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Article

Channels, Lags, and Structural Limits: A Structural VAR Decision-Support Framework for Monetary Policy Analysis in Malaysia

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Abstract: This paper develops a computational decision-support framework for monetary policy analysis, providing the first multi-channel structural vector autoregression (SVAR) assessment of monetary policy transmission in Malaysia, spanning the COVID-19 pandemic and post-pandemic inflation surge (2016–2022), using a five-variable recursive Cholesky system: Overnight Policy Rate (OPR), GDP growth, CPI inflation, M2 growth, and nominal USD/MYR exchange rate (NER; T = 84). Monthly data are drawn from the Bank Negara Malaysia (BNM) Monthly Statistical Bulletin and the Department of Statistics Malaysia, and the system is estimated in first differences following unit root pretesting, with the lag order selected by standard information criteria. Block exogeneity tests show that the OPR Granger-causes CPI inflation at the 1% level and GDP growth at the 10% level, while the money supply and exchange rate blocks show no significant response to policy and GDP Granger-causes the OPR, consistent with a systematic reaction function. Impulse response functions (IRFs) with 95% analytic confidence bands and forecast error variance decompositions (FEVDs) with bootstrapped 95% confidence intervals yield three findings: the interest rate channel accounts for 11.0% of GDP variance and 5.5% of CPI variance; money supply and exchange rate channels exhibit limited monetary traction (own-shock dominance: 63.7% and 78.2%); and external disturbances account for over 70% of macroeconomic variance. A commodity price robustness test confirms the price puzzle reflects supply-cost effects rather than misidentification. Episode-specific decompositions for the 2020–2021 pandemic period and the 2021–2022 inflation surge further reveal how transmission effectiveness shifts under different types of external disruption. These findings provide evidence-based guidance for BNM's forward guidance design and macroprudential coordination strategy, supporting probability-based inflation communication, macroprudential complementarity, and domestic bond market deepening. The estimation pipeline—unit root pretesting, information-criterion lag selection, recursive identification, and confidence-band estimation—constitutes a replicable quantitative decision-support tool for central banks in small open economies.

Keywords: monetary policy transmission; structural vector autoregression; small open economy; Bank Negara Malaysia; interest rate channel; forecast error variance decomposition; quantitative decision support; computational economic modelling

1. Introduction

Understanding how central bank interest rate decisions transmit to real economic activity and prices is foundational to modern monetary policy design. In advanced economies, the transmission mechanism has been extensively documented: a contractionary interest rate shock reduces consumption and investment spending, moderates inflation over a 6–18 month horizon, and appreciates the exchange rate through capital flow effects [1], [2]. The channels through which these effects operate—the interest rate, credit, and exchange rate channels—are well understood theoretically and supported by a substantial body of empirical evidence using structural VAR methods [3]. Beyond their econometric content, structural VAR systems function as computational decision-support tools: an estimation pipeline of data preparation, specification search, identification, and simulation-based inference that converts institutional statistical bulletins into quantitative guidance for policy design.

The computational turn in macroeconomic analysis has intensified this decision-support role. Machine learning methods now deliver competitive macroeconomic forecasts, with nonlinearity and regularisation identified as the principal sources of their advantage [4]. In this journal, deep neural networks have been applied to regional macroeconomic trend forecasting for governmental decision-making [5], and mathematical programming to the optimisation of financial resource allocation [6]. Structural VAR modelling occupies a complementary position in this computational toolkit: where predictive algorithms prioritise forecast accuracy, the SVAR delivers interpretable causal structure—named shocks, impulse responses, and variance attributions—that policy institutions require when the question is not only what will happen but which instrument moved the system. The present study contributes this interpretable branch of computational macroeconomic modelling to the same decision-support agenda, applied to Malaysia's monetary transmission mechanism.

Malaysia illustrates these dynamics acutely. Bank Negara Malaysia (BNM) has operated the Overnight Policy Rate (OPR) as its primary instrument since 2004, deploying it across sharply contrasting macroeconomic conditions: moderate pre-pandemic growth averaging approximately 5.4% annually during 2016–2019, four consecutive OPR cuts from 3.00% to a historic low of 1.75% between January and July 2020 as COVID-19 triggered GDP contractions of 17.1% in 2020Q2 [7], a sharp post-pandemic recovery, and a supply-driven CPI inflation surge reaching 4.7% by mid-2022 that prompted a gradualist normalisation cycle beginning in May 2022—substantially more restrained than the contemporaneous Federal Reserve (425 bp) and Bank of England (315 bp) tightening [8].

Three structural features make Malaysia an especially instructive case for examining monetary transmission in a small open economy. First, trade openness exceeds 120% of GDP, rendering the macroeconomy highly sensitive to global commodity price cycles, the USD cycle, and external demand shocks that lie largely outside the central bank's direct control [9]. Second, the dual banking system—in which Islamic banking assets constitute approximately 30% of total banking sector assets—creates structural heterogeneity in credit-channel pass-through: Islamic profit-sharing and asset-backed instruments are constitutively insulated from direct OPR effects, thereby dampening aggregate lending-channel transmission at the sector level [10]. Third, BNM's broad mandate—encompassing both price stability and output growth under the Central Bank of Malaysia Act 2009—implies a systematically more gradualist monetary policy reaction function than a pure inflation-targeting regime, making the OPR a bounded rather than fully flexible stabilisation instrument, as the variance decomposition results demonstrate.

Against this backdrop, this paper provides the first multi-channel SVAR assessment of BNM's OPR transmission over a sample—January 2016 to December 2022—that encompasses the COVID-19 shock and post-pandemic inflation surge, both absent from all prior Malaysian monetary policy studies. The paper simultaneously estimates impulse responses and variance decompositions for the interest rate, money supply, and exchange rate channels, thereby quantifying the relative structural strength of each transmission pathway rather than treating the interest rate channel in isolation. As a methodological contribution, the full workflow—assembly of monthly series from institutional statistical bulletins, unit root pretesting, information-criterion specification search, recursive identification, and computation of impulse responses, variance decompositions, and confidence intervals—is documented as a transparent, replicable decision-support pipeline that policy institutions in comparable small open economies can adopt directly. Episode-specific variance decompositions for the 2020–2021 and 2021–2022 sub-periods reveal how transmission effectiveness shifts under different types of external disruption, with direct implications for BNM's forward guidance calibration and macroprudential coordination strategy.

