditions" reflect the model response under hypothetical conditions where V/U remains at the level in 2019 Q4, relative food and energy price changes are pre-pandemic averages, shortages are at 'normal' pre-pandemic levels, and productivity growth is 0.5% per year in line with post-2007 averages. The dynamic effects of two dummies for the pandemic period are removed. See **Haskel (2023)** and **Haskel, Martin and Brandt (2023)** for details and discussion. Inflation is annual inflation, based on a transformation of quarterly inflation, on which the model is fitted. Equivalent quarterly chart in the Appendix.

Following **Bernanke and Blanchard (2023)**, this decomposition is produced by simulating the model under different information sets and comparing the results.[7] The further one gets from the jumping-off point of 2019 Q4, the less precise the model estimates will be. Overall, the model fits the data remarkably well, though at quarterly frequency the match is not quite as good in recent quarters (see quarterly chart in the appendix).

[6] Two changes since my November 2023 speech and associated paper are 1) we now use the Global Supply Chain Pressure Index (GSCPI), published by the Federal Reserve Bank of New York, as a measure of shortages; and 2) we now seasonally adjust the energy price data. The impacts of both changes are small.
[7] The model is given outturn data for all periods up to 2019 Q4 inclusive. Then, the model is simulated quarter by quarter. The prediction of the full model uses the outturn data of all the exogenous variables but the past model estimates of the endogenous variables (wage growth, price inflation, and short-run and long-run inflation expectations) rather than their outturns. To decompose the model prediction into the role of each of the exogenous variables, we set each of the exogenous variables in turn to a counterfactual value (as in the 'initial conditions'), and re-simulate the model, giving alternative predictions for all the endogenous variables. The difference between the full dynamic model prediction and this partial model outcome is the contribution of the particular exogenous variable to the endogenous variable outcome. This contribution covers both direct and indirect effects via other endogenous variables.

So, what caused UK inflation over this period? Looking at the whole period, the "initial conditions" (grey) bars represent the model estimate of what inflation would have been had the economy remained in its pre-pandemic condition and no further shocks had occurred. Since the UK labour market was tight at the end of 2019 (the V/U ratio was high), and assuming it would stay that way for 4 years, the model predicts a gradual increase in wage growth and price inflation, consistent with the right-hand panel of Chart 2. It is of course impossible to know what would have happened absent the pandemic, but it seems unlikely that the Bank of England would not have responded to cool the labour market.[8]

Turning to the post-2020 drivers of UK inflation, and proceeding chronologically, what caused the rise in inflation in 2021 as the economy recovered from the pandemic? The initial increases in inflation in 2021 were driven by energy prices (dark blue bars) and shortages (yellow bars). As seen in Chart 2, such price shocks would be transitory in an economy with well-anchored expectations and little real wage resistance (the blue economy). The UK in the inflation-targeting era is such an economy, as we'll explore in more detail later (Charts 5-7). Thus, the model says that *the MPC was right to think about these initial price shocks as transitory*.

However, in late-2021 and early-2022, two important things changed. First, the labour market quickly tightened (V/U increased) and began to put upward pressure on inflation (red bars). As Chart 2 showed, labour market tightness has persistent inflation effects, even in an economy with well-anchored expectations. In Chart 2, which is a decomposition of annual inflation, the red bars only appear positive from 2022 Q2. But in quarterly inflation (Chart A in the Appendix) labour market tightness started pushing up on inflation (via wages) in 2021 Q4, immediately after the end of the furlough scheme at the end of September 2021.[9]

Second, the price shocks continued and intensified, with larger energy price shocks following Russia's invasion of Ukraine, and an emerging food price shock (light blue bars). The repeated and large nature of these shocks increased the risk of the de-anchoring of expectations, and introduced a role for inertia. Recall that in the model, inflation depends on past inflation – that is, inflation is sticky. High inflation, no matter what the cause, risks

[8] Interestingly, in the cross-country work described in **Bernanke and Blanchard (2024)** (see their Figure 8), the importance of these starting conditions seems only relevant in the UK: in the US, Japan and the Euro Area, initial conditions in 2019 Q4 seemed consistent with target inflation. **Haskel, Martin and Brandt (2023)** note that the MPC judged the UK labour market to be "tight" in late 2019 and early 2020.

[9] The furlough scheme closed on 30 September 2021, with one million jobs still furloughed at the end. The lags in the official labour market data meant we didn't know whether this would translate to a spike in unemployment until 14 December. Meanwhile Omicron was designated a Covid-19 "variant of concern" by the WHO on 26 November, there were Omicron cases in the UK from 27 November, a new vaccine booster program announced on 30 November, work from home guidance re-introduced on 13 December, and a major incident declared in London on 18 December. In the face of all of that, the MPC raised rates on 16 December.

becoming embedded if it persists for too long. *In my view, the Bank of England was right to raise interest rates in late 2021, the first major central bank to do so.*[10]

Finally, what about inflation in 2023? As Chart 3 shows, headline CPI inflation is falling sharply, driven by falling energy prices (the negative blue bars). In the data for May 2024, the latest release, annual UK CPI inflation was 2.0%. This is excellent news, but as the effects of energy prices and base effects fade, the May MPR forecast is for inflation to rebound and peak at around 2.6% in late-2024 and early-2025, before falling to the 2% target in early-2026. I view this shape to the inflation forecast as a feature, not a bug. Crucially, it reflects that underlying inflation is persistent and declining more slowly, with headline inflation pushed around by volatile energy and base effects.

To summarise, the model suggests the initial burst in inflation in 2021 and the subsequent rise in 2022 was driven mostly by external shocks (energy and food prices and shortages). The subsequent fall has been driven by the unwinding of these shocks, but the labour market has remined tight and policy has rightly leaned against this.

Some other accounts of the pandemic-era inflation

This is quite a different narrative to some others. The “greedflation” theory is that inflation was caused by firms profiteering and raising their mark-ups. While there may be variation across firms, products and industries, there is no evidence for this in aggregate in the UK, at least that I can discern in official data (see **Haskel, 2023**). The *level* of corporate profits has increased, but so too has the level of wages and the level of prices. As a share of total national income, profits have remained largely the same.

Another theory is that the inflation of summer 2021 could have been detected, and acted upon sooner, had the Bank based policy on money supply growth which rose sharply in late 2020 and 2021. The money supply and inflation have a theoretically and empirically strong relationship at very low frequencies of 20-80 years, with a correlation coefficient of around 0.8. However, as Box B in the **May 2024 Monetary Policy Report** makes clear, this relationship breaks down at higher-frequencies (2-8 years), and money growth has not proved a reliable short-run indicator of inflation in the UK – indeed, the correlation at higher-frequencies is weakly negative over the past 80 years, around -0.1 (Chart A, Box B, May 2024 MPR).

Finally, it has been argued that since inflation expectations are well-anchored, and since CPI inflation was 2.0% in May 2024, the Bank need not have raised rates at all. My view is

[10] The Bank of England raised rates in December 2021, and started quantitative tightening (QT) in February 2022. The Federal Reserve’s tightening cycle began in March 2022, also ending quantitative easing (QE) at the same time, and beginning QT in June 2022. The Riksbank tightening started in May 2022, ceasing QE in April 2022 and starting QT later in the year, while the ECB tightening began in July 2022 and QT started in March 2023.

that this confuses cause and effect. I would argue that inflation expectations have stayed well-anchored precisely *because* the MPC responded to above-target inflation by raising interest rates.

