Norges Bank

8 | 2025

Staff memo

Estimating the Neutral Real Rate of Interest in Norway

20.06.2025

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ISSN 1504-2596 (online)
ISBN 978-82-8379-366-6 (online)

Estimating the Neutral Real Rate of Interest in Norway

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June, 2025

Abstract

The neutral real interest rate (r^*) can serve as a benchmark for central banks when evaluating the appropriate stance of monetary policy. This paper presents updated estimates of the neutral rate for Norway and documents the current suite of models employed by Norges Bank. Relative to previous years, two additional models including more financial data have been integrated into the model portfolio. The models indicate a gradual upward trend in the Norwegian r^* in the post-pandemic period. The current average point estimate from the model portfolio is 0.4 percent.

*The views expressed are those of the authors and do not necessarily reflect those of Norges Bank. Any errors or omissions are the responsibility of the authors. Thanks to Karsten Gerdrup, Nicolai Ellingsen, Christian Presterud and Junior Maih for useful comments.

1 Introduction

The neutral real interest rate (r^*) is a key macroeconomic concept in modern economics. Introduced by the Swedish economist Knut Wicksell (1907), this rate is defined as the interest rate that neither increases nor decreases prices.[1] When the economy is no longer influenced by short-term business cycle disturbances, the policy rate will converge towards the neutral real interest rate.

Additionally, the difference between the actual real interest rate and the neutral real rate can indicate whether monetary policy is expansionary, contractionary, or neutral. Hence, the neutral real rate serves as a valuable benchmark for central banks to evaluate the stance of monetary policy.

The concept is theoretically appealing but poses challenges in empirical estimation. For example, macroeconomic models that are used to estimate r^* often rely on potential output, which itself is an unobservable variable.[2] Recent critiques, such as those from the Bank for International Settlements (BIS) (e.g. Benigno et al. (2024)), highlight these estimation difficulties. Since the neutral rate is an underlying unobservable equilibrium rate, it must be inferred through statistical models that filter out an estimate from observable data.

To clarify our understanding and application of the neutral rate, we define it as the real policy rate that ensures output remains at its potential level, thereby also closing the inflation gap over time (see figure 1). Our model portfolio aims to estimate the neutral real rate to which the economy is expected to converge over medium-long horizon, when all current shocks are expected to have dissipated.[3] We employ various models to estimate r^*, each with distinct specifications and definitions.

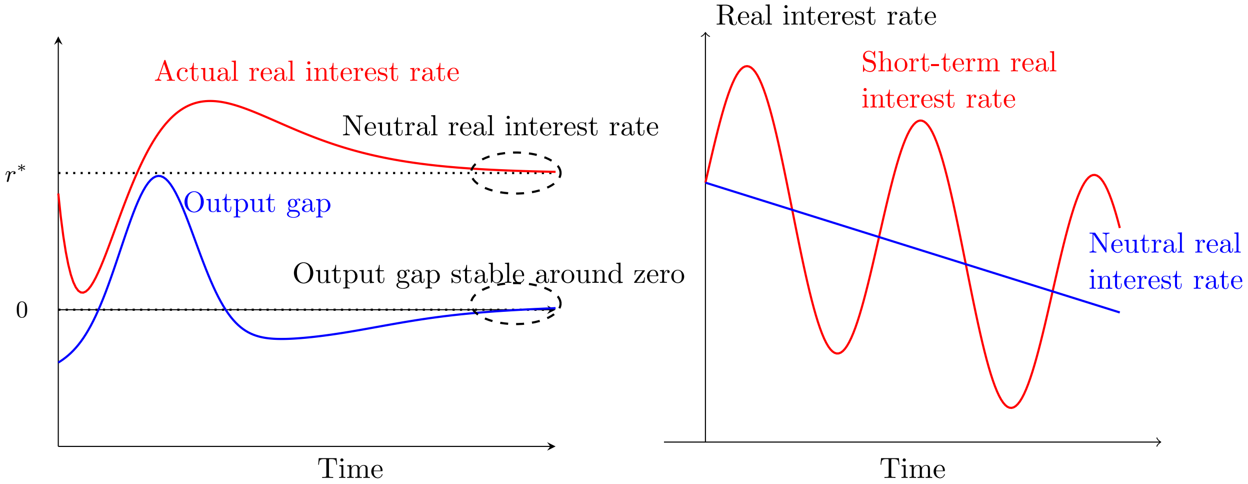


Figure 1: Relationship between neutral rate, short-term real interest rate and the output gap.

In recent years, the neutral real rate has received considerable attention. In the years prior to the pandemic, particular attention was paid to the challenges posed to monetary policy by persistently low interest rates, especially the effective lower bound, which limits the central bank's ability to stimulate the economy (Brand et al. (2024), Benigno et al. (2024)). A declining neutral rate has often been cited as a reason for this (e.g. Platzer and Peruffo (2022), Thwaites (2015)). As shown in figure 2, international long-term money market rate expectations fell globally until 2020. In the years following the pandemic, attention has shifted somewhat. The sharp increase in interest rates has reignited discussions about the "new normal" level of interest rates, bringing renewed interest to the topic. Figure 2 shows five-year rates five years ahead adjusted for inflation expectations. These can serve as

[1]The neutral interest rate is also referred to as the equilibrium rate, natural rate, normal rate and r^*. All broadly refer to the same concept. In this paper, we will use "neutral rate".

[2]See Hagelund et al. (2018).