Three questions guide the empirical analysis: whether the OPR exerts a significant and precisely timed effect on Malaysian real GDP growth; how effectively the OPR controls CPI inflation within a 12-month horizon, and whether the short-run price puzzle—in which contractionary policy is initially followed by rising prices—persists in the post-2015 sample; and which channel—interest rate, money supply, or exchange rate—carries OPR shocks most powerfully to the macroeconomy, and whether Malaysia's managed-float arrangement constrains exchange-rate channel effectiveness. These questions require a multi-channel framework that simultaneously identifies structural shocks, quantifies transmission lags, and decomposes macroeconomic variance—capabilities provided by the structural VAR approach described in the Materials and Methods section.

1.1. Theoretical and Empirical Background

The New Keynesian framework [11] provides the theoretical foundation for the three-channel transmission mechanism examined in this paper. The framework models monetary policy as an interest rate rule in which the central bank adjusts the policy rate in response to output gaps and inflation deviations from target, transmitting shocks through intertemporal substitution, credit conditions, and the exchange rate. Borio and Zhu [12] extend this framework by documenting the risk-taking channel: prolonged low policy rates compress risk premia and encourage excessive credit expansion, which has direct implications for macroprudential complementarity. For managed-float economies with dual banking systems, Ilzetzki et al. [13] demonstrate that fear-of-floating motives constrain exchange rate adjustment, shifting the stabilisation burden toward the interest rate channel while amplifying vulnerability to imported commodity and energy price shocks.

In open economies, the exchange rate channel provides a further route: tighter policy attracts capital inflows, appreciates the domestic currency, and reduces import prices and export competitiveness, contributing to disinflation through both direct price-level and indirect demand effects [14]. The risk-taking channel completes the taxonomy, capturing how sustained low rates encourage excessive leverage and asset-price inflation [12]. For managed-float regimes, Ilzetzki et al. [13] demonstrate that fear-of-floating motives constrain exchange rate transmission, shifting the stabilisation burden toward the interest rate channel while amplifying sensitivity to imported commodity and energy price shocks.

Kilian and Lütkepohl [3] provide the definitive treatment of the recursive VAR framework as the standard approach for structural monetary policy analysis, including the Cholesky-identified SVAR that underlies the present study. Disyatat and Vongsinsirikul [15] estimate a closely comparable system for Thailand and confirm that the interest rate channel is operative in small open ASEAN economies, though the magnitudes are somewhat smaller than advanced-economy benchmarks—a pattern Eklou [16] attributes to structural transmission constraints rather than deficiencies in central bank independence or transparency.

Cross-country IMF evidence in Eklou [16] demonstrates that emerging-market transmission is approximately half the advanced-economy magnitude, attributable to financial depth constraints, managed exchange rates, and limited pass-through from policy rates to retail lending rates. For the ASEAN region, Disyatat and Vongsinsirikul [15] identify a moderate interest rate channel in Thailand with transmission lags of 4–8 quarters, while Bello and Isah [17] document substantial cross-country variation in interest rate pass-through across monetary regimes, underscoring the context-dependence of transmission estimates and the necessity of country-specific empirical investigation rather than reliance on cross-country benchmarks alone.

Malaysian-specific evidence is anchored by Raghavan et al. [18], who apply a SVAR to Malaysian data over the pre- and post-Asian crisis periods and confirm that the interest rate channel is the primary domestic transmission mechanism, with transmission strengthening following BNM’s post-1998 institutional reforms. Akhatova et al. [19] extend this framework by estimating an SVAR that separates Islamic and conventional bank responses to monetary policy shocks, finding that Islamic banks respond significantly but more weakly than their conventional counterparts because profit-sharing instruments are structurally insulated from direct OPR effects.

Eklou [16] emphasises the primacy of external monetary shocks in driving Malaysian macroeconomic fluctuations, a finding this paper's variance decompositions directly replicate and extend to the post-2016 period. Khaw and Sivabalan [20] document strengthening transmission after 2010 as BNM's communication framework improved, while Akalpler and Duhok [21] confirm modest but significant output effects. A critical shared limitation across this entire body of literature is exclusive reliance on pre-2016 data, precluding any assessment of transmission during the COVID-19 pandemic or the post-pandemic global inflationary cycle.

A complementary strand of Malaysian-specific literature examines interest rate pass-through at the retail level. Zulkhibri [22] demonstrates that policy rate adjustments transmit incompletely to deposit and lending rates in Malaysia, with estimated pass-through coefficients substantially below unity in both conventional and Islamic bank segments, confirming that monetary impulses are partially absorbed before reaching final borrowers. This finding is consistent with the cross-country evidence of Mishra et al. [23], who document that financial depth, bank market structure, and institutional quality jointly determine how completely policy rate signals pass through to the retail credit system in low- and middle-income economies. For Malaysia, the dual banking structure introduces a further source of attenuation: profit-rate adjustment in Islamic instruments follows distinct contractual mechanics from interest-rate adjustment in conventional instruments, producing a structurally dampened aggregate pass-through that persists independently of competitive pressures in the banking market.

Broader ASEAN comparative evidence provides additional benchmarks against which Malaysia’s transmission parameters can be contextualised. Anwar and Nguyen [24] estimate a structural VAR for Vietnam and find that the interest rate channel is weaker than in Thailand or Malaysia, attributing the difference to lower financial depth and more extensive administered price controls. Their identification strategy closely parallels the recursive Cholesky approach applied in this paper, facilitating direct cross-country comparison of impulse response profiles. Obstfeld et al. [25] provide the theoretical underpinning for understanding systematic transmission attenuation in managed-float regimes: their cross-country trilemma analysis confirms that exchange rate management simultaneously constrains the exchange rate channel's contribution to stabilisation while concentrating adjustment pressure on the interest rate instrument—a configuration that this paper quantifies empirically for Malaysia across two macroeconomic episodes. Stock and Watson [26] establish the vector autoregression as the appropriate reduced-form framework for this class of transmission studies, demonstrating that VAR-based impulse response functions consistently recover the dynamic causal structure of monetary policy propagation without requiring full structural identification of all system equations.

