Norges Bank

2 | 2026

Documentation Note

Indicators of the neutral rate

19 June 2026

About the publication

Documentation Notes provide concise documentation of analyses or calculations featured in the Monetary Policy Report, speeches, and other publications where opportunities for further elaboration are constrained. An important goal of the Documentation Notes is to make the analyses more accessible to a broader audience, thereby contributing to verifiability and transparency. In some cases, related code and datasets will also be included.

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Approved for publication by the Director of the Monetary policy analysis unit, Ørjan Robstad.

Indicators of the neutral rate

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This note documents how the estimates and intervals in chart M from MPR 2/26 are constructed, see chart 1 below. The chart combines three types of evidence: model-based estimates, international comparisons, and market-based indicators.

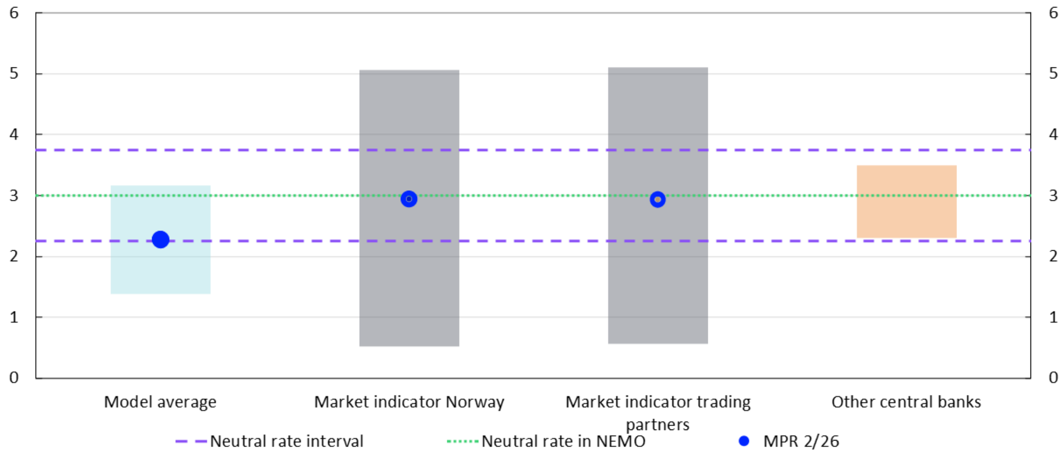

Chart 1: Indicators of the neutral rate

1 Indicator from the model portfolio

Norges Bank uses a portfolio of models to estimate the neutral interest rate, $\bar{r}$, for Norway, see Almlid and Asshoff (2025). Model average in chart 1 shows the average of the model estimates together with an uncertainty interval around this average.

We have improved how uncertainty is measured in the model estimates. Overall, there are two main sources of uncertainty in these models: uncertainty about the estimated model parameters (parameter uncertainty) and, for a given set of parameters, uncertainty about the unobserved neutral rate itself (filtering uncertainty).

The models are estimated using Bayesian methods. This gives a set of draws from the distribution of possible parameter values. For each parameter draw, the neutral rate is re-estimated using the Kalman smoother. In this way, each model produces many possible paths for $\bar{r}$, where the variation across paths reflects both parameter uncertainty and uncertainty about the unobserved state.

The uncertainty interval from the model portfolio is calculated as follows:

1. For each model, we start with the estimated distribution for $\bar{r}$.
2. We take draws from each model distribution and pool the draws across all models in the portfolio.[1]
3. The lower and upper bounds of the interval are calculated as the 5th and 95th percentiles of the pooled distribution.

The chart shows a 90 percent uncertainty interval. The interval should therefore be interpreted as a measure of total model-based uncertainty around the estimate of the neutral rate. See Appendix A for more technical documentation.

2 Indicator from other central banks

Chart 1 also shows estimates of the neutral interest rate from the ECB, FED, BoE and Sveriges Riksbank as "Other central banks". The interval reflect Norges Bank's interpretation of these central banks' communication and published analysis on the neutral rate.

For the Federal Reserve, the interval is calculated by taking the range of FOMC participants' longer-run projections for the nominal federal funds rate.[2] For the Bank of England,[3] the ECB[4] and the Riksbank,[5] the interval is taken from their respective most recently published estimates of the neutral rate, drawing on a range of macroeconomic, financial market-based and survey-based measures.

To calculate an aggregate interval based on estimates from other central banks, we use import weights. The average is weighted by the four jurisdictions relative trade weights. The latest available weights are:

[1] We take 10 000 draws from each model.