[3]In practice, the time it takes for the effect of different disturbances to fade will vary. See Norges Bank (2024) "Norges Bank's Monetary Policy Handbook, Version 2.0" and Norges Bank Papers 3/2024.

the basis of market-based expectations of the neutral real money market rate.[4]

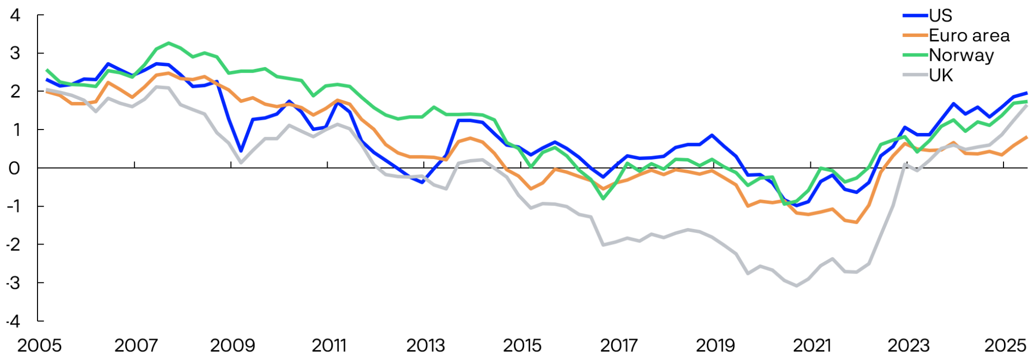


Figure 2: Market-based real money market rate expectations.

The aim of this Staff Memo can be divided in three parts: (1) to provide a brief review of the main determinants of the neutral rate cited in the literature; (2) to document the recently updated model portfolio at Norges Bank; and (3) present new estimates of the neutral rate for Norway.

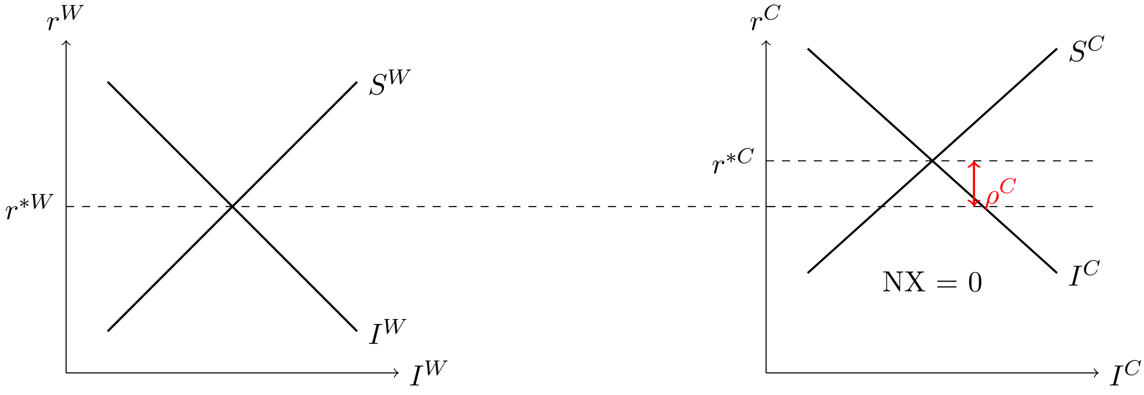
2 Theory and background

The neutral rate can be understood as an endogenous rate determined by the collective behavior of economic agents, which in turn is influenced by long-term structural factors. This chapter provides an overview of the most cited structural factors in the literature and introduces a simple framework to understand their impact on the neutral rate.

We follow Blanchard (2022), who categorizes these factors within a macroeconomic framework of loanable funds. This is a market where traded loans are the quantity, and r^* is the price. The supply of loanable funds, or desired savings, is an upward-sloping function of the interest rate, as higher returns incentivise savings from households, businesses, and the government. Investment demand for loanable funds is downward-sloping, reflecting reduced borrowing in response to higher funding costs. The neutral rate is the level at which desired savings and investment are in equilibrium. Through this lens, factors affecting the propensity to save or invest determine the neutral rate and its evolution.

This framework also distinguish between global and domestic neutral rates. With relatively free capital mobility across borders, the collective behavior driving desired savings and investments tends to be balanced globally. In this sense, the global neutral rate acts as a benchmark for domestic rates. Nevertheless, country-specific factors can cause variations in domestic neutral rates. For example, economies with higher growth rates relative to other countries might experience higher investment demand, leading to a higher neutral rate. Hence, in this framework, ρ^C denotes the country-specific premium that captures deviations between the global and domestic neutral rate. Therefore, changes in ρ^C reflect domestic factors or global developments that affect small open economies asymmetrically compared to rest of the world. In figure 3, the left-hand panel illustrates balanced global savings and investments, indicating a global equilibrium with the neutral rate r^{*W}. The right-hand panel illustrates the equilibrium in a small open economy, where $r^{*C} \neq r^{*W}$ due to the presence of a country-specific risk premium, ρ^C.

[4]Inflation swaps are used for the euro area, the UK and the US. For Norway, economists' overall inflation expectations five years ahead from Norges Bank's Expectations Survey are used.



(a) World Market

(b) Country Market

Figure 3: Blanchard (2022) and Cacciatore (2024): Framework for global and domestic r^*.

