

Threshold Effects of Exchange Rates and Monetary Policy on Economic Growth in Pakistan

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Abstract

This study examined the threshold effects of exchange rate and M2 money supply on economic growth in Pakistan, using seasonally adjusted quarterly time-series data from 1982-Q1 to 2020-Q4. Hansen's (2000) threshold regression method was employed to endogenously determine multiple thresholds rather than imposing arbitrary breakpoints. The results confirmed three distinct threshold regimes for each variable. For the exchange rate, the first regime (low exchange rate) showed a significant positive effect on growth, the second regime (medium exchange rate) exhibited a significant negative effect, and the third regime (high exchange rate) revealed an insignificant effect. For the money supply, all three threshold regimes showed positive effects: strongest in the low M2 regime, weakest in the medium regime, and moderate recovery in the high regime. These findings confirm non-linear, regime-dependent effects, implying that the State Bank of Pakistan should calibrate exchange rate and monetary interventions according to prevailing threshold levels to maximize growth impact.

Keywords: Threshold Effects, Exchange Rate, Money Supply, Economic Growth

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1. INTRODUCTION

Economic growth, a fundamental objective of macroeconomic policy, encompasses the increase in a country's real Gross Domestic Product (GDP) over time (Hikmah et al., 2025). It is one of the most widely used indicators of macroeconomic performance. This increase is largely driven by improvements in productivity, the efficiency with which goods and services are produced (Gürak, 2024). Consequently, economic expansions raise income and spending power, which improve the quality of life and standards of living (Varona & Gonzales, 2025). Given the importance of economic growth for the overall health of a macroeconomy, economists continue to investigate the factors that drive economic growth. In this context, it is important to understand how and when changes in exchange rates and money supply influence changes in economic growth. However, prior studies have reached varying conclusions on the nature of these relationships, identifying both positive and negative effects. For example, Jahan (2024) found a positive relationship between exchange rate depreciation and growth in Bangladesh, while Odoom et al. (2025) reported negative effects in Ghana. These inconsistencies suggest the need for further investigation.

Threshold analysis allows detection of nonlinearities when a threshold variable crosses a critical value (Correia et al., 2024). Earlier studies have typically examined the relationships of exchange rate and money supply with economic growth using linear frameworks (Jahan, 2024; Odoom et al., 2025). However, macroeconomic relationships are rarely linear; instead, they often exhibit regime-switching behavior where the magnitude and even the direction of the effect depend on the level of the conditioning variable (Bucci, 2025, 2026; Hansen, 2000). This non-linearity has important policy implications: a depreciation that stimulates growth under one exchange rate regime may become contractionary under another, just as money supply expansions that boost output in a liquidity-constrained environment may lose effectiveness or fuel inflation when the economy approaches potential output. Linear models, by imposing a constant coefficient, obscure these regime-dependent dynamics and may lead to policy miscalibration.

What distinguishes this study from prior research is threefold. First, while existing threshold studies on Pakistan have typically examined exchange rate and money supply effects separately or in isolation, this study simultaneously investigates both variables within a unified threshold framework, allowing for comparative analysis of their respective regime-switching patterns. Second, this study applies Hansen's (2000) threshold regression method to quarterly time series data for Pakistan, a technique that endogenously determines threshold values rather than imposing



arbitrary breakpoints, thereby avoiding specification bias and providing statistically robust regime estimates. This methodological rigor is particularly relevant for emerging economies like Pakistan, where structural breaks and policy shifts are frequent. Third, unlike prior studies that have either assumed linearity or imposed a single threshold, this study allows for multiple thresholds, recognizing that the exchange rate–growth and money supply–growth relationships may exhibit more complex non-linear patterns with distinct regimes (Bucci, 2025). By identifying these multiple thresholds, the study provides policymakers with actionable, context-specific guidance: for instance, how much depreciation is tolerable before it turns contractionary, and at what level of money supply does additional liquidity cease to stimulate growth. These insights are critical for designing counter-cyclical monetary and exchange rate policies that are calibrated to prevailing economic conditions.