[2] Federal Open Market Committee (2026), "Summary of Economic Projections, March 2026", Board of Governors of the Federal Reserve System, 18. mars 2026. https://www.federalreserve.gov/monetarypolicy/fomcprojtabl20260318.htm

[3] Bank of England (2025), "Box A: The long-run equilibrium interest rate", Monetary Policy Report, February 2025.

[4] Brand, C., N. Lisack and F. Mazelis (2025), "Natural rate estimates for the euro area: insights, uncertainties and shortcomings", ECB Economic Bulletin, Issue 1/2025.

[5] Seim, A. (2024), "Neutral interest rate – meaning, limitations and assessment", speech at Sveriges Riksbank, 26 november 2024.

Trading partner	Weight
Euro area	0.57
Sweden	0.11
United States	0.27
United Kingdom	0.05

Historically, the interest rate level in Norway has been somewhat higher than among trading partners. In the model framework, this is viewed as a permanent NOK risk premium. Looking ahead, the differential is assumed to be around 0.5 percentage point, in line with the average from the past decade. We therefore add 0.5 percent to the trading partner central bank interval so that it functions as an indicator for the Norwegian neutral rate.

3 Market-based indicators

The market-based indicators in chart 1 are derived from nominal Overnight Indexed Swap (OIS) rates, adjusted for a measure of the term premia and inflation expectations in excess of the inflation target to obtain a measure of the neutral interest rate. For Norway, the starting point is the one year ahead four years forward OIS-rate (1Y4Y), while the trading partner indicator is a weighted average of corresponding rates for the euro area, Sweden, UK and the United States. chart 2a) compares the 1Y4Y OIS rates with the 5Y5Y forward rate, which is an alternative market indicator for the neutral rate. The 5Y5Y rate was used when Norges Bank updated its view on the neutral rate in (Norges Bank, 2025b).

Term premia are not directly observable and must be estimated. The literature on term premia is mostly focused on term premia in government bonds, but there are some studies on OIS contracts. Lloyd (2021) analyze ex post excess returns in OIS contracts and finds evidence of term premia in longer OIS contracts, but not the first 1-2 years. Barahona and Rodríguez-Moreno (2024) also find evidence of term premia in OIS contracts using an ACM-model following (Adrian et al., 2013).The term premium estimate relies on the simple decomposition:

$$TP_{(t,n)} = y_{(t,n)} - E_t[r_{(t,n)}] \tag{1}$$

where the term premia at horizon n is the nth year of the yield-curve, $y_{(t,n)}$, subtracted for the expected short term interest rate over the same period. Crump et al. (2016) use survey data to approximate the expected interest rate. Here we rely on the simple assumption that if expected short rates are flat far ahead, any remaining slope reflects the term premium. We use the slope of the yield curve between horizon 5 and 10, before we extrapolate that estimate to all years $n > 1$. The assumption that expected short rates are flat beyond five years is backed by consensus forecast, see chart 2b. We explicitly assume that the first year of the OIS-curve is free of term premia, and that longer horizons contain a term premium. This assumption is backed by the findings in Lloyd (2021). The expression for the term premia on horizon $n > 1$ is

$$TP_n = (n-1)(y_{(t,10)} - y_{(t,5)})/5 \tag{2}$$

The term premium calculated for the 1Y4Y rate is shown in chart 3a). As the OIS markets are larger in the United States and euro area we focus on these contracts when estmimating the term premium. The same estimate is then applied to both the Norwegian and the trading partner indicators. This is a simple way of creating an indicator for the term premium. If expected rates are not flat, the slope will also reflect changes in expected policy rates. The movement in the indicator is therefore cross-checked against Norges Banks ACM model, see Benum et al. (2023).

The ACM model is estimated on government bonds. Term premia are typically larger in government bonds than in OIS because government bonds expose investors to duration, funding and balance sheet risks that OIS largely avoids. Term premia in OIS are smaller, but not zero—they mainly reflect residual risk around future policy rates, plus market frictions and balance sheet effects. See chart 3. panel b) and c) for a comparison of 5Y5Y term premia from the two methods. Our measure of the term premium have undergone the same change in the last 3 years as the ACM-model estimate, but is substantially lower.

Market pricing of interest rates 4-5 years ahead may not reflect the expectation of a balanced economy. Expectations of inflation higher than target or an upside risk to inflation will result in expectations that the interest rate will be above its neutral level. For simplicity we assume that market pricing, after adjusting for term premia, expects the real rate to be at it's neutral level in 4-5 years. A measure of inflation expectations in excess of the inflation target is then subtracted. Survey-based inflation expectations are used for Norway[6], while market-based measures from inflation swaps from the US and euro area are applied for trading partners. Inflation swaps may contain insurance premiums and thus may not reflect true expectations. We do not attempt to correct for this. Table 1 shows the calculations behind the market indicators in chart 1.