Empirical estimates from various countries suggest a general decline in the neutral rate over the past 30 years, although the extent and consistency of this trend varies across countries. More recently, some evidence points to a slight increase since 2020 (e.g. Bank of England (2025)). As a result, the literature on the structural drivers of the neutral rate predominantly focuses on the declining global rate, and hence global developments explaining this evolution. On the demand side, the literature converges on two main factors: demographic shifts and rising income inequality. On the supply side, the decline is linked to a lack of viable investment opportunities. In the following, we look deeper into each of these structural drivers individually with respect to the most recent academic findings, examining their effects on investments and savings, all else equal.

Potential growth — A key driver identified in the literature is the trend growth rate (Rachel and Smith (2015); Holston et al. (2017); Lunsford and West (2019), Obstfeld (2023)). This factor is understood to influence both the demand and supply side of the economy. Stagnating growth rates have been a persistent trend across advanced economies, largely attributed to declining productivity growth over the past few decades (Goldin et al. (2024)). To illustrate its effect on the neutral rate, Rachel and Smith (2015) consider a simple Ramsey model in which household saving decisions are influenced by productivity trends. Lower productivity reduces expected future income, thereby increasing household savings. On the supply side, lower productivity expectations diminish the anticipated returns on real capital, leading firms to scale back employment growth and capital investments. This leads to a shift in both the savings and investment schedules, pulling down the neutral rate.

Lunsford and West (2019) use annual data from 1890 to 2016, and find long-run correlation between safe real interest rates and labour force hours growth to be positive, which is consistent with overlapping generations models. Demographic changes, such as an aging population, also indirectly affect the neutral rate through the potential growth channel. An aging workforce places downward pressure on the labour supply, resulting in similar effects on potential growth as described (Eggertsson et al. (2019a)).

Demographic changes — An aging population, declining birth rates, and increased life expectancy also have direct implications for savings behaviour (Auclert et al. (2021); Eggertsson et al. (2019b); Lunsford and West (2019); Papetti (2021); Davis et al. (2024)). The desire to smooth consumption over a lifetime has led workers to increase savings for retirement. With the baby boomer generation progressing through the workforce, aggregate savings rates have risen, potentially contributing to a decline in the neutral rate. While an aging population would typically lead to decreased savings as individuals exit the workforce, this effect appears to be offset by rising longevity (Auclert et al. (2021)). Increased life expectancy amplifies the need for greater retirement savings, resulting in higher aggregate savings, all else equal.

Carvalho et al. (2025) suggest that, in combination with other global factors, demographic trends play an important role in explaining the decline in the US real interest rates between 1990 and 2019. They argue that since 2019, the downward pressure on interest rates from population aging has eased.

Papetti (2021) looks at this effect for the euro area. He employs a large-scale overlapping generation model and quantifies the extent to which demographics account for the decrease in the neutral real interest rate. The model predicts a decrease of the neutral real rate of about 1.4 percentage point by 2030, compared to the average level in the 1980s. Two channels prevail in providing the downward impact: the increasing scarcity of effective labour input and the growing willingness of individuals to save due to longer life expectancy.

Rising income inequality — Wealthier households tend to save a larger portion of their income relative to lower-income households. This increased saving behavior lowers the average propensity to consume, thereby reducing overall demand for goods and services. Lower consumption, in turn, leads to diminished investment demand, further contributing to a decline in the neutral rate (Mian et al. (2021); Rachel and Smith (2015); Straub (2019); Eggertsson and Mehrotra (2017); Obstfeld (2023)).

Eggertsson and Mehrotra (2017) uses a quantitative overlapping generation model, and finds that rising income inequality due to skill-biased technical change has a sizable effect on the real interest rate. Mian et al. (2021) uses US microdata which suggests that rising income inequality has had a more substantial impact on the decline in the neutral rate than demographic changes.

Deleveraging — High levels of debt might have also influenced the neutral rate, particularly through the effect on saving behavior (Obstfeld (2023)). Some argue that in the years leading up to the 2008 financial crisis, excessive private debt fueled demand-driven growth, temporarily elevating the neutral rate. Rachel and Summers (2019) estimate that an increase in public debt-to-GDP ratio from 18 percent to 58 percent in advanced economies over the last four decades should have raised real rates by between 1.5 and 2 percentage points. Since the financial crisis, however, the private sector has undergone a prolonged period of deleveraging, leading to increased savings, which might have lowered the neutral rate.

Less capital-intensive firms — On investment behaviour more specifically, some researchers emphasise that modern businesses, particularly major technology companies, require less capital to operate, thus the overall demand for investment decreases. This reduction in investment demand can lead to a lower neutral real rate (Rachel and Smith (2015)).

Change in risk appetite — Another contributing factor is the increased demand for safe assets, which has widened the spread between risk-free rates and returns on capital (Del Negro et al. (2017); Krishnamurthy and Vissing-Jorgensen (2012)). Not only has the total volume of savings increased, but savers have also exhibited a growing preference for safe and liquid assets. The growing demand for safe assets lowers yields and widens the spread between safe and risky assets. This reflects heightened risk aversion, leading to increased caution among firms when investing in riskier projects. Similarly, households have adopted more precautionary saving behaviors, channeling their savings into safe assets.

Higher mark-ups — Another contributing factor might be increased market power in product and labour markets, alongside a growing market share of dominant firms. This rise in market power can lead to higher markups and profits, while also contributing to lower real interest rates. These dynamics may reduce firms' incentives to invest in capital, leading to lower total investment levels despite higher profitability (Mankiw (2022)).

