ENDOGENOUS GROWTH, CREDIT CONSTRAINTS, AND MONETARY POLICY TRANSMISSION: A STRUCTURAL DYNAMIC ANALYSIS

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ABSTRACT

Understanding how monetary policy affects real economic activity through financial markets remains a central issue in macroeconomic policy debates, particularly in emerging economies characterized by shallow financial systems and persistent credit constraints. This study investigates the dynamic interaction between monetary policy, credit markets, and economic growth in Nigeria using annual macroeconomic data covering the period 1990–2024. The analysis employs a Vector Autoregression (VAR) framework to examine the transmission of monetary shocks through interest rates, liquidity conditions, and private sector credit. The empirical results reveal strong macro-financial linkages. Credit markets display substantial persistence, while increases in real interest rates significantly reduce private sector credit, indicating the presence of borrowing constraints consistent with the financial accelerator mechanism. In contrast, expansions in broad money supply increase credit availability, supporting the bank lending channel of monetary policy transmission. Inflation dynamics respond strongly to credit and interest rate movements, suggesting that financial conditions play a central role in price adjustments. However, economic growth reacts gradually, implying that monetary policy influences output primarily through indirect credit-market channels rather than immediate output responses. The findings highlight the importance of strengthening financial intermediation and credit allocation mechanisms to improve monetary policy effectiveness and support sustainable long-run growth in emerging economies.

Keywords: *Monetary Policy Transmission; Credit Channel; Financial Frictions; Economic Growth; Nigeria*

JEL: O43, E12, E42, E43, E52

1. Introduction

The effectiveness of monetary policy in shaping macroeconomic outcomes remains one of the central debates in modern monetary economics. While early theoretical frameworks emphasized the long-run neutrality of money, subsequent research has increasingly recognized that financial frictions, credit constraints, and institutional structures fundamentally alter both the transmission and the persistence of monetary impulses.

The interaction between monetary policy, credit markets, and real activity has become particularly salient in the aftermath of recurrent financial crises and within emerging economies characterized by shallow financial markets and structural rigidities.

Within the traditional New Keynesian paradigm, monetary policy operates primarily through adjustments in short-term nominal interest rates, often governed by Taylor-type rules. However, the assumption that policy rate movements translate smoothly into real economic outcomes has been challenged by models incorporating nominal debt rigidities and borrowing constraints. Graham and Wright (2007) demonstrate that when debt contracts are denominated in nominal terms and households face binding credit constraints, inflationary shocks alter the real burden of debt and generate prolonged deviations in real interest rates. In such settings, monetary transmission depends critically on balance sheet structures rather than solely on intertemporal substitution through the policy rate. This insight implies that the real interest rate channel cannot be understood independently of prevailing credit market conditions.

The credit channel literature extends this reasoning by emphasizing the role of financial intermediaries and borrower net worth in amplifying monetary shocks. Bernanke and Gertler (1995) argue that the external finance premium, driven by asymmetric information and agency problems, magnifies the effects of policy-induced changes in interest rates. Monetary tightening raises borrowing costs disproportionately for constrained firms, thereby reducing investment and output beyond what conventional interest rate models predict. Empirical evidence further supports this amplification mechanism. Gilchrist and Zakrajšek (2010) show that fluctuations in credit spreads, particularly the excess bond premium component, possess substantial predictive power for real activity and can intensify the contractionary impact of financial disruptions. These findings underscore that lending interest rates and credit conditions operate as active transmission channels rather than passive reflections of policy decisions.

The heterogeneity of transmission across institutional environments has also received increasing attention. Ciccarelli et al. (2013) document that the effectiveness of monetary policy within the euro area varies across countries and over time, especially during episodes of financial fragility. Their evidence indicates that the bank lending and borrower balance sheet channels become more pronounced in stressed economies, revealing that transmission is state dependent and shaped by financial health. Similarly, Beck et al. (2014) highlight the role of financial intermediaries in mediating monetary impulses, demonstrating that banking sector frictions influence the responsiveness of lending to policy rate adjustments. Collectively, these studies suggest that credit to the private sector is not merely an intermediate variable but a structural determinant of macroeconomic dynamics.

While much of this literature has focused on advanced economies, emerging and developing economies present distinct structural challenges. Financial systems in these economies are often characterized by limited market depth, greater reliance on bank intermediation, and weaker institutional credibility. Brandão et al. (2021) show that monetary policy shocks reduce output growth and inflation in emerging markets when exchange rates are flexible and policy frameworks are credible. However, structural characteristics such as financial underdevelopment and dollarisation can weaken or distort transmission. This evidence raises fundamental questions about the channels through which monetary policy affects growth and price stability in financially constrained environments.

Beyond cyclical transmission, recent research has linked financial constraints to long-term growth. Aghion et al. (2009) develop an endogenous growth framework in which firms allocate investment between short-term projects and productivity-enhancing long-term innovations under liquidity risk. Their empirical analysis demonstrates that countercyclical policy fosters industry growth more strongly in sectors reliant on external finance. This perspective implies that credit constraints shape not only short-run fluctuations but also the trajectory of gross domestic product per capita. Furthermore, Algan and Ragot (2010) challenge the classical neutrality proposition by showing that inflation can influence capital accumulation when households face borrowing constraints. In incomplete market settings, changes in inflation alter precautionary savings behaviour and thus affect long-run growth.

Despite these advances, several unresolved issues remain. First, although financial accelerator models incorporate credit frictions, they often treat long-term growth as exogenous. Conversely, endogenous growth models rarely integrate detailed monetary transmission mechanisms. Second, empirical analyses frequently examine either interest rate channels or credit aggregates in isolation, without jointly modelling policy rates, money growth, lending rates, and output within a unified structural framework. Third, the dynamic feedback between gross domestic product per capita and borrowing constraints remains underexplored, particularly in emerging economies where credit markets are evolving and structural vulnerabilities persist.