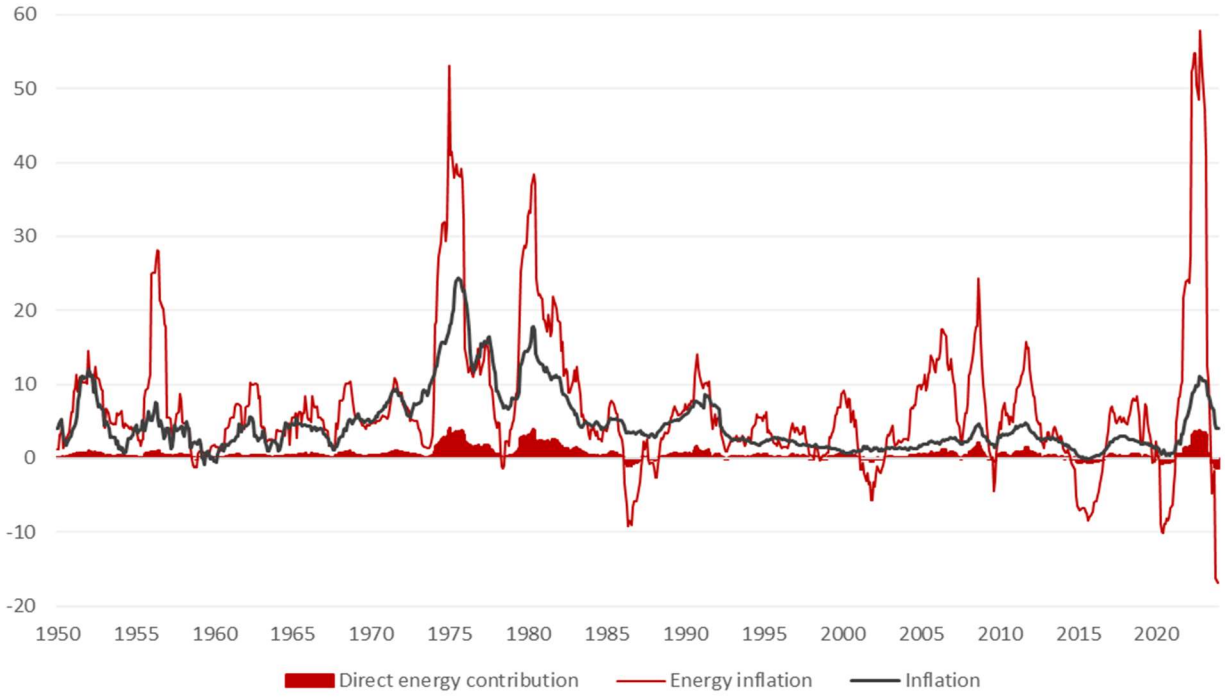
Applying the model to the past

So far, I've described the pandemic-era inflation, but what of the past? The 1970s was a period of high energy shocks and enduring inflation. Can the model tell us then how the UK inflation process has changed over time?

A history of shocks

It is first worth noting that the large price shocks faced in the UK (and euro area) in recent years are not without historical parallel. **Chart 4** shows UK inflation since 1950 and the associated changes in energy prices. Energy prices here include household energy bills of electricity and natural gas (and some solid fuels), as well as fuels for transportation (petrol and diesel), and account for the changing mix over time. As the chart shows, energy price shocks are common. The 1974 and 1979 shocks show up clearly. The shock in 2022 was larger at its peak than the shocks of the 1970s, though perhaps more short-lived.

Chart 4: UK inflation and energy contributions, 1950 to 2023



Source: ONS, author's calculations.
Notes: CPI components used since 1989, RPI components used prior to 1989 in the absence of CPI data for earlier periods. Given limited breakdowns in historic RPI data, the energy inflation rates and contributions should be seen as indicative only.

Chart 4 also shows UK inflation. Here the difference between the pandemic era and the 1970s era is notable. Just before the 1974 oil price shock UK inflation was already near 10%. Following that shock it rose to almost 25%, and even though the shock wore away, inflation only dropped to 7% by 1978. By contrast, the pandemic era shock, which was much larger, started with inflation at around 1% in 2020. It then rose to 11% but fell rapidly and in December 2023 had gone down to 4%.

Why were the 1970s so different?

Why, then, does the response of inflation to an energy price shock in the modern economy differ to that of the 1970s economy?[11]

To answer this, we have tried to fit the Bernanke-Blanchard model to UK data dating back to the 1960s. Full details are in a technical appendix. Naturally, working with historical data presents challenges. Many of the variables that we rely on are not available on an entirely consistent basis historically, though excellent work by Ryland Thomas and colleagues, as part of an **ESCoE project**, has developed the "**Millenium of macroeconomic data**" which is a fantastic resource and made our lives much easier. Despite this, there is no reliable series for long-run inflation expectations earlier than 1985 in the UK, and so we have modelled a backseries. I should therefore emphasise that this is a work in progress, and should be interpreted as indicative only.

To understand the possible changes in the model and the economy over time, we estimate the model using three 30-year windows. The first such window is 1967-1997, broadly the period before inflation targeting in the UK. Thus, we can contrast the economy as to how it looked during the era of the 1970s energy shocks, with how it looks in the modern era.

Chart 5 shows the estimated response in the model to an energy price shock, based on three estimation windows: 1967-1997 (red), 1977-2007 (orange), and 1989-2019 (blue). These are broadly speaking: a pre-inflation targeting era, a transition era, and the modern era. The first panel shows the response to inflation in quarter-on-quarter annualised space, then second panel in annual inflation space, and the third panel in price level space. Recall that the theoretical model responses in Chart 2 were on quarter-on-quarter inflation, which correspond to the first panel of Chart 5. The second and third panel of Chart 5 are simply transformations of the quarter-on-quarter inflation response, to aid in understanding. As in Chart 2, imagine that inflation was at steady-state (e.g. at target) before the shock, so Chart 5 shows the *response* of inflation to the shock (e.g. deviation from steady-state).

The shock is a one-period energy price inflation shock – that is to say, the level of energy prices goes up unexpectedly in period 0 and stays up. The shock is calibrated to be 1pp

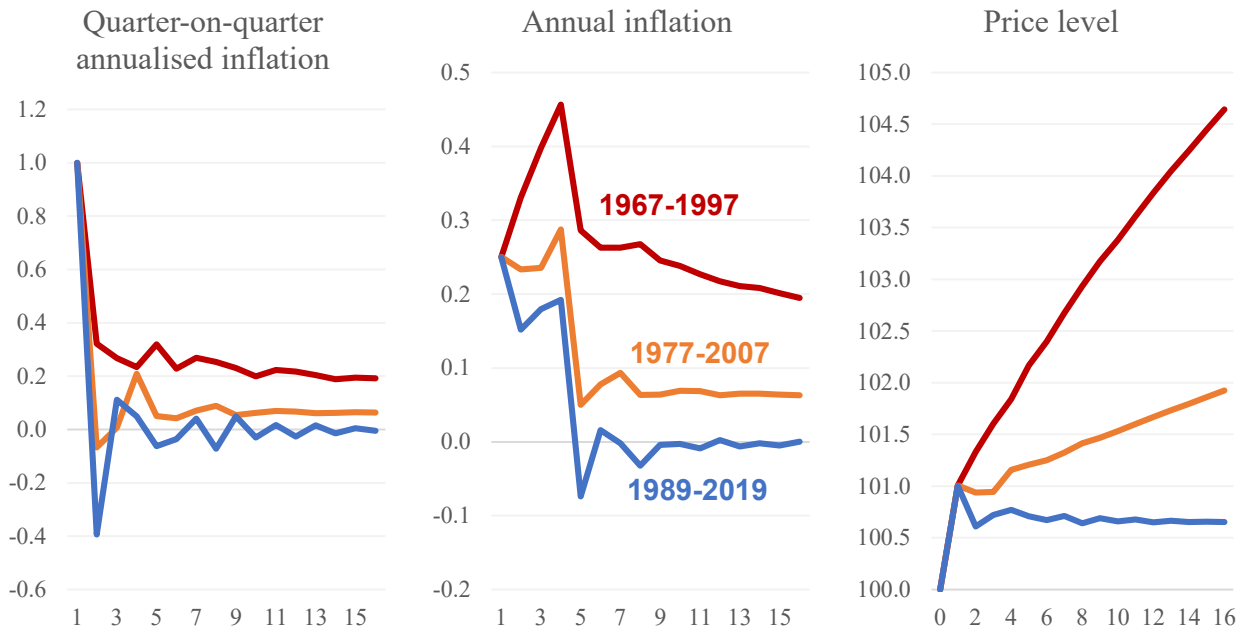
[11] There is much excellent work in this space already, including on real wage resistance effects as analysed by, for example, **Bruno and Sachs (1985)**, **Layard, Nickell and Jackman (2005)**, and **Newell and Symons (1987)**: see **Bean (1994)** for a survey. See also **Blanchard and Gali (2007)**.

on quarter-on-quarter annualised inflation on impact (in period 1) in all estimation periods for comparability. Importantly these estimated model responses assume no other shocks to the exogenous variables. These are, in effect, the impulse response functions of the model to a single shock in isolation.

The model seems to capture the stylised story for the 1970s pretty well. In all the panels of Chart 5 the red line (highest line on all charts) shows a persistent response of inflation to a one-off energy shock. The model estimated on 1967-97 data (red line, at the top) is in striking contract with the model estimated on 1989-2019 data (blue line, at the bottom).

The model covering the 1970s inflation episode (the red line, estimated on 1967-97 data) looks very much like the red line from the simulated model in Chart 2. Recall that in Chart 2, the hypothetical economy with a persistent inflation response to shocks was an economy with weakly anchored expectations and strong real wage resistance. In this economy, a price shock (such as an energy price shock) leads to permanently higher inflation. By contrast, the model estimated on 1989-2019 data (blue line) looks like the 'blue' economy from Chart 2 – the energy price shock causes temporary inflation, but no long-run effect on inflation. The model estimated on 1977-2007 data (orange line), the intermediate period, follows an intermediate path.