These are currently the most cited factors explaining shifts in the neutral rate. While there is broad qualitative consensus on the main drivers of the neutral rate, there remains difficulties quantifying the relative contributions to each factor. The conclusions often depend on the methodological approach employed.

In the portfolio of models we use to estimate the neutral rate, these structural factors are captured by the distinct models in simplified and different ways.

3 Model portfolio

This section documents the current model portfolio used by Norges Bank to estimate the neutral interest rate. Different types of empirical models are employed. Each model varies by the amount of theoretical structural that is applied..

Relative to later years, we have made some changes to our portfolio.[5] The model portfolio used in previous years has primarily used historical macroeconomic data to estimate the underlying neutral rate. To include some financial data in our estimate of the neutral rate, a market-based approach was used explicitly together with these estimates. These were the deflated five-year rates five years ahead. It is likely that this measure cannot be assumed to be a direct indication of market expectations of future policy rates, partly because long-term rates reflect more than just expectations of future policy rates – they are also influenced by term premiums that can vary over time. Norges Bank has therefore expanded its model portfolio to include models that control for term premiums in the estimate of r^*. These new models, the ACM and the macro-finance model, are viewed as an enhanced way to extract the neutral rate from financial data.

3.1 State-space model

Our state-space model is based on the approach first published by Laubach and Williams (2003) and later refined by Holston et al. (2017). It is a semi-structural model that uses a state-space approach along with the Kalman filter to extract the neutral real rate, relying on New Keynesian economic relationships.

We have made some modifications compared to the benchmark model. First, as Norway is a small, open oil-exporting economy, the oil price is included as a control variable. Second, an additional equation links the real interest rate gap to developments in the inflation gap and output.[6] Third, we have added a "Covid stringency index", which correlates with potential output. This index serves as an indicator of containment measures during the pandemic, helping to explain the unusual trajectory of output during this period.

The revised model can be summarized as follows in state-space format:

The measurement equations:

$$\hat{y}_t = \lambda_y \hat{y}_{t-1} - \frac{1}{\sigma}(r_{t-1} - r^*_{t-1}) + \gamma_{y,\Delta op} \Delta op_t + e_{\hat{y},t} \tag{1}$$

$$\pi_t = \lambda_\pi \pi_{t-1} + \gamma_{\pi,y} \hat{y}_{t-1} + e_{\pi,t} \tag{2}$$

The transition equations:

$$\Delta y^*_t = g_t + \gamma_{y^*,\Delta si} \Delta si_t + e_{\Delta y^*,t} \tag{3}$$

$$\Delta y_t = \Delta \hat{y}_t + \Delta y^*_t \tag{4}$$

$$r^*_t = \sigma g_t + z_t \tag{5}$$

$$(r_t - r^*_t) = \lambda_r (r_{t-1} - r^*_{t-1}) + \gamma_{r,\hat{y}} \hat{y}_t + \gamma_{r,\pi} \pi_t + e_{r,t} \tag{6}$$

$$g_t = g_{t-1} + e_{g,t} \tag{7}$$

$$z_t = z_{t-1} + e_{z,t} \tag{8}$$

Equation (1) represents the investment-savings (IS) relationship, linking the output gap to the real rate gap. $1/\sigma$ represents the intertemporal elasticity of substitution, and op is the oil price. Equation (2) represents the backward-looking Phillips curve, linking the inflation rate to the output gap.

The transition equations specify the law of motion of certain variables. Equation (3) models potential output as a random walk with a stochastic drift, incorporating the "Covid stringency index" to account

[5] See Brubakk et al. (2018) and Meyer et al. (2022) for documentation of the previous model portfolio.

[6] This adjustment enhances the stability of neutral rate estimates over time.

for the pandemic's impact. Equation (4) decomposes output growth into changes in the output gap and changes in potential output. Equation (5) defines the neutral rate, which is equal to trend growth multiplied by the intertemporal elasticity of substitution, plus other unspecified determinants, denoted by z.[7] Equation (6) models the real interest rate gap, which evolves based on its previous value, along with developments in the inflation and output gaps. The variables g and z are modeled as random walk, as specified in Equations (7) and (8).

The following four variables are observable: real GDP, the three-month money market rate (NIBOR) deflated by core inflation, core inflation of domestically produced goods and services and the oil price. We also estimate this model using wages instead of inflation; in this case, wage growth replaces domestic inflation.[8] All observables are demeaned prior to estimation, using data from 1994 onwards. The unobservable variables are modeled linearly, allowing the Kalman filter to estimate these variables and construct the likelihood function. The model adopts a Bayesian perspective.[9]

During the estimation process, the Kalman filter adjusts estimates of the unobserved variables (the neutral rate, potential output, and its trend growth rate) based on the distance between the Kalman filter's predicition for real GDP and inflation and their actual values. For example, if the output gap turns out to be lower than predicted at $t-1$ using the Kalman filter, the model reduces the estimated neutral rate. The output gap estimate, in turn, relies on the estimated Phillips curve. If inflation is lower than predicted by the existing estimates for potential output, the level of the potential output is revised up. The neutral rate estimate derived from this model is then, by definition, the rate that simultaneously closes both the output and inflation gaps.

We simulate a sequence of 1,000,000 random samples from the prior distribution of the parameters. We then obtain 50,000 draws from the simulated posterior distribution. For each of these 50,000 parameter draws, we obtain an estimate using the Kalman filter.