These gaps motivate the present study. The central research problem concerns how monetary policy rate adjustments, broad money growth, lending interest rates, and real interest rates interact with credit to the private sector to influence inflation and gross domestic product per capita within financially constrained emerging economies. The study seeks to answer three interrelated questions. First, how do credit constraints modify the transmission of monetary policy shocks to output and inflation? Second, does the interaction between money growth and lending behaviour amplify or dampen real economic responses? Third, can a structural dynamic framework reconcile short-term stabilisation objectives with long-term growth outcomes under endogenous borrowing constraints?

The objective of this research is therefore to develop and empirically evaluate a structural dynamic model that integrates endogenous growth with credit-constrained monetary transmission. By jointly analysing monetary policy rate, broad money growth, lending and real interest rates, inflation, credit to the private sector, and gross domestic product per capita, the study aims to bridge the analytical divide between the New Keynesian interest rate tradition, the credit channel literature, and endogenous growth theory. In doing so, it contributes to the broader debate on the macroeconomic relevance of financial frictions for price stability, output dynamics, and financial stability in emerging economies. The remainder of the paper proceeds as follows. Section 2 reviews the relevant literature, Section 3 outlines the methodology and data analysis, Section 4 presents results and discussions, and Section 5 concludes with policy implications and directions for future research.

2. Literature Review

2.1 Monetary Policy Transmission

The theoretical foundations of monetary policy transmission have evolved significantly from early neutrality-based frameworks toward models that emphasize the importance of financial frictions and institutional structures in shaping macroeconomic dynamics. Classical monetary theory, particularly within the Monetarist tradition, posits that sustained inflation is ultimately a monetary phenomenon driven by excessive growth in the money supply. In this perspective, changes in money growth influence the general price level in the long run while real economic variables remain determined by structural factors such as technology and preferences. Consequently, monetary policy is traditionally viewed as neutral in the long term, affecting nominal variables without permanently altering real economic outcomes.

However, subsequent theoretical developments have challenged this neutrality proposition, especially in environments characterized by incomplete markets and borrowing constraints. Algan and Ragot (2010) demonstrate that when heterogeneous agents face binding credit constraints, inflation can influence capital accumulation through precautionary savings behavior. Under such conditions, households increase savings to protect against future liquidity shocks, thereby affecting investment and long-run output dynamics. This theoretical insight implies that monetary policy may exert persistent real effects when financial frictions prevent agents from perfectly smoothing consumption over time. The interaction

between broad money growth, inflation, and capital accumulation therefore becomes particularly relevant in financially constrained economic systems.

The New Keynesian framework provides a more explicit account of monetary policy transmission through the interaction of nominal rigidities and policy rules. Within this paradigm, central banks influence economic activity primarily through adjustments in short-term nominal interest rates, often guided by Taylor-type policy rules that respond to deviations of inflation and output from target levels. Monetary policy affects aggregate demand by altering real borrowing costs and influencing expectations regarding future economic conditions. Graham and Wright (2007) extend this framework by incorporating nominal debt contracts and credit-constrained households into a dynamic general equilibrium model. Their analysis shows that when debt obligations are denominated in nominal terms, inflation shocks modify the real burden of debt and thereby influence consumption and investment behavior.

In such settings, the real interest rate path following a monetary policy shock depends not only on central bank reactions but also on the distribution and rigidity of debt contracts across economic agents. This insight suggests that the effectiveness of Taylor-type policy rules implicitly relies on assumptions regarding flexible balance sheets and unconstrained borrowing. When these assumptions do not hold, monetary transmission may operate through more complex channels involving balance sheet adjustments and changes in financial conditions. The conceptualisation of core macroeconomic variables further shapes the understanding of transmission mechanisms. The monetary policy rate is typically defined as the short-term nominal interest rate controlled by the central bank and serves as the primary policy instrument influencing intertemporal substitution decisions (Graham & Wright, 2007). However, several studies emphasize the distinction between nominal and real interest rates, particularly when inflation dynamics alter the real cost of borrowing. When debt contracts are fixed in nominal terms, inflation shocks can redistribute wealth between borrowers and lenders, thereby influencing consumption and investment decisions.

In addition, monetary transmission may operate through interactions between policy rates, lending rates, and liquidity conditions in financial markets. While the policy rate reflects the stance of monetary authorities, lending interest rates incorporate additional components such as risk premia and intermediary

constraints. As a result, the responsiveness of lending rates to policy signals plays a critical role in determining the overall strength of monetary transmission. These interactions highlight the importance of examining monetary policy within a broader macro-financial framework that accounts for both price-based and balance-sheet transmission channels.

2.2 Credit Channel and Financial Frictions

While traditional monetary transmission models emphasize the interest rate channel, a substantial body of literature highlights the role of financial frictions in amplifying and propagating monetary shocks through credit markets. The credit channel theory developed by Bernanke and Gertler (1995) represents a major advancement in this direction. Their framework argues that monetary policy influences economic activity not only through changes in borrowing costs but also through its effects on borrower balance sheets and the external finance premium. In the presence of asymmetric information and agency problems, firms and households often face borrowing costs that exceed the risk-free interest rate. Monetary tightening weakens borrower net worth and increases this external finance premium, thereby magnifying the contractionary effects of policy shocks on investment and output.

This theoretical perspective shifts attention from aggregate interest rates to the distributional consequences of monetary policy across borrowers and lenders. Because financial markets are imperfect, firms often rely on intermediated credit subject to agency problems and collateral constraints. Policy-induced increases in interest rates reduce asset values and borrower net worth, thereby tightening borrowing constraints and limiting access to external finance. As a result, the contractionary impact of monetary policy may extend beyond the direct cost-of-capital channel to include balance-sheet effects that amplify macroeconomic fluctuations. The financial accelerator framework further formalizes these amplification mechanisms by integrating credit spreads and balance-sheet dynamics into macroeconomic models. Gilchrist and Zakrajšek (2010) demonstrate that changes in credit spreads, particularly the excess bond premium component, play a significant role in transmitting financial disturbances to the real economy. Their analysis shows that credit spreads capture variations in financial risk and investor sentiment, both of which influence borrowing conditions for firms. When financial conditions deteriorate, rising credit spreads increase the cost of external finance and reduce investment and consumption.