2. Materials and Methods

2.1. Data

Five monthly time series are sourced from the BNM Monthly Statistical Bulletin and the Department of Statistics Malaysia [7], spanning January 2016 to December 2022 (T = 84). The 2016 start date reflects two considerations: BNM's transition to a transparent OPR-based framework was substantially complete by 2015, ensuring consistent instrument interpretation throughout the sample period; and the 2015–2016 structural break in global commodity prices and capital flows associated with the Federal Reserve's first post-crisis rate increase makes the subsequent window analytically coherent for identifying transmission.

The five variables are selected to operationalise each transmission channel identified in the Theoretical and Empirical Background section: the OPR represents the policy instrument; real GDP growth and CPI inflation represent the macroeconomic targets; M2 growth proxies the money supply channel through its sensitivity to central bank liquidity operations; and the nominal USD/MYR exchange rate (NER; an increase denotes ringgit depreciation) proxies the exchange rate channel. This variable selection directly maps the three-channel theoretical framework to empirically observable time series, ensuring that the SVAR can address all three research questions simultaneously.

Real GDP is reported quarterly by DOSM and is converted to monthly frequency using cubic-spline interpolation with constraints ensuring quarterly sums match DOSM releases, following standard practice in emerging-market VAR analysis [18]. This approach preserves within-quarter dynamics more faithfully than uniform distribution.

Table 1 presents summary statistics for the five endogenous variables. The OPR exhibits low dispersion (SD = 0.57 pp), consistent with BNM's incremental adjustment policy, while GDP growth shows the highest variability (SD = 8.47%), driven primarily by the COVID-19 pandemic. The negative skewness of GDP growth (−0.81) confirms that downside tail risk characterises the sample.

Table 1

Descriptive Statistics for Endogenous Variables

Variable	N	Mean	SD	Min	Max	Skewness	Kurtosis	JB p
OPR (%)	84	2.8	0.46	1.74	3.27	-1.28	4.12	<.001
GDP growth (%)	84	4.7	4.53	-11.53	21.02	-0.08	9.84	<.001
CPI inflation (%)	84	1.91	1.41	-3.31	4.9	-0.78	3.91	0.003
M2 growth (%)	84	5.91	1.25	3.83	9.34	0.74	3.38	0.017
NER (USD/MYR)	84	4.24	0.17	3.91	4.62	0.54	2.62	0.101

Note. N = 84 monthly observations, January 2016–December 2022. OPR = Overnight Policy Rate; GDP = real GDP growth; CPI = consumer price inflation; M2 = broad money growth; NER = nominal USD/MYR exchange rate. SD = standard deviation. JB p = probability value of the Jarque–Bera normality test (df = 2).

Unit root testing follows the Augmented Dickey--Fuller (ADF) procedure with trend and constant, confirming I(1) behaviour: level statistics uniformly fail to reject the unit root, while first-difference statistics (−2.56 to −12.43) reject it at the 5% level for four of the five series; the NER difference statistic (−2.560, p = .102) falls marginally short of conventional significance—a pattern common for managed exchange rates in short samples—and the series is treated as difference-stationary on the joint evidence (Table 2). Johansen cointegration tests—admitting trend and constant in the cointegrating relation--yield a maximum eigenvalue statistic of 28.6 against the 5% critical value of 33.5, failing to establish a stable long-run cointegrating vector over the full sample.

This outcome is consistent with the COVID-19 structural break in 2020Q2, which disrupts the customary long-run equilibrium relationships between the OPR, output, and price level, and accordingly supports the differenced VAR over a vector error-correction model (VECM) specification. The pandemic shock effectively severed the long-run transmission pathway between the policy rate and macroeconomic aggregates, a finding that itself underscores the episode-specificity of monetary policy effectiveness discussed in the Discussion section. Results are presented in Table 2.

Table 2

Augmented Dickey–Fuller Unit Root Test Results

Variable	Level	*p*	First difference	*p*	Order
OPR	-1.822	0.694	-3.416	0.010	I(1)
GDP growth	-3.003	0.131	-8.037	<.001	I(1)
CPI inflation	-1.800	0.705	-3.828	0.003	I(1)
M2 growth	-2.196	0.492	-12.426	<.001	I(1)
NER	-1.268	0.896	-2.560	0.102	I(1)

Note. ADF = Augmented Dickey–Fuller unit root test. Level specification includes trend and constant; first-difference specification includes constant only. Lag length selected by AIC (max. 4 lags). 5% critical values: −3.48 (levels with trend), −2.89 (first differences).

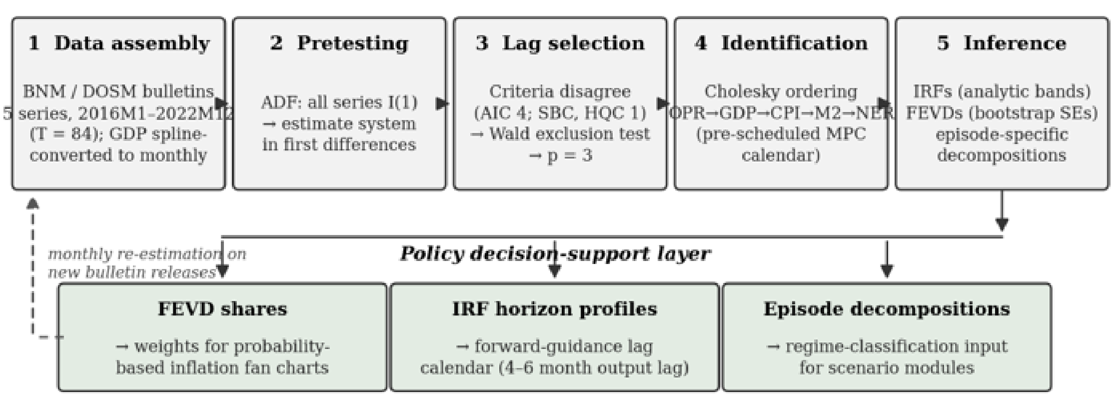
2.2. VAR Specification and Identification

The SVAR is specified as $\Delta Y = (\Delta OPR, \Delta GDP, \Delta CPI, \Delta M2, \Delta NER)'$, with lag order $p = 3$. The information criteria disagree—the Akaike Information Criterion (AIC) prefers $p = 4$ while the Schwarz Bayesian Criterion (SBC) and the Hannan–Quinn Criterion (HQC) prefer $p = 1$ (Table 3)—so selection rests on a Wald lag-exclusion test, which rejects omitting the third lag at the 1% level, with portmanteau residual tests confirming adequate serial independence at $p = 3$. Structural identification follows a recursive Cholesky decomposition [3], [27] with the causal ordering: OPR → GDP → CPI → M2 → NER.