2. LITERATURE REVIEW

2.1. Relationship between Exchange Rate and Economic Growth

The exchange rate is the amount of local currency required to purchase one unit of a foreign currency (Missio et al., 2015; Odoom et al., 2025). A rising exchange rate, depreciation of the local currency, is conventionally expected to promote economic growth. Depreciation makes domestic goods cheaper relative to foreign goods, encouraging exports while making imports more expensive. This improves net exports and stimulates aggregate demand (Sasaki et al., 2022). In this context, devaluation of currency can be recommended as a policy tool to foster economic expansion (Ribeiro et al., 2020; Ridhwan et al., 2024). Structuralist economists, however, contend that devaluation can harm emerging economies due to heavy reliance on imported inputs (Ribeiro et al., 2020), particularly machinery and intermediate goods. Rising exchange rates may lead to higher costs for imported inputs, with a detrimental effect on output levels (Pane & Patunru, 2023; Sasaki et al., 2022). These opposing views suggest the existence of a nonlinear relationship between exchange rates and economic growth.

2.2. Relationship between Money Supply and Economic Growth

The role of money in driving economic growth has remained a subject of debate across different schools of thought (Bajrami et al., 2025; Basnet & Gyanwaly, 2024; Buthelezi, 2023). Mercantilists held that large quantities of gold and silver reserves have a favorable impact on output by expanding the money supply, thereby advancing national wealth and economic activity



(Hinton, 1955; Howey, 1982). In contrast, classical economics correlated the money supply with the general price level. Under full employment, money supply and prices are positively connected. John Maynard Keynes challenged this view by arguing that economies neither adjust automatically nor always maintain full employment (Torr, 2022). From the Keynesian perspective, monetary expansion lowers interest rates, stimulating investment and aggregate demand, which increases real output, particularly when the economy operates below full employment (Mishkin, 2004). This suggests that the effect of money supply on economic growth may be regime-dependent and nonlinear, a possibility that linear models cannot capture and that motivates the threshold approach employed in this study.

2.3. Theoretical Justification and Rationale of the Threshold Model

Economic theory advocates for the use of nonlinear connection models to analyze the dynamics of an economic system. The main concept underlying threshold models is that when the values of a variable surpass a threshold value, the process may behave differently. The term “threshold co-integration” refers to a nonlinear cointegration model (Balke & Fomby, 1997). These nonlinear dynamics are particularly relevant for money supply, exchange rates, economic growth, and inflation, as these relationships are often shaped by governmental policies, structural change, and regime-switching.

2.4. Empirical Studies on Exchange Rate and Economic Growth

The varying impacts of real exchange rates on economic growth are reported, while the causes of such differences have not been examined and discussed (Ridhwan et al., 2024). The exchange rate-economic growth thresholds suggest that quarterly depreciation of official and unofficial exchange rates should be targeted at not more than 2.4% and 2.5%, respectively, to enhance growth (Oyadeyi et al., 2025).

Missio et al. (2015) studied a large group of 63 developing countries. They looked at how real exchange rates and production growth rates changed from 1978 to 2007. The study found that growth was supported by maintaining a competitive real exchange rate. This study says that when a country's money loses value, it can hurt the economy's growth over time because exports become more affected by changes in people's income.

Ribeiro et al. (2020) incorporated the structural characteristics of developing countries while examining the effect of the real exchange rate on economic growth. The sample covered the period



1990 to 2010 and included 54 developing nations. According to the statistical findings, depreciation has a detrimental impact on economic growth in emerging nations.

Tarawalie (2010) determined the relationship between the real exchange rate and economic expansion in Sierra Leone for the years 1990-Q1 to 2006-Q4. The findings demonstrated that the real exchange rate had a favorable effect on output growth. Sierra Leone's output growth was particularly supported by a fall in the real exchange rate.

Aman et al. (2017) used a three-stage least squares approach to investigate the connection between Pakistan's currency exchange rate and output growth from 1976 to 2010. The researcher's conclusions showed that the growth of export-oriented and import-replacement industries had a favorable impact on economic growth. Additionally, Obansa et al. (2013) examined how currency rates affected economic growth in Nigeria from 1970 to 2010, revealing a significant positive association of exchange rate with economic expansion. Table 1 summarizes some relevant studies.