Table 1: Calculation of market-based normal interest rate indicators

Component	**Norway**	**Trading partners***
Forward rate (1Y4Y)	3.71	3.08
Inflation adjustment	−0.35	−0.18
Term premium	−0.42	−0.42
Permanent risk premium	—	+0.50
Market indicator neutral rate Norway	2.94	2.98

* The trading partner OIS-rate uses weights shown above. For the term premium and inflation expectations we only use US and euro-area data with the weights: $\bar{f}_{\text{TP}} = 0.7 \cdot f_{\text{EUR}} + 0.3 \cdot f_{\text{USD}}$

To calculate the uncertainty bands around the market indicators we use information from option prices in US interest rate markets. The Norwegian interest rate market is less liquid, and corresponding measures for Norway are therefore more difficult to interpret. The source is the Federal Reserve Bank of Atlanta's *Market Probability Tracker* (Federal Reserve Bank of Atlanta, n.d.), which estimates probability distributions implied by options referencing three-month average SOFR. These distributions provide information about how markets price different outcomes for short-term interest rates. Specifically Atalanta Fed publishes mean, mode, 25th and 75th percentile of the implied distribution in three years. We use a split normal approximation to find 5th and 95th percentile for comparison with the model uncertainty band. Options prices reflect both uncertainty around the neutral rate and about the economic situation at the given future date. That gives a bias towards a larger uncertainty band.

[6]Specifically we use the expectations of economists and the social partners expectation of inflation in five years, see (Norges Bank, 2026)

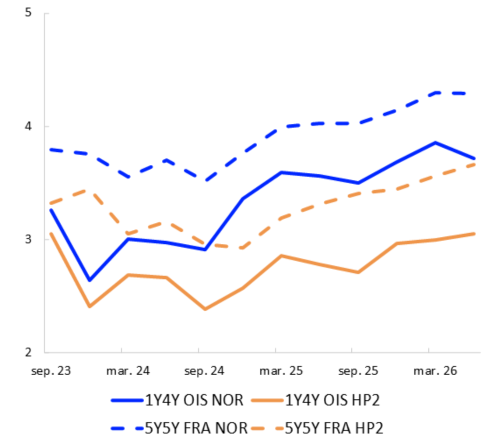

Chart 2a) Market rates

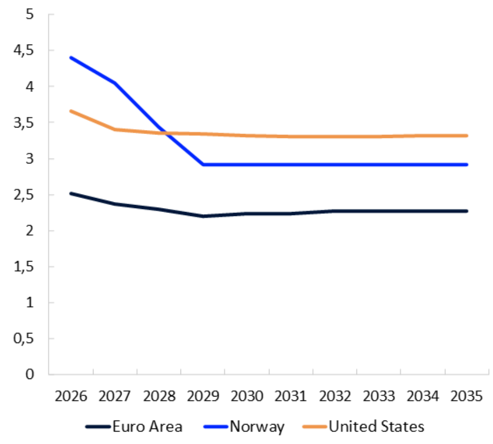

Chart 2b) Interest rate expectations*

*Expected policy rate, end of year, consensus. Source: Focus economics

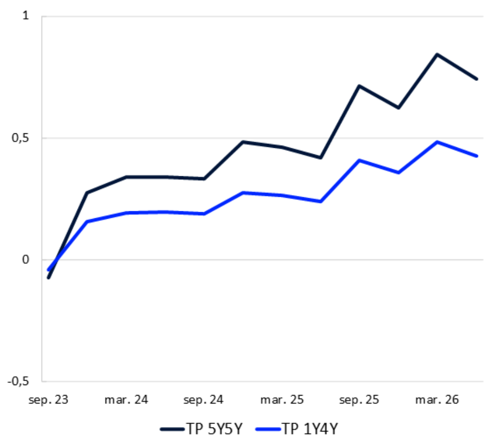

Chart 3a) Term premium indicator

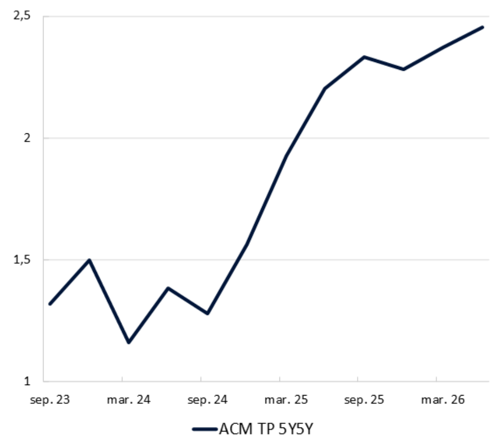

Chart 3b) ACM Term premium

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A Construction of the uncertainty interval

