Analysis

Recent insights into r*: An analysis using a modified Holston-Laubach-Williams model

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AUTHORS



Lauri Vilmi
Senior Adviser



Mika Kortelainen
Adviser

It is well known that the real natural rate of interest, r*, is an inherently unobservable variable, and therefore reasonable estimates of its level are hard to determine. In our search for such estimates, we first apply a semi-structural model by Holston, Laubach and Williams (2023) and the Federal Reserve Bank of New York's recent estimate of the euro area natural rate. We then tweak this estimate by adding the euro area projections for real gross domestic product, inflation and short-term interest rates to our data set. In addition, we incorporate different inflation expectation series into the model by using either survey or market-based inflation expectations in a similar manner to Carvalho (2023). According to our results, r* for the euro area currently lies somewhere between 0.2% and 0.8%.

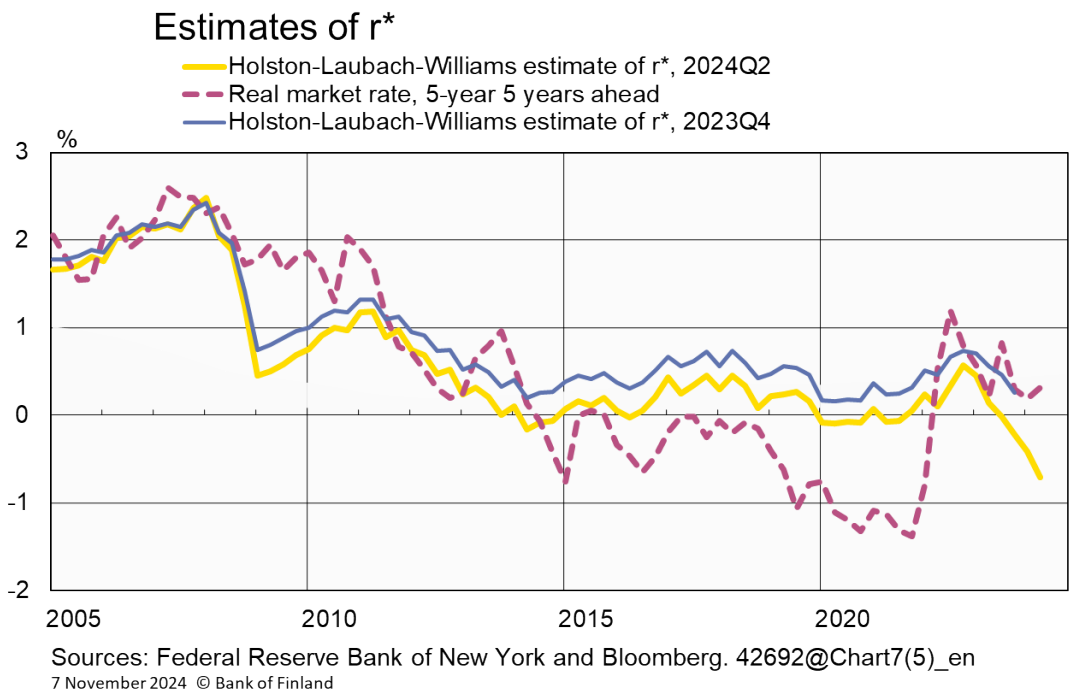


We use a modified version of the Holston, Laubach and Williams (HLW) model to analyse the current level of the euro area natural rate of interest, or r-star (r*). This is the real interest rate expected to prevail when the economy is at its potential level and inflation is stable. The HLW model is often considered to be the most prominent method for estimating r*. The model is semi-structural and consists of equations for the investment-savings (IS) curve and the Phillips curve. It uses a state-space framework and the Kalman filter to extract trends from data on real gross domestic product (GDP), inflation and short-term interest rates. It incorporates both transitory and permanent shocks to supply and demand, allowing for time-varying volatility, especially during periods such as the COVID-19 pandemic.

The Federal Reserve Bank of New York ('New York Fed') has published updated estimates of r* based on the HLW model. These updated estimates indicate that r* for the euro area is clearly negative, standing at -0.7% in the second quarter (Q2) of 2024. This was a significant downward revision from the estimate for Q4 2023, which suggested a natural rate of about 0.3%. At the same time, the New York Fed revised downwards the entire trajectory of the natural rate. Its current HLW-based estimate of r* for the euro area is significantly lower than the long-term (5-year 5 years ahead) real market rate, which has remained positive at slightly below 0.5%.

The downward revision of the New York Fed's estimate of r* for the euro area is substantial but not unprecedented. For example, at the beginning of 2023, the New York Fed's HLW-based estimate of r* was 0.9%, but in Q3 2023 it was negative at -0.7%. At the end of 2023, the estimate again showed a positive natural rate of 0.3%, before falling once more to -0.7% (see Chart 1). These sharp movements illustrate the great uncertainty related to the estimation method and the real-time assessment of the level of r*.