3.2 TVP-VAR

This modelis a VAR model, based on Lubik and Matthes (2015) with time-varying parameters (TVP), which enable the model to account for changes in economic relationships over time. In addition, the model inlcudes stochastic volatility, which accounts for time variation in the variances of the error processes that affecting the VAR. This is particularly important for explaining developments in GDP through the pandemic. This model is useful because most macroeconomic time series exhibit some form of nonlinearity. This can be captured using the flexible framework of a TVP-VAR with stochastic volatility.

The simple representation of the model is:

$$X_t = \Theta_t X_{t-1} + e_t \tag{9}$$

$$\Theta_t = \Theta_{t-1} + u_t \tag{10}$$

X_t is a matrix of endogenous variables, Θ_t denotes a vector of time-varying parameters, and e_t and u_t are exogenous disturbances.

This model uses the following observable variables: Norwegian mainland GDP, the CPI-ATE and the three month money market rate (NIBOR). It is estimated using Bayesian methods. Following Primiceri (2005), we use Gibbs sampling techniques, enabling us to transform the non-linear TVP-VAR into a conditionally linear state-space model at each step of the Gibbs sampling procedure. This approach allows the fundamental nonlinearity of the TVP-VAR model to be decomposed into blocks that are conditionally linear, thereby making a rather complex nonlinear inference problem tractable.

[7] The z term captures everything else that affects the neutral rate other than trend growth, such as various underlying structural factors that affect saving and investment imbalances over and beyond trend growth. Some of the determinants presented in chapter 2 may be captured in this variable.

[8] In the state-space model where we use wage growth instead of domestic inflation we also include the oil price and the productivity growth in the Phillips-curve. For more information about the model, see Brubakk et al. (2018).

[9] The priors on the unobservables are informed by economic theory and previous empirical research on the Norwegian economy. See appendix table 1 and 2.

The neutral rate estimate using this model is the forecast of the real money market interest rate at the five year horizon. We begin by obtaining smoothed estimates of the time-varying parameter vector, Θ_t, over the entire sample period. For each t, we then produce a forecast of the real rate five years out.

3.3 ACM model

In the finance literature, several models estimate bond risk premiums using treasury yields. This is connected to the neutral rate because longer-term yields contain information about the prevailing short-term real rate. These financial models offer a straightforward approach to estimating this rate, which we can interpret as a nominal measure of the neutral rate (i^*).[10] Hence, these models yield an estimate of the neutral rate solely based on financial data. The most widely used model for this purpose is the one introduced by Adrian et al. (2013), commonly known as the ACM model.

For a simplified depiction of the model, assume that r_t^* represents the common trend among safe real rates of different maturities. Let $f_t^{(n,m)}$ denote the forward nominal interest rate at horizon n for a safe asset with maturity m. Then, the following identity holds:

$$f_t^{(n,m)} = \tau_t^* + r_t^* + x_t^{(n,m)}, \tag{11}$$

where τ_t^* is the expected trend inflation and $x_t^{(n,m)}$ is the term premia.

The estimation uses only zero-coupon yield curves. The model employs principal components to decompose the term structure into a set of factors. Linear regressions are then used to estimate the price of risk related to maturity. The average expected short-term rate over period n can then be estimated by setting the price of risk to zero. For a long-term horizon, this can be interpreted as an estimate of the neutral rate. The bond risk premiums are derived by taking the difference between the zero-coupon yield curve and the estimated short-term rate.

Following the work of Benum et al. (2023), who apply this model to Norwegian data, we obtain monthly estimates of the expected short-term rate. Based on our definition of the neutral rate, we focus on the model's estimates at horizons of five and ten.[11] To have a comparable measure among the models, we subsequently calculate the 5Y5Y forward rate of these estimates, giving our ACM estimate used in the model portfolio. See Benum et al. (2023) for a more detailed description of the model.

3.4 Macro-finance model

The different macro and finance models in the literature can yield diverging estimates of the neutral rate. Both the finance and macroeconomic approaches present unique advantages and limitations. On the one hand, finance models use forward-looking data and capture high-frequency variations in interest rates. However, they exclude macroeconomic data and lack a theoretical foundation, limiting their economic interpretability. On the other hand, macroeconomic models are grounded in structural relationships between economic variables but lack forward-looking information embedded in financial data and can only be estimated at lower frequencies.

Recent literature has made progress in merging the strengths of both approaches to mitigate their respective limitations (Davis et al. (2024); Feunou and Fontaine (2023); Brand et al. (2020)). These macro-finance models incorporate term-structure models of interest rates, linking long-maturity interest rates to macroeconomic factors.

Almlid (2024) applies one of these macro-finance models to Norwegian data, following the methodology of Davis et al. (2024). The idea of the model is to decompose the average yield ($\bar{y}_t$) into three variables: trend inflation (τ_t), the real rate (r_t), and the price-of-risk factor (x_t).

[10] We then deflate the nominal rate by the inflation target.

[11] To be precise, this model estimates the future three month risk-free short rate five and ten years ahead.

The setup is a no-arbitrage, affine term structure model, similar to the ACM model. It gives affine solutions for bond prices, yields, forwards and excess returns. By averaging the solution for yields across all maturities, we have the following decomposition of the average yield:[12]

$$\bar{y}_t = a_y + b_\tau \tau_t^* + b_r r_t^* + \epsilon_t^{\text{cyc}}. \tag{12}$$

The model adds the law of motion for the neutral rate commonly used in the macroeconomic literature:

$$r_t^* = g_t + z_t, \tag{13}$$

g_t denotes the observable real GDP trend[13], while the headwinds term, z_t, captures all other factors affecting the neutral rate, similar as in the state-space model. Plugging this into equation (12) yields:

$$\bar{y}_t = a_y + b_\tau \tau_t^* + b_{r^*} g_t + b_{r^*} z_t + \epsilon_t^{\text{cyc}}. \tag{14}$$

The model treats the following three variables as observables: Average yield ($\bar{y}_t$) is calculated from the zero-coupon yield curve, trend inflation (τ_t) using a moving average of core inflation, and growth rate g_t of real GDP.

