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Examining the Complex Role of Fiscal and Monetary Policy Shocks in Shaping Exchange Rate Dynamics: A Case Study of Pakistan's Currency Behavior

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ABSTRACT

This study departs from conventional literature by using quarterly data instead of annual data, enabling a more detailed exploration of short-term and long-term exchange rate fluctuations. It introduces an innovative analysis of the asymmetric effects of fiscal and monetary shocks on the Real Effective Exchange Rate (REER), a dimension often overlooked in prior research. The impulse response analysis reveals a clear pattern: negative shocks cause currency depreciation, while positive shocks lead to appreciation, except for money supply, where positive shocks result in unexpected depreciation. Variance decomposition emphasizes the dominant role of monetary policy tools—money supply and interest rates—over fiscal measures like government spending and taxes in influencing REER. The study recommends focusing on investment-driven fiscal policy to prevent excessive currency appreciation while supporting economic growth. Additionally, policies such as export promotion, import substitution, tight monetary regulation, and strong foreign reserves are essential for long-term exchange rate stability.

Keywords: *Exchange Rate Dynamics, Fiscal Policy Shocks, Monetary Policy Shocks, Real Effective Exchange Rate (REER), Vector Autoregression (VAR), Vector Error Correction Model (VECM), Asymmetric Effects.*

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INTRODUCTION

The exchange rate is a critical element in a nation's economic framework, shaping trade balances, inflation, and overall macroeconomic stability. Changes in exchange rates directly affect international competitiveness by influencing the relative prices of exports and imports in global markets (Edwards, 1989). Both monetary and fiscal policies play a central role in shaping these exchange rate dynamics. Monetary policy, through tools like interest rate adjustments and changes in money supply, directly impacts inflation and capital flows, which in turn influence the value of a country's currency (Frenkel & Johnson, 1978). On the other hand, fiscal policy, including government spending and taxation, affects investor confidence and the demand for domestic versus foreign assets, subsequently affecting exchange rate movements (Blanchard, 1981).

A strong theoretical framework underpins the relationship between these policies and exchange rates. According to the Monetary Approach, increasing the money supply leads to currency depreciation by reducing purchasing power, while higher interest rates attract foreign capital, appreciating the currency (Branson, 1977). The Purchasing Power Parity (PPP) theory supports this view, suggesting that exchange rates adjust to equalize prices across countries, with inflation or monetary changes correcting deviations (Dornbusch, 1976). Fiscal policy also plays a crucial role, as the Portfolio Balance Approach posits that government borrowing and spending initially raise interest rates and appreciate the currency, but concerns over debt sustainability can lead to depreciation (Blanchard, 1981). Investor preferences also influence capital flows, which further affect exchange rates (Kouri, 1976). These frameworks highlight the intricate interactions between monetary and fiscal policies, inflation expectations, and investor sentiment in determining exchange rate stability.

Building on this theoretical foundation, recent years have seen a growing body of research that delves into how fiscal and monetary policies influence exchange rates, often revealing intricate and dynamic interactions. For example, expansionary policies—whether through increased money supply or fiscal borrowing—generally lead to currency depreciation. Frenkel & Johnson (1978) and Dornbusch (1976) explained this via the "overshooting" mechanism, where exchange rates initially react more sharply than other macroeconomic variables. Similarly, Blanchard (1981) and Bénassy-Quéré et al. (2014) pointed out that fiscal expansions, while temporarily strengthening a currency due to higher interest rates, often lead to long-term depreciation, particularly in countries with high debt. In contrast, contractionary policies—such as reduced government spending or increased interest rates—are generally stabilizing, attracting foreign capital and curbing inflation, as seen in Branson (1977), Obstfeld & Rogoff (1995), and Shahbaz et al. (2018). The interaction between these policies and exchange rates is complex, shaped by factors like investor confidence, debt sustainability, inflation expectations, and global economic conditions.

In Pakistan, an emerging economy with significant external vulnerabilities, the exchange rate is especially sensitive to policy shifts and external shocks. The country's high external debt, inflationary pressures, reliance on imports, and exposure to geopolitical risks make it imperative to understand the varied impacts of fiscal and monetary policies. Several studies have explored these dynamics in Pakistan’s context. For instance, Shahbaz et al. (2018) examined the effect of monetary policy on exchange rate fluctuations, finding that monetary tightening appreciates the Real Effective Exchange Rate (REER), while monetary expansion causes depreciation. Similarly, Rehman, Ilyas, and Alam (2019) analyzed how fiscal deficits drive exchange rate volatility, concluding that large fiscal imbalances result in rupee depreciation due to increased borrowing and inflation. Javid and Munir (2016) used a Vector Error Correction Model (VECM) to study the long-run relationship between fiscal policy and exchange rates, showing that higher government expenditure leads to currency depreciation, primarily due to inflation. Ahmed, Zaman, and Sial (2017) found that fiscal deficits, when combined with loose monetary policy, worsen exchange rate depreciation. Likewise, Khan and Qayyum (2011) demonstrated the crucial role interest rate adjustments play in managing exchange rate volatility by influencing capital flows.