Chart 5: Response of inflation to a one-period energy price shock, different estimation windows

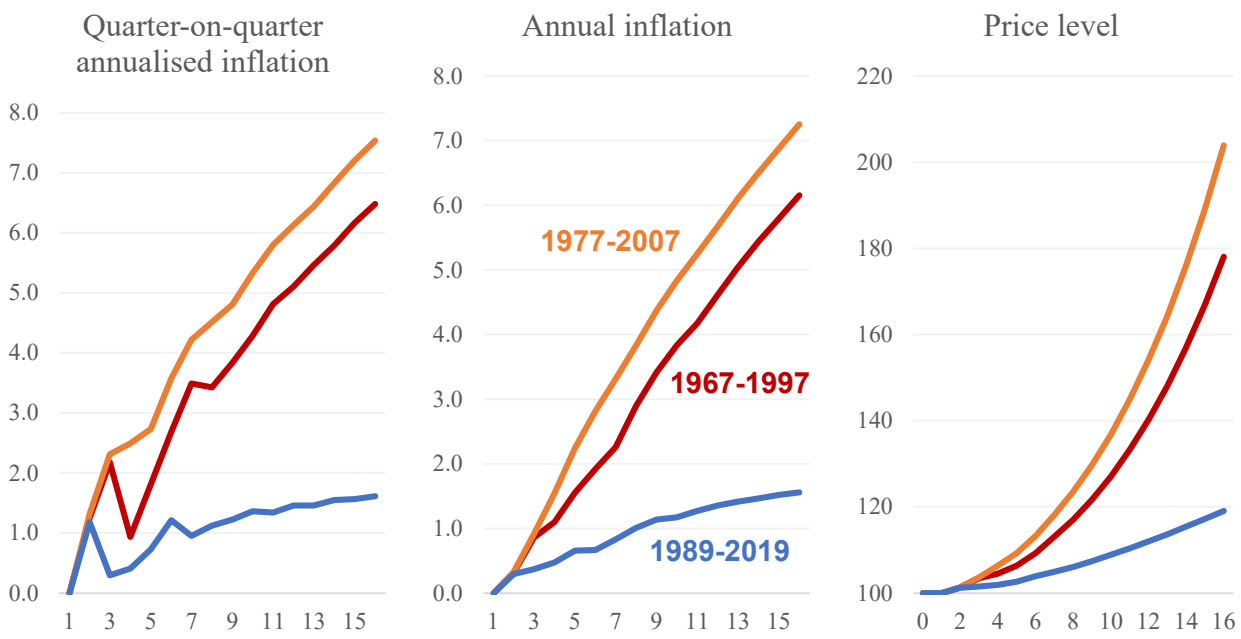


Source: Author's calculations, based on **Haskel, Martin and Brandt (2023)** and **Bernanke and Blanchard (2023).**

Notes: First panel shows the response of quarter-on-quarter annualised inflation to a one-period energy price shock, calibrated to have a 1pp effect on quarter-on-quarter annualised inflation on impact. Second panel shows the response of annual inflation. Third panel shows the response of the price level. Coloured lines in each panel reflect different estimation periods: 1967-1997 (red), 1977-2007 (orange), 1989-2019 (blue).

Chart 6 is equivalent to Chart 5 but for a labour market tightness shock – a permanently higher level of V/U. Again, it is clear that the earlier periods had less well-anchored expectations – a permanently tighter labour market leads to a wage-price spiral (ever-increasing inflation) which is much more aggressive in the earlier periods than the modern era.

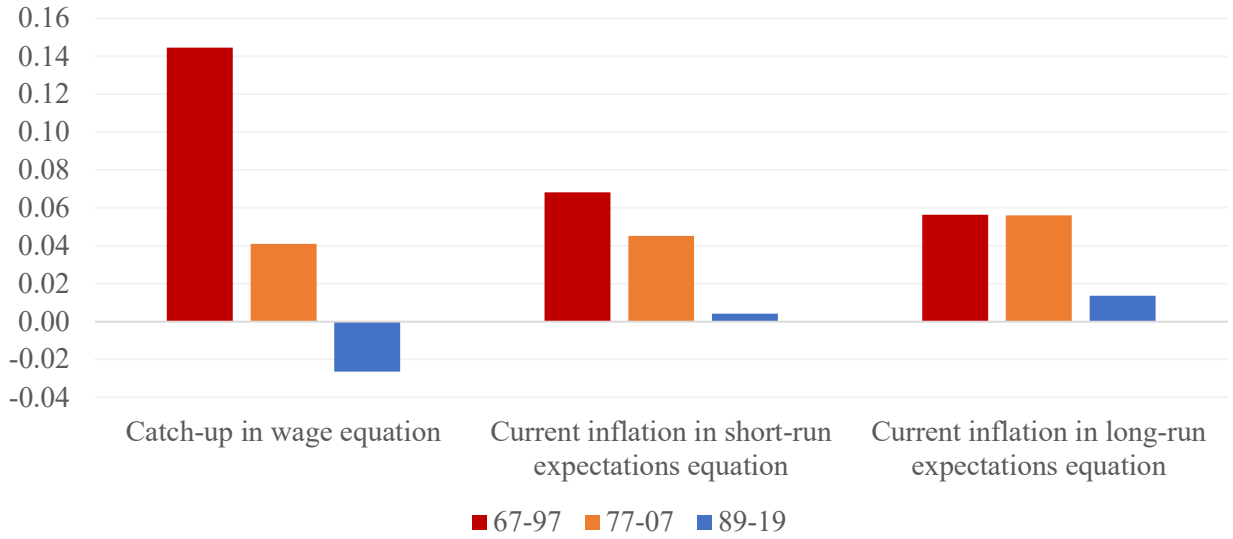
Chart 6: Response of inflation to a permanent labour market tightness shock, different estimation windows



Source: Author's calculations, based on **Haskel, Martin and Brandt (2023)** and **Bernanke and Blanchard (2023).**
Notes: First panel shows the response of quarter-on-quarter annualised inflation to a permanent labour market tightness shock (V/U permanently higher by 0.1). Second panel shows the response of annual inflation. Third panel shows the response of the price level. Coloured lines in each panel reflect different estimation periods: 1967-1997 (red), 1977-2007 (orange), 1989-2019 (blue).

Examining the coefficients in the estimated equations gives some insight into these differences. **Chart 7** shows the sum of coefficients on catch-up in the wage equation, actual inflation in the short-run expectations equation, and actual inflation in the long-run expectations equation, for the three estimation periods. Catch-up (real wage resistance) appears to have been important in the 1967-1997 period, but not in the later periods. Expectations were more responsive to actual inflation in the earlier periods, but much less so in the modern era. It appears then that the UK economy has transitioned from a 'red' economy to a 'blue' economy – with stronger anchoring of inflation expectations, and weaker real wage resistance. That means that price shocks today should have less long-lasting effects on inflation that they would have had in the past.

Chart 7: Selected coefficients from Bernanke-Blanchard model, different estimation periods



Source: Author's calculations, based on **Haskel, Martin and Brandt (2023)** and **Bernanke and Blanchard (2023).**
Notes: The coefficients given in the notes to Chart 2 related to a stylised version of the model, with several differences to the empirical model which underlies the empirical results in Chart 7 and other charts. Coloured bars reflect different estimation periods: 1967-1997 (red), 1977-2007 (orange), 1989-2019 (blue).

This is very good news for policymakers. It suggests that the economic costs of bringing down inflation, in the form of higher unemployment and lower economic output, might be less today than they were in the past. Indeed, as found in **Blanchard and Galí (2007)**, real wage rigidities lead to a trade-off between stabilising inflation and closing the output gap. The simulations in Charts 5 and 6 suggest that a shock of a given size leads to less inflation today than in the past. In other words, second-round effects today are smaller than in the past – in the language of the model, that's because catch-up effects are smaller and/or inflation expectations are now more well-anchored.[12]

However, this statistical model cannot tell us *why* this is the case – there is nothing causal here.[13] Most likely is that inflation expectations are better anchored because of a credible inflation targeting regime and an independent central bank (see a little more discussion in the concluding section). It could also be that policymakers are (or perceived to be) more willing to act as required to achieve price stability.

Crucially though, the fact that inflation expectations seem well-anchored does not mean policymakers should do nothing in response to price shocks. Rather, the model identifies, from past relationships in the data, the reaction of inflation to price shocks *conditional on*

[12] It is not easy to disentangle these effects, but it is an interesting question which of the two are more important here.
[13] Of course, it is important to note that there are other differences in the UK and global economies since the 1970s, including the transformation of supply chains and use of oil and gas. Some of these differences will be picked up in the data and the coefficients, others will not.

past reactions of policy. If expectations react little to inflation in the estimation period, that will largely be because of the reaction (and expected reaction) of monetary policy to inflation over that period. If monetary policy today were not to react to inflation, in contrast to the past, then outcomes could be quite different.

