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From r* to the Optimal Policy Rate: Identifying a Time-Varying Forward-Looking Taylor Rule for the National Bank of Poland

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Abstract

Aim: This paper identifies a forward-looking Taylor-type rule with time-varying coefficients for Poland and derives the implied optimal policy-rate path for the National Bank of Poland over the period 2010-2024. It assesses how expectations, a time-varying neutral rate, and parameter recalibration alter the evaluation of monetary stance relative to a constant-parameter benchmark.

Methodology: A New Keynesian-structured Bayesian SVAR was estimated on quarterly data, and conditional forecasts were used to obtain expected inflation and the expected output gap. The optimal policy-rate path and rule coefficients were recovered through constrained numerical optimisation under the effective lower bound by minimising the Equilibrium Monetary Policy Gap (EMPG), defined as the squared deviation of the policy rate from the neutral interest rate.

Results: The forward-looking time-varying rule generated a substantially lower EMPG than the classic Taylor rule and indicated a marked divergence after 2022 between the conventional interest-rate gap and the broader monetary policy gap.

Implications and recommendations: Static Taylor rules may misstate the policy stance when the neutral rate and reaction coefficients change over time.

Originality/value: The paper provides novel evidence for Poland by jointly combining a forward-looking Taylor-rule framework, time-varying parameters, and an explicit neutral-rate benchmark within a New Keynesian BSVAR model.

Keywords: forward-looking Taylor rule, time-varying parameters, neutral interest rate (r*), Bayesian SVAR, monetary policy gap

1. Introduction

The National Bank of Poland (NBP) conducts monetary policy under a Direct Inflation Targeting (DIT) regime with a continuous inflation target of 2.5% and a symmetric tolerance band of ±1 percentage point (Pietryka, 2008). In this framework, the benchmark interest rate (BIR) is the primary policy instrument and an important signal in anchoring inflation expectations.

A standard point of departure for characterising interest-rate setting is the Taylor rule (1993), which links the policy rate to deviations of inflation from target and output from potential. Policy prescriptions based on a constant-parameter rule can be problematic when two empirically relevant features are present. First, the natural (neutral) rate of interest (NRI) is unobservable and may vary over time. Second, the central bank's effective reaction coefficients may change with the macro-financial environment, implying time variation in reaction-function parameters.

This paper identifies a normative, forward-looking policy rule for Poland by estimating time-varying reaction-function parameters and deriving the corresponding optimal BIR path over 2010–2024 (quarterly). The normative criterion was the minimisation of the Equilibrium Monetary Policy Gap (EMPG), defined as the deviation of the optimal BIR from the NRI process. Expected (forward-looking) inputs were obtained from a New Keynesian structured Bayesian Structural VAR (BSVAR). Conditional forecasts were then embedded in the forward-looking Taylor-type rule, and the optimal policy-rate path was computed using numerical optimization (Brent search and L-BFGS-B) subject to feasibility constraints, including the zero lower bound and bounds on structural parameters.

Thus this study asked whether a forward-looking Taylor-type rule with time-varying coefficients provides a more informative benchmark for National Bank of Poland (NBP) rate-setting than a conventional constant-parameter specification. The empirical analysis was organized around three testable hypotheses. H1: augmenting the rule with model-consistent expectations and a time-varying neutral interest rate lowers the Equilibrium Monetary Policy Gap (EMPG) relative to the classic Taylor benchmark. H2: the optimal reaction coefficients are time-varying, meaning that the relative policy weight on the expected inflation gap and the expected output gap is not stable over the sample. H3: after the 2022 inflation shock, the conventional interest-rate gap and the broader forward-looking monetary policy gap cease to convey the same information about policy stance. Framing the contribution in this way permits a direct comparison between alternative rule designs and clarifies the conditions under which a neutral-rate-anchored policy diagnostic is more informative for Poland.

2. Literature Review

The natural (neutral) rate of interest is a standard component of modern monetary-policy reaction functions embedded in New Keynesian frameworks, particularly when the policy rule is formulated in a forward-looking manner and the effective lower bound is a relevant constraint. Recent contributions stress that treating the natural rate as a time-varying process, rather than a fixed calibrated constant, can improve the internal consistency of policy prescriptions in environments where the risk of binding lower-bound episodes is non-trivial (Daudignon & Tristani, 2025).

A central challenge is that the natural rate is unobservable and must be estimated, which makes policy prescriptions sensitive to measurement error. Benigno et al. (2024) argued that alternative identification strategies used in New Keynesian, semi-structural (Laubach–Williams-type), yield-curve-based, and survey-based approaches can yield materially different r* estimates and imply a wide uncertainty band, which can translate into systematic deviations in the implied policy-rate setting. Consistent with this emphasis on uncertainty, related evidence suggests that post-pandemic estimates of the natural rate have tended to move upward across methodologies, although the magnitude depends on the specific identification and data sources employed (Hartley, 2025).

Theory typically links movements in the natural rate to time preference, trend productivity growth (as a driver of potential output growth), and, in life-cycle settings, demographic forces that affect saving and investment behavior over the long run (cf. Bielecki et al., 2020; Cacciatore et al., 2024). DSGE models with life-cycle mechanisms and contractual frictions highlight that shifts in long-run growth and population structure can alter the equilibrium real rate and thereby the intercept term of interest-rate rules, with implications for how strongly policy should respond to output and inflation stabilization objectives (Bullard & DiCecio, 2025). The practical implication for interest-rate rules is that a time-varying neutral-rate component may be needed to avoid attributing slow-moving structural changes to the cyclical part of the rule.