The unobserved state variables to be estimated are z_t and ϵ_t^{cyc}. These are assumed to follow independent AR(1) processes, hence the Kalman filter can be used. The Kalman system in this model is defined as:

$$\begin{pmatrix} z_t \\ \epsilon_t^{\text{cyc}} \end{pmatrix} = \begin{pmatrix} \rho_z & 0 \\ 0 & \rho_{\text{cyc}} \end{pmatrix} \begin{pmatrix} z_{t-1} \\ \epsilon_{t-1}^{\text{cyc}} \end{pmatrix} + \begin{pmatrix} e_t^z \\ e_t^{\text{cyc}} \end{pmatrix} \tag{15}$$

$$\bar{y}_t = a_y + b_\tau \tau_t^* + b_{r^*} g_t + b_{r^*} z_t + \epsilon_t^{\text{cyc}}. \tag{16}$$

The model uses Bayesian estimation.[14] The intuition behind the modeling choice of the priors is to ensure that the headwinds factor (z_t) aligns with the observed frequencies of macroeconomic data. Meaning the slower-moving structural changes should be captured by z_t, while the more volatile, high-frequency fluctuations typically seen in financial markets, is captured by the error term ϵ_t^{cyc}. This specification implies a view of the neutral rate equal to the long-term definition.

The estimation process draws 50000 different theta (θ), and estimates the neutral rate accordingly. It uses a random-walk Metropolis-Hasting algorithm to sample from the posterior distribution. The mean of the posterior distribution is then used as a fixed parameter set in the Kalman filter.

Through this estimation of z_t, the model obtain estimates of r^* that is anchored in both macroeconomic and financial data. For a more detailed description of the model and estimation, see Almlid (2024).

4 Overall assessment of the Norwegian r*

This chapter gives a brief overview of how we assess the estimates of the neutral real rate. We mainly use estimates from the model portfolio presented in chapter 3. Given the uncertainty in model-specific estimates, an average estimate provides the most robust measure for the neutral rate. In addition, we assess the neutral rate of other countries, especially Norway's trading partners.

4.1 Portfolio estimates

Figure 4 presents the different model estimates of the Norwegian neutral real money market rate from 2005 until 2025. To account for uncertainty we compute a simple average of the estimates, and include model specific confidence intervals around the estimates to obtain an overall uncertainty band.[15]

[12] The associated price-of-risk factor (x_t) is absorbed in the ϵ^{cyc} term.
[13] The GDP trend is adjusted for cyclical fluctuations using a one-sided HP-filter.
[14] See table 3 in appendix for priors.
[15] We use the 68 percent confidence intervals.

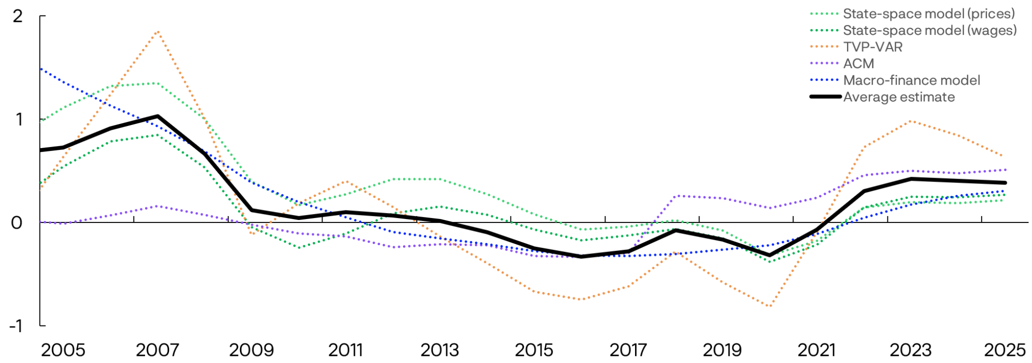


Figure 4: Model estimates of r^*.

Norges Bank publishes a most likely interval for the neutral rate. This communicated interval may diverge from the model-based estimates, as Norges Bank also takes information not captured by the models into consideration. The green lines in figure 5 depict Norges Bank's historical assessments of the neutral real money market rate. During the past two years, Norges Bank have revised up the assessed interval of r^*.[16] The latest interval for the neutral real money market rate is between 0.4 and 1.65 percent. Given the projected money market premium of 0.15 percent, this gives an estimate of the neutral real policy rate between 0.25 and 1.5 (see Monetary Policy Report 2/2025).