Despite these contributions, several gaps remain in the literature, particularly concerning Pakistan. Most existing research focuses on the symmetric effects of policy shocks, often neglecting the asymmetric nature of these relationships. However, recent studies (Belke & Klose, 2017; Bahmani-Oskooee & Mohammadian,

2017) underscore the significance of these asymmetries, showing that positive and negative shocks affect exchange rates differently. For instance, Bahmani-Oskooee and Mohammadian (2017) found that fiscal expansions lead to stronger currency depreciation compared to the more modest appreciation caused by fiscal contractions. Belke and Klose (2017) showed that monetary loosening results in sharper depreciation than the relatively weaker appreciation from monetary tightening.

In Pakistan's case, these asymmetries are particularly relevant given the country's susceptibility to external shocks and the nonlinear responses of its economy to policy changes. Furthermore, much of the existing literature focuses on short-term impacts and relies on annual data, which fails to capture the full scope of short-term fluctuations and long-term relationships between policy shocks and the REER (Javid & Munir, 2016; Rehman et al., 2019).

This study seeks to address these gaps by employing Vector Autoregression (VAR) and Vector Error Correction Models (VECM) to analyze both the short- and long-term effects of fiscal and monetary shocks on Pakistan's REER, using quarterly data from 1980Q1 to 2020Q4. The use of quarterly data provides a more detailed analysis, revealing short-term fluctuations often missed in annual studies. Additionally, by examining the asymmetric effects of fiscal and monetary shocks, this study offers fresh insights into how positive and negative shocks differentially affect exchange rates, equipping policymakers with critical tools to manage exchange rate volatility and foster macroeconomic stability.

The remainder of the paper is organized as follows: Section 2 reviews the relevant literature, Section 3 presents the data and methodology, Section 4 discusses the results, and Section 5 concludes with policy implications.

LITERATURE REVIEW

Economists have long been interested in the relationship between exchange rates and monetary and fiscal policies. Currency depreciation is often the result of expansionary policies like raising the money supply or borrowing to fund budget deficits. The overshooting effect in which exchange rates react sharply before stabilizing over time was initially used by Frenkel and Johnson (1978) and Dornbusch (1976) to explain this. Blanchard (1981) and Bénassy-Quéré et al. (2014) noted that although fiscal expansions can cause a short-term spike in interest rates they frequently lead to long-term depreciation because of inflation and worries about the sustainability of the debt particularly in highly indebted nations. Conversely contractionary measures like cutting back on spending or hiking interest rates have a tendency to keep currencies stable. Research by Obstfeld & Rogoff (1995) Shahbaz et al. (1995) and Branson (1977) demonstrate that greater interest rates draw in foreign capital which strengthens the currency and causes inflation to increase. In Pakistan Shahbaz et.al (2018) noted that the Real effective exchange rate (REER) was strengthened by monetary tightening while Rehman Ilyas and Alam (2019) discovered that significant fiscal deficits caused the rupee to weaken because of increased borrowing and rising inflation. The asymmetric effects of these policies have been clarified by more recent studies. According to Bahmani-Oskooee & Mohammadians (2017) research fiscal expansions typically result in more depreciation than the slight appreciation that comes from fiscal contractions. Belke and Klose (2017) also observed that monetary loosening causes a more significant depreciation of currency than monetary tightening which yields more moderate gains. For nations like Pakistan where external vulnerabilities can amplify the effects of such shocks this asymmetry is especially pertinent. Javid and Munir (2016) demonstrated that increased government spending in Pakistan causes currency depreciation because of inflationary pressures while Ahmed Zaman and Sial (2017) discovered that the depreciation gets worse when fiscal deficits are coupled with loose monetary policy. Further investigation into the impact of asymmetric shocks on exchange rates in developing nations such as Pakistan is necessary in light of these findings. This will aid policymakers in mitigating currency volatility and preserving economic stability. To sum up research suggests that monetary and fiscal expansionary policies typically result in currency depreciation whereas contractionary policies can stabilize the exchange rate. Nonetheless the growing comprehension of disparities in the effects of these regulations emphasizes the necessity for additional investigation. Understanding these dynamics is essential for developing policies that effectively address both short-term volatility and long-term economic stability for Pakistan where the exchange rate is highly sensitive to both external shocks and internal policy shifts.