2.5. Empirical studies on Money supply and Economic growth

The money supply has a positive impact on economic growth, signifying the importance of monetary policy (Bajrami et al., 2025; Pastpipatkul & Ko, 2025). Twinoburyo and Odhiambo (2018) examined how monetary policy affected Tanzania's GDP. Time series data from 1975 to 2012 were used for the investigation. The study employed bounds testing combined with an autoregressive distributed lag (ARDL) model. Money supply and interest rate were utilized as independent variables. The results suggested a relationship between output and monetary policy when using short-term interest rates, but a long-term linkage between Tanzania's GDP and monetary policy was not discovered. There is an inverse relationship between monetary policy and output when using the money supply.

Saidi et al. (2020) examined the impact of the internet, money supply, and volatility on Indonesia's economic expansion. Data for the internet, money supply, and GDP were analyzed annually from 1994 to 2017 using the ARDL model. Economic growth was represented by the GDP time series. The results demonstrated that volatility, the internet, and the money supply over the long run had little bearing on economic development. However, they have an immediate impact on economic expansion.

Furthermore, Lut and Moolio (2015) undertook a study to investigate the impact of monetary policies on the GDP of Cambodia. The study analyzed quarterly time series data covering the



period from 2000 to 2012. The study looked at how the amount of money in circulation and the interest rates affect Cambodia's GDP, using a multiple regression model. Results indicated that Cambodia's money supply had a minor but positive impact on its GDP, without any major impact of interest rates. Table 1 summarizes some of the relevant studies on this relationship.

Table 1: Summary of Empirical Studies

Author(s)	Country of Study	Period	Key Finding(s)
Exchange Rate and Economic Growth			
Oyadeyi et al. (2025)	Nigeria	2022	Quarterly depreciation should be capped at 2.4% (official) and 2.5% (unofficial) to enhance growth (threshold effects).
Odoom et al. (2025)	Ghana	2000-2022	Time-frequency nexus among exchange rate, inflation, monetary policy rate, public debt, and economic growth.
Ridhwan et al. (2024)	Meta-analysis (multiple countries)	Various	Varying impacts of real exchange rates on growth are reported; causes of differences remain underexamined.
Ribeiro et al. (2020)	54 Developing Nations (cross-country panel)	1990-2010	Real exchange rate depreciation has a detrimental impact on economic growth in developing countries.
Aman et al. (2017)	Pakistan	1976-2010	Exchange rate movements had a positive impact on growth through export-oriented and import-replacement industries.
Missio et al. (2015)	63 Developing Countries (cross-country panel)	1978-2007	Maintaining a competitive real exchange rate supports growth; depreciation can harm long-term growth by making exports more income-elastic.
Wimanda (2014)	(Cross-country/regional)	1980-2008	Threshold effects of exchange rate depreciation and money growth on inflation.
Obansa et al. (2013)	Nigeria	1970-2010	A significant positive association between exchange rate movements and economic expansion.
Nawaz (2012)	Pakistan	1972-2010	Exchange rate impacts output level; bounds testing approach confirms long-run relationship.
Tarawalie (2010)	Sierra Leone	1990-2006	Real exchange rate depreciation (a fall) had a positive effect on output growth.



Author(s)	Country of Study	Period	Key Finding(s)
Money Supply and Economic Growth			
Bajrami et al. (2025)	Western Balkan countries (panel: Albania, Bosnia, etc.)	2000-2023	Money supply has a positive impact on economic growth, showing the importance of monetary policy.
Pastpipatkul & Ko (2025)	Thailand	2003-2024	Efficacy of monetary and fiscal policies on economic growth; money supply positively influences growth.
Basnet & Gyanwaly (2024)	Nepal	1975-2022	Money supply positively influences economic growth in Nepal.
Jahan (2024)	Bangladesh	1995-2023	Empirical analysis of exchange rate dynamics, inflation, money supply, and economic growth.
Buthlezi (2023)	South Africa	1990-2021	The impact of money supply varies across different states of inflation and economic growth (regime-dependent effects).
Saidi et al. (2020)	Indonesia	1994-2017	Money supply had no long-run effect on growth but did have a short-run positive impact.
Twinoburyo & Odhiambo (2018)	Tanzania	1975-2012	A short-run relationship with interest rates but no long-term linkage; an inverse relationship when using money supply.
Lut & Moolio (2015)	Cambodia	2000-2012	Money supply had a minor but positive impact on GDP; interest rates had no major effect.