Within this framework, lending interest rates incorporate both policy-induced interest rate changes and risk premia reflecting borrower creditworthiness. Consequently, lending rates embody a combination of monetary policy signals and financial market conditions. Gilchrist and Zakrajšek (2010) further decompose credit spreads into expected default risk and excess premia components, demonstrating that fluctuations in excess premia have substantial predictive power for real economic activity. Empirical research also highlights the heterogeneity of credit transmission mechanisms across institutional environments. Ciccarelli et al. (2013) show that the effectiveness of monetary policy depends on the fragility of banks and borrowers. Their panel evidence suggests that financial stress alters the responsiveness of credit supply to policy shocks, implying that monetary transmission is state-dependent. When financial systems are under stress, banks facing capital and liquidity constraints may reduce lending more aggressively in response to policy tightening.

Similarly, Beck et al. (2014) emphasize the role of monopolistically competitive banks in mediating policy effects. Their theoretical model shows that banks make lending decisions based not only on policy rates but also on their internal balance sheet conditions and regulatory constraints. This approach departs from the assumption of frictionless financial intermediation and highlights the importance of intermediary behavior in shaping credit supply. These insights underscore that monetary transmission operates through a complex interaction of policy rates, lending behavior, and financial market conditions. Credit to the private sector therefore functions as a key intermediary variable linking monetary policy decisions to real economic outcomes. In economies characterized by financial imperfections and reliance on bank intermediation, the credit channel becomes a particularly important mechanism through which monetary policy influences macroeconomic dynamics.

2.3 Financial Constraints and Economic Growth

Beyond short-term macroeconomic stabilization, financial constraints also play a crucial role in shaping long-term economic growth. The endogenous growth literature emphasizes that access to finance influences the allocation of investment and the accumulation of productive capital. When firms face borrowing constraints, they may be unable to undertake productivity-enhancing investments, thereby limiting long-run economic development.

Aghion et al. (2009) provide a prominent theoretical contribution by developing an endogenous growth model in which firms allocate resources between short-term projects and productivity-enhancing long-term investments. In their framework, firms face liquidity risk and financing constraints that affect their investment choices. Because long-term innovation projects involve greater uncertainty and delayed returns, financially constrained firms may prioritize short-term investments that generate immediate cash flows. This behavior can reduce the rate of technological progress and slow long-term economic growth. The relationship between financial constraints and growth also interacts with monetary policy conditions. When monetary policy affects credit availability and borrowing costs, it can indirectly influence firms' investment decisions and the allocation of resources across sectors. Policies that alleviate financing constraints may encourage investment in long-term innovative activities, thereby supporting productivity growth. Conversely, tightening credit conditions may discourage riskier but potentially more productive investments.

Algan and Ragot (2010) further challenge the classical neutrality of money by demonstrating that inflation can influence capital accumulation in economies characterized by incomplete financial markets. When households face borrowing constraints, inflation alters real interest rates and affects precautionary savings behavior. These changes influence aggregate investment and capital formation, generating persistent real effects of monetary policy. This theoretical insight suggests that the interaction between inflation dynamics and financial constraints can shape both short-term macroeconomic fluctuations and long-term growth trajectories. Empirical evidence also supports the importance of financial constraints for growth dynamics. Lochner and Monge-Naranjo (2002) show that borrowing limits depend on expected earnings capacity, implying that income growth can relax effective credit constraints. As incomes increase, borrowers become more creditworthy and gain greater access to financial markets. This dynamic feedback between income growth and credit access suggests that financial development and economic growth may reinforce each other over time.

These theoretical and empirical insights highlight that financial constraints influence both cyclical fluctuations and structural economic transformation. When credit markets function efficiently, they facilitate the allocation of resources toward productive investments and technological innovation. However, when borrowing constraints are binding, investment decisions may become biased toward short-term activities with lower productivity potential. Consequently, understanding the interaction

between monetary policy, credit markets, and investment behavior is essential for explaining long-run economic growth. Integrating these elements into a unified analytical framework allows for a more comprehensive understanding of how macroeconomic policies influence both stabilization and development outcomes.

Despite significant advances in the literature on monetary policy transmission, credit markets, and financial constraints, several important gaps remain. First, a large proportion of existing studies analyse monetary transmission primarily through the interest rate channel, with limited integration of credit constraints and balance sheet effects. Although the New Keynesian framework emphasizes the policy rate as the principal instrument of monetary authorities, the credit channel literature highlights the critical role of lending conditions and borrower net worth in shaping the responsiveness of investment and output to policy shocks. Second, financial accelerator models largely focus on short-run macroeconomic fluctuations while treating long-run growth as exogenous, whereas endogenous growth models emphasize financial constraints but seldom incorporate detailed monetary transmission mechanisms. Consequently, the interaction between monetary policy, credit dynamics, and long-run economic growth remains insufficiently explored. Furthermore, empirical studies frequently examine interest rates, credit aggregates, and output indicators separately rather than within a unified structural framework. This study addresses these limitations by integrating monetary policy, credit conditions, and growth dynamics within a comprehensive structural model.

3. Methodology

3.1 Data Description

This study employs annual macroeconomic data for Nigeria covering the period 1990–2024 to examine the interaction between monetary policy, credit markets, and economic growth within a macro-financial transmission framework. Nigeria provides a relevant case study due to its bank-dominated financial system, evolving monetary policy regime, and persistent credit market frictions typical of emerging economies.