DATA AND METHODOLOGY

For this study, we used quarterly data for Pakistan from 1980Q1 to 2020Q4. The Pakistan Bureau of Statistics, SBP, and Handbook of Statistics have all provided data. The sources, annotations, and variable units are compiled in Table 4.

Beginning with an overview of the theoretical underpinnings, this section delves into the specifics of the econometric techniques applied in research analysis. It presents a VAR model that looks at delayed reactions to assess how the REER reacts to fiscal shocks and monetary shocks. In addition, tests for causality, VDA and IR analysis are included in the econometric analysis. Moreover, the use of the VECM makes a detailed analysis of long-term dynamics possible.

Basic model

REER= F (G, T, M, R) ……………………………………3.1

$REER = \alpha_0 + \alpha_1 G + \alpha_2 T + \alpha_3 M + \alpha_4 R + \epsilon_t$…………...3.2

REER= Real Effective Exchange rate

G = Government Expenditure

T = Tax Revenue

M = Money Supply

R = Interest Rate

The REER has been using is a dependent variable. Government expenditure, Tax revenue, Money supply, and Interest rate are independent variables. The REER is the function of government expenditure, tax revenue, money supply, and interest rate. α_0 is the intercept term. $\alpha_1, \alpha_2, \alpha_3, and\ \alpha_4$ are slope coefficient and ϵ_t are residual term.

REER = Real Effective Exchange Rate, M = Money Supply (M2, Broad Money)

R = Interest Rate, G = Government expenditure, T = Tax revenue

VAR AND SVAR MODEL

The abbreviation VAR stands for Vector Autoregression, in which "Vector denotes the incorporation of multiple variables in the model, and Autoregressive refers to the inclusion of past (lag) values of the dependent variable in equation." Numerous econometric models were frequently employed for the evaluation and study of macroeconomic projections and trends prior to the macroeconomic instability of the 1970s. Christopher Sims unveiled a novel approach in 1980 that he called the "VAR model." Sims handled all endogenous variables as endogenous functions of their historical (lag) values. This method covered four important topics for macroeconomic econometricians: policy analysis, structural inferences, macroeconomic forecasting, and data summarization and description.

For more than 40 years, the emphasis has been on data description and summary; yet, because these two areas necessitate expertise and experience, they have drawn criticism. To determine the combined dynamic and causal links among a group of variables, Sims proposed the VAR model. Analysing the dynamics of random disturbances or shocks, it is a multivariate model extension of univariate autoregression. It is also used for forecasting linked time series on a group of variables.

SVAR is designed to illustrate the immediate impact among variables, involving multiple variables depicted by a linear vector of observations based on their own past values and the values of other variables, alongside constant or trend components (Bernanke 1986, Blanchard & Watson 1986, Sims 1986). When estimating SVAR, the model must be either over-identified or exactly identified. SVAR relies on identification assumptions that allow for the interpretation of correlations in a traditional manner. This assumption may entail the full VAR model to identify all causal relationships among the variables, or in a single-equation model, only a specific causal relationship is identified. In a VAR framework, there is no differentiation between exogenous and endogenous variables; all variables are treated equally. The key characteristic of SVAR is that innovations must be uncorrelated, as stipulated by the identification assumption. Formally, this necessitates setting the covariance term to zero or ensuring that the variance-covariance matrix of residuals follows a diagonal structure.

In this study, the VAR model is employed to depict the movement of exchange rates in reaction to monetary and fiscal shocks. The model includes five endogenous variables: REER, Government expenditure, Tax revenue, money supply and interest rates. These variables are utilized to analyse how REER responds to monetary and fiscal shocks.

The general form of VAR model is as follows.

$$Y_t = \sum_{i=1}^{k} X_i Y_{t-1} + U_t$$

The variables Y_t = ($REER_t$, G_t T_t, M_t R_t) are significant in assessing the impact of fiscal and monetary shocks on exchange rates. The coefficient matrix Xi represents the coefficients of all variables. Y_{t-1} and U_t refer to the vector of lagged variables and error terms, respectively. Express the equations above in matrix form to represent the specified VAR model,

where p denotes the possible lag length.