3. DATA AND METHODOLOGY

3.1. Model Specification

Vector Markov-switching autoregressive (VMSAR), vector smooth transition autoregressive (VSTAR), and vector threshold autoregressive (VTAR) models are three alternative approaches to modeling nonlinear interactions in economics (Bucci, 2025, 2026; Helali, 2022). The core idea is that a different model structure may apply when data exceeds a threshold compared to when values are below it, capturing the complex, nonlinear connections between macroeconomic variables. Among these, the threshold autoregression framework is particularly suitable for this study.

Threshold models allow the relationship between variables to change when a threshold variable crosses an unknown critical value, which is estimated from the data rather than imposed arbitrarily



(Bacchiocchi & Fanelli, 2005; Balakrishnan & Ouliaris, 2006; Wimanda, 2014). This study employs Hansen's (2000) sequential threshold regression procedure to examine the nonlinear effects of the exchange rate and money supply (M2) on economic growth in Pakistan. [Stationarity](#) of all variables was confirmed using the Augmented Dickey-Fuller (ADF) test before threshold estimation. The following equation represents the specification of a general threshold regression model with a single threshold, where all variables are expressed in logarithmic form to stabilize variance and interpret coefficients as elasticities:

$$y_t = \beta_j x_t + \delta z_t I(th_t \leq \lambda) + \delta_2 z_t I(th_t > \lambda) + \mu_t \quad (1)$$

Where;

y_t = Dependent variable (output growth)

x_t = Vector of explanatory variables (Foreign Direct Investment, Government Expenditures, Gross fixed capital formation)

β_j = Vector of coefficients,

z_t = Function indicator (a regime-dependent variable of interest),

th_t = Threshold variable (Exchange rate, Money Supply)

λ = Threshold value

μ_t = Error term

Two threshold models are specified based on our variables of interest: the exchange rate and the money supply.

3.1.1. Threshold Model for Exchange Rate

For the exchange rate, which serves as both the threshold variable and the regime-dependent variable, the three-regime model is specified as:

$$y_t = c + \beta_o FDI_t + \beta_1 TGE_t + \beta_2 GFI_t + \tau_1 d_t [(ER_t)I(ER_t \leq ER^*)] + \tau_2 (1 - d_t) [(ER_t)I(ER_t > ER^*)] + \theta M_t + \mu_t \quad (1.1)$$

Where; y_t = output growth

ER_t = Exchange rate in period 't'



ER^* = Threshold value of exchange rate

M_t = Money growth in period 't'

GFI_t = Gross fixed investment 't'

FDI_t = Foreign Direct Investment in period 't'

TGE_t = Total Government Expenditure.

$d_t = (1 \text{ if } ER_t \leq ER^* \text{ } 0 \text{ if } (ER_t > ER^*))$

3.1.2. Threshold Model for Money Supply

Similarly, the three-regime model for money supply is specified as:

$$y_t = c + \beta_0 FDI_t + \beta_1 TGE_t + \beta_2 GFI_t + \theta_1 d_t [(M2_t)I(M2_t \leq M2^*)] + \theta_2 (1 - d_t) [(M2_t)I(M2_t > M2^*)] + \tau ER_t + \mu_t \quad (1.2)$$

Where; $d_t = (1 \text{ if } M_t \leq M^* \text{ } 0 \text{ if } (M_t > M^*))$ and $M2_t$ is the broad money supply.

3.2. Data and Variables

The data sample comprises seasonally adjusted quarterly time series data of study variables from 1982-Q1 to 2020-Q4, from the Handbook of Statistics on the Pakistan Economy and the World Bank database. Table 2 shows the measures and descriptions of study variables.

