"How the Bank of England can start to solve its prediction puzzle " Opinion piece, *The Financial Times Alphaville*, 15 August 2023. Available here.

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In his 2013 Nobel Memorial Prize in Economics Sciences lecture, Lars Peter Hansen noted: Part of a meaningful quantitative analysis is to look at models and try to figure out their deficiencies and the ways in which they can be improved. At that time, the quantitative models of the Bank of England had consistently underestimated CPI inflation. A decade later, things haven't got much better. The BoE has now appointed Fed chair Ben Bernanke to take the lead in reviewing Threadneedle Street's forecasting models and record. There's an awful lot for Bernanke and his team to look at, but I want to focus on two interesting areas: the role of public expectations in forecasting, and the impact of quantitative easing on inflation.

Public perceptions

Take a look at this chart, which compares CPI with the BoE's one-year forecast (using the mode, or most likely outcome of the Bank's fan charts) based n market expectations of interest rates and actual CPI inflation, and public expectations: What can we see? — Since 2006, the BoE has under-estimated CPI inflation by an annual average of 68 basis points (the median 'bias' is, however, lower and equal to 38 basis points). — Public expectations of inflation have over-estimated actual CPI inflation by an annual average of "only" 10 basis points (the median 'bias' is, however, higher and equal to 50 basis points). This suggests that the BoE's inflation quantitative models could benefit from considering public's expectations for inflation because the latter potentially caries the same or even better predictive power than the Bank's own inflation forecasts. Such expectations certainly matter: they increase worker demands for higher wages and, therefore, add to inflationary pressures. As part of this, it is also essential to assess why the public expectations follow such trends — it would be undesirable if, for instance, BoE communications ended up substantially shaping a metric that is then re-imputed into their analysts' calculations.

Easy does it

What about QE and its role in driving UK CPI inflation higher? One interesting way of examining this is through Divisia M4 growth. Divisia money weights different forms of money according to their likelihood of

being spent. Notes and coins have a higher weight than money held in mutual funds, for example. Divisia money feasibly acts as a monetary policy variable, which allows one to capture monetary policy stance when interest rates approach their effective lower bound. Divisia money growth has been found to predict UK quite well, and more so when UK growth is quite weak. In fact, very weak annual GDP growth rates since mid 2022 (annual growth in the second quarter was just 0.4 per cent) are directly associated with the big drop in Divisia money discussed below. At the same time, Divisia money growth retains its explanatory power even if additional drivers of UK economic growth and inflation (such as Brexit and financial stress) are considered. Let's explore this relationship further. Here's UK CPI inflation and Divisia M4 growth together: Divisia money growth reached a high of 19 per cent in the first quarter of 2021, prior to UK inflation peaking at 10.7 per cent in late 2022. This (potentially) suggest that money growth affects inflation with long and variable lags — which is both helpful and unhelpful for BoE forecasters.

Putting it together

To explore this further, I have built an inflation model which projects UK CPI inflation in terms of expected inflation (based on the public expectations of inflation mentioned above), past inflation (a measure of inflation persistence), excess demand in the economy (based on the Office for Budget Responsibility measure of the output gap), and Divisia M4 growth. Here's how it looks: And here's the (fairly tight) spread between my model and the actual CPI reading: Let's get into the weeds a bit. This is a "quantile" regression model, where the impact of money on inflation is asymmetric. That is, I allow for the impact of changes in money to vary depending on low versus high levels of existing inflation: The quantitative model (estimated over the sample period 1999-2023 based on quarterly data) confirms that the impact of increased money on UK inflation is inflationary when inflation is already high. At the top 25% of the inflation distribution, an increase in money growth by 5 percentage points lifts UK inflation by approximately half a percentage point in the short run (that is, within a quarter). The impact is much more powerful (and statistically significant) than the corresponding effect on inflation at the bottom 25% of the inflation distribution. Between late 2019 and early 2021, Divisia M4 growth increased by some 15 percentage points, which, according to the model, would potentially add about 1.5 percentage points to UK inflation. That is not much. However, these are direct effects (from money to inflation). Indirect effects also come into play since higher money growth adds to excess demand in the economy and, at the same time, raises inflation expectations. Additional excess demand

and higher inflation expectations raise, in turn, inflation further. In other words, an increase in Divisia money growth (a proxy for QE effects) has thrown some fuel into the inflation "fire".