The dataset is obtained from the World Bank World Development Indicators (WDI) and the International Monetary Fund (IMF) databases. The variables include gross domestic product per capita (GDPPC) as a

measure of economic growth, broad money supply (M2) capturing liquidity conditions, private sector credit (PSC) representing financial intermediation, real interest rate (RIR) and lending interest rate (LR) reflecting borrowing costs, inflation (INF) measuring price dynamics, and gross fixed capital formation (GFCF) representing investment activity. Descriptive statistics are reported to summarize the distribution and variability of the variables prior to model estimation.

Table 1: Definition of Variables

Variable	Definition	Source
GDPPC	Gross domestic product per capita	World Bank (2025)
M2	Broad money supply	IMF (2025)
PSC	Credit to the private sector	World Bank (2025)
RIR	Real interest rate	World Bank (2025)
LR	Lending interest rate	IMF (2025)
INF	Consumer price inflation	IMF (2025)
GFCF	Gross fixed capital formation	World Bank (2025)

This study adopts a structural dynamic empirical strategy grounded in the New Keynesian monetary transmission framework, the credit channel and financial accelerator literature, and endogenous growth models with financial constraints (Bernanke & Gertler, 1995; Graham & Wright, 2007; Gilchrist & Zakrajšek, 2010; Aghion et al., 2009). The analysis employs a Structural Vector Autoregression (SVAR) to jointly model monetary policy rate, broad money growth (M2), lending rate, real interest rate, inflation, credit to the private sector, investment, and GDP per capita. Structural shocks are identified using theoretically consistent sign restrictions derived from the financial accelerator and interest rate transmission mechanisms.

Prior to estimation, integration properties are examined and the Johansen procedure is used to assess cointegration, justifying estimation in levels where long-run relationships exist. Endogeneity between credit and output is addressed through structural identification. Robustness is assessed through alternative lag specifications and stability diagnostics, acknowledging potential small-sample limitations. To empirically evaluate these mechanisms, a Structural Vector Autoregression (SVAR) framework is employed.

The vector of endogenous variables is defined as:

$$X_t = [GDPPS_t + MS2_t + PSC_t + RIR_t + LR_t + INF_t + GFCF_t]' \quad (1)$$

Where, $GDPPS_t$ is Real GDP per capita, $MS2_t$ is Broad money supply, PSC_t is Private sector credit (% of GDP), RIR_t is Real interest rate LR_t denote Lending rate, while INF_t represents Inflation, $GFCF_t$ is the Gross fixed capital formation.

The reduced-form VAR equation is:

$$= \quad + \qquad (2)$$

Where $A(L)$ is a lag polynomial and μ_t represents reduced-form innovations. Structural shocks ε_t are recovered by decomposing the covariance matrix of μ_t using sign restrictions imposed over short horizons.

3.2 Structural Identification

Structural shocks ε_t are recovered using a sign-restriction identification strategy consistent with the theoretical framework. The structural representation model is:

$$= \quad + \qquad (3)$$

Where X_t is [GDPPC$_t$, M2$_t$, PSC$_t$, RIR$_t$, LR$_t$, INF$_t$, GFCF$_t$]' is the vector of endogenous variables, A is the contemporaneous structural coefficient matrix. A(L) is a matrix polynomial in the lag operator, and ε_t represents mutually uncorrelated structural shocks.

The relationship between structural shocks and reduced-form innovations is defined as:

$$= \qquad (4)$$

Identification is achieved by imposing economically motivated sign restrictions over short horizons. No zero restrictions are imposed on contemporaneous relationships, allowing flexibility in the dynamic structure. Structural impulse responses are derived from admissible decompositions satisfying these sign constraints. A contractionary monetary policy shock is identified by the following restrictions: (i) an increase in the real interest rate, (ii) a decline in private sector credit, (iii) a reduction in real GDP per capita, and (iv) downward pressure on inflation. Conversely, a positive liquidity shock (M2 expansion) is constrained to increase credit and output while lowering the real interest rate. No restrictions are imposed on impact magnitudes, allowing the data to determine dynamic adjustment paths.

Impulse response functions and forecast error variance decompositions are derived from admissible structural draws consistent with these sign conditions. Robustness is assessed through alternative horizon restrictions and sub-sample stability checks. This identification strategy enhances credibility by aligning empirical restrictions with established theoretical mechanisms while preserving flexibility in dynamic transmission patterns.

4. Results and Discussion

4.4.1 Preliminary Tests

4.4.2 Descriptive Statistics

Table 2: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
GDPPC	0.756	1.422	-3.427	2.508
M2	2.980	0.798	0.328	4.475
PSC	10.502	3.463	4.958	19.626
RIR	18.433	4.087	11.483	31.650
LR	3.153	9.831	-31.453	18.180
INF	18.770	16.595	5.388	72.836
GFCF	1.809	0.957	-0.668	3.699

From Table 2, real GDP per capita exhibits moderate volatility, while inflation (mean = 18.77%) and real interest rates (18.43%) reflect persistent macroeconomic instability. High dispersion in lending rates suggests financial frictions, consistent with financial accelerator theory. Investment variability supports endogenous growth dynamics driven by capital accumulation shocks.

4.4.3 Correlation Test

Table 3: Correlation Matrix

Variable	GDPPC	M2	PSC	RIR	LR	INF	GFCF
GDPPC	1.000						
M2	0.007	1.000					
PSC	0.055	-0.172	1.000				
RIR	0.081	0.410*	-0.567*	1.000			
LR	0.368*	-0.234	0.401*	-0.216	1.000		
INF	-0.412*	0.021	-0.511*	0.393*	-0.506*	1.000	
GFCF	0.215	0.250	-0.089	0.004	0.156	-0.101	1.000

In Table 3, the correlation structure provides strong support for the study's macro-financial framework. The significant negative relationship between real interest rates and private sector credit (−0.567, $p<0.05$) confirms the presence of credit constraints consistent with the financial accelerator hypothesis. Similarly, the positive association between lending rates and credit (0.401, $p<0.05$) reflects lending channel dynamics, while inflation is negatively related to credit (−0.511, $p<0.05$) and lending rates (−0.506, $p<0.05$), consistent with cost-of-credit effects. The positive RIR–inflation relationship (0.393, $p<0.05$) aligns with Fisher-type dynamics. Importantly, the moderate magnitude of correlations indicates no

severe multicollinearity, validating the suitability of SVAR frameworks for structural macroeconomic analysis.