Table 2: Description of study variables

Variable	Acronym	Measure	Description
Exchange Rate	ER	PKR/US\$	Quantity of PKR equivalent to 1US\$.
Broad Money Supply	M2	PKR in million	"Money plus quasi money" includes currency, demand deposits, savings deposits, and time deposits.
Economic Growth (GDP)	EG	PKR in million	An increase in the production of goods and services, assessed in terms of an increase in GDP.
Foreign Direct Investment	FDI	PKR in million	Investment made by business concerns in one country into business concerns in another country.
Total Government Expenditure	TGE	PKR in million	Current and development expenditure of a government
Gross Fixed Investment	GFI	PKR in million	Government and private investment, comprising spending on machinery, equipment, structures, and inventory changes.



4. RESULTS

This section explains the outcomes of threshold models 1 and 2 (Hansen, 2000). First, the threshold effect of the exchange rate on economic growth is estimated (model 1). Second, the threshold effect of money supply (M2) on economic growth is estimated (model 2). Stationarity of all variables was confirmed before estimation, as reported in the methodology section.

4.1. Threshold Model 1: Effect of Exchange Rate on Economic Growth

The threshold model 1 identified three thresholds for the exchange rate-economic growth (GDP) relationship. Table 3 shows how GDP responds above and below each threshold value of the exchange rate. The coefficients of all variables, including the threshold variable (exchange rate) and non-threshold variables, presented their impact on economic growth (Hansen, 2000), at 1%, 5%, and 10% of significance levels.

Results showed that the coefficient of the first threshold is positive and strongly significant (0.242, $p > 0.000$) at a low level of exchange rate ($ER < 2.875$). The coefficient of the second threshold remained significant but turned negative (-0.072, $p < 0.000$), as the exchange rate moved to the medium range of exchange rate ($2.875 \leq ER \leq 3.831$). However, the coefficient of the third threshold became almost zero and insignificant (0.003, $p > 0.000$) at the high level of exchange rate ($ER \geq 3.831$). The coefficients of the non-threshold variables, money supply M2, foreign direct investment, and gross fixed investment, are significant and positive. The coefficient of total government expenditure is negative, demonstrating that Pakistan's economic growth and overall government spending have a negative connection. Specifically, the coefficient of total government expenditure is -0.03% and is significant, showing that a 1% increase in government expenditure decreases GDP by 0.03% on average.



Table 3: Threshold Effect of Exchange Rate on Economic Growth (Model 1)

Variables	Coefficient	Standard error	P-value
Threshold variable ER			
$ER \leq 2.875$	0.242***	0.019	0.000
$2.875 \leq ER \leq 3.831$	-0.072***	0.012	0.000
$ER \geq 3.831$	0.003	0.015	0.836
Non-Threshold Variables			
TGE	-0.035**	0.013	0.009
GFI	0.084***	0.012	0.000
FDI	0.014***	0.003	0.000
M2	0.256***	0.016	0.000
Notes: SSR= 0.206, F-stat 29967.99, $R^2=0.999$ (high R^2 value is not a concern, as stationarity was confirmed through unit root test). *** $p<0.01$, ** $p<0.05$, * $p<0.10$. ER=Exchange Rate, TGE=Total Government Expenditure, GFI=Gross Fixed Investment, FDI=Foreign Direct Investment, M2=Broad Money Supply.			

4.2. Threshold Model 2: Effect of Money Supply on Economic Growth

The threshold model 2 identified three thresholds for the M2 money supply-economic growth (GDP) relationship. Table 4 shows how GDP responds above and below each threshold value of the money supply. The coefficients of all variables, including the threshold variable (money supply) and non-threshold variables, presented their impact on economic growth (Hansen, 2000), at 1%, 5%, and 10% of significance levels.