A complementary strand emphasises fiscal and institutional determinants of natural-rate dynamics. Campos et al. (2025) developed a framework in which fiscal conditions and debt dynamics influence the natural rate through households' portfolio decisions and expectations, implying that post-pandemic fiscal expansions can raise the equilibrium real rate and shift the policy-rate intercept. Nuño (2025) similarly examined how institutional features – such as debt dynamics and the inflation-target regime – interact with natural-rate movements and lower-bound risks, and used regime-switching tools to capture structural changes associated with large shocks, including the pandemic. Taken together, this literature suggests that ignoring time variation in the neutral-rate component can bias the assessment of monetary-policy stance and the inferred optimality of alternative rule specifications.

The evidence for Poland is more limited, particularly regarding forward-looking rules with time-varying parameters. Existing work for the NBP highlights that allowing for interest-rate smoothing and adaptive dynamics can materially affect inferred policy behaviour. For example, Górajski and Kuchta (2022) estimated an adaptive Taylor-type specification with policy-rate smoothing and solved an optimisation problem defined by a welfare-loss criterion; they also found that an inertial (super-inertial) rule can rationalise observed policy-rate dynamics. More broadly, the interest-rate smoothing mechanism is consistent with the interpretation that central banks adjust rates gradually to mitigate the effects of real-time measurement error and uncertainty surrounding inflation and output gaps, a point emphasised in the broader literature (Orphanides & Williams, 2007).

In general, prior research indicates three elements that are central for a normative policy-rule analysis in Poland: (i) incorporating the natural rate as a time-varying process rather than a constant; (ii) explicitly acknowledging estimation uncertainty and potential structural breaks in the post-pandemic period; and (iii) allowing reaction-function coefficients, especially the degree of inertia and the relative responses to inflation and activity, to vary over time. These considerations shaped the forward-looking, time-varying Taylor-type framework adopted in this study.

3. Methodology

Identifying an optimal benchmark interest rate (BIR) in a Taylor-type reaction-function framework requires a measure of the neutral interest rate (NRI), which is not directly observable. In this study, the NRI was treated as a time-varying latent process and approximated using a model-consistent expected real rate. Specifically, the ex-ante real rate is defined as the long-term nominal rate adjusted for expected inflation. Expected inflation is modelled as an adaptive forecast error process:

$$y_{\pi,t} = \mathrm{E}_{t-1}\left[y_{\pi,t}\right] + \varepsilon_{\pi,t}.$$

The resulting NRI proxy is interpreted as the long-run real rate consistent with a macroeconomic environment in which inflation and output are close to their equilibrium paths.

Forward-looking inputs for the policy rule were obtained from a Bayesian Structural VAR (BSVAR) estimated on quarterly data. Let y_t denote an $N \times 1$ vector of endogenous variables. The reduced--form VAR(P) is:

$$y_t = \sum_{p=1}^{P} A_p y_{t-p} + \varepsilon_t, \qquad \varepsilon_t \sim \mathcal{N}(0, \Sigma),$$

where d_t collects deterministic terms (intercept and/or trend). In compact form:

$$y_t = A x_t + \varepsilon_t,$$

with x_t stacking lags of y_t and deterministic terms.

To control over-parameterisation and improve finite-sample performance, the autoregressive parameters were assigned Minnesota-type priors, augmented with hierarchical local–global shrinkage (Woźniak, 2024). Intuitively, shrinkage pulls coefficients toward a parsimonious benchmark while still allowing the data to override the prior when the signal is strong. Hyperparameters were set according to standard practice, and the specification chosen to balance flexibility with robustness.

To recover economically interpretable shocks and generate conditional forecasts consistent with a New Keynesian structure (Lütkepohl, 2005), the VAR was structured non-recursively using **sign restrictions** on the contemporaneous impact matrix. Structural shocks η_t satisfy:

$$\varepsilon_t = B_0^{-1} \eta_t, \quad \eta_t \sim \mathcal{N}(0, I_N), \quad \mathbb{E}[\eta_t, \eta'_{t-h}] = 0 \ (h \neq 0).$$

Let L be the Cholesky factor of Σ such that $\Sigma = \mathrm{LL}'$. A candidate impact matrix can be written as:

$$B_0^{-1} = LQ,$$

where Q is an orthogonal rotation matrix (Rubio-Ramirez et al., 2010). The orthogonal rotations were obtained by Gibbs sampling following the algorithm of Waggoner and Zha (2003). Draws of Q were retained if the implied impulse responses satisfy the imposed sign restrictions. This approach restricts the space of admissible models through inequalities without imposing exact zero constraints, thereby preserving flexibility while maintaining theoretical coherence.