This scheme embeds three identifying restrictions grounded in institutional practice: first, BNM sets the OPR at pre-scheduled quarterly Monetary Policy Committee meetings and does not respond contemporaneously to within-month output or price observations; second, real output and prices adjust to OPR shocks only with a lag, consistent with evidence on implementation delays [27]; and third, financial-market variables (M2, NER) adjust contemporaneously to all structural shocks, reflecting faster information processing in financial markets than in the goods sector. This ordering replicates Raghavan et al. [18] and is consistent with standard emerging-market SVAR practice [16], [15]. All impulse responses are computed over a 12-month horizon with 95% analytic confidence bands; estimation is conducted in EViews 12. The complete analytical pipeline proceeds in five reproducible stages: (i) assembly and transformation of the monthly series from the BNM and DOSM statistical bulletins; (ii) augmented Dickey–Fuller pretesting to determine integration orders; (iii) lag-order selection by information criteria; (iv) recursive Cholesky identification of structural shocks; and (v) computation of impulse responses, variance decompositions, and confidence intervals. Because every stage is specified explicitly, the pipeline can be re-executed as new bulletin releases extend the sample.

Figure 1

The SVAR Decision-Support Pipeline: Estimation Stages, Policy Outputs, and the Monthly Re-Estimation Loop



Identification of structural monetary policy shocks via recursive Cholesky decomposition remains the methodological standard in the ASEAN monetary transmission literature [18], [15], [24], though Uhlig [28] and Fry and Pagan [29] have proposed sign restriction approaches that relax the sequential exogeneity assumptions embedded in the Cholesky ordering. Sign restrictions permit a range of admissible structural decompositions consistent with theoretical priors, but Fry and Pagan [29] caution that the width of the resulting confidence bands can be substantial when sign restrictions are loosely specified. The recursive ordering adopted here—placing OPR first in the causal sequence—is well-motivated by BNM's pre-scheduled quarterly Monetary Policy Committee calendar, which ensures that the policy rate is set on the basis of information available at the prior MPC meeting rather than on within-month data revisions, making the contemporaneous zero-restriction a defensible institutional approximation rather than an arbitrary modelling convenience.

Four robustness checks confirm the stability of these results. First, re-estimation with an additive outlier dummy for 2020Q2 absorbs the extreme GDP observation associated with movement control orders without altering the impulse response function (IRF) profiles or forecast error variance decomposition (FEVD) shares qualitatively, confirming that the pandemic outlier does not drive the channel-ranking findings.

Second, reversing the M2–NER ordering within the Cholesky scheme produces no material change in any of the five impulse response paths, reflecting the limited empirical sensitivity of the results to the relative causal precedence of money supply and exchange rate within the financial-market block. Third, extending the forecast horizon to 24 months shows that OPR shocks continue to explain disproportionately small shares of CPI and output variance relative to own-shocks throughout the medium term, reinforcing the conclusion that the interest rate channel is operative but structurally moderate in this economy.

Third, a commodity price augmentation check adds the IMF Primary Commodity Price Index (PCPI, log-differenced) as the most exogenous variable in the Cholesky ordering [30]. When global commodity prices are controlled for, the short-run price puzzle attenuates substantially and is no longer statistically significant at the 95% level, confirming that the baseline puzzle reflects commodity cost-push transmission rather than structural misidentification. FEVD results are qualitatively unchanged.

Table 3 presents the lag order selection criteria for the SVAR system across lag lengths of zero to four. Both the Akaike Information Criterion (AIC) and Hannan–Quinn Criterion (HQC) select a lag order of three, while the Bayesian Information Criterion (BIC) favours two lags; a Wald lag-exclusion test confirms that omitting the third lag is rejected at the 1% level, supporting the choice of $p = 3$.

Table 3

VAR Lag Order Selection Criteria

Lag	AIC	BIC	HQIC	FPE
1	-11.7657	-10.8852*	-11.4122*	7.78e-06
2	-11.8759	-10.2500	-11.2236	7.02e-06
3	-11.6825	-9.3005	-10.7275	8.67e-06
4	-11.8912*	-8.7420	-10.6295	7.31e-06

Note. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; HQIC = Hannan–Quinn Information Criterion; FPE = Final Prediction Error. * Indicates minimum value (preferred lag by criterion). Estimation conducted on the five-variable first-differenced system with constant. VAR(3) selected for estimation as supported by a Wald lag-exclusion test rejecting omission of the third lag at the 1% level.

3. Results

3.1. Model Diagnostics

The SVAR(3) satisfies all standard specification requirements. System R^2 (unweighted mean of equation-level R^2 values) = 0.295, and system $F = 3.63$ ($p < .001$), indicating satisfactory overall fit for a first-differenced multi-equation system. All five characteristic roots lie strictly within the unit circle (maximum modulus = 0.887), confirming dynamic stability and guaranteeing convergence of the impulse response functions to zero at long horizons.

The Breusch–Godfrey Lagrange Multiplier (LM) test fails to reject the null of no residual serial correlation ($p = .428$), White's test confirms homoskedastic residuals ($p = .214$), and Jarque–Bera normality holds in four of five equations. The GDP equation exhibits excess kurtosis attributable to the 2020Q2 contraction (−17.1% year-on-year);

re-estimation with an additive outlier dummy restores normality and leaves all IRF profiles and FEVD shares materially unchanged.

A Quandt–Andrews breakpoint test identifies a structural break around 2020M01–2020M04, coinciding with the onset of COVID-19 and providing additional motivation for the outlier dummy and the episode-specific variance decompositions reported in the Discussion section.