It should also be noted that monetary and fiscal policy, both domestic and global, are effectively in the model, but not easily identifiable. Increases in energy and food prices could be due to expansions in aggregate demand (both domestically and globally) or contractions in aggregate supply, or a combination thereof. Aggregate demand will depend, in turn, on monetary and fiscal policy (both domestically and globally). Similarly, V/U reflects in part demand for labour, which will depend in part on domestic aggregate demand, which partly reflects monetary and fiscal policy. The effect of monetary policy tightening will, to a large extent, be seen through declining V/U. While the primitive drivers are not identified in the model, their effects are implicitly included.

Finally, I should say that whilst drafting this speech we were made aware of parallel work in progress by Michael Bordo and colleagues at the Bank, Oliver Bush and Ryland Thomas.[14] They use econometric methods to find upward inflation expectations regime changes in the 1970s, which have subsequently fallen. Their results are directionally very similar to those here. They find substantial contributions of such expectations changes to 1970s inflation persistence, and have a fascinating discussion of the institutional reasons for this, including the role of permissive monetary and fiscal policy. They argue that higher inflation expectations were brought down after regime shifts, including the introduction of inflation targeting and the independence of monetary policy making.

Making real-time judgements on inflation: a real-world case study

I turn now to recent policymaking in the UK.

The **Bernanke review** rightly points out the difficulties that any forecaster has in making judgements in real time with noisy data. I want to spend a moment setting out a case study that illustrates this very point. To be clear, my purpose is not to make excuses. Rather, for those interested in real-time policy making, I hope it is an interesting real-world example of some of the issues that have to be confronted.

Under the framework of wages and prices set out in the Bernanke-Blanchard model, the prospects for inflation depend upon a number of key issues, notably the exogenous

[14] An early version of the paper is available at - **Michael Bordo, Oliver Bush and Ryland Thomas (2022)** "*Muddling Through or Tunnelling Through? UK monetary and fiscal exceptionalism during the Great Inflation*". In more recent work they apply a modified version of the Bernanke and Blanchard model to the UK in the 1970s.

variables such as relative energy and food prices. The other key exogenous variable is labour market tightness. A tighter labour market increases wage pressure which then feeds through into prices and expectations in the system. The measure of labour market tightness used in the Bernanke-Blanchard model is the vacancies-to-unemployment (V/U) ratio. Labour market tightness is among the measures that the MPC watches closely to understand inflation persistence, and the Bernanke-Blanchard model says that it is right to do so (see Chart 2). However, understanding this in real-time is challenging, so I want to provide a case study of how difficult it is in practice to apply this model in real time (see **Bernanke and Blanchard (2024)** for a similar discussion across countries with data to 2023 Q2).

Setting the scene: data available at our February 2024 meeting

My aim in this case study is to show how successive data releases matter. **Chart 8** plots the vacancy rate against the unemployment rate, with the relationship between the two described by the Beveridge curve, *using the data available at the February 2024 MPC meeting*.[15] What is this curve? Think of the labour market as matching workers with jobs. In a recession, vacancies tend to fall, and unemployment rises, tracing out a downward-sloping line. A labour market with worse matching means more unemployed at given vacancies, shifting the line outwards.

Starting with the pre-pandemic era, the Beveridge curve lay roughly along the downward sloping blue line shown in the chart. Then came the pandemic, which led to a sharp fall in vacancies and rise in measured unemployment, attenuated by the furlough programme. During this time the labour market was enormously influenced by public policy, and so it's difficult to interpret the dynamics around the labour market over this period.

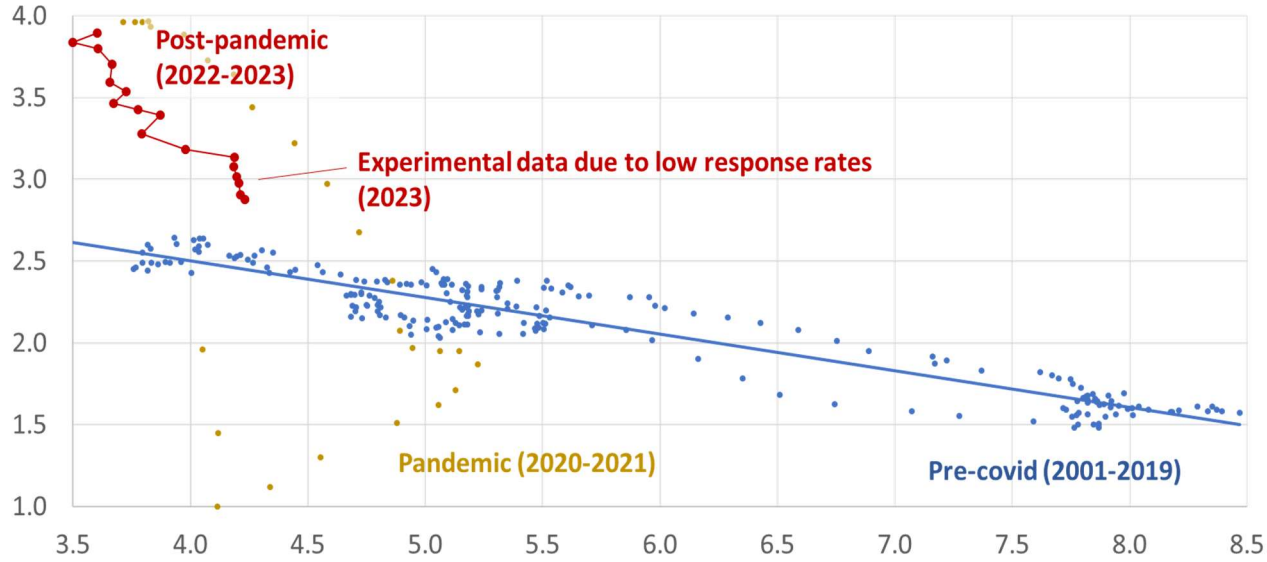
Turning to the post-pandemic data which lie on the top left of the chart, there are two eras. Between 2022 and 2023 (the top left orange dots) unemployment fell and vacancies rose sharply. At the peak of this adjustment the vacancy rate was a little above the unemployment rate, meaning that for every unemployed person there was about one vacancy. This is in marked contrast to the kinds of ratios we see in more normal times along the blue line where more than two unemployed people are pursuing each vacancy.

From 2023, however, the red linked-up dots, the labour market began to loosen as vacancies started to fall. What was happening to unemployment? The data available to us at the February 2024 MPC meeting was a combination of data from the Labour Force

[15] This diagram has featured in recent Monetary Policy Reports (Chart 3.5 in **May 2024** and **Feb 2023**, amongst others) and in speeches by colleagues past and present on the MPC (such as **Greene, 2024**, **Broadbent, 2023** and **Nickell, 2001**). I stressed the importance for inflation of movements on the Beveridge curve in **Haskel (2021)**. See **Yashiv (2007)** for a brief survey on the Beveridge curve.

Survey (LFS) up to 2023 Q2, and thereafter experimental data published by the Office for National Statistics (ONS).[16]

Chart 8: Vacancy rate, unemployment rate and Beveridge curve, data available at February 2024 MPC meeting



Source: ONS, author's calculations.

Notes: Pre-covid "Beveridge curve" is a simple linear line of best fit through the data and is intended as illustrative only. Data during the pandemic are distorted by the furlough scheme. Experimental data due to low response rates cover periods from May-July 2023 to Sept-Nov 2023.

The combination of the vacancies data (which come from a separate survey) and this experimental unemployment data traced out the economy from the northwest to the southeast along the red line. As the chart shows, it looked like the economy was starting to travel down an outwardly-shifted Beveridge curve, relative to the pre-pandemic Beveridge curve illustrated by the blue line.[17]

How does this relate to inflation? If the economy is moving along an outwardly-shifted Beveridge curve, that is a sign that the matching process between vacancies and unemployment has become impaired. Thus, any level of unemployment is associated with higher vacancies, and thus more wage pressure. Ultimately monetary policy would have to

[16] This experimental data was an interim measure published by the ONS in response to their suspension of the LFS results, following the dramatic decline in response rates to that survey during and since the pandemic. The ONS extended the unemployment rate using the Claimant Count – a measure constructed using largely administrative data, that tracks the number of claims for out-of-work benefits. This should be related to the economic unemployment rate (as defined by ILO definitions), but the two are not the same conceptually or empirically.

[17] I should immediately add that the true Beveridge curve is not a line of best fit between these points, but must be estimated using auxiliary data on job hires, flows into and out of unemployment, and so forth. However, a much more formal statistical analysis of these data confirms the view that the Beveridge curve had shifted out relative to pre-pandemic, at least for the quarters for which the necessary data were available.

respond to this – the impaired labour market requires the monetary authorities to set a higher interest rate than they would otherwise have done, in order to return inflation sustainably to target. This reading of the labour market therefore suggests a more 'hawkish' outlook to rate setting, and in conjunction with a number of other signals, was one of the reasons that I was on the more 'hawkish' side in my voting record.