The empirical objects required for the policy rule, expected inflation and expected output gap, were taken from the BSVAR conditional forecasts. The benchmark constant-parameter Taylor rule was used as a reference:

$$i_n^{opt} = r_t^* + 1{,}5(\pi_t - \pi^*) + 0{,}5(Y_t^{gap}),$$

where i_n^{opt} is the optimal nominal policy rate, r_t^* is the NRI process, π^* is the inflation target, and Y_t^{gap} is the output gap. The main specification is a forward-looking, time-varying Taylor-type rule:

$$i_n^{opt} = r_t^* + \alpha_t^{\pi}(E_t[\pi_{t+1}] - \pi^*) + \beta_t^{Y}(E_t[Y_{t+1}^{gap}]).$$

In the forward-looking rule, α_t^{π} measures the marginal response of the policy rate to the expected inflation gap, holding the expected output gap constant. A higher value of α_t^{π} therefore implies a more forceful stabilisation response to projected inflation deviations from the 2.5% target. By contrast, β_t^{Y} measures the response to expected cyclical conditions, that is, to deviations of output from potential. A higher β_t^{Y} implies greater stabilization weight placed on real activity. Since the baseline normalisation imposes $\alpha_t^{\pi} + \beta_t^{Y} = 2$, time variation in one coefficient is informative about the reallocation of policy weight away from the other objective. Economically, the estimated coefficient paths summarize how the optimal rule shifts the inflation-activity trade-off across changing macroeconomic conditions. To account for the effective lower bound, the implemented rule was truncated at zero:

$$i_n^{opt} = \max\{0, r_t^* + \alpha_t^{\pi}(E_t[\pi_{t+1}] - \pi^*) + \beta_t^{Y}(E_t[Y_{t+1}^{gap}])\}$$

and the time-varying coefficients α_t^{π} and β_t^{Y} were chosen to minimise the Equilibrium Monetary Policy Gap (EMPG), defined as the deviation of the optimal policy rate from the neutral rate:

$$EMPG_t = i_t^{opt} - r_t^*.$$

Economically, the EMPG captures the magnitude of deviations of the policy stance from the neutral-rate-consistent benchmark. Higher EMPG values indicate greater monetary-policy misalignment relative to equilibrium conditions, whereas lower values imply that policy is set closer to the level consistent with macroeconomic balance. EMPG is interpreted as a loss-type metric of policy deviation. The loss function is the mean squared gap at time t:

$$\mathcal{L}_t = \left(i_n^{opt} - r_t^*\right)^2.$$

Optimisation was conducted using (i) Brent's method (Brent, 1973) for one-dimensional searches and (ii) L-BFGS-B (Byrd et al., 1995) for constrained nonlinear optimisation. To reflect institutional plausibility and avoid extreme reaction coefficients, the parameters were restricted to:

$$\alpha_t^{\pi}, \beta_t^{Y} \in [0.5; 1.5].$$

Therefore, optimisation could be expressed in a single free parameter (e.g. α_t^{π}, with $\beta_t^{Y} = 2 - \alpha_t^{\pi}$). The resulting time path of $(\alpha_t^{\pi}, \beta_t^{Y})$ defines the estimated forward-looking, time-varying normative reaction function for the NBP over 2010-2024.

All the estimations, optimisations, and figures were produced in R (R Core Team, 2025). The empirical workflow relied in particular on the bsvars and bsvarSIGNs (Wang & Woźniak, 2025) packages for Bayesian structural VAR estimation, KFAS (Helske, 2017) for state-space modelling and Kalman smoothing.

4. Results

The empirical analysis was based on a three-variable New Keynesian–structured BSVAR estimated on quarterly data for 2010Q1–2024Q3. The variables were: (i) real activity proxied by GDP (log-transformed), (ii) core inflation (core CPI, y/y, %), and (iii) the 10-year government bond yield as a long-term market interest rate (MIR, %). Figure 1 shows the time-series dynamics over the sample.