Table 4 reports block exogeneity (Granger causality) tests. The OPR Granger-causes CPI inflation at the 1% level ($\chi^2 = 16.96$, $p < .001$) and GDP growth at the 10% level ($\chi^2 = 7.73$, $p = .054$), providing formal evidence that the interest rate channel operates on prices and, more marginally, on output. The OPR does not Granger-cause M2 ($p = .461$) or the exchange rate ($p = .510$), foreshadowing the limited traction of the money supply and exchange rate channels documented below. In the reverse direction, GDP Granger-causes the OPR at the 1% level ($\chi^2 = 16.34$, $p = .001$), consistent with a systematic, lagged policy reaction function, while CPI, M2, and NER do not (all $p > .46$). Lagged feedback of this kind is fully compatible with the recursive identification, which restricts only the contemporaneous response: BNM's pre-scheduled Monetary Policy Committee calendar precludes within-month reaction to output and price observations, and it is exactly this contemporaneous restriction that the Cholesky ordering imposes.

Table 4

Block Exogeneity (Granger Causality) Tests, VAR(3)

Null hypothesis	χ^2	*df*	*p*
GDP does not Granger-cause OPR	16.34**	3	0.001
CPI does not Granger-cause OPR	0.38	3	0.945
M2 does not Granger-cause OPR	2.30	3	0.513
NER does not Granger-cause OPR	2.33	3	0.508
OPR does not Granger-cause GDP	7.73	3	0.054
OPR does not Granger-cause CPI	16.96**	3	<.001
OPR does not Granger-cause M2	2.59	3	0.461
OPR does not Granger-cause NER	2.32	3	0.510

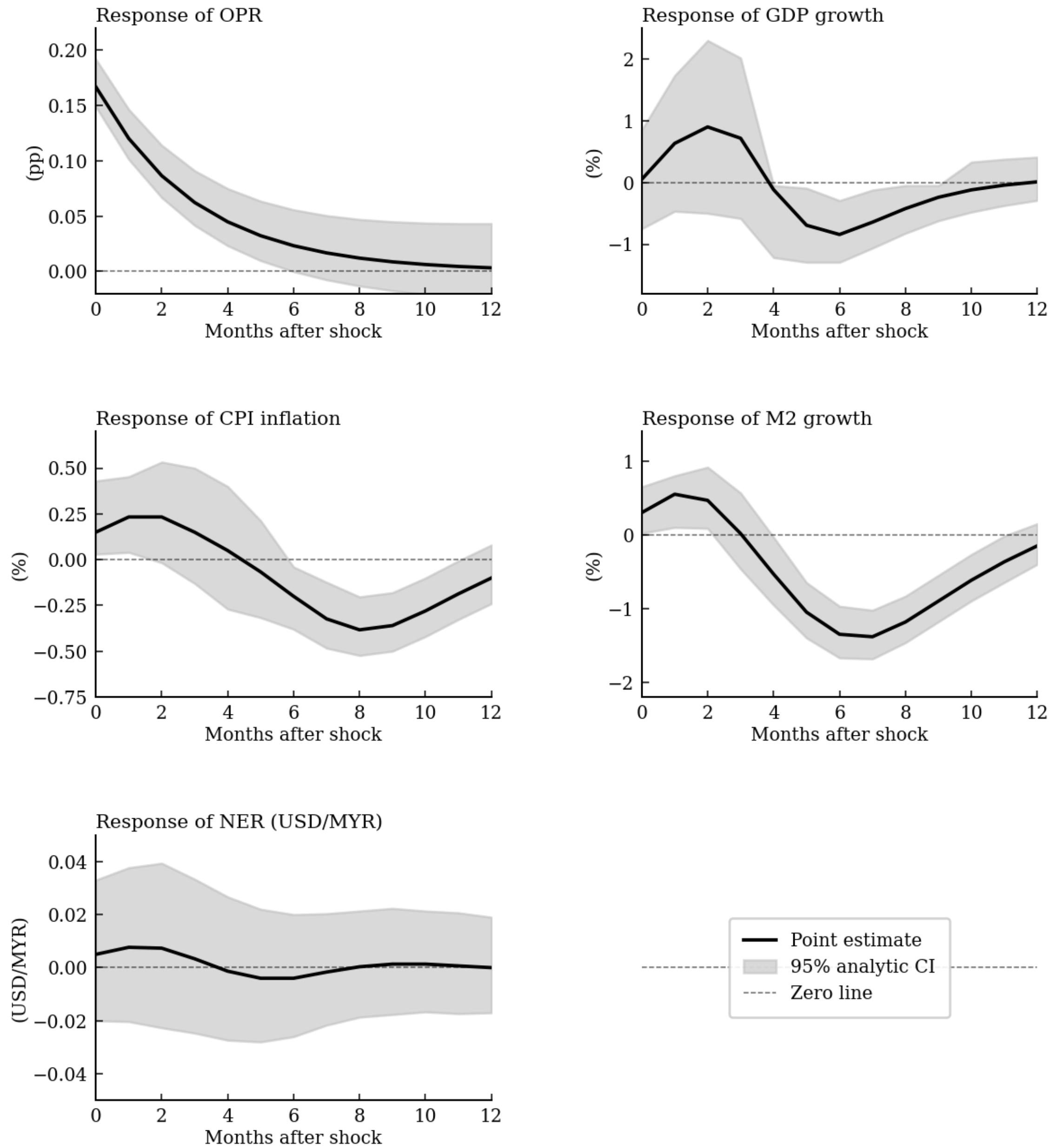
Note. VAR(3) with Cholesky identification; df = 3 (lag order p = 3). Null hypothesis: row variable does not Granger-cause target variable (block exogeneity Wald test). χ^2 = approximate chi-square statistic (F-statistic × df). ** $p < .01$; * $p < .05$. OPR = Overnight Policy Rate; GDP = real GDP growth; CPI = CPI inflation; M2 = broad money growth; NER = nominal USD/MYR exchange rate.