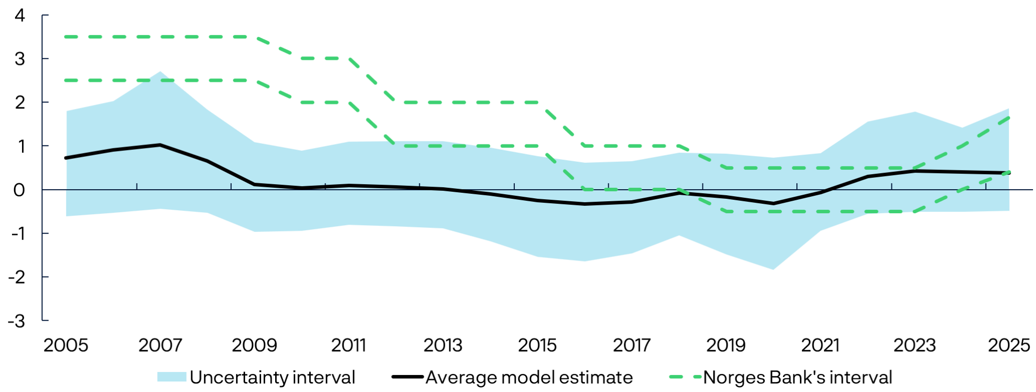


Figure 5: Estimate of the neutral real money market rate

4.2 R* for our trading partners

With free capital mobility, it is reasonable to assume that savings and investment decisions are determined on a global scale. Understanding the global neutral rate, particularly those of Norway's main trading partners, provides valuable insight into the likely range of the Norwegian neutral rate. As a small, open economy, it is important to consider the neutral rate estimates published by other central banks.

Based on publicly available information from our trading partners, we can plot the communicated intervals for the neutral interest rates (see figure 6). The estimate for trading partners in aggregate is import-weighted (I-44 weighted). To estimate relative weights for these four trading partners, we use each country's share of the sum of the four countries' share in I-44, which gives relative weights whose total sums up to 1.[17]

[16] See *Monetary Policy Report* 2/2024 and 2/2025.

[17] Weights at present: Euro area countries (0.58), Sweden (0.11), US (0.26), UK (0.05).

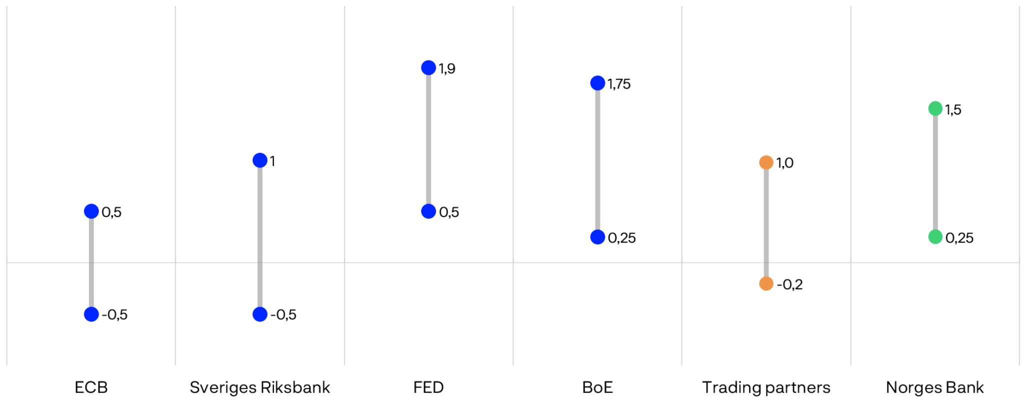


Figure 6: Estimates of our trading partners' r^*.

As shown in the framework in chapter 2, the country specific neutral rate is often connected to the global neutral rate. However, as previously mentioned, a domestic factor may cause them to diverge from the global trend. For Norway, it is expected to maintain a positive interest rate differential relative to its trading partners, to compensate for the risk associated with investing in a smaller currency. In Norges Bank's main policy analysis model, NEMO, this long-term interest rate differential against trading partners is explicitly modelled to be 0.5 percentage points. This illustrates how estimates of the neutral rate among trading partners can serve as an input in assessing the likely range of the Norwegian r^*.

5 Current developments

In light of recent analysis, a key question is whether the neutral real interest rate will remain around current levels in the years ahead or whether structural shifts are underway that could alter its long-run trajectory. This section discusses factors that may influence the evolution of r^*, based on the conceptual framework outlined previously and drawing on recent insights from international institutions and central banks.

A central determinant of the neutral rate is the outlook for both domestic and international long-term economic growth. The expected path of productivity and potential output influences the return on capital and, by extension, the real interest rate. Technological innovation, particularly in areas such as artificial intelligence (AI), may play a role. While the effects are highly uncertain, AI has the potential to improve productivity and raise potential growth, which, if realised, could exert upward pressure on the neutral rate (Benigno et al., 2024; Obstfeld, 2023).

Another important structural force is the transition to a low-carbon economy. This process may affect the neutral rate through multiple channels. If the transition prompts sustained investment in renewable energy, infrastructure, and green technology—supported by coordinated public and private sector efforts—aggregate demand could be boosted, potentially lifting r^*. However, the macroeconomic implications of the green transition will depend on the speed and coordination of its implementation. A more disorderly or delayed adjustment could instead dampen investment and increase uncertainty, with less pronounced effects on the neutral rate (BIS, 2023; OECD, 2023).

At the same time, some longer-standing structural headwinds persist. High levels of public and private debt in many advanced economies may constrain investment and limit the fiscal space for countercyclical policy. This could reinforce the global savings-investment imbalance, maintaining downward pressure on real interest rates (Obstfeld, 2023; Benigno et al., 2024).