4.4.4 Unit Root Tests

Table 4: Augmented Dickey–Fuller (ADF) Unit Root Tests

Variable	Test Statistic Z(t)	1% Critical	5% Critical	10% Critical	p-value	Order of Integration
GDPPC	-2.130	-3.696	-2.978	-2.620	0.2325	I(1)
M2	-3.373	-3.696	-2.978	-2.620	0.0119	I(0)
PSC	-2.703	-3.696	-2.978	-2.620	0.0735	I(1)
RIR	-1.572	-3.696	-2.978	-2.620	0.4977	I(1)
LR	-2.960	-3.696	-2.978	-2.620	0.0388	I(0)
INF	-2.565	-3.696	-2.978	-2.620	0.1005	I(1)
GFCF	-10.268	-3.696	-2.978	-2.620	0.0000	I(0)

From Table 4, the Augmented Dickey–Fuller results revealed mixed integration properties across variables. Broad money (M2), lending rate (LR), and gross fixed capital formation (GFCF) are stationary at levels, indicating I(0) processes. In contrast, GDPPC, private sector credit (PSC), real interest rate (RIR), and inflation (INF) fail to reject the unit root null, suggesting I(1) behaviour. This combination of I(0) and I(1) variables supports estimation of a level VAR framework without differencing, preserving long-run structural information while allowing dynamic monetary and credit transmission analysis.

4.4.5 Long-Run Dynamics: Vector Error Correction Model

Table 5: Vector Error Correction Model (VECM) Results

Dependent Variable	Error Correction Term (ECT)	Coefficient	z-stat	P-value
ΔGDPPC	CE1	-0.205	-1.72	0.085
ΔM2	CE1	1.921	4.38	0.000
ΔPSC	CE3	-0.366	-4.41	0.000
ΔRIR	CE3	-0.257	-1.89	0.058
ΔINF	CE1	-0.742	-3.70	0.000
ΔGFCF	CE1	0.906	2.56	0.010

The Vector Error Correction Model (VECM) results in Table 5, revealed the presence of four statistically significant cointegrating relationships, indicating stable long-run equilibrium linkages among monetary aggregates, credit conditions, inflation, investment, and economic growth. The error-correction coefficient in the GDP per capita equation is negative and weakly significant (−0.205; p = 0.085), suggesting that deviations from equilibrium are corrected gradually through adjustments in output following macro-financial shocks.

In contrast, monetary and financial variables display stronger adjustment dynamics. The money supply equation records a positive and highly significant adjustment coefficient (1.921; $p < 0.01$), indicating that liquidity conditions respond strongly to disequilibrium. Private sector credit also adjusts significantly (−0.366; $p < 0.01$), implying active correction within credit markets. Inflation (−0.742; $p < 0.01$) and investment (0.906; $p = 0.01$) similarly respond to long-run imbalances, while the real interest rate shows a weaker but statistically relevant adjustment (−0.257; $p = 0.058$).

Generally, the results suggested that macroeconomic disequilibria are primarily resolved through adjustments in monetary and financial variables rather than immediate output changes. Growth responds more gradually, whereas credit supply and liquidity conditions react more quickly to restore equilibrium. This pattern underscores the stabilising role of financial intermediation, where credit contractions emerge in response to financial imbalances. The findings align with endogenous growth and financial accelerator perspectives, emphasising that long-run output dynamics are shaped by interactions between credit markets, liquidity conditions, and investment behaviour.

4.4.6 Baseline VAR Model Diagnostics (Lag Specification)

Table 6 : Baseline VAR Model Diagnostics

Equation	RMSE	R^2	χ^2	Prob > χ^2
GDPPC	3.609	0.286	13.636	0.058
PSC	1.591	0.825	160.288	0.000
RIR	2.566	0.670	69.122	0.000
LR	8.368	0.408	23.431	0.001
INF	6.434	0.871	229.093	0.000
M2	14.118	0.535	39.160	0.000
GFCF	11.993	0.228	10.013	0.188

Model Statistic	Value
Observations	34
Log Likelihood	-673.283
AIC	42.899
HQIC	43.756
SBIC	45.413
FPE	1.07e+10
Det(Sigma_ml)	3.74e+08

From Table 6, the VAR diagnostics confirm strong explanatory power for credit (R^2=0.825, $p<0.01$) and inflation (R^2=0.871, $p<0.01$), indicating robust macro-financial linkages. Significant χ^2 statistics for PSC, RIR, LR, INF, and M2 support dynamic interactions predicted by the credit channel and financial accelerator theories, while GDP growth shows weaker short-run responsiveness (p=0.058).

4.4.7 VAR Lag Order Selection Criteria

Table 7: VAR Lag Order Selection Criteria

Lag	LL	LR	p-value	FPE	AIC	HQIC	SBIC
1	-601.94	208.34	0.000	7.0e+09	42.448	43.292	45.038*
2	-538.68	126.52	0.000	4.7e+09	41.528	43.111	46.385
3	-463.99	149.39*	0.000	5.8e+09	39.870*	42.192*	46.994

In Table 7, Lag order selection tests indicated mixed evidence across information criteria. The Akaike Information Criterion (AIC), Hannan–Quinn Information Criterion (HQIC), and the likelihood ratio test select lag order three, whereas the Schwarz Bayesian Information Criterion (SBIC) favours lag one. Given the relatively limited sample size typical of macroeconomic data for emerging economies, the baseline specification adopts lag one to maintain model parsimony while preserving sufficient degrees of freedom. The parsimonious lag structure ensures that estimated dynamics reflect economically meaningful relationships without introducing excessive parameterization that could distort inference. Adopting a parsimonious lag specification aligns with structural VAR practice in macro-financial studies, where small samples and persistent variables necessitate careful trade-offs between dynamic richness and estimation stability.