Data available at our March 2024 meeting

By the March 2024 MPC meeting, however, the ONS published revised data.[18]

Chart 9 shows the *new* vacancy and unemployment data available to us at the March 2024 MPC meeting (green dots and line), in contrast with that from the February 2024 meeting (red dots and line, which were shown in Chart 8). The new data re-weighted the population over the past couple of years towards older people, who are more likely to be economically inactive. It also replaced the experimental Claimant Count-based estimates with 6 months of genuine survey data. These revisions painted a strikingly different picture.

While the fall in the vacancy rate was about the same as in the previous data, the apparent rise in unemployment in late 2023 was revealed to be temporary and most likely due to sample variability. Instead, the unemployment rate fell sharply back to the low levels seen through most of 2022 and 2023, as shown by the green line shifting towards the southwest. Looking through the volatility in the green line, the data were now much more indicative of travelling down the steep portion of the pre-pandemic Beveridge curve, rather than travelling along an outwardly-shifted curve as the previous data (red dots and lines) had suggested.

If indeed we are back on the pre-pandemic Beveridge curve, and that remains uncertain given the ongoing data issues, that suggests that the labour market might not have been as badly impaired by the pandemic as we had thought. This suggests inflation could be returned to target at a lower interest rate than would have been the case with an outwardly-shifted Beveridge curve. Such new information was, along with other conjunctural data, my motivation for changing my vote at the March meeting to a hold.

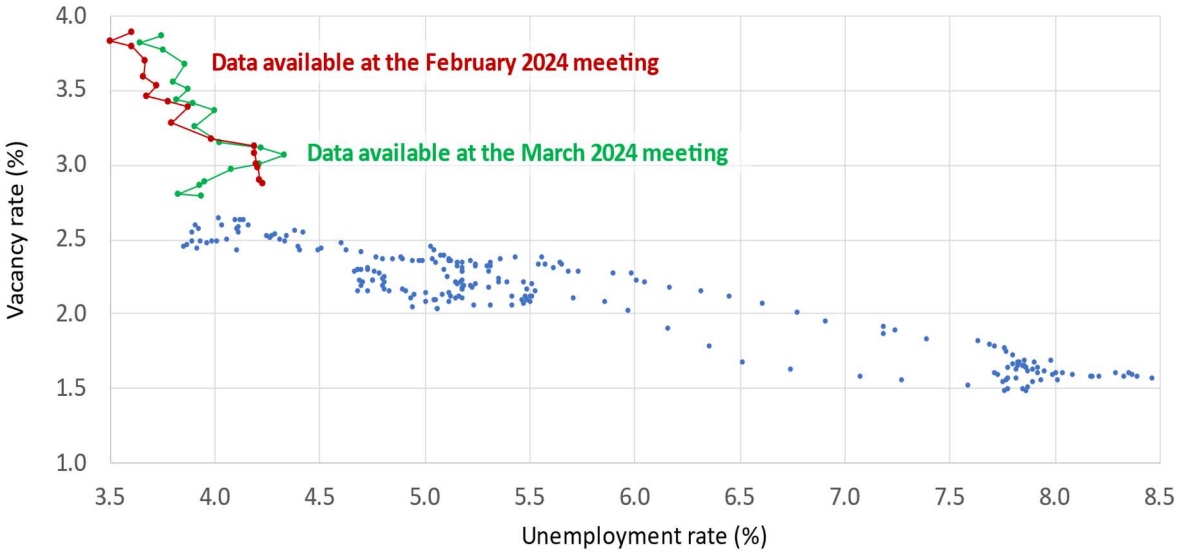
That being said, I remain concerned that the labour market remains somewhat impaired, consistent with an increase in the natural rate of unemployment (U*), albeit not as much of

[18] While response rates were still low, the ONS had corrected one of the issues that led them to suspend the releases, namely re-weighting of the data to new population information. Following the 2021 census, new information on the size and composition of the population had become available, but had not yet been reflected in the LFS weights. This led to concerns that the data was increasingly unrepresentative of the population. The re-weighting of the data published in February 2024 accounted for this, though several other shortcomings of the data remain – not least the low response rate and small achieved sample, as well as further population information that is still not accounted for.

an increase as I had previously feared. Judging the labour market continues to be critical and difficult.

All this is to illustrate one corner of the difficulties involved in making policy in real time. While economic models give a helpful structure to think about the economy, they are only as good as the data you put in. Interpreting that data in real-time is sometimes difficult.

Chart 9: Vacancy rate, unemployment rate and Beveridge curve, data available at March 2024 MPC meeting and comparison with earlier data



Source: ONS, author's calculations.
Notes: Data during the pandemic are distorted by the furlough scheme and are removed from this chart for clarity. Data available at the February 2024 meeting run up to Sept-Nov 2023 and data available at the March 2024 meeting run up to Dec-Feb 2024.

This example is complementary, I think, to a number of themes raised in the recently-published **Bernanke review of forecasting for monetary policy making and communication at the Bank of England**. One particularly perspicacious point (page 13, paragraph 1) is that economic forecasting is made even harder since it's often not even clear where the economy is starting from. Rightly, data is revised as further information is gathered: it takes time, for example, for respondents to reply to official questionnaires.

I find it useful that many of the recommendations try to address this issue related to decision making under radical uncertainty.[19] I would like to add that I'm a supporter of the MPC's decision to embrace and act upon the twelve Bernanke recommendations. To me, broadening the information base upon which to take decisions (better data, using a variety of models, more scenarios) can improve our operational resilience. For example,

[19] "Radical uncertainty" as set out by John Kay and Mervyn King in their important book "**Radical Uncertainty: Decision-making for an Unknowable Future**".

scenarios in particular have external and internal benefits. Externally, they help outsiders to learn more about how the MPC is thinking. Internally, they help the organisation to learn more about its models (their strengths, assumptions and limitations) and to provide a mechanism to consider a wide range of information.

Future inflation: persistence and second-round effects

What of the future? As the above section noted, the future path of the driving variables, notably food, energy, shortages and the V/U ratio are key to the evolution of inflation, both via their direct effects on wages and prices and their "second-round" or indirect effects. We can think about these second-round effects as capturing the effect of price shocks on inflation expectations, as well as via real wage resistance (catch-up), which both push up wage growth and so increase inflation.

How important are these second-round effects, and how long will they persist? To illustrate these points, Charts 10 and 11 explore a variant of the Bernanke-Blanchard model that tries to remove the second-round effects of price shocks. This is an inexact science, so the results should be treated as indicative only, but I find this a useful experiment.

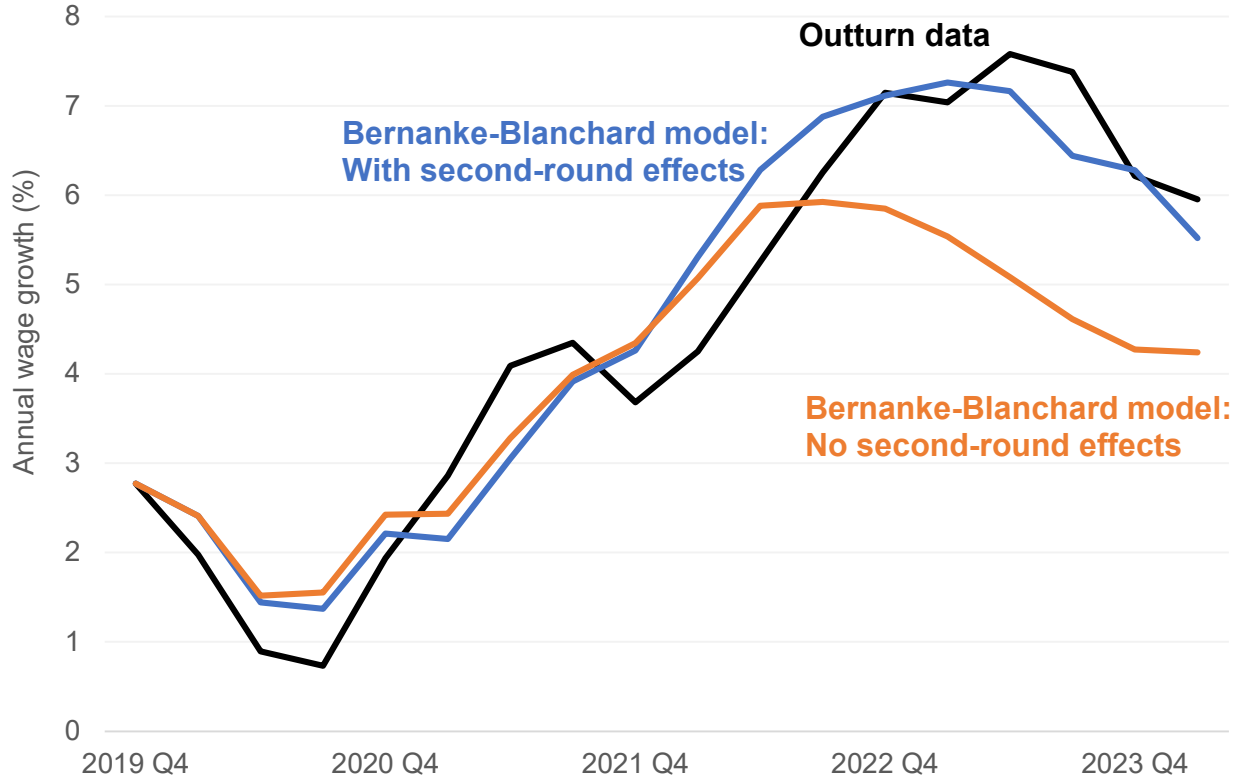
I will define second-round effects as the impacts on wage growth and inflation from higher-than-normal inflation expectations and catch-up effects. To capture this, we simulate the model over the past few years and assume no catch-up effects on wage growth, and hold short-run and long-run inflation expectations at their long-run averages. Wage growth still increases in response to labour market tightness, and price inflation still reacts to energy and food prices and wage growth, but the feedback loop from prices to wages (and then back to prices etc) is cut off.