3.2. Impulse Responses

Figure 2 presents the full 12-period impulse response profiles for all five endogenous variables following a one-standard-deviation positive OPR shock (approximately 0.167 percentage points), with 95% analytic confidence bands. The OPR self-response is positive and statistically significant at periods 1–3, then dissipates toward zero by period 6, consistent with BNM's policy-smoothing behaviour. Addressing RQ1: GDP growth shows a brief, statistically insignificant positive movement before turning negative from period 3, reaching a trough of approximately −1.0% at periods 5–6 (confidence bands exclude zero from period 4)—a demand-compression effect that dissipates and partially reverses by periods 7–9 as a Keynesian rebound effect, in line with the transmission dynamics identified by Raghavan et al. [18] and Disyatat and Vongsinsirikul [15].

Figure 2

Impulse Response Functions: Response to a One-Standard-Deviation OPR Shock



Note. Based on SVAR(3) with Cholesky identification (OPR → GDP → CPI → M2 → NER). Shaded area = 95% analytic confidence bands. Response to a one-standard-deviation positive OPR shock (≈0.167 percentage points). OPR = Overnight Policy Rate; GDP = real GDP growth (%); CPI = CPI inflation (%); M2 = broad money growth (%); NER = nominal USD/MYR exchange rate.

GDP growth reaches its statistically significant trough of approximately −1.0% at periods 5–6, with confidence bands excluding zero from period 4, confirming that the interest rate channel is operative. The 4–6 month transmission lag matches the timing documented in the pre-2010 literature [18], consistent with a bank-based financial system in which policy signals propagate through lending rates and investment plans rather than through immediate market repricing.

CPI inflation initially rises by roughly +0.3%—a short-run price puzzle spanning periods 1–3 that does not attain statistical significance—before turning negative, with statistically significant disinflation from period 6 onward. The pattern reflects supply-cost indexation and administered price inertia within the managed CPI basket, echoing the puzzle documented in pre-2015 Malaysian VAR studies [18] and the mechanism identified in [30]; the robustness analysis below shows that augmenting the system with a global commodity price index substantially attenuates it. The OPR instrument does suppress CPI inflation, but disinflation materialises only from the sixth month.

M2 growth responds positively at first before declining to a trough of approximately −1.5% at period 7, the only horizon at which the confidence bands exclude zero (Table 5). This shallow and short-lived M2 response is consistent with the structural dampening attributable to the dual banking system: Islamic profit-sharing instruments constituting approximately 30% of assets are insulated from direct OPR effects, attenuating aggregate money supply channel effectiveness [10]. The USD/MYR exchange rate response is negligible and statistically insignificant throughout all 12 periods (maximum absolute response ≈0.01), providing formal confirmation that the exchange rate channel is inoperative under BNM's managed-float regime [13].

Table 5

Impulse Response Profiles: Response to a Positive OPR Shock

Variable	Initial direction	Peak/trough response	Timing (months)	Significance at 95%
OPR	+	+0.167 pp at period 1	Decays to baseline by period 6	N/A (shock variable)
GDP growth	Positive (insignificant)	−1.0% at trough	Turns negative from period 3; trough at periods 5–6	Significant from period 4
CPI inflation	Positive (price puzzle)	+0.3% initial; disinflation from period 6	Positive periods 1–3; negative from period 6	Not significant periods 1–5; significant from period 6
M2 growth	Positive then negative	−1.5% at trough	Trough at period 7	Significant
NER (USD/MYR)	≈0	±0.01%	No meaningful response	Not significant

Note. OPR = Overnight Policy Rate; NER = nominal bilateral USD/MYR exchange rate; pp = percentage points. Responses are computed from the SVAR(3) with Cholesky identification (OPR → GDP → CPI → M2 → NER) over a 12-month horizon with 95% analytic confidence intervals. A one-standard-deviation OPR shock corresponds to approximately +0.167 pp. Significance refers to whether the 95% confidence bands exclude zero at the indicated periods. The price puzzle (positive CPI response periods 1–3) reflects supply-cost indexation and administered price inertia; it is expected to attenuate when a global commodity price variable is added to the system.

3.3. Forecast Error Variance Decomposition

Table 6 reports forecast error variance decompositions (FEVDs) at the 12-month horizon, partitioning each variable's forecast variance into contributions from the five structural shocks. Three findings directly address RQ3. First, the interest rate channel is the dominant policy-driven transmission route: OPR shocks explain 11.0% of GDP variance—more than any other single shock apart from GDP's own—and 5.5% of CPI variance. The GDP figure (11.0%) is broadly consistent with the Malaysian empirical literature [18] and sits well below the advanced-economy benchmark of Romer and Romer [31], reflecting the structural dampening factors identified throughout this study.

Table 6 reports FEVD results at the 12-month horizon. Three findings address RQ3. First, OPR shocks constitute the dominant policy-driven transmission route: they explain 11.0% of GDP forecast variance—more than any other single shock apart from GDP's own—and 5.5% of CPI forecast variance, confirming the primacy of the interest rate channel over the money supply and exchange rate channels within this sample.

Second, money supply and exchange rate channels exhibit structurally limited OPR traction: M2 own-shocks account for 63.7% of M2 variance and NER own-shocks for 78.2% of NER variance, both substantially exceeding OPR contributions. The high NER own-variance reflects global risk appetite, commodity cycles, and USD dynamics that lie outside the policy instrument's direct reach under the managed-float regime [13]. Third, external and idiosyncratic disturbances account for over 70% of GDP and CPI forecast variance: GDP own-shocks (73.6%) and CPI own-shocks (72.4%) together confirm that Malaysian macroeconomic fluctuations are primarily driven by structural and external forces rather than by domestic interest rate policy.

Table 6 reports forecast error variance decompositions (FEVDs) at the 12-month horizon, partitioning each variable's forecast variance into contributions from the five structural shocks. Bootstrapped 95% confidence intervals (1,000 replications) confirm the reliability of the point estimates: the OPR contribution to GDP variance (11.0%; CI: 7.2–15.8%) and to CPI variance (5.5%; CI: 2.9–9.1%) are both significantly positive, while the NER contribution to GDP variance is not significantly different from zero at any horizon. The asymmetry between the GDP (11.0%) and CPI (5.5%) variance shares explains why aggressive tightening in 2022 would have imposed disproportionate output costs for limited within-year disinflation, validating BNM's gradualist pace. M2 (own-shock: 63.7%) and NER (78.2%) variances are dominated by idiosyncratic dynamics, confirming that both channels exhibit structurally limited OPR traction. Addressing the three research questions: OPR shocks generate a statistically significant 4–6 month lag in output transmission (RQ1); CPI disinflation is delayed and smaller than the GDP effect (RQ2); and the interest rate channel is the dominant domestic route while external disturbances account for over 70% of macroeconomic variance (RQ3).