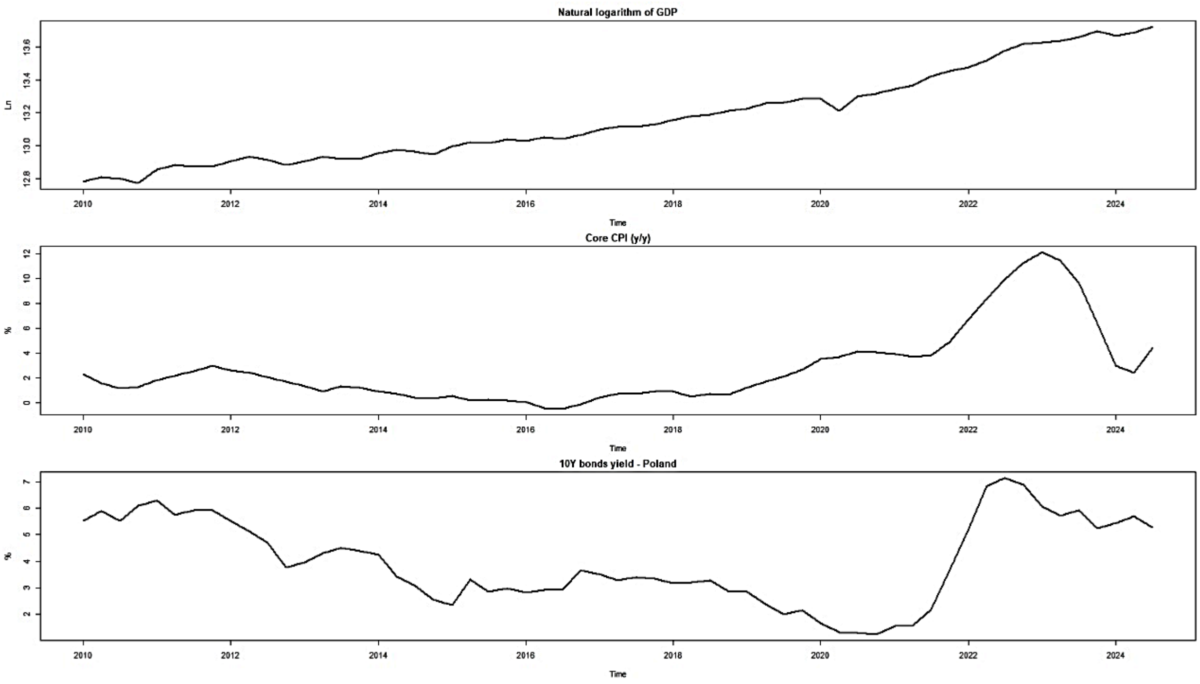

Fig. 1. Data used in the BSVAR model (2010Q1-2024Q3): ln(GDP), core CPI (y/y), and 10-year government bond yield

Source: own elaboration based on Statistics Poland (GUS) and stooq.pl.

Using the BSVAR-implied expectations and a real-rate construction (the nominal 10-year yield adjusted for expected inflation), the study derived a time-varying neutral rate of interest (NRI) and then applied Kalman smoothing to extract its systematic component. In this paper, the NRI is interpreted as a long-horizon neutral-rate proxy and should therefore be read cautiously, as it can embed term-premium and fiscal components in addition to the equilibrium real rate. Figure 2 reveals a clear regime pattern rather than a single representative average. In 2010-2018, the NRI remained mostly positive and comparatively stable, averaging 3.11%, with values fluctuating around a narrow positive range. In 2019-2021, it fell markedly and turned negative on average (-1.30%), before declining further in 2022-2023 to an average of -3.53% and a trough of about -4.67% in 2022Q1. Only in 2024 did the series visibly recover, returning to positive territory and averaging 1.51%. Over the full sample, the estimated NRI averaged around 1.21%. The output gap was close to zero on average over the full sample (roughly 0.01), but this near-zero mean masked substantial time variation: it oscillated around balance for most of the pre-pandemic sample, turned more volatile around the pandemic and post-pandemic adjustment, reached a deep negative reading of around -2.59 in 2024Q1, and then rebounded sharply to about 1.83 by 2024Q3. The economic message of Figure 2 is therefore not that the NRI and the gap are simply characterised by their sample averages, but that both series exhibited pronounced state dependence, especially after 2019.

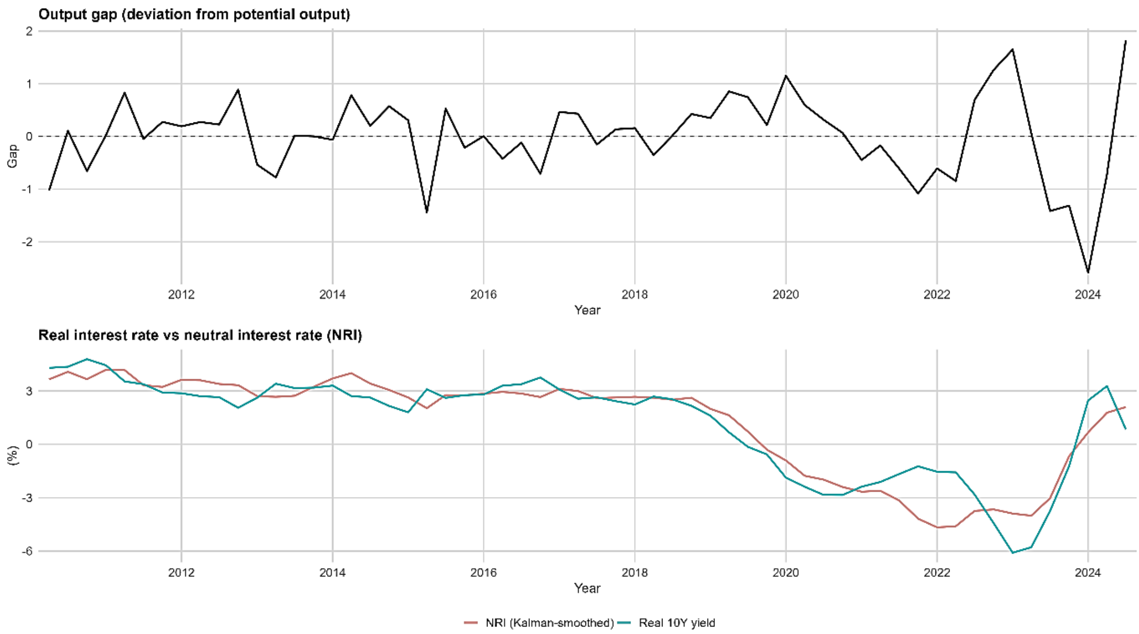

Fig. 2. Output gap (upper panel) and real interest rate versus the neutral interest rate (lower panel), 2010Q2-2024Q3

Source: own elaboration based on the BSVAR-implied expectations and Kalman filtering.