The results showed that the effect of the independent variable at the first threshold is strongest and significant (0.406, $p<0.000$) at the low level of money supply ($M2 \leq 12.554$). The effect of the independent variable at the second threshold dropped to the weakest level (0.216, $p<0.000$), in the medium range of money supply ($12.554 < M2 < 14.025$). The effect of the independent variable at the third threshold increased again to a significant and moderate level (0.262, $p<0.000$ at the high level of money supply ($M2 \geq 14.025$), while it remained below the low-regime peak. The coefficients of the non-threshold variables, foreign direct investment and gross fixed investment, are positive and significant, indicating a positive impact on economic growth. The exchange rate coefficient is positive but not statistically significant. The coefficient for total government



spending is negative, which shows that total government spending and economic growth in Pakistan are related in a way that when government spending increases, economic growth tends to decrease.

Table 4: Threshold Effect of Money Supply on Economic Growth (Model 2).

Variables	Coefficient	Standard error	P-value	Effect Strength
Threshold variable: Money Supply M2				
$M2 \leq 12.554$	0.406***	0.019	0.000	Strongest
$12.554 \leq M2 \leq 14.025$	0.216***	0.015	0.000	Weakest
$M2 \geq 14.025$	0.262***	0.016	0.000	Moderate
Non-Threshold Variables				
TGE	-0.036***	0.013	0.007	
GFI	0.078***	0.012	0.000	
FDI	0.015***	0.002	0.000	
ER	0.004	0.014	0.797	
Notes: SSR=0.019, F-stat=31522.170, $R^2 = 0.999$ (high R^2 value is not a concern, as stationarity was confirmed through unit root test) . ***p<0.01, **p<0.05, *p<0.10. ER=Exchange Rate, TGE=Total Government Expenditure, GFI=Gross Fixed Investment, FDI=Foreign Direct Investment, M2=Broad Money Supply.				

5. DISCUSSION

The exchange rate–economic growth relationship exhibits a distinct three-regime switching pattern. In the low-depreciation regime, the positive effect indicates that depreciation supports growth through the competitive export channel. This aligns with prior research (Aman et al., 2017; Nawaz, 2012; Obansa et al., 2013). However, Ribeiro et al. (2020), using large panels of developing countries, found depreciation to be generally detrimental. This divergence likely stems from differences in import dependence: Pakistan's relatively diversified manufacturing base may benefit from moderate depreciation, whereas more structurally vulnerable economies experience immediate cost-push shocks that overwhelm export gains.

In the moderate regime, the effect turns negative. This reflects the structuralist view that currency depreciation raises imported intermediate input costs, eroding profitability and suppressing output (Missio et al., 2015). This finding is consistent with Odoom et al. (2025) in Ghana and Ribeiro et al. (2020) across 54 developing nations. The positive-to-negative transition explains prior



contradictory results: studies reporting positive effects likely captured low-depreciation episodes, while those reporting negative effects captured moderate-to-high depreciation periods.

In the high-depreciation regime, the effect becomes insignificant. This breakdown can be attributed to three reinforcing factors. First, at extreme depreciation levels, the economy may experience exchange rate pass-through saturation, where further depreciation fails to stimulate exports due to inelastic foreign demand or domestic supply constraints (Wimanda, 2014). Second, persistent depreciation triggers inflationary expectations, prompting contractionary monetary policy responses that offset any competitive gains. Third, elevated risk premiums on foreign currency-denominated debt discourage investment and trade financing. This finding aligns with Ridhwan et al. (2024), whose meta-analysis found that exchange rate impacts often vanish at extreme values, and with Oyadeyi et al. (2025), who identified threshold effects in Nigeria beyond which further depreciation ceased to enhance growth. Pane and Patunru (2023) also support this perspective, demonstrating that imported inputs play a critical role in firms' productivity and exports in emerging economies, implying that extreme depreciation may disrupt production networks, not stimulate growth.

For the money supply (M2), a similar three-regime pattern emerges, with a clear economic rationale for each regime. In the low M2 regime, the strongest effect reflects binding liquidity constraints: when credit is scarce, any additional liquidity is productively absorbed, amplifying the marginal impact of monetary expansion. This is consistent with Keynesian theory, monetary expansion lowers interest rates and stimulates activity below full employment and is supported by Galbraith (1996), who found stronger money-output effects below threshold values, and by Buthelezi (2023), who documented regime-dependent effects in South Africa. Bajrami et al. (2025) and Pastpipatkul & Ko (2025) also reported positive money supply effects in Western Balkan countries and Thailand, respectively (Mishkin, 2004).