Demographic trends remain a particularly influential factor. Populations in many advanced economies are aging, and fertility rates continue to decline. In Norway, the fertility rate has fallen to around 1.4 children per woman—well below the replacement level (Ministry of Children and Families (2025)). While the current older population tends to remain active longer, a sustained decline in the workingage population could reduce potential growth and raise the demand for safe assets, contributing to lower estimates of the neutral rate over the long term as shown in the years until 2019 (Schnabel, 2024; Obstfeld, 2023).

While these structural forces may have offsetting effects, some indicators suggest that the downward pressures observed in the post-pandemic period may be easing. Empirical estimates, including those based on macro-finance models and state-space frameworks, suggest that the negative influence of certain headwinds has diminished in recent years (Benigno et al., 2024).

Nonetheless, considerable uncertainty surrounds the future path of r^*. The net effect of innovation, climate transition, fiscal dynamics, and demographic change is still unclear.

6 Conclusion

The neutral rate is an important concept for central banks; although its estimates are uncertain and cannot serve as an exact yardsticks, it remains an important tool for communication and framing monetary policy discussions.

Norges Bank's updated model estimates indicate that the neutral interest rate is trending upwards. All models estimate that the neutral rate has risen above 0 percent. On the whole, the average estimate of the neutral rate is around 0.4 percent. Looking ahead, factors such as technological innovation, particularly advancements in artificial intelligence and the transition to a low-carbon economy may influence the future trajectory of the neutral interest rate.

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7 Appendix

Parameter	Prior mean	Prior distribution	Posterior mean
λ_π	0.5 (0.25)	Beta	0.47
$\gamma_{\hat{y}}$	0.5 (0.25)	Beta	0.29
$\lambda_{\hat{y}}$	0.5 (0.25)	Beta	0.74
σ	1 (2)	Normal	2.27
$\gamma_{\hat{y},\Delta op}$	0 (1)	Normal	0.06
Std of e_π	1 (2)	Inverse Gamma	0.53
Std of $e_{\hat{y}}$	1 (2)	Inverse Gamma	0.58
Std of $e_{\Delta y^*}$	0.5 (2)	Inverse Gamma	0.32
Std of e_g	0.5 (2)	Inverse Gamma	0.43
Std of e_z	0.5 (2)	Inverse Gamma	0.52

Table 1: Estimated parameters from the state-space model using domestic prices. Standard deviation in parentheses.

Parameter	Prior mean	Prior distribution	Posterior mean
$\lambda_{\Delta w}$	0.5 (0.25)	Beta	0.27
$\gamma_{\hat{y}}$	0.5 (0.25)	Beta	0.32
$\lambda_{\hat{y}}$	0.5 (0.25)	Beta	0.73
σ	1 (2)	Normal	2.24
$\gamma_{\hat{y},\Delta op}$	0 (1)	Normal	0.07
$\gamma_{\Delta w,\Delta op}$	0 (1)	Normal	0.02
$\gamma_{\Delta w,\Delta prod}$	1 (0.5)	Normal	1.07
Std of $e_{\Delta w}$	1 (2)	Inverse Gamma	0.68
Std of $e_{\hat{y}}$	1 (2)	Inverse Gamma	0.52
Std of $e_{\Delta y^*}$	0.5 (2)	Inverse Gamma	0.35
Std of e_g	0.5 (2)	Inverse Gamma	0.45
Std of e_z	0.5 (2)	Inverse Gamma	0.37

Table 2: Estimated parameters from the state-space model wage growth. Standard deviation in parentheses.

	Distribution	Mean	Variance
ρ_z	Beta	0.997	1.5×10^{-6}
ρ_y	Normal	0.9	1.0×10^{-2}
σ_z	Normal	$\mu_{\sigma z}(i)$	$3.0 \times \mu_{\sigma z}(i) \times 10^{-2}$
σ_y	Normal	$\mu_{\sigma y}(i)$	$3.0 \times \mu_{\sigma y}(i) \times 10^{-2}$
a_y	Normal	0.0	1.0×10^{-3}
b_τ	Normal	1.0	1.0×10^{-1}
b_{r^*}	Normal	1.0	1.0×10^{-1}
σ_{b_r}	Normal	0.1	1.0×10^{-1}
σ_{a_y}	Normal	0.025	1.0×10^{-2}

Table 3: Prior specifications of the macro-finance model

Comparison with previous *Monetary Policy Reports*:

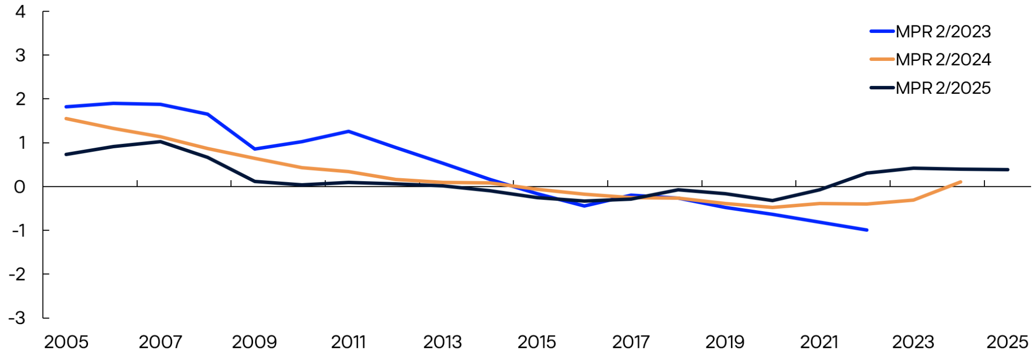

Figure 7: Comparison of model portfolio estimates.