Next, the author evaluated policy-rate prescriptions under two rule families. First, the classic contemporaneous Taylor rule was constructed with conventional coefficients and compared the implied policy-rate path (with and without the zero lower bound) to the NBP reference rate. Figure 3 shows that the classic rule is not only different in level from the observed policy path, but becomes especially restrictive during the inflationary episode. With the zero lower bound imposed, the classic rule rose to approximately 11.39% in 2023Q1, whereas the observed NBP reference rate peaked at 6.75%. The difference was already substantial in 2022Q4 (about 10.18% versus 6.75%) and remained economically large through most of 2023. Hence, under a constant-parameter benchmark, the observed NBP stance appears materially less restrictive than the prescription implied by a conventional inflation-gap-tilting rule. At the same time, the earlier part of the sample shows long stretches during which the zero lower bound truncates the rule at zero, indicating that the constant-parameter benchmark is sensitive both to the lower-bound constraint and to the unusually large inflation shock.

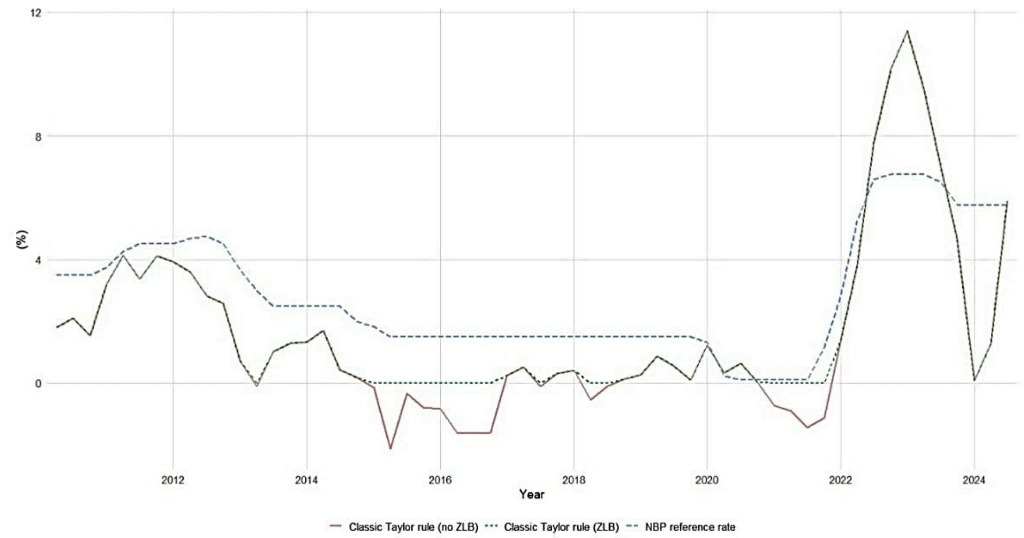

Fig. 3. Classic Taylor-rule implied policy rate vs. the NBP reference rate (with and without the zero lower bound)

Source: own elaboration based on NBP data and BSVAR inputs.

Second, the author estimated an anticipatory (forward-looking) Taylor-type rule that uses BSVAR conditional forecasts and allows for time-varying reaction coefficients. Figure 4 reports both the implied optimal policy-rate path and the evolution of the estimated coefficients obtained from the Brent and L-BFGS-B optimisation. The main result is that the optimised rule substantially improves neutral-rate consistency relative to the classic benchmark. The mean EMPG loss was 4.27 under Brent optimisation and 4.32 under L-BFGS-B, compared with 21.18 for the classic Taylor rule and 15.48 for the observed NBP reference rate. This corresponds to an EMPG reduction of about 80% relative to the classic rule and about 72% relative to the observed polity path. The coefficient paths are economically interpretable. The average Brent solution implied $\alpha_t^{\pi} = 0.78$ and $\beta_t^{Y} = 1.22$, while the average L-BFGS-B solution implied $\alpha_t^{\pi} = 0.70$ and $\beta_t^{Y} = 1.30$. Moreover, the output-gap coefficient exceeded the inflation-gap coefficient in roughly 72% of the sample under Brent and 71% under L-BFGS-B. Thus, under the adopted EMPG criterion, the optimal rule generally assigns more weight to cyclical stabilisation than to a mechanically stronger response to expected inflation. This is precisely the type of interpretation that the time-varying coefficients were meant to provide.

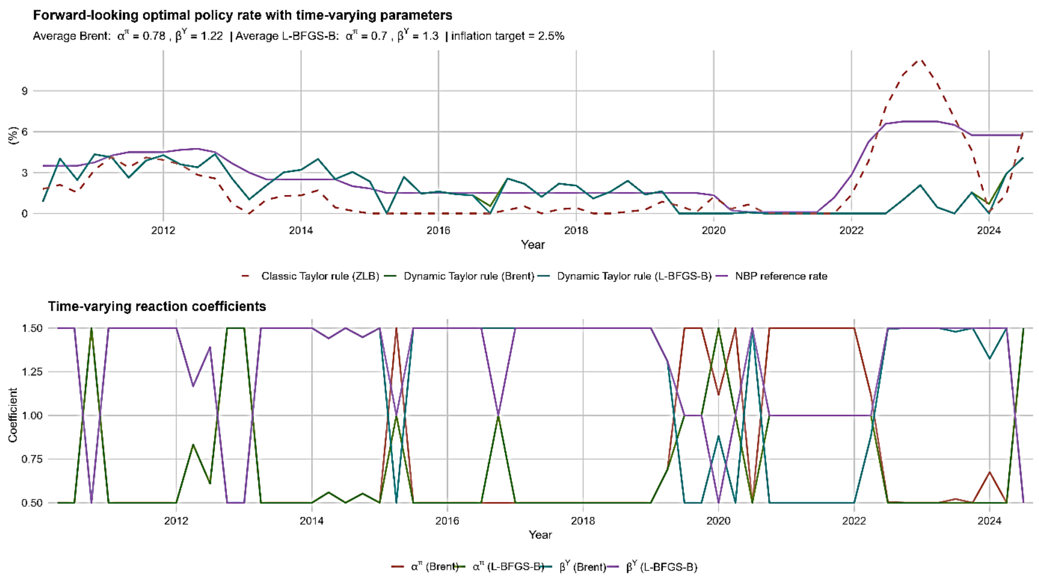

Fig. 4. Forward-looking optimal policy rate with time-varying parameters and time-varying reaction coefficients

Source: own elaboration based on the BSVAR conditional forecasts and Brent/L-BFGS-B optimization.