$$\begin{bmatrix} REER_t \\ G_t \\ T_t \\ M_t \\ R_t \end{bmatrix} = \begin{bmatrix} \phi_0 \\ \omega_0 \\ \rho_0 \\ \sigma_0 \\ \lambda_0 \end{bmatrix} + \sum_{i=1}^{p} \begin{bmatrix} \phi_{1i} & \phi_{2i} & \phi_{3i} & \phi_{4i} & \phi_{5i} \\ \omega_{1i} & \omega_{2i} & \omega_{3i} & \omega_{4i} & \omega_{5i} \\ \rho_{1i} & \rho_{2i} & \rho_{3i} & \rho_{4i} & \rho_{5i} \\ \sigma_{1i} & \sigma_{2i} & \sigma_{3i} & \sigma_{4i} & \sigma_{5i} \\ \lambda_{1i} & \lambda_{2i} & \lambda_{3i} & \lambda_{4i} & \lambda_{5i} \end{bmatrix} \begin{bmatrix} REER_{t-i} \\ G_{t-i} \\ T_{t-i} \\ M_{t-i} \\ R_{t-i} \end{bmatrix} + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \\ \mu_{4t} \\ \mu_{5t} \end{bmatrix} \qquad (2)$$

The corresponding Structural VAR (SVAR) model is written as follows.

$$\begin{bmatrix} REER_t \\ G_t \\ T_t \\ M_t \\ R_t \end{bmatrix} = \begin{bmatrix} a_0 \\ b_0 \\ c_0 \\ d_0 \\ f_0 \end{bmatrix} + \sum_{i=0}^{p} \begin{bmatrix} a_{1i} & a_{2i} & a_{3i} & a_{4i} & a_{5i} \\ b_{1i} & b_{2i} & b_{3i} & b_{4i} & b_{5i} \\ c_{1i} & c_{2i} & c_{3i} & c_{4i} & c_{5i} \\ d_{1i} & d_{2i} & d_{3i} & d_{4i} & d_{5i} \\ f_{1i} & f_{2i} & f_{3i} & f_{4i} & f_{5i} \end{bmatrix} \begin{bmatrix} REER_{t-i} \\ G_{t-i} \\ T_{t-i} \\ M_{t-i} \\ R_{t-i} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \\ e_{5t} \end{bmatrix} \qquad (3)$$

Now in the simplified VAR model, the indexing starts at 1 while in the SVAR model, this starts from zero. This is the crucial difference between the reduced form VAR and the structural VAR models. In the structural VAR model, the indexing starts from zero. This way, the variables at time t can be included into the identified shocks which are specified by the pure dependent variable of shocks: This is because the structural VAR necessitates imposing identification constraints on the structural parameters to be estimated. Estimation and interpretation of the VAR model require different analytical techniques, such as Granger Causality tests, IRF, and VDA.

Also, concerning innovation accounting in the IRF and VDA implementation, identification restrictions must be imposed to transform VAR back into SVAR. The most common form of identification restriction is ordering on the variables with respect to the timing of their instantaneous effects on each other. This is generally referred to as the Cholesky ordering or Cholesky restrictions. Next, we will analyse the three analytical tools of the VAR model, given as follows.

Impulse response analysis

An IRF is an analytical tool designed to show the impact of sudden changes in one variable on other related variables over time. It isolates the dynamic trajectory of how external changes impinge on internal variables and how these changes propagate within the system to affect other variables. For instance, an IRF traces the instantaneous effect of the shocks that hit the current period on the changes in relevant variables- without any lag in the current period, with one-period lag in the next period, and with two-period lag in the second subsequent period until the impact stabilizes. The formulation of IRF allows studying the interaction among the endogenous variables in a systematic way.

IRF for Real effective Exchanger Rate

$\partial REER_{1t}/\partial e_{1t-i} = C_{11}(i)$	$\partial REER_{1t}/\partial e_{1t} = C_{11}(0)$	$\partial REER_{1t}/\partial e_{1t-1} = C_{11}(1)$	$\partial REER_{1t}/\partial e_{1t-2} = C_{11}(2)$	$\partial REER_{1t}/\partial e_{1t-3} = C_{11}(3)$
$\partial REER_{1t}/\partial e_{2t-i} = C_{12}(i)$	$\partial REER_{1t}/\partial e_{2t} = C_{12}(0)$	$\partial REER_{1t}/\partial e_{2t-1} = C_{12}(1)$	$\partial REER_{1t}/\partial e_{2t-2} = C_{12}(2)$	$\partial REER_{1t}/\partial e_{2t-3} = C_{12}(3)$