4.4.8 Baseline VAR (Lag 1) Coefficient Estimates

Table 8: VAR (Lag 1) Coefficient Estimates

Dependent Variable	Lagged Variable	Coefficient	z-stat	p-value
GDPPC	GDPPC	0.347	2.00	0.046
	PSC	0.004	0.02	0.983
	RIR	0.165	0.85	0.394
	LR	0.122	1.71	0.087
	INF	0.018	0.38	0.703
	M2	0.011	0.30	0.766
	GFCF	-0.075	-1.48	0.139
PSC	PSC	0.591	6.18	0.000
	RIR	-0.346	-4.05	0.000
	M2	0.065	4.00	0.000
RIR	RIR	0.670	4.86	0.000
	INF	-0.102	-3.07	0.002
LR	LR	0.470	2.83	0.005
	RIR	-0.771	-1.72	0.086
INF	PSC	1.597	4.14	0.000
	RIR	1.685	4.88	0.000

	LR	-1.201	-9.42	0.000
	INF	0.256	3.07	0.002
M2	PSC	-2.929	-3.46	0.001
	M2	0.477	3.30	0.001
GFCF	GFCF	-0.369	-2.20	0.028

The VAR estimates revealed several monetary transmission channels as reflected in Table 8. The liquidity channel is supported by the positive effect of money supply on credit (M2→PSC = 0.065, $p<0.01$). The financial accelerator is confirmed by the negative effect of real interest rates on credit (−0.346, $p<0.01$). Credit expansion significantly raises inflation (1.597, $p<0.01$), indicating demand-side amplification. And real interest rates (1.685, $p<0.01$), confirming financial-driven monetary transmission dynamics.

4.4.9 Dynamic Transmission: Impulse Response Analysis

To assess dynamic transmission mechanisms, we analyse orthogonalised impulse response functions (IRFs) with 95% confidence intervals.

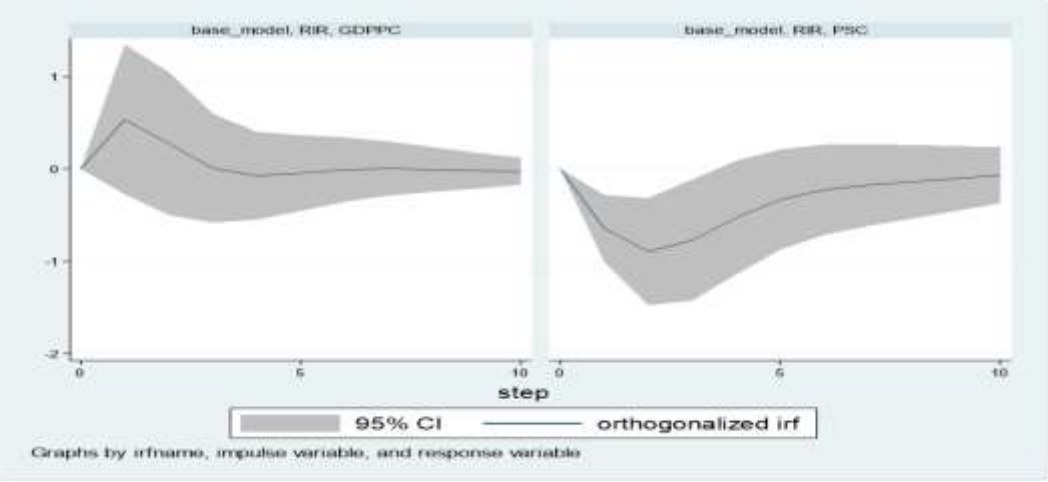

Figure 1. Impulse responses: Monetary Policy Shock (Real Interest Rate → GDPPC)