Finally, the author compared the conventional interest-rate gap with the monetary policy gap implied by the forward-looking rule. Figure 5 shows that the two measures co-moved only partially in the earlier sample and then diverged decisively after 2022. In the pre-2022 subsample, the Pearson correlation was approximately 0.344 and statistically significant, indicating that both gap concepts still contained related information about the stance of policy. Over the full sample, however, the correlation fell to around 0.169 and was no longer statistically significant. This breakdown is economically important. After the inflation shock period (NBP, 2023;2024), the policy rate remained far above the forward-looking optimal rate implied by the EMPG criterion, whereas the real market-rate-based gap followed a markedly different trajectory. The divergence supports the interpretation that market-rate conditions, excess liquidity, and the operating framework can weaken the link between the policy rate and broader transmission conditions, so that the conventional interest-rate gap alone becomes and insufficient diagnostic of monetary stance.

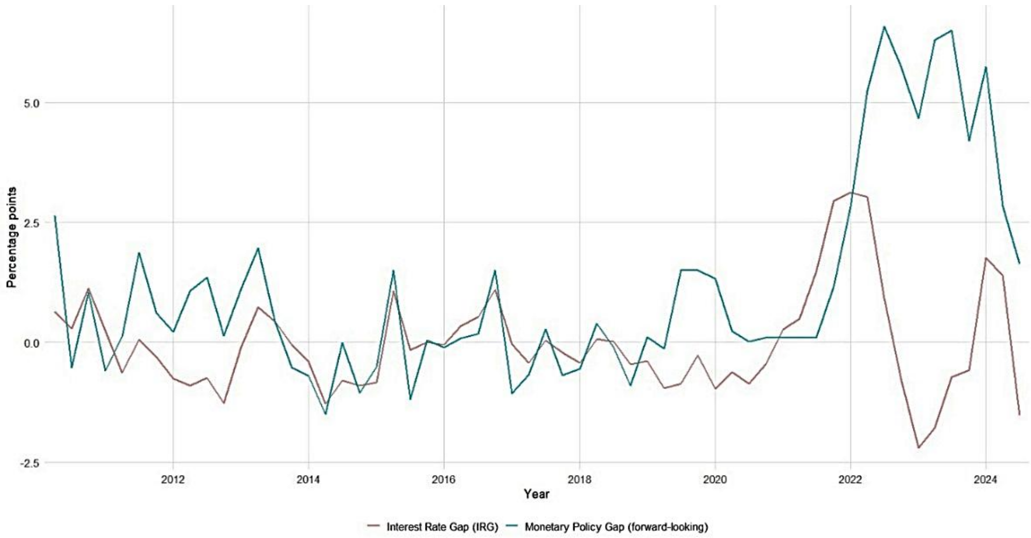

Fig. 5. Divergence between the interest-rate gap and the forward-looking monetary policy gap after the inflationary shock of 2022

Source: own elaboration based on the NBP reference rate and the forward-looking Taylor-type rule estimates.

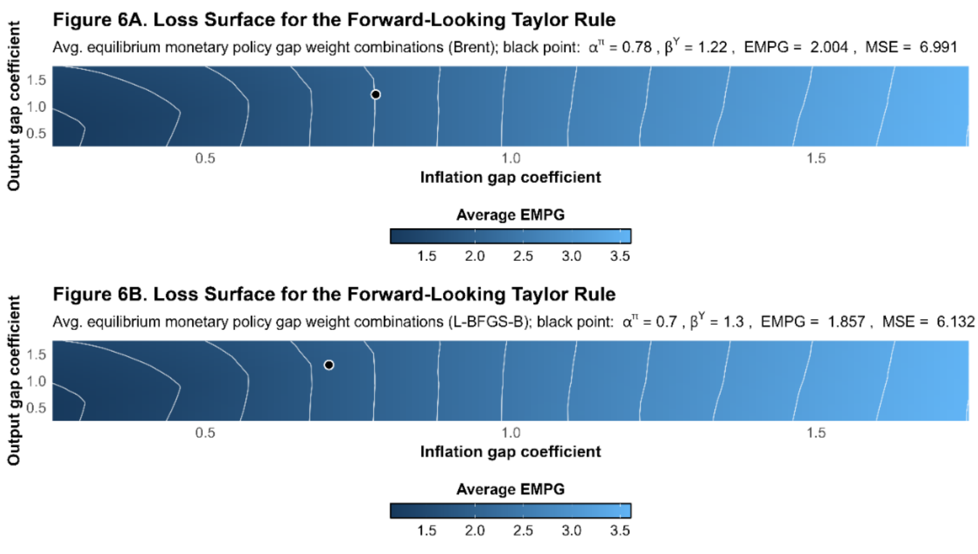

Fig. 6. Loss surfaces for the forward-looking Taylor rule: average EMPG across inflation-gap and output-gap coefficient combinations (the black dots mark the average optimal parameter pairs).