In the medium M2 regime, the effect weakens to its lowest level, indicating a neutral zone where additional liquidity is absorbed without triggering real responses. This reflects diminishing returns as the economy nears potential output, coupled with market expectations of policy normalization. This aligns with Twinoburyo and Odhiambo (2018), who found no long-term monetary policy, GDP linkage in Tanzania, and with Saidi et al. (2020), who reported no long-run money supply effect in Indonesia.



In the high M2 regime, the effect partially recovers, though not to the low-regime peak. This rebound reflects a balance of opposing forces: while inflation fears and supply-side frictions weaken transmission, the sheer volume of liquidity still exerts positive pressure through credit channels. This contrasts with Lut and Moolio (2015), who found only minor effects in Cambodia, and Basnet and Gyanwaly (2024), who reported sustained positive effects in Nepal, differences that may reflect Pakistan's relatively deep banking sector. Overall, the low M2 regime corresponds to tight credit with productive absorption; the medium regime reflects diminished policy effectiveness near potential output; and the high regime captures a complex interplay of inflationary pressures and partial transmission recovery (Galbraith, 1996).

6. LIMITATIONS AND FUTURE RESEARCH

The selection of control variables was based on theoretical relevance and model parsimony. In threshold regression, over-parameterization is a concern because estimating the threshold and regime-specific coefficients consumes substantial degrees of freedom (Hansen, 2000). To preserve estimation precision, this study focused on the core monetary determinants of growth, exchange rates and money supply. Other potential controls, such as fiscal policy, foreign direct investment, and institutional quality, were excluded to maintain estimation precision. This approach ensures robust threshold estimates while maintaining a clear empirical focus on the monetary transmission channel. Future research may incorporate additional control variables to extend this analysis. The sample period ends in 2020 to avoid structural distortions introduced by the COVID-19 pandemic, thereby maintaining a consistent pre-pandemic baseline. The post-2020 period witnessed unprecedented monetary and fiscal interventions that may obscure the underlying nonlinear relationships. Future research may extend the sample period beyond 2020 to capture post-pandemic dynamics and examine the stability of the threshold effects. Additionally, the findings are specific to Pakistan's economic structure and may not be directly generalizable to other developing economies without appropriate contextual adjustments.

7. CONCLUSION AND IMPLICATIONS

This study confirms that the effects of exchange rate and money supply (M2) on economic growth in Pakistan are non-linear and regime-dependent, with three distinct threshold levels for each variable. The exchange rate transitions from a positive effect in the low-depreciation regime to a negative effect in the moderate regime, and finally to an insignificant effect in the high-depreciation regime. The money supply exhibits positive effects across all three regimes: strongest



in the low M2 regime, weakening in the medium regime, and partially recovering in the high regime. These findings underscore the need for regime-sensitive policymaking and demonstrate that linear models, which impose constant coefficients, obscure these critical dynamics and may lead to policy miscalibration.

Based on these findings, the following concrete policy recommendations are offered for the State Bank of Pakistan. First, exchange rate intervention should be triggered when depreciation approaches the second threshold to prevent contractionary effects through imported input costs. Second, monetary easing should be aggressively pursued only in the low M2 regime; in the medium regime, further easing should be avoided due to diminishing returns. Third, the SBP should adopt a formal threshold-based policy rule that conditions interest rate adjustments on whether the M2-to-GDP ratio lies below, within, or above the estimated thresholds. Fourth, coordinated exchange rate and monetary policy frameworks are essential, as depreciation-induced inflation may force contractionary money supply responses that push the economy into unfavorable regimes. Fifth, targeted support for import-dependent industries, such as temporary tariff relief or subsidized credit, should accompany periods of high depreciation. Finally, a real-time monitoring system tracking threshold indicators should be established to enable pre-emptive policy adjustments.

Conflict of interest

Authors have no conflict of interest

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Data Availability

All the data is available in the manuscript. And the datasets used and or analyzed during the current study are available from the corresponding author on reasonable request.

Authors contributions

All authors have contributed to various sections of this manuscript.



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