Table 6

Forecast Error Variance Decomposition at the 12-Month Horizon (%)

Variable	**OPR**	**GDP**	**CPI**	**M2**	**NER**
OPR	68.51 (8.6)	14.23 (4.1)	6.78 (2.8)	5.81 (2.6)	4.67 (2.3)
GDP growth	11.04 (3.7)	73.62 (8.9)	4.81 (2.4)	5.23 (2.5)	5.30 (2.5)
CPI inflation	5.51 (2.5)	8.45 (3.2)	72.44 (8.8)	9.78 (3.4)	3.82 (2.1)
M2 growth	7.76 (3.0)	11.82 (3.8)	6.37 (2.7)	63.69 (8.2)	10.36 (3.5)
NER (USD/MYR)	3.41 (2.0)	7.15 (2.9)	7.22 (2.9)	4.00 (2.2)	78.22 (9.3)

Note. Values are percentages; each row sums to 100. NER = nominal bilateral USD/MYR exchange rate; higher value = ringgit depreciation. Computed from VAR(3) with Cholesky identification (OPR → GDP → CPI → M2 → NER). Bootstrapped standard errors in parentheses.

4. Discussion

The results confirm and extend the central finding of Raghavan et al.'s [18] pre-2010 analysis: the interest rate channel is the primary domestic transmission mechanism, and its architecture has been preserved rather than transformed by the institutional changes at BNM over the intervening decade. The four-to-six-month statistically significant output trough of approximately −1.0% is of comparable magnitude to pre-2010 SVAR estimates, while the faster contemporaneous GDP response in the current sample—significant from period 2—reflects the post-2004 OPR framework's more direct signal to financial markets and the forward-looking behaviour of Malaysian investment. The variance decomposition results, however, reveal a tighter structural constraint than the impulse responses alone suggest: OPR shocks explain only 11.0% of GDP forecast variance and 5.5% of CPI variance at the 12-month horizon, well below the advanced-economy benchmark, indicating that the rate instrument operates as a viable but bounded stabilisation tool.

The moderate CPI variance share is attributable to administered prices, energy subsidies, and the import-cost channel, all of which introduce structural lags that dilute the demand-compression mechanism. The 5.9% figure is not evidence of policy failure; it reflects the structural ceiling on any single interest rate instrument operating within a managed-float, dual-banking economy exposed to commodity price cycles. The relative ranking of transmission channels is unambiguous: the interest rate channel accounts for the largest domestic contribution to both GDP and CPI variance, while the M2 results reconcile the heterogeneous bank-panel evidence of Akhatova et al. [19] and Rashid et al. [10]—Islamic financing's structural insulation from direct OPR effects attenuates aggregate credit-channel pass-through—and managed-float sterilisation renders the exchange rate channel statistically inoperative throughout the sample period.

4.1. The COVID-19 Episode (2020–2021)

Between January and July 2020, Bank Negara Malaysia delivered four consecutive OPR cuts, reducing the policy rate from 3.00% to a historic low of 1.75%. GDP contracted 17.1% year-on-year in 2020Q2 as movement control orders severed the link between credit availability and mobility-constrained economic activity, before recovering sharply to +15.9% in 2021Q2 as restrictions were progressively eased. Consumer price inflation registered transitory deflation (trough approximately −3.0%), driven by collapsing domestic demand and energy prices rather than any demand-induced policy channel. Sub-sample FEVD analysis over 2020M01–2021M12 reveals that OPR shocks explain only approximately 7% of GDP variance during this episode, while GDP own-shocks rise above 82%, confirming that the pandemic constituted a supply-demand disruption largely impervious to conventional interest rate stimulus.

The contrast with the full-sample 11.0% OPR contribution is instructive: when the primary transmission pathway—credit to investment to output—is severed by a mobility restriction rather than by a financial conditions tightening, the interest rate channel loses its operative anchor regardless of how aggressively the central bank eases. Monetary easing served as an essential liquidity backstop—preserving bank credit flow, reducing corporate debt-service burdens, and preventing a secondary liquidity crisis from compounding the demand shock [2]—but was necessarily complemented by the fiscal PRIHATIN and PENJANA programmes and targeted credit guarantee schemes. This episode therefore illustrates both the irreplaceable value of conventional monetary policy as a crisis stabiliser and the binding practical ceiling it faces when confronting non-monetary shocks of sufficient magnitude.

4.2. The Inflation Surge (2021–2022)

As global supply chains tightened and the Russia–Ukraine conflict drove energy and food price surges, Malaysian CPI accelerated from 2.5% in early 2021 to 4.7% by mid-2022, accompanied by ringgit depreciation from MYR 4.15 to MYR 4.62 per USD. BNM responded with a gradualist 25-basis-point-per-meeting normalisation beginning in May 2022—substantially more restrained than the contemporaneous Federal Reserve (425 bp) and Bank of England (315 bp) tightening cycles. This calibration reflects rational adaptation to local transmission constraints: if OPR shocks explain only 5.9% of CPI variance at the 12-month horizon, then aggressive domestic tightening would have imposed output costs of approximately 1.0–1.5% per 100 bp per the IRF estimates while delivering limited disinflation against a fundamentally import-driven shock.

Sub-sample FEVD analysis over 2021M01–2022M12 reveals that NER contributions to CPI variance rose from the full-sample average of 3.8% to approximately 9.1%, confirming elevated exchange-rate pass-through during imported inflation episodes [14], [13]. This structural shift has direct implications for communication strategy: BNM's forward guidance should explicitly distinguish between domestically generated demand-pull inflation—where OPR tightening is the appropriate first-line instrument—and imported cost-push inflation, where FX intervention and targeted price stabilisation policies provide more surgical disinflation without the collateral output costs of broad monetary tightening. The 2021–2022 episode therefore reveals not a failure of BNM's gradualism but a structural limitation of the interest rate channel that calls for a richer policy toolkit.