Source: own elaboration based on the EMPG (MSE) loss function evaluated for the forward-looking Taylor-type rule using BSVAR-based inputs

Figure 6 provides the optimisation interpretation by mapping the loss surface over admissible Taylor-rule coefficients. Two results stand out. First, the low-loss region was not diffuse, and concentrated in a band characterised by inflation-gap coefficients below 1 and output-gap coefficients above 1. The average optimal points reported in the figure – approximately $(\alpha_t^{\pi},\ \beta_t^{Y}) = (0.78, 1.22)$ for Brent and $(\alpha_t^{\pi},\ \beta_t^{Y}) = (0.70, 1.30)$ for L-BFGS-B – lie squarely in that region. Second, the surface changed smoothly around the optimum rather than displaying multiple disconnected minima, which suggests that the identified optimum was not a numerical artefact of one particular algorithm. Figure 6 therefore supports the substantive conclusion drawn from Figure 4: under the EMPG criterion, combinations that place relatively more weight on cyclical stabilisation than on a strong inflation-gap response are associated with systematically lower policy-loss values for Poland over the considered sample.

5. Discussion and Conclusions

This paper proposes a forward-looking, time-varying Taylor-type instrument rule for Poland in which the benchmark policy-rate path is recovered by minimising the Equilibrium Monetary Policy Gap (EMPG), defined as the squared deviation between the rule-implied policy rate and a time-varying neutral interest rate (NRI). As the rule is fed with model-consistent expectations from a New Keynesian-structured BSVAR and estimated under an effective lower bound, the framework was designed to evaluate whether a neutral-rate-anchored and expectation-sensitive policy rule provides a more informative benchmark for the National Bank of Poland than a conventional constant-parameter Taylor specification.

The results provide support for all three hypotheses formulated in the paper. H1 is supported: augmenting the rule with forward-looking inputs and a time-varying NRI materially lowered the EMPG relative to the classic Taylor benchmark. The central implication is that a policy rule with fixed coefficients and no explicit allowance for time variation in the neutral rate can generate a benchmark path that is systematically too distant from equilibrium-consistent monetary conditions. In substantive terms, the results indicate that once expectations and a shifting neutral benchmark are incorporated, the implied assessment of monetary stance changes non-trivially, especially during periods of macroeconomic stress.

H2 is also supported: the estimated reaction coefficients were not stable over the sample. The relative policy weight assigned to the expected inflation gap and the expected output gap changed over time, implying that the trade-off embedded in the normative rule is state-dependent rather than constant. This is economically important because it suggests that a single pair of Taylor-rule coefficients is unlikely to describe adequately the policy environment over 2010-2024. In particular, the finding that the output-gap coefficient frequently exceeds the inflation-gap coefficient should not be interpreted as evidence that inflation stabilisation is unimportant. Rather, within the EMPG-based optimisation problem, it indicates that the policy configuration most closely aligned with the neutral-rate benchmark often places greater marginal weight on cyclical stabilisation than would be implied by a mechanically inflation-centred rule. This interpretation is consistent with the broader view that policy rules may exhibit time variation across changing macroeconomic states and shifting shock environments (Camehl & Woźniak, 2023).

H3 is likewise supported: from 2022 onward the conventional interest-rate gap and the forward-looking monetary policy gap ceased to deliver equivalent information about monetary stance. This divergence is one of the most policy-relevant results of the paper, which implies that, in the post-inflation-shock period, the distance between the policy rate and the neutral benchmark can no longer be inferred reliably from the conventional interest-rate gap alone. A plausible interpretation is that the relationship between the administered policy rate and broader financing conditions weakened in an environment shaped by excess liquidity, corridor-related frictions, and incomplete pass-through to market rates. Under such conditions a narrow reading of stance based solely on the reference rate may understate the extent to which transmission departs from the equilibrium-consistent benchmark.

Taken together these findings refine the interpretation of Taylor-type rules in an economy such as Poland. The main contribution of the paper is not to claim that the estimated rule reproduces the true structural objective function of the central bank, but rather shows that a forward-looking rule with time-varying coefficients and an explicit neutral-rate anchor yields a more informative normative diagnostic than a static benchmark when the underlying macroeconomic environment is changing. This is particularly relevant in the presence of large shocks, when both the level of the neutral rate and the effective strength of policy transmission may shift. In that sense, the paper contributes to the literature by demonstrating that mismeasurement of stance may arise not only from uncertainty surrounding r*, but also from the use of overly rigid reaction-function benchmarks.

The results also have several implications for monetary-policy analysis. First, they caution against treating the classic Taylor rule as a sufficient benchmark for evaluating policy appropriateness in real time. When both the neutral rate and the effective response coefficients vary, a constant-parameter rule may confound structural change with policy deviation. Second, the evidence suggests that expectation-based diagnostics are particularly valuable when inflation shocks are large and persistent, because the relevant stance of policy depends not only on current inflation and activity, but also on the anticipated trajectory of these variables. Third, the post-2022 divergence between the two gap measures implies that central-bank communication and policy assessment may benefit from complementing standard rate-gap indicators with broader diagnostics that incorporate transmission conditions. In this sense, the paper's framework may be useful as a practical empirical device for distinguishing between the level of the policy instrument and the effective monetary stance transmitted to the economy.