Notably, the same quantitative model "prefers" public expectations of inflation over the BoE's own inflation expectations. Here's how the latter looks, to compare — a worse, but not overwhelmingly worse, statistical fit: There are several moving parts here, but public expectations of inflation have a better explanatory power than the Bank's own forecasts in dictating UK inflation movements. This is clearly a problem for the Bank's policymakers, whose forecasts are (supposed to be) more sophisticated than those formed by the public.
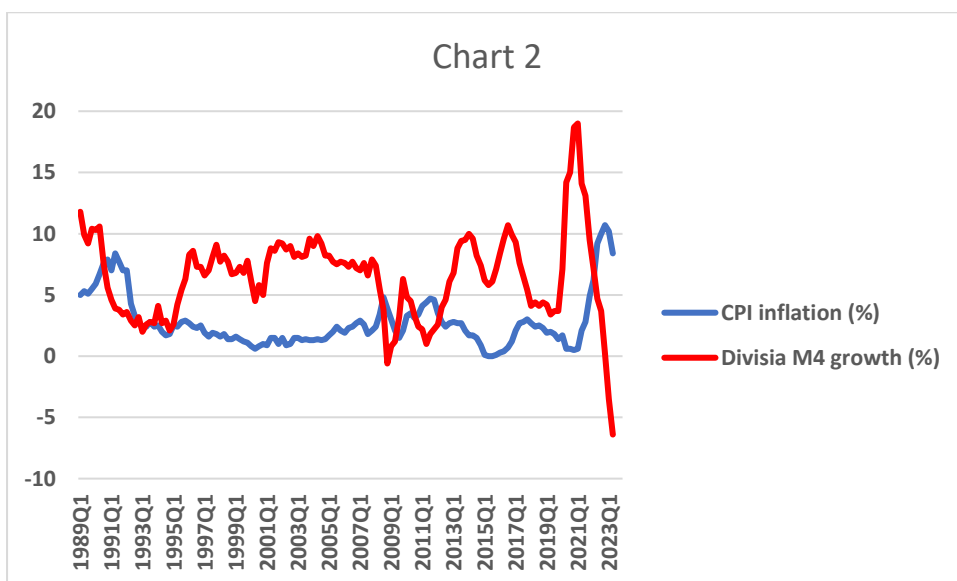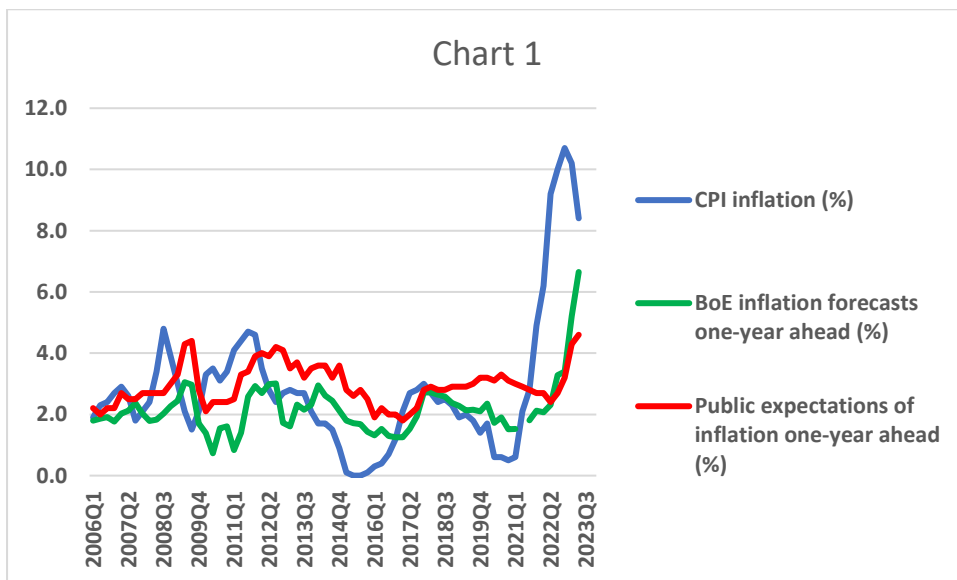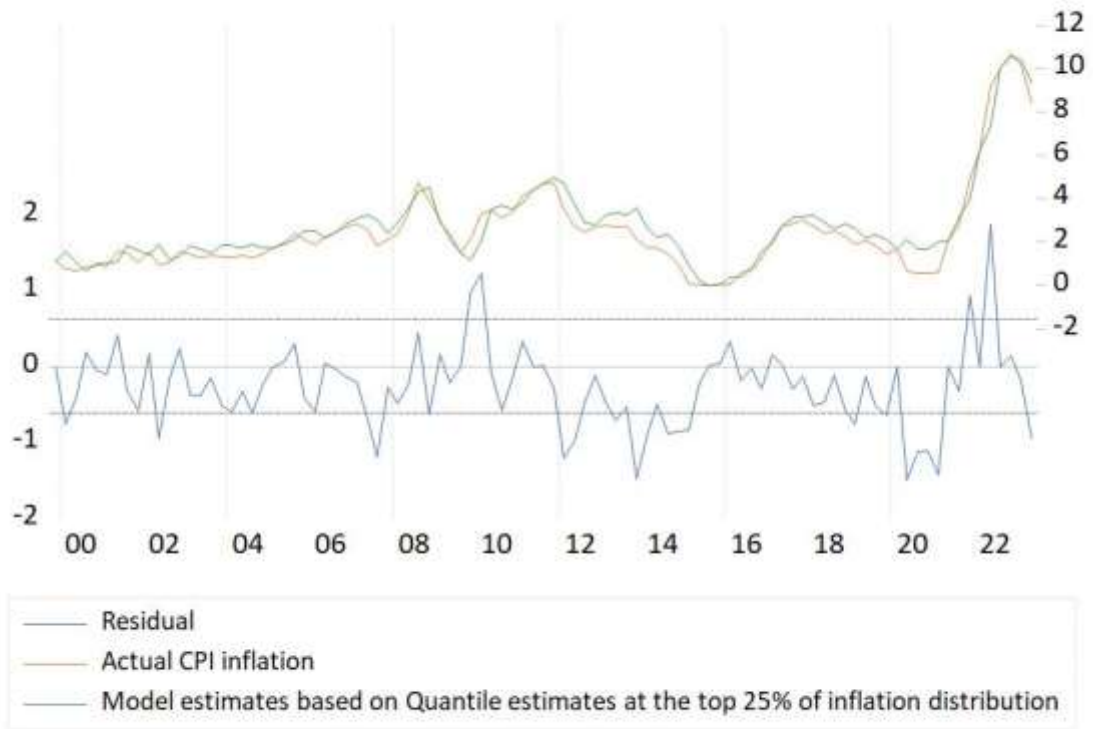
Chart 1

Lines: CPI inflation (%), BoE inflation forecasts one-year ahead (%), Public expectations of inflation one-year ahead (%)

Chart 2

Lines: CPI inflation (%), Divisia M4 growth (%)

Chart 3

- —— Residual
- —— Actual CPI inflation
- —— Model estimates based on Quantile estimates at the top 25% of inflation distribution

Chart 4

- —— Residual
- —— Actual CPI inflation
- —— Model estimates based on Quantile estimates at the top 25% of the inflation distribution using the inflation forecasts of the BoE