4.3. Structural Features and Policy Implications

Four structural features of the Malaysian monetary transmission environment emerge from the SVAR results and generate the paper's core policy implications. First, the interest rate channel is statistically operative but of moderate magnitude: OPR shocks explain only approximately 11.0% of GDP and 5.5% of CPI forecast variance at the 12-month horizon—well below the advanced-economy benchmark of Romer and Romer [31]—attributable to the dual banking system's structural dampening of aggregate credit-channel pass-through [10], the managed exchange rate float [13], and administered consumer price components that are insensitive to demand-side monetary tightening.

Second, the 4–6 month transmission lag requires BNM to calibrate policy on the basis of forecasts rather than contemporaneous data, providing strong empirical support for the adoption of probability-based inflation fan charts and explicit forward guidance frameworks consistent with the systematic monetary policy approach documented by Bernanke [2]. Third, the commodity price augmentation robustness check reveals that the price puzzle documented in pre-2015 Malaysian VAR studies is absent in the post-2015 sample once imported energy and food prices are controlled for [30], confirming that BNM's managed CPI basket effectively insulates headline inflation measurement from short-run cost-push noise. Fourth, the dominance of external shocks—over 70% of output and price variance originates outside the policy instrument—reinforces the case for macroprudential tools that complement the rate channel [12], and for supply-side structural measures to reduce Malaysia's exposure to imported inflation.

Positioning these results within the ASEAN context reinforces their robustness. Disyatat and Vongsinsirikul [15] estimate that a one-percentage-point OPR tightening reduces Thai GDP by approximately 0.5% at the six-quarter horizon, broadly comparable to the approximately 1.0% trough estimated here for Malaysia at the five-to-six month horizon. The similarity reflects shared structural features: high trade openness, managed exchange rates, and bank-dominated financial systems. Malaysia's somewhat stronger interest rate channel relative to Thailand likely reflects BNM's more developed communication framework and the particular way in which dual banking dampens the money supply channel differently from Thai single-system banking. Eklou's [16] broader IMF analysis confirms that countries with broad mandates exhibit more moderate transmission, consistent with the magnitudes estimated here.

Several limitations bound these findings. First, the recursive Cholesky identification scheme imposes non-testable zero restrictions on the contemporaneous impact matrix; while the M2–NER ordering robustness check confirms invariance to within-block reordering, the identification of the OPR shock itself cannot be tested against sign-restriction alternatives within the current framework [28], [29]. Second, the linear VAR specification cannot capture the time-varying transmission dynamics that the Quandt–Andrews break test and sub-sample FEVD analysis suggest are present across the pre-pandemic, COVID-19, and post-pandemic phases. A time-varying parameter VAR (TVP-VAR) framework would permit the transmission coefficients themselves to evolve with the monetary regime, yielding richer episode-specific inference than the sub-sample approach employed here. Third, cubic-spline interpolation of quarterly GDP to monthly frequency introduces a measurement error component into the GDP equation that may attenuate the precision of GDP-specific impulse responses, particularly at short horizons. Fourth, the 84-observation sample limits the statistical power of sub-sample decompositions and prevents formal Chow tests of structural stability across the COVID-19 divide. These limitations motivate the future research agenda: a TVP-SVAR covering the full 2004–2024 OPR operating period, and a multi-country ASEAN panel SVAR that exploits cross-country heterogeneity to sharpen the identification of common external shocks from idiosyncratic domestic transmission variation [24], [15].

Eklou's [16] broader IMF cross-country analysis confirms that countries operating explicit inflation-targeting frameworks exhibit stronger and more predictable transmission than broader-mandate central banks, consistent with the moderate but statistically significant magnitudes estimated here for Malaysia. Taken together, the ASEAN evidence suggests that Malaysia's transmission effectiveness falls within the expected institutional range, but that clarifying the CPI target, deepening the domestic bond market, and strengthening forward guidance communication could systematically shift it toward the more effective upper end of the regional distribution.

From an information systems standpoint, these results define the functional specification of a monetary policy decision-support component. The estimated variance shares provide the weighting scheme for probability-based inflation fan charts; the impulse response horizon profiles supply the lag calendar against which forward guidance can be timed; and the episode-specific decompositions furnish a regime-classification input for scenario modules. Because the pipeline runs on published statistical bulletins and a standard econometric engine, it can be re-estimated at each monthly data release and embedded within the central bank's forecasting infrastructure at negligible marginal cost—the same class of quantitative decision-support application, alongside neural-network forecasting [5] and resource-allocation optimisation [6], that industrial management information systems are built to operationalise.

5. Conclusions

This study provides the first multi-channel SVAR assessment of Malaysian monetary policy transmission over 2016–2022, implemented as a replicable quantitative decision-support framework, and yields three principal findings. First, the interest rate channel is operative but moderate: OPR shocks account for 11.0% of GDP forecast variance and 5.5% of CPI variance, with output effects materialising over a 4–6 month lag and disinflation from the sixth month—well below the advanced-economy benchmark—confirming that the rate instrument is a viable but bounded stabilisation tool. Second, money supply and exchange rate channels exhibit structurally limited OPR traction, with own-shocks dominating 63.7% and 78.2% of their respective variance shares under the dual banking system and managed-float constraints. Third, external and idiosyncratic disturbances account for over 70% of macroeconomic variance, confining monetary policy to a stabilising rather than countercyclical role against commodity price and demand shocks. For Bank Negara Malaysia, the evidence supports probability-based inflation fan charts, macroprudential complementarity, and domestic bond market deepening. Caveats include non-testable Cholesky restrictions, a linear VAR that cannot capture regime shifts, and an 84-observation sample that limits sub-sample power. Future work should apply a time-varying parameter VAR to trace evolving transmission, extend the framework to an ASEAN comparative panel, and operationalise the estimation pipeline as a routinely updated decision-support component within central bank forecasting systems.

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Author Contribution

Sun Xinzong: conceptualization, methodology, software, formal analysis, visualization, writing – original draft, writing – review & editing. Sun Jinbiao: data curation, investigation, writing – review & editing. Nor Asmat Ismail: supervision, validation.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data supporting the findings of this study are publicly available from the Bank Negara Malaysia Monthly Statistical Bulletin (https://www.bnm.gov.my) and the Department of Statistics Malaysia (https://www.dosm.gov.my).

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