Each model in the portfolio is estimated by Bayesian methods and can be written as a state-space system.[7] Let θ collect the static parameters of a given model. Its representation is

$$\xi_t = T(\theta)\,\xi_{t-1} + R(\theta)\,\varepsilon_t, \qquad \varepsilon_t \sim \mathcal{N}(0,\, Q(\theta)), \tag{3}$$

$$y_t = Z(\theta)\,\xi_t + d(\theta), \qquad \bar{r}_t = s'\xi_t, \tag{4}$$

with y_t observed and ξ_t the latent states, and s a selection vector extracting the neutral rate $\bar{r}_t$. The target object is the conditional distribution of the path $\bar{r}_{1:T}$ given $y_{1:T}$, which decomposes as

$$p(\bar{r}_{1:T} \mid y_{1:T}) = \int \underbrace{p(\bar{r}_{1:T} \mid y_{1:T}, \theta)}_{\text{filtering}}\ \underbrace{p(\theta \mid y_{1:T})}_{\text{parameters}}\ \mathrm{d}\theta. \tag{5}$$

Given a prior $p(\theta)$ and the Gaussian likelihood $p(y_{1:T} \mid \theta)$ delivered by the Kalman filter, the posterior is

$$p(\theta \mid y_{1:T}) \ \propto\ p(y_{1:T} \mid \theta)\, p(\theta). \tag{6}$$

We get a sample from the posterior

$$\{\theta^{(m)}\}_{m=1}^{M} \sim p(\theta \mid y_{1:T}) \tag{7}$$

by Markov chain Monte Carlo. For fixed $\theta^{(m)}$, the Kalman smoother delivers the conditional distribution of the latent neutral rate. Because the system is linear and Gaussian, this distribution is Gaussian,

$$\bar{r}_t \mid y_{1:T}, \theta^{(m)} \ \sim\ \mathcal{N}\Big(\hat{\bar{r}}^{(m)}_{t|T},\ P^{(m)}_{t|T}\Big), \tag{8}$$

with smoothed mean and variance

$$\hat{\bar{r}}^{(m)}_{t|T} = s'\hat{\xi}^{(m)}_{t|T}, \qquad P^{(m)}_{t|T} = s'\Sigma^{(m)}_{t|T}\, s. \tag{9}$$

Drawing $\bar{r}_t^{(m)}$ from (8) for each $\theta^{(m)}$, each draw carries both sources of uncertainty in (5). The ensemble $\{\bar{r}_t^{(m)}\}_{m=1}^{M}$ is a Monte Carlo sample from $p(\bar{r}_t \mid y_{1:T})$. Pooling draws across models j,

$$\mathcal{D}_t = \bigcup_j \Big\{\bar{r}_t^{(j,m)}\Big\}_{m=1}^{M}, \qquad \mathcal{I}_t = \Big[\, Q_{0.05}(\mathcal{D}_t)\,,\ Q_{0.95}(\mathcal{D}_t)\ \Big], \tag{10}$$

where Q_α is the empirical α-quantile. $\mathcal{I}_t$ is the reported 90% interval. Table 2 reports the distribution of the neutral rate estimate at the end of the sample for each model in the portfolio, together with the pooled distribution that underlies the 90% interval. The per-model percentiles are computed directly from the model draws; the pooled row stacks the draws from all four models into a single distribution.

[7] For simplicity we present the state-space framework in its time-invariant form here; the TVP-VAR fits the same structure but with time-varying coefficients.

Table 2: Distribution from model portfolio.

Model	Mean	P5	P10	P25	P50	P75	P90	P95
Macro-finance	2.29	1.90	1.98	2.13	2.29	2.45	2.60	2.69
SS-model with price	2.15	1.20	1.41	1.76	2.15	2.54	2.88	3.09
SS-model with wage	2.27	1.37	1.57	1.90	2.27	2.64	2.97	3.16
TVP-VAR	2.41	1.38	1.61	1.98	2.40	2.84	3.20	3.42
Pooled	2.28	1.39	1.62	1.97	2.28	2.58	2.94	3.16

⋆ The models are estimated on the real money market rate and transformed to nominal policy rate terms using the inflation target of 2% and our projection for the long term money market premium of 0.25 percentage point.