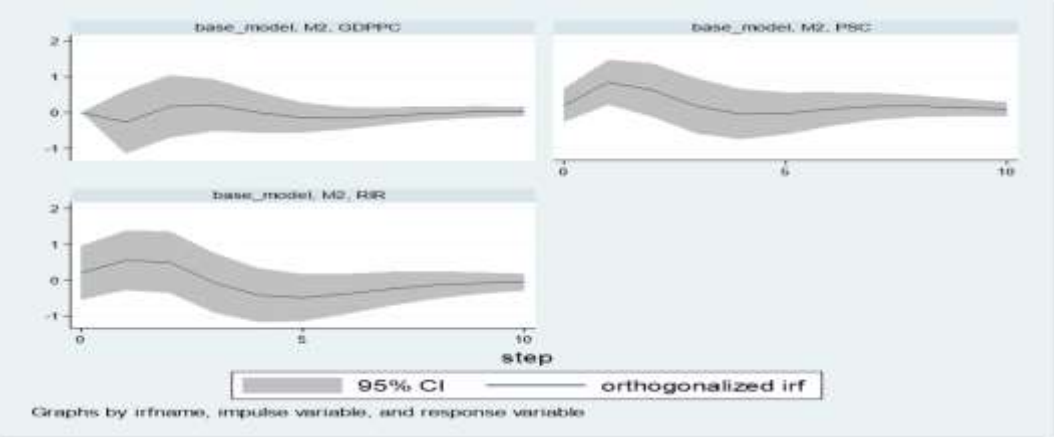

Figure 2: Impulse responses M2, RIR, PSC → GDPPC

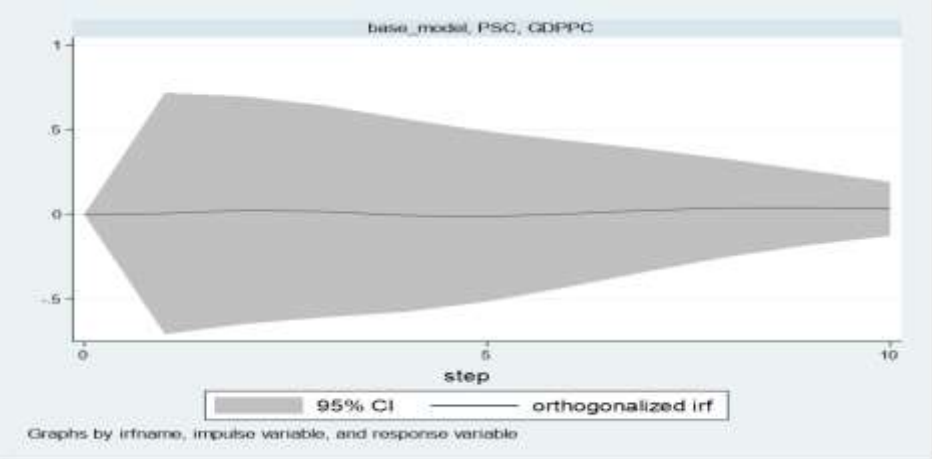

Figure 3: Impulse responses: Credit Shock (PSC → GDPPC)

Impulse response analysis from Figure 1 to 3, revealed that contractionary interest rate shocks generate negative responses in GDP per capita over subsequent periods. Monetary expansions through increases in money supply produce positive responses in credit and investment. Credit shocks generate persistent positive effects on output, indicating that financial intermediation dynamics influence growth trajectories over time.

The impulse responses suggest that monetary policy influences real economic activity primarily through financial intermediation channels. Interest rate increases tighten credit conditions, which in turn dampen investment and output. Conversely, credit expansions support economic activity by easing borrowing constraints. These dynamics are consistent with the New Keynesian interest rate channel and the credit channel of monetary transmission, while also supporting financial accelerator models in which credit market conditions amplify the real effects of monetary policy shocks.

4.4. 9 Forecast Error Variance Decomposition

Table 9: Forecast Error Variance Decomposition (FEVD)

Shock Source	Horizon 1	Horizon 5	Horizon 10*	Dominance
GDPPC (Own shock)	58.58%	47.79%	47.47%	Dominant short-run
Lending Rate (LR)	24.42%	30.55%	30.56%	Dominant external driver
Inflation (INF)	15.92%	12.15%	12.10%	Moderate contributor
Private Sector Credit (PSC)	0.81%	1.85%	1.84%	Weak direct
Real Interest Rate (RIR)	0.22%	2.76%	2.74%	Increasing role
GFCF (Investment)	0.03%	3.79%	3.79%	Gradual influence
Money Supply (M2)	0.03%	1.12%	1.51%	Minimal effect

From Table 9, the forecast error variance decomposition indicates that GDP per capita fluctuations are initially dominated by own innovations, accounting for approximately 58.6% of variance in the short run and stabilizing around 47% in the longer horizon. Among external drivers, lending rate shocks account for the largest share of output variance, explaining roughly 30% of fluctuations over longer horizons. Inflation contributes between 12% and 16% of output variance, while real interest rates and investment exhibit smaller but increasing contributions. Money supply and private sector credit shocks account for relatively modest shares of output variance.

These results indicate that while growth dynamics exhibit strong internal persistence, financial conditions, particularly borrowing costs, play a significant role in shaping long-run output variability. The dominance of lending rate shocks suggests that credit costs represent a key transmission channel through which monetary policy affects real economic activity. The decomposition results reinforce the central role of the interest rate channel within a broader macro-financial framework. At the same time, the gradual influence of credit and investment dynamics supports a financial accelerator–augmented endogenous growth interpretation, where financial conditions shape the propagation of macroeconomic shocks over time.

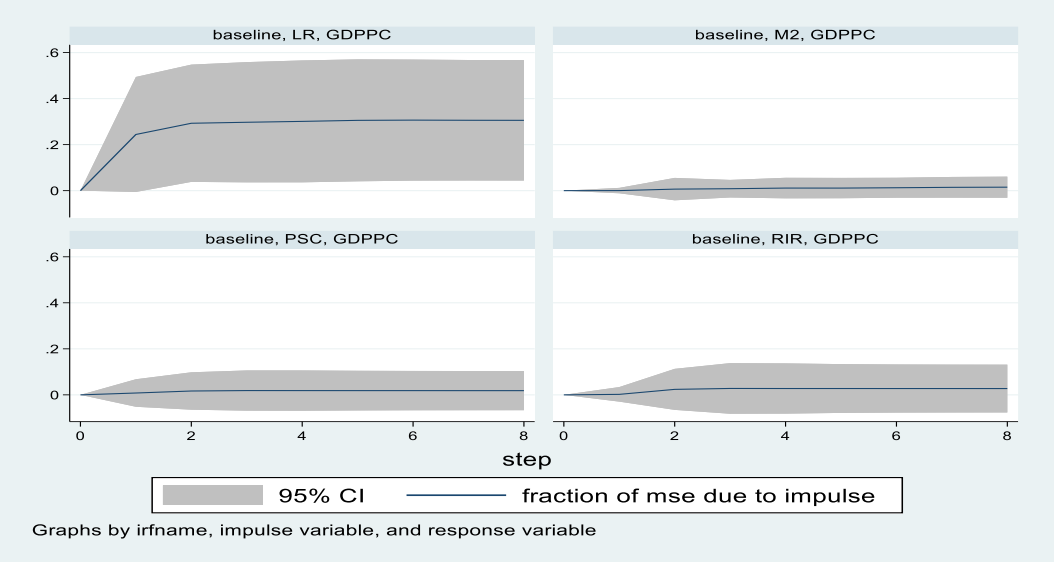

Figure 4: The baseline FEVD graphs

The FEVD graphs in Figure 4, indicate that lending rate shocks account for a persistently large share of GDP per capita forecast variance, rising rapidly and stabilizing around 30%, confirming the dominance of the interest rate channel in monetary transmission. In contrast, money supply (M2) and private sector credit (PSC) shocks contribute marginally, suggesting liquidity effects are weak. Real interest rate shocks exhibit moderate but increasing influence, consistent with intertemporal substitution mechanisms. Overall, the evidence supports a financial accelerator–augmented endogenous growth framework in which growth persistence coexists with structurally significant credit-cost channels rather than direct monetary expansion effects.