IRF for Government Expenditure

$\partial G_{1t}/\partial e_{1t-i} = C_{11}(i)$	$\partial G_{1t}/\partial e_{1t} = C_{11}(0)$	$\partial G_{1t}/\partial e_{1t-1} = C_{11}(1)$	$\partial G_{1t}/\partial e_{1t-2} = C_{11}(2)$	$\partial G_{1t}/\partial e_{1t-3} = C_{11}(3)$
$\partial G_{1t}/\partial e_{2t-i} = C_{12}(i)$	$\partial G_{1t}/\partial e_{2t} = C_{12}(0)$	$\partial G_{1t}/\partial e_{2t-1} = C_{12}(1)$	$\partial G_{1t}/\partial e_{2t-2} = C_{12}(2)$	$\partial G_{1t}/\partial e_{2t-3} = C_{12}(3)$

IRF for Tax Revenue

$\partial T_{1t}/\partial e_{1t-i} = C_{11}(i)$	$\partial T_{1t}/\partial e_{1t} = C_{11}(0)$	$\partial T_{1t}/\partial e_{1t-1} = C_{11}(1)$	$\partial T_{1t}/\partial e_{1t-2} = C_{11}(2)$	$\partial T_{1t}/\partial e_{1t-3} = C_{11}(3)$
$\partial T_{1t}/\partial e_{2t-i} = C_{12}(i)$	$\partial T_{1t}/\partial e_{2t} = C_{12}(0)$	$\partial T_{1t}/\partial e_{2t-1} = C_{12}(1)$	$\partial T_{1t}/\partial e_{2t-2} = C_{12}(2)$	$\partial T_{1t}/\partial e_{2t-3} = C_{12}(3)$

IRF for Money Supply

$\partial M_{1t}/\partial e_{1t-i} = C_{11}(i)$	$\partial M_{1t}/\partial e_{1t} = C_{11}(0)$	$\partial M_{1t}/\partial e_{1t-1} = C_{11}(1)$	$\partial M_{1t}/\partial e_{1t-2} = C_{11}(2)$	$\partial M_{1t}/\partial e_{1t-3} = C_{11}(3)$
$\partial M_{1t}/\partial e_{2t-i} = C_{12}(i)$	$\partial M_{1t}/\partial e_{2t} = C_{12}(0)$	$\partial M_{1t}/\partial e_{2t-1} = C_{12}(1)$	$\partial M_{1t}/\partial e_{2t-2} = C_{12}(2)$	$\partial M_{1t}/\partial e_{2t-3} = C_{12}(3)$

IRF for Interest Rates

$\partial R_{1t}/\partial e_{1t-i} = C_{11}(i)$	$\partial R_{1t}/\partial e_{1t} = C_{11}(0)$	$\partial R_{1t}/\partial e_{1t-1} = C_{11}(1)$	$\partial R_{1t}/\partial e_{1t-2} = C_{11}(2)$	$\partial R_{1t}/\partial e_{1t-3} = C_{11}(3)$
$\partial R_{1t}/\partial e_{2t-i} = C_{12}(i)$	$\partial R_{1t}/\partial e_{2t} = C_{12}(0)$	$\partial R_{1t}/\partial e_{2t-1} = C_{12}(1)$	$\partial R_{1t}/\partial e_{2t-2} = C_{12}(2)$	$\partial R_{1t}/\partial e_{2t-3} = C_{12}(3)$

Based on the sample structural residuals, the magnitude of each shock is equal to one standard deviation of the shock. We choose the order of REER, Money Supply (M), Interest Rate (R), Government Expenditure (G), and Tax Revenue (T) based on previous research (e.g., Rogers, 1999). We take this context to mean that there is no correlation between the structural disturbance terms.

Vector error correction model (VECM)

Consider the general VAR model.

$$Y_t = \sum_{i=1}^{k} X_i Y_{t-1} + U_t$$

Where A_i's are K×K coefficients matrix, $V_t = [ER_t, G_t, T_t, M_t\ R_t]'$ and $U_t = [U_{1t}, U_{2t}, \ldots\ U_{kt}]'$ is an error term (white noise).

$$Y_t = X_1 Y_{t-1} + X_2 Y_{t-2} + X_3 Y_{t-3} - - - + X_n Y_{t-1} + U_t \qquad (5)$$

If the determinant of (Ik – A12 –, – AnZn) ≠ 0 for every |Z| ≤ 1, then the VAR model is stable. We may calculate VECM in order (n-1) by subtracting Vt-1 from equation (5) on both sides and rearranging the equation, in accordance with the methods described in (Lutkepohl, 2004; Lutkepohl, 2013, Chamalwa 2016, Ahmed et al. 2019).

$$\Delta Y_t = \pi Y_{t-1} + \tau_1 \Delta Y_{t-1} + \cdots + \tau_{n-1} \