Chart 1.



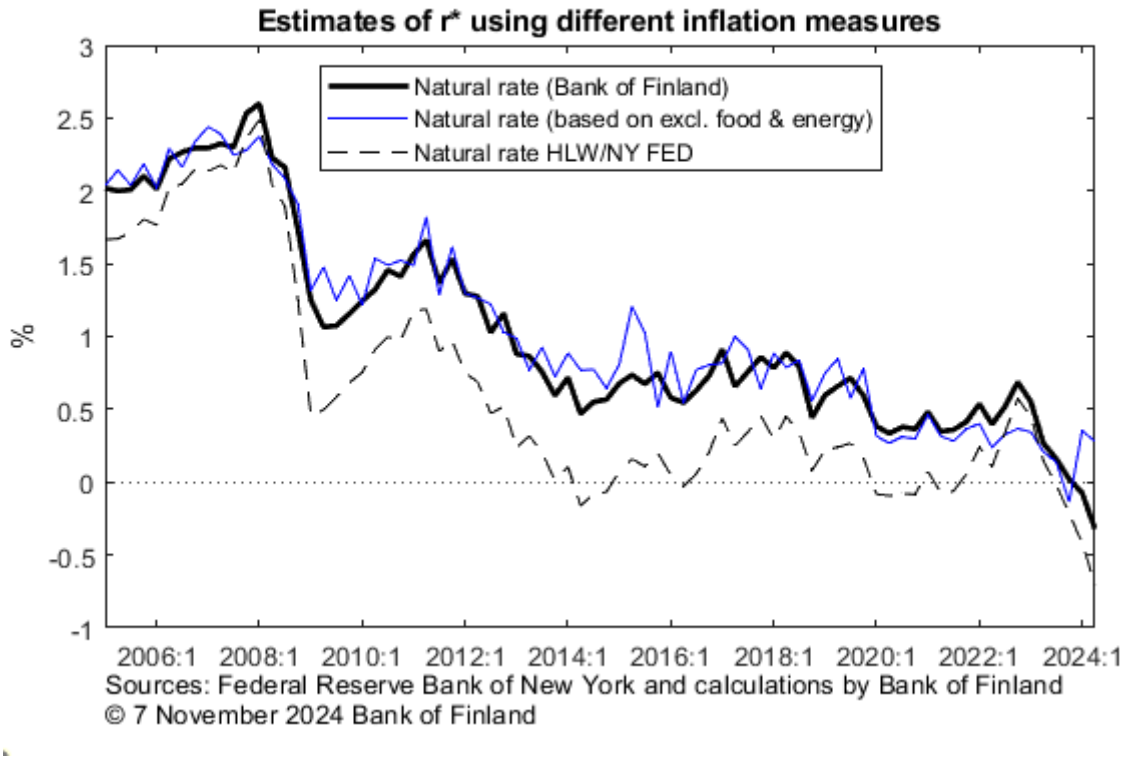
We study the robustness of the New York Fed's current HLW-based estimate with an otherwise similar framework but one which uses Bayesian methods. Chart 2 compares our estimate (black line) to the original HLW-based estimate (black dashed line), where the latter is estimated using a three-step maximum likelihood estimation. The estimates are fairly similar and indicate that there is currently a clearly negative natural rate, though the Bayesian estimation yields a slightly less negative estimate of -0.3%. Overall, the two different methods do not produce substantially different estimates of r*.

Next, we modify the measure of core inflation. The HLW model excludes only energy prices from headline inflation, whereas we exclude both food and energy prices. Given that food prices have recently added to the volatility of inflation, it is appropriate to analyse a series that excludes food prices. We then augment the data with the European Central Bank's (ECB) September forecast to alleviate potential end-point problems. Finally, we replace the HLW model's backward-looking expectations with various forward-looking measures of expectations.

The blue line in Chart 2 depicts estimates of r* based on the same Bayesian methods as the black line but using a core inflation series that excludes both food and energy prices instead of the series used by the New York Fed that excludes only energy prices. Even this small change raises the level of r*, bringing its current rate to a mildly positive level. The higher level of r* is probably because energy and food inflation in recent quarters has been lower than services inflation, and so the

exclusion of these items provides a stronger measure of price pressures and leads to higher natural rate estimates.

Chart 2.