These conclusions, however, should be interpreted subject to several limitations. Firstly, the EMPG is a normative diagnostic of neutral-rate consistency, not a fully micro-founded welfare criterion. Minimising the distance between the policy rate and the NRI is analytically useful, but it is not equivalent to solving the central bank's full intertemporal welfare problem. The proposed rule should therefore be interpreted as a disciplined benchmark for policy alignment rather than as a definitive welfare-optimal rule. Secondly, the NRI remains model-dependent and is measured with uncertainty. In the present framework, this was inferred from a real-rate construction, a parsimonious BSVAR, and subsequent smoothing, so the estimated series may reflect not only equilibrium real-rate movements but also term-premium, fiscal, or other financial components. This uncertainty necessarily propagated into the EMPG and into the inferred optimal coefficients. Thirdly, the empirical system remains deliberately parsimonious. While a three-variable BSVAR improves tractability and transparency, it may omit channels that are potentially important for a small open economy, including exchange-rate dynamics, external monetary conditions, commodity-price shocks, and broader financial variables. If such omitted channels materially affect inflation expectations, output-gap dynamics, or interest-rate transmission, then the estimated rule may understate the complexity of the actual policy environment. Fourthly, the expectations entering the rule are model-consistent forecasts from the BSVAR rather than expectations derived from a fully structural model. The framework should therefore be understood as semi-structural and normative, not as a complete structural characterization of policy design. Finally, the bounded parameter space used in the optimisation ensures economically plausible solutions, but it may also compress the estimated variation in reaction coefficients if the unconstrained optimum lies outside the admissible region.

These limitations point directly to several avenues for future research. A first priority is robustness analysis with respect to the measurement of the neutral rate and the construction of inflation and activity gaps. A second extension would be to embed the rule in a richer small-open-economy environment with external and financial variables, which may be especially important for interpreting post-2022 transmission patterns. A third direction is to allow for more explicit forms of instability, including stochastic volatility or regime-switching dynamics, so that shifts in shock variance and policy environment are modelled directly rather than absorbed indirectly by changing coefficients. A fourth extension would be to integrate policy inertia more explicitly, in line with evidence on incomplete and heterogeneous pass-through from policy rates to retail rates (Munir et al., 2022). Finally, incorporating fiscal-monetary interactions more fully would help assess whether part of the estimated time variation in the neutral benchmark or in the implied optimal rule reflects broader fiscal transmission mechanisms rather than purely monetary considerations (Caramp & Silva, 2023).

In general, the evidence presented in this paper suggests that the assessment of monetary-policy stance in Poland is materially altered once the benchmark rule is made forward-looking, explicitly anchored to a time-varying neutral rate, and allowed to adjust its response coefficients over time. The analysis therefore supports a broader methodological conclusion: in an environment characterised by structural change, large shocks, and uncertain transmission, policy evaluation based on fixed-coefficient rules is likely to be too rigid to serve as a reliable benchmark. A time-varying, neutral-rate-consistent framework offers a more credible basis for interpreting the stance of monetary policy and for identifying when the policy instrument departs from equilibrium-consistent transmission conditions.

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Od r* do optymalnej polityki stopy procentowej: identyfikacja zmiennej w czasie, antycypacyjnej reguły Taylora dla Narodowego Banku Polskiego

Streszczenie

Cel: Artykuł identyfikuje antycypacyjną regułę Taylora dla Polski ze współczynnikami zmieniającymi się w czasie oraz wyznacza implikowaną ścieżkę optymalnej stopy polityki pieniężnej NBP w latach 2010-2024. Pokazuje, jak modelowo wyznaczone oczekiwania, zmienna w czasie neutralna stopa procentowa i rekalibracja parametrów zmieniają ocenę nastawienia polityki względem benchmarku o stałych parametrach.

Metodyka: Na danych kwartalnych oszacowano nowokeynesowski bayesowski model SVAR, a z prognoz warunkowych uzyskano oczekiwaną inflację i oczekiwaną lukę produktową. Ścieżkę stopy optymalnej oraz współczynniki reguły odzyskano za pomocą ograniczonej optymalizacji numerycznej przy dolnej granicy stóp, minimalizując lukę równowagowej polityki pieniężnej (EMPG), zdefiniowaną jako kwadrat odchylenia stopy polityki od neutralnej stopy procentowej.

Wyniki: Antycypacyjna reguła ze zmiennymi w czasie parametrami dała niższą EMPG niż klasyczna reguła Taylora i ujawniła wyraźną rozbieżność po 2022 r. między tradycyjną luką stopy procentowej a luką polityki pieniężnej.

Implikacje i rekomendacje: Stałoparametrowe reguły mogą zniekształcać ocenę nastawienia polityki, gdy neutralna stopa i współczynniki reakcji zmieniają się w czasie. Dalsze badania powinny testować odporność wyników na alternatywne miary r*.

Oryginalność/wartość: Artykuł łączy antycypacyjną regułę Taylora, parametry zmienne w czasie oraz benchmark neutralnej stopy procentowej w nowokeynesowskim modelu BSVAR dla Polski.

Słowa kluczowe: antycypacyjna reguła Taylora, parametry zmienne w czasie, neutralna stopa procentowa (r*), bayesowski SVAR, luka polityki pieniężnej