Second-round effects in past data

Chart 10 shows three lines. The black line is actual data on wage growth (adjusted for compositional and furlough effects during the pandemic). The blue line is the full Bernanke-Blanchard model simulation and shows a reasonable fit to the black line. The orange line is the model *without* second-round effects. This suggests that wage growth would have risen (due to a tight labour market) over the past couple of years, but would have been substantially lower in the absence of second round effects. The effect of second-round effects on annual wage growth is estimated to have been about 1pp in late 2022, just under 2pp throughout 2023, and about 1pp in early-2024. The consequences for inflation follow directly, given the importance of wage growth in inflation and the lagged relationship – peaking at about 1pp in late 2023 and now beginning to fade.

These are large effects. While Chart 5 showed that the long-run effects of price shocks on inflation are negligible in the modern economy with anchored inflation expectations, the dynamic effects can be large, especially in response to large shocks.

Chart 10: Annual wage growth simulations from the Bernanke-Blanchard model, with and without second-round effects



Source: Author's calculations, based on an update of **Haskel, Martin and Brandt (2023)**.
Notes: Outturn data are "underlying" annual growth in private regular pay, as estimated by Bank of England staff, stripping out compositional and furlough effects during the pandemic. Bernanke-Blanchard model estimates come from dynamic simulations of the model, with outturn data for periods up to 2019 Q4 and only data on exogenous variables thereafter. The "No second-round effects" line eliminates the effect of catch-up and above-normal inflation expectations on wage growth.

Second-round effects in the future

Turning to the future, how long might these second-round effects last? We could try to answer this again with the Bernanke-Blanchard model, by projecting wage growth and inflation with and without second-round effects. To do this, we immediately need to decide on some conditioning paths for the exogenous variables. For energy prices we follow the forecast in **May 2024 Monetary Policy Report (MPR)**, which extends until 2027. For food prices, the May MPR gives a 6-month forecast, and thereafter I assume food price inflation reverts to pre-pandemic averages. We assume shortages return immediately to their pre-pandemic average, and productivity growth averages 0.5% per year in line with the recent (slow) record.

For V/U, we take the May 2024 MPR forecast for unemployment and combine that with the assumption that the economy will move along the pre-pandemic Beveridge curve. This gives a forecast for vacancies that corresponds with that for unemployment, and combining gives a trajectory for V/U.

How should we simulate the forecast without second-round effects? As Chart 10 showed, without second-round effects to date, the model predicts that wage growth (and inflation) would be lower than they actually are. In fact, the outturn data on wage growth (and inflation) were also higher than the simulated 'full' model (including second-round effects) in 2024 Q1. Should we simulate the model afresh, starting from the recent outturn data? Or persist with the model estimates from Chart 10? The answer is not immediately obvious, but to make some progress we will proceed as follows.

Chart 11 shows some of the same data as in Chart 10, now overlaid with some additional lines. First, Chart 11 includes the wage growth 'swathe' (grey) from Chart 3.8 of the May 2024 MPR, which is based on three wage growth models maintained by Bank of England staff. It also includes the MPC's wage growth forecast consistent with the May 2024 MPR (black dashed line).

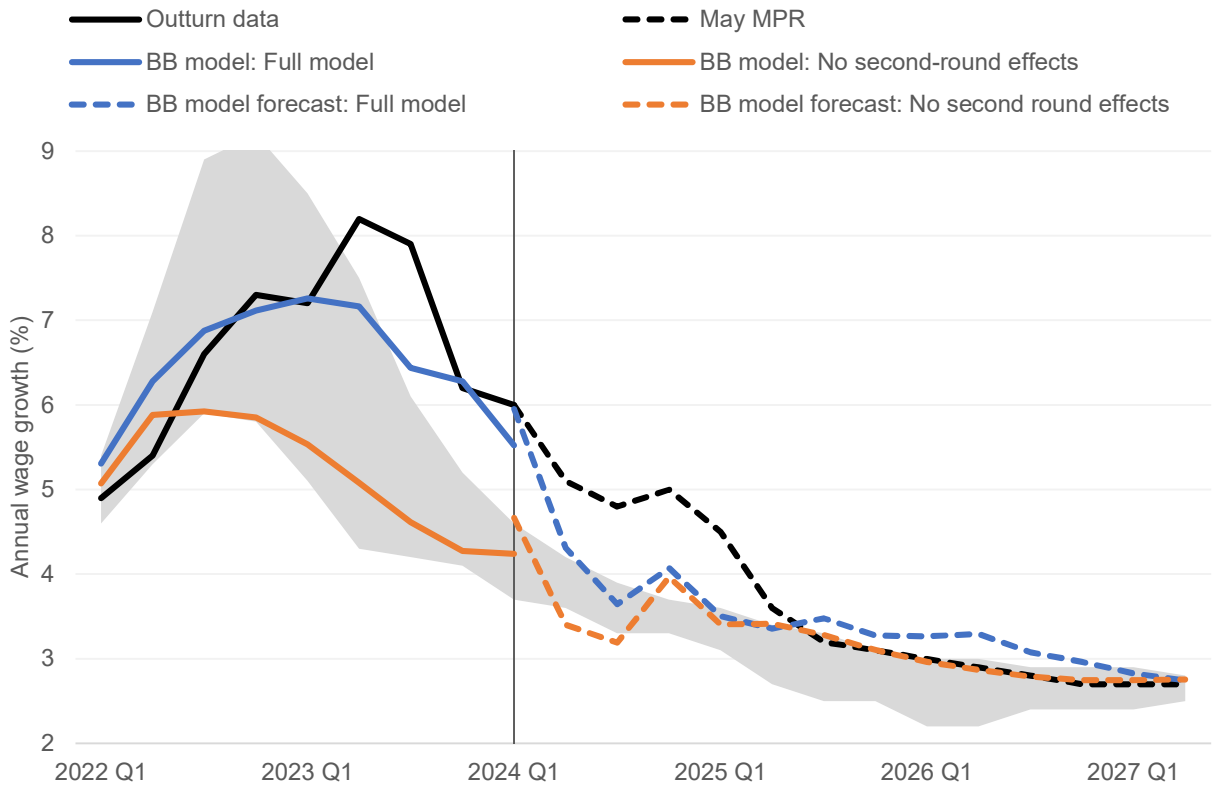
The other dashed lines are two simulations of the Bernanke-Blanchard model. The dashed blue line is the 'full' Bernanke-Blanchard model simulation (including second-round effects), starting from the outturn data up to 2024 Q1. This starts above the solid blue line, since the recent wage growth outturn data have been above the prior simulation of the model.

The dashed orange line is the Bernanke-Blanchard model simulation excluding second-round effects. This starts slightly above the orange solid line, consistent with the 'full' model projections, to account for the under-estimation of outturn wage growth in the 'full' model and thus be more comparable with those projections with second-round effects (the blue dashed lines).

Three points emerge. First, the Bernanke-Blanchard model simulation excluding second-round effects (orange lines) is broadly within the grey swathe, both over the past and into the future. This would suggest that those suite of models (or at least one of them) does not fully account for second-round effects.

Second, the gap between the model forecasts with and without second-round effects persists during 2024, but shrinks and the lines quickly converge (compare dashed orange and dashed blue lines). This convergence, around the end of 2024, suggests that the additional wage growth due to the second-round effects of past unexpected price shocks will have disappeared by the end of 2024. Does that mean that price inflation will return to target at that point? No. Price inflation endures even with no second-round effects. This is for two reasons: first, wages take time to pass through into prices, and second, inflation itself is sticky and so high past inflation has lasting effects. The May 2024 MPR forecast has inflation returning to the 2% target in early 2026, and the Bernanke-Blanchard model (conditioned on similar assumptions) exhibits similar dynamics.