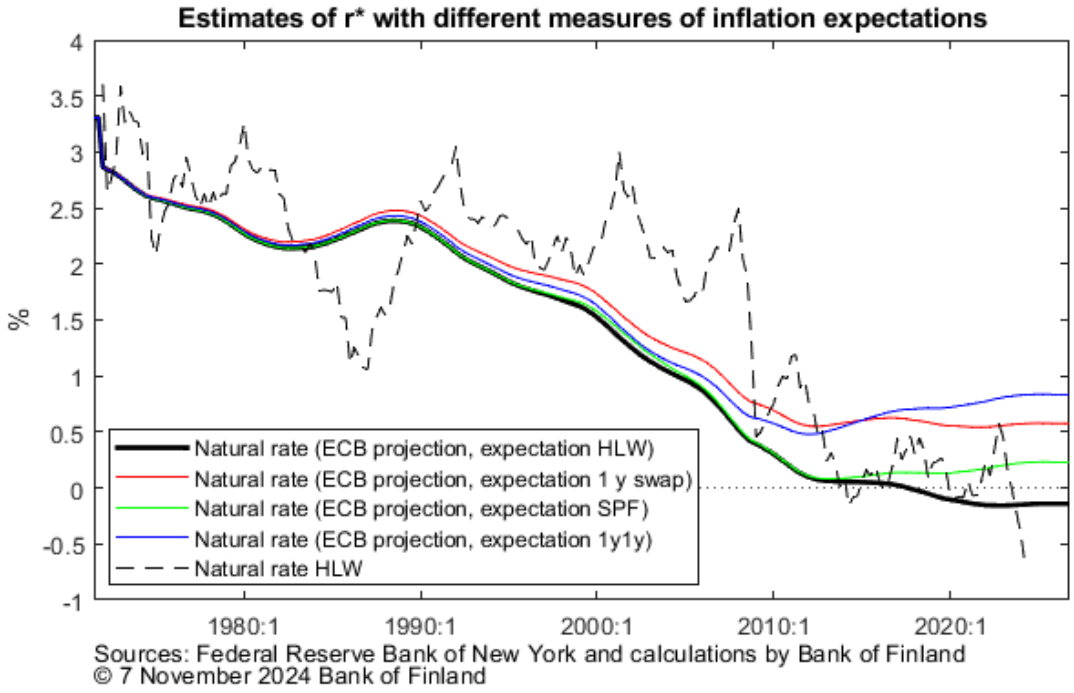
As noted by Laubach and Williams (2003), methods to estimate r* are subject to considerable real-time measurement error. One way to address end-point problems and test the robustness of the current r* estimate is to examine how the real-time estimate would change if the data set were to be extended with forecasts. More specifically, we assume that the euro area economy will evolve according to the ECB's September 2024 forecast. Furthermore, as the HLW model is purely backward-looking and its inflation expectations are formed on the basis of past inflation, we modify the model by adding forward-looking inflation expectations. We use three alternative measures for inflation expectations: the 1 year ahead expectations from the ECB's Survey of Professional Forecasters (SPF), a 1 year ahead inflation swap rate and the 1-year 1 year ahead forward rate.

Chart 3 presents trajectories of r* estimated using a further modified HLW model that is supplemented with the ECB's forecasts and with measured inflation expectations and smoothed with the Kalman smoother. Compared to the Kalman filter, used in the original HLW model, the Kalman smoother provides an alternative estimate of the unobserved variable, r*, by utilizing both

past and future data points. The Kalman smoother approach allows for a more precise identification of the underlying trend by minimizing the noise from short-term variations.

Even after adding the forecast trajectories of output, inflation and interest rates to the data, the estimate of the current level of r* is slightly negative (-0.15%). But, when inflation expectations (market or survey-based) are added to the model, the estimated natural rate path rises significantly (green, red and blue lines in Chart 3). The lower estimated level of r* in the HLW-based estimation appears to stem from backward-looking expectations, which add excessive persistence to the inflation process during the periods of high inflation volatility experienced in recent years. In the case of the estimations shown in green, red and blue, the current level of r* varies between 0.2% and 0.8%.

Chart 3.



Conclusions

The New York Fed's most recent update of its HLW-based estimate of r* indicated a clearly negative rate for the euro area, at -0.7% in Q2 2024. This article calculates corresponding estimates using a slightly modified HLW model. We modify the original model by adjusting the inflation measure, taking instead inflation excluding energy and food prices, and by using various

forward-looking (instead of backward-looking) expectations and applying Bayesian estimation methods. Additionally, we supplement the data with the ECB's latest forecasts to mitigate end-point problems. With these modifications, our estimates of the current level of r* for the euro area are slightly positive (between 0.2% and 0.8%). This is also in line with the long-term real market rate (5-year 5 years ahead), which is currently around 0.5%.

Sources

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The opinions expressed in this article are those of the authors and do not necessarily represent the views of the Bank of Finland.

Keywords

euro area, inflation expectations, natural rate of interest