Robustness Check

4.5 Model Stability

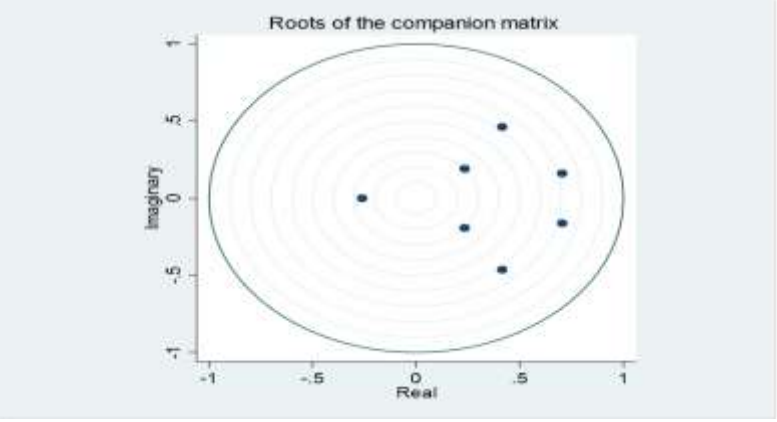

Figure 5. Stability Condition: Roots of the Companion Matrix

In Figure 1, The stability diagnostics indicate that all roots of the companion matrix lie strictly within the unit circle, confirming that the VAR system satisfies the stability condition. This result implies that shocks to monetary policy, credit markets, and inflation generate convergent dynamic responses rather than explosive trajectories. The stability of the estimated system supports the validity of the structural transmission[i] framework, allowing impulse response analysis to be interpreted as meaningful representations of dynamic macro-financial adjustment processes.

Table 10: Alternative Lag Specification (VAR) Robustness Check

Key Relationship	Lag 1 (Baseline VAR)	Lag 2 VAR	Lag 3 VAR	Robustness Outcome
GDPPC → GDPPC	0.347*	0.455*	0.491***	Persistent growth dynamics
M2 → PSC	0.065***	0.065***	0.040	Liquidity–credit link stable
RIR → PSC	−0.346***	−0.425***	−0.235†	Credit contraction effect consistent
PSC → INF	1.597***	2.977***	4.178***	Credit strongly inflationary
RIR → INF	1.685***	2.097***	2.416***	Monetary tightening affects prices
LR → INF	−1.201***	−1.314***	−1.591***	Lending rate dampens inflation

Notes: *** p<0.01, ** p<0.05, * p<0.10, † weak significance.

Alternative lag estimations confirm the stability of key transmission mechanisms as indicated in Table 10. The liquidity–credit link (M2→PSC), credit contraction effect of real interest rates (RIR→PSC), and strong inflation responses to credit and interest rates remain consistent across lag specifications. Growth persistence also remains stable, indicating that the baseline VAR findings are robust to alternative dynamic structures.

Table 11: VAR Lag Selection Criteria

Lag	Log Likelihood	LR	p-value	FPE	HQIC	SBIC
0	-706.108	—	—	2.3e+11	46.113	46.331
1	-601.940	208.34	0.000	7.0e+09	43.292	45.038
2	-538.681	126.52	0.000	4.7e+09	43.111	46.385
3	-463.986	149.39	0.000	5.8e+09	42.192	46.994

Table 12: VAR Stability Test

Eigenvalue	Modulus
0.7039 ± 0.1616i	0.722
0.4144 ± 0.4633i	0.622
0.2333 ± 0.1920i	0.302

Eigenvalue	Modulus
-0.2613	0.261

From Table 12, the robustness diagnostics confirmed the reliability of the VAR specification. Model statistics indicate acceptable explanatory power across equations, particularly for credit (R^2=0.825) and inflation (R^2=0.871). Lag selection criteria support the chosen dynamic structure, while the stability test shows all eigenvalues within the unit circle. These results confirm that the estimated VAR system is stable and robust. Robustness checks based on alternative lag specifications and VAR stability diagnostics confirm that the core transmission relationships remain stable across model specifications, indicating that the estimated macro-financial dynamics are not sensitive to lag structure or dynamic instability.

Residual Diagnostics

Table: 13. VAR Residual Diagnostics

Test	Statistic	p-value	Result
LM Serial Correlation (Lag 1)	67.45	0.041	Weak evidence of autocorrelation
LM Serial Correlation (Lag 2)	48.13	0.508	No autocorrelation
Stability Test	All roots < 1	—	VAR stable

Table 13, Residual diagnostics confirmed the adequacy of the VAR specification. Although weak serial correlation appears at lag 1 (p = 0.041), it disappears at lag 2 (p = 0.508). All eigenvalues lie inside the unit circle, confirming system stability and validating impulse response and variance decomposition analysis.

6. Conclusions and Policy Recommendations

This study examined how monetary policy interacts with credit constraints to influence growth dynamics within a structural framework integrating endogenous growth and financial frictions. The findings highlight the central role of lending conditions and credit transmission in shaping macroeconomic outcomes, contributing theoretically by bridging monetary transmission and growth literature, and methodologically through a structural dynamic approach. While the analysis is constrained by aggregate data and potential small-sample limitations, it provides new insight into credit-mediated policy effects in financially constrained economies. Future research should incorporate regime-switching models and micro-level credit data to capture nonlinear transmission mechanisms and deepen understanding of financial–growth interactions in evolving monetary systems.

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