Chart 11: Annual wage growth projections from the Bernanke-Blanchard model, with and without second-round effects



Source: Author's calculations, based on an update of **Haskel, Martin and Brandt (2023)**, May 2024 MPR (chart 3.10).

Notes: Bernanke-Blanchard model estimates come from forecasts from the model, with outturn data for periods up to 2024 Q1 and conditioning paths of exogenous variables thereafter (as described in text). The "No second-round effects" line eliminates the effect of catch-up and above-normal inflation expectations on wage growth, both in the past and in the forecast.

Third, the MPC forecast for wage growth is above all of those from the Bernanke-Blanchard model in the near-term. One reason for this is the increase in the National Minimum Wage in April 2024. Naturally the Bernanke-Blanchard model cannot anticipate this, but accounting for it would move the dashed blue line substantially closer to the MPC's forecast (black dashed line). A second reason is that the MPC have taken steers from a range of information not available to the model, such as information from the **Bank of England's regional agents** on expected pay settlements this year, and survey data from the **Decision Maker Panel** and other sources. They point to pay settlements of around 5% this year, above the forecast of the Bernanke-Blanchard model. Through judgement, the MPC is able to account for this information in a way that an economic model cannot easily do.

There are many things that this simulation cannot account for. Naturally the forecast is sensitive to the assumed path for V/U. The degree of second-round effects will also depend on any future price shocks. In this model, unexpectedly low inflation can also lead to negative second-round effects, i.e. downward pressure on wage growth. Nominal wage rigidity might limit the extent to which downward price shocks lead to lower wage growth.

The effects of all of this for inflation are broadly consistent with the MPC's forecast in the May 2024 MPR, namely that there are considerable second-round effects at play currently, and that they will fade over the coming years.

In summary, the model suggests that in the current conjuncture, second-round effects matter a good deal.

Conclusion

I've tried in this speech to answer some questions using an updated version of the Bernanke-Blanchard model applied to the UK. Referring back to questions in the introduction, I would summarise the answers as follows.

Let me start with the past.

First, was the Bank "behind the curve" when inflation started? No. Our updated results confirm the conclusion I set out in **November 2023**. The initial burst of inflation was due to the economy being hit by a succession of external shocks, unforeseen by even the most informed market participants. The inflationary impulse from the labour market was minimal until 2021 Q4, at which point, the Bank raised rates, the first major central bank to do so. And we did so in the face of the Omicron variant of the coronavirus which, at the time, looked like it might require the entire nation to be locked down again and revaccinated. These are the actions of an institution ahead of the curve, not behind it.

Second, why was inflation so much more persistent in the 1970s than it appears to be today? Our new evidence in this speech suggests that the 1970s labour market was much less flexible (in the form of higher real wage resistance), and expectations were less well-anchored.

Third, what of the challenges of making policy in real-time? I have tried to show an example of how the flow of new data will rightly have policymakers changing their minds and how vital economic measurement is to policymaking.[20]

[20] On a personal note, in a speech in **July 2021**, with over 1.5 million workers still on furlough and the unknown Delta variant spreading I argued that "tight policy was not the right policy". We know now, but didn't know then, that many of those furloughed workers were absorbed into the labour market and the vaccine was robust to the Delta variant. The labour market became very tight very quickly.

I turn to the future.

What is the near-term inflation outlook? Assuming no further shocks, the model suggests that it depends on the interaction of a tight labour market and second-round effects as previous inflation works its way through the wage-price system. That previous inflation is sufficient to impart momentum to current inflation, although not as much as in the 1970s. I hope this helps explain why the MPC is looking closely at labour market conditions and underlying inflationary indicators such as services inflation. The labour market continues to be tight, and I worry it is still impaired. I would rather hold rates until there is more certainty that underlying inflationary pressures have subsided sustainably.

Finally, the more long-term overarching question is the importance of central bank credibility. A credible institution is something that the public trusts: in the case of a Central Bank, to fulfil its remit of price stability. Trust is an (intangible) asset and so, like any asset, depreciates and requires investment to be maintained. So how can a central bank make that investment, or put another way, earn that trust?

Organisational scientists cast trust in an "ABI" framework – the trustor needs to demonstrate to the trustee: ability, benevolence, and integrity.[21]

Applying this to the Bank of England, to the extent that integrity means sticking to promises, the economics literature concentrates heavily on independence from political interference as a key determinant (on the theory that an independent institution is more likely to stick to its promise, in this case to keep inflation down, because it is free from political interference). But this ABI framework suggests other elements matter too.

What of ability? As the Bernanke review sets out, the Bank is not short of ability: it has top PhDs and experienced staff. But the *perception* of ability is, I suspect, heavily influenced by forecast errors, not least since the Bank sets such great store by the central forecast. Perhaps this is an area where the scenarios that the Bernanke review suggests will help: they will allow outsiders to learn more about our view of the economy, and allow us to learn more about how our models work under different circumstances.

Turning to benevolence, I suspect many think that benevolence is split between "hawks" (who don't have much of it) and "doves" (who do). This is a category error. All MPC members are committed to the remit, but view the appropriate policy stance differently. If you will forgive a personal note, during my time on the committee I have been variously described as being both amongst the most dovish and the most hawkish. This shows how uninformative those labels are. As Keynes is reputed to have said: "When the facts

[21] See **Mayer at al. (1995)**. I'm grateful to Professor Bobby Duffy of King's College London for discussions on this. The academic literature has specific discussions around these headings, but a broad summary would be this: Ability is competence and influence; Benevolence is working towards a goal with no extrinsic reward; Integrity is adherence to set goals and principles.

change, I change my mind – what do you do, sir?"[22] What this highlights, I think, is the repeated need for the committee, as it does, to keep earning trust by being clear about what facts are changing and the models by which it interprets them.

In conclusion, a central bank is part of a very delicate social bargain: trusted with great powers, but having to earn that trust. Anyone working at the Bank of England knows what a privilege it is to be given that trust. Equally, anyone leaving the Bank knows it is bigger than any single individual. With good data, models and economics my successors can take and explain hard decisions. There will be times when this doesn't earn the public's affection, but it will end up earning their trust.

Thank you.

I am grateful to Josh Martin and Vitor Dotta for their help preparing this speech. Thanks also to Andrew Bailey, Harvey Daniell, Swati Dhingra, Bobby Duffy, Chris Duffy, Andrew Gimber, Huw Pill, Doug Rendle, Martin Seneca, Carleton Webb and Tim Willems for helpful comments. Finally, it has been an extraordinary privilege to serve on the Monetary Policy Committee and I'd like to thank colleagues throughout the Bank for all their work and support.

[22] This and similar quotes have also been attributed to Paul Samuelson, who has in turn attributed them to Keynes, who expressed a similar idea in 1924.

Appendix

Brief description of our Bernanke-Blanchard model equations:

The nominal wage level depends on expected prices, real aspirational wages, and labour market tightness

$$w_t = p_t^e + \omega_t^A + \beta x_t$$

Real aspiration wages are a function of the last period's real aspiration wages, last period's realised real wage, and wage-push factors

$$\omega_t^A = \alpha\omega_{t-1}^A + (1-\alpha)(w_{t-1} - p_{t-1}) + z_{\omega,t}$$

Substituting and rearranging gives:

$$w - w_{t-1} = (p_t^e - p_{t-1}) + \alpha(p_{t-1} - p_{t-1}^e) + \beta(\alpha x_t - (1-\alpha)\Delta x_{t-1}) + z_\omega$$

Prices depend on the wage level plus a non-wage price-push term

$$p = w + z_P$$

Short-run inflation expectations are a weighted average of long-run expectations and last period's actual inflation

$$p_t^e - p_{t-1} = \delta\pi^* + (1-\delta)\left(p_{t-1} - p_{t-2}\right)$$

Long-run expectations are an average of lagged long-run expectations themselves and last period's actual inflation

$$\pi^* = \gamma\pi^*_{t-1} + (1-\gamma)\left(p_{t-1} - p_{t-2}\right)$$

The model at work:

Inflation is wage changes plus shocks

$$\Delta p = \Delta w + \Delta z_P$$

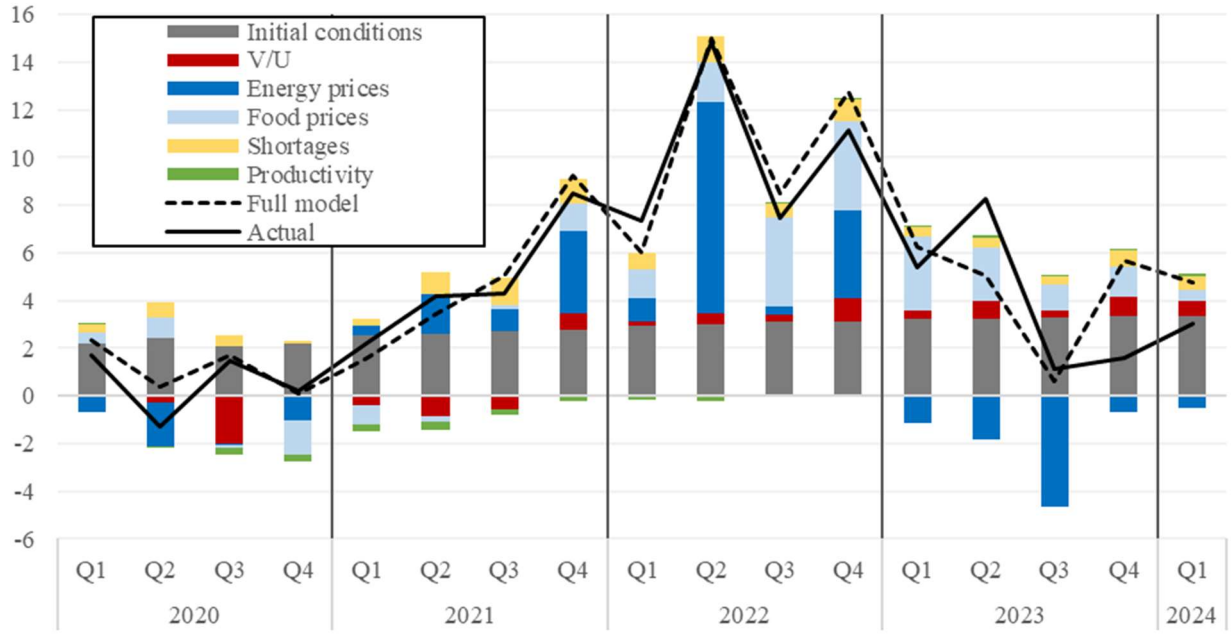
Wages growth depends on expected inflation, catch-up, labour market tightness (level and change), and a wage-push shock

$$\Delta w = \underbrace{\Delta p_t^e}_{\text{Exp inf}} + \alpha \underbrace{(p_{t-1} - p_{t-1}^e)}_{\text{Catch up}} + \beta(\underbrace{\alpha x + (1-\alpha)\Delta x}_{\text{Lab tightness}}) + z_\omega$$

Expected inflation is a weighted average of long-run inflation expectations and last year's inflation

$$\Delta p_t^e = \delta\gamma \underbrace{\pi^*}_{\substack{\text{Long run} \\ \text{inf expects}}} + (1-\delta\gamma) \underbrace{\Delta p_{t-1}}_{\text{Lagged inf}}$$

Chart A: Decomposition of quarter-on-quarter annualised seasonally adjusted UK inflation, 2020 Q1 to 2024 Q1



Source: Author's calculations, update of **Haskel, Martin and Brandt (2023)**.
Notes: "Initial conditions" reflect the model response under hypothetical conditions where V/U remains at the level in 2019 Q4, relative food and energy price changes are pre-pandemic averages, shortages are at 'normal' pre-pandemic levels, and productivity growth is 0.5% per year in line with post-2007 averages. The dynamic effects of two dummies for the pandemic period are removed. See **Haskel (2023)** and **Haskel, Martin and Brandt (2023)** for details and discussion. Inflation is quarter-on-quarter annualised seasonally adjusted inflation. Chart 3 in the main text is the annual equivalent of this chart.

Historic Bernanke-Blanchard model

For this speech we applied the Bernanke-Blanchard model to the UK since 1967. The basic structure of the model is the same as in **Haskel, Martin and Brandt (2023)**. The data used for estimating the model are also mostly the same as in **Haskel, Martin and Brandt (2023)** for periods since 1989 – see the technical appendix to that paper for more details and links. There are a few small changes, and the data were extended historically, as summarised below. The speech uses estimates of the model equations for three 30-year windows, chosen to be representative of changes in the estimated model parameters over time. Windows of 30-years were used to ensure sufficient time periods in each estimation window for robust results.

- Price inflation – **CPI published by ONS** (from 1988) linked onto the **historic CPI published by ONS** (pre-1988). Seasonally adjusted using the "seasonal" package in R (an implementation of X-13ARIMA-SEATS).
- Wage growth – private sector regular pay from **Average Weekly Earnings (AWE)** (from 2000), extended historically using private sector regular pay AWE backcast by Bank of England staff (to 1987), extended further using historic whole economy total pay AWE published by ONS (pre-1987) (available **here**, see **Crane and Elliott (2013)** for more details). Adjusted for compositional changes using the trend (from a HP filter) in labour composition from the **ONS compositionally adjusted labour input measures**.
- Vacancies-to-unemployment ratio (V/U):
    - For vacancies, the **Vacancies Survey** (from 2000), extended historically using job centre vacancies (to 1980), extended further using various series for vacancies notified to employment offices (pre-1980), as compiled in the **Millenium of macroeconomic data** (Thomas and Dimsdale, 2017).
    - For unemployment, the official unemployment data from the Labour Force Survey (LFS) (from 1971), extended historically using administrative unemployment levels from **Denman and Macdonald (1996)**, sourced from the **Millenium of macroeconomic data** (Thomas and Dimsdale, 2017).
    - Given trends in V and U rates over such a long period of time, we de-trend the V/U ratio as follows: fit a HP filter through the V and U rates separately, with smoothing parameter 16,000 and 8,000 respectively (based on testing); combine the respectively trends for a V/U trend; use this constructed V/U trend to de-trend V/U; use the de-trended V/U in estimation and drop the constant from the wage equation.
- Productivity growth – market sector output per hour worked **published by ONS** (from 1997), extended historically using previous vintages of market sector output per hour worked and output per worker published by ONS (to 1992), extended further using annual market sector output per hour worked published by ONS as part of their **growth accounting data** (to 1970), extended further using **whole economy output per worker** (pre-1970). Trend extracted using HP filter with smoothing parameter 1,600.
- Energy prices – energy aggregate of CPI **published by ONS** (from 1988), linked onto a constructed energy aggregate from **various RPI indices** (pre-1988). Energy covers household energy bills of electricity, gas and oil, and vehicle fuels of petrol and diesel. Seasonally adjusted using the "seasonal" package in R (an implementation of X-13ARIMA-SEATS). In estimation, energy prices are expressed relative to wages.
- Food prices – food and non-alcoholic beverages aggregate of CPI **published by ONS** (from 1988), linked onto the food and non-alcoholic beverages aggregate of historic CPI published by ONS (pre-1988). Seasonally adjusted using the

"seasonal" package in R (an implementation of X-13ARIMA-SEATS). In estimation, food prices are expressed relative to wages.

- Shortages – the **Global Supply Chain Pressure Index (GSCPI)** as published by the Federal Reserve of New York (from 1998), extended historically using the **Index of Global Real Economic Activity (IGREA)** as published by the Federal Reserve of Dallas (pre-1998). Converted into z-scores for use in estimation, and drop the constant from the price equation.
- Short-run (one-year) inflation expectations – a composite measure covering households, experts and financial markets expectations, from the **Millenium of macroeconomic data** (Thomas and Dimsdale, 2017). This measure is benchmarked to the composite measure constructed by **Anderson and Maule (2014)**, and adjusted for the difference in the main inflation measure (CPI, RPI, etc.) over time.
- Long-run (five to ten years) inflation expectations – a composite measure covering households, experts and financial markets expectations, from the **Millenium of macroeconomic data** (Thomas and Dimsdale, 2017) (from 1985). This measure is benchmarked to the composite measure constructed by **Anderson and Maule (2014)**, and adjusted for the difference in the main inflation measure (CPI, RPI, etc.) over time.
    - To extend historically, in the absence of any data or direct measures to our knowledge, we model a backseries. Our approach and results are similar to the long-run inflation expectations variables in the **FRB/US model** used by the Federal Reserve, which similarly is based on survey data back to the 1980s, and prior to this is a backcast using time-series models (see **Clark and Nakata (2008)** and **Mishkin (2007)** for description, and the FRB/US model documentation for details).
    - For the backcast, we regress long-run inflation expectations on the average inflation over the preceding 6 years, the deviation of annual inflation in the previous quarter relative to that trend, and short-run inflation expectations in the previous quarter, for quarters from 1985 Q1 (when we first have long-run inflation expectations estimates) to 1996 Q4 (prior to Bank of England independence). We use the fitted model to estimate long-run inflation expectations prior to 1985.
    - The backcast starts around 2-3% in the late 1960s, following inflation up with a lag during the early 1970s, peaking around 12-13% in 1975, before stabilising around 10-11% through the rest of the 1970s. It picks up again to 12-13% in 1980, before falling steadily with inflation to settle around 4-5% from the late 1980s to the early 1990s. The data-based estimates from the **Millenium of macroeconomic data** (Thomas and Dimsdale, 2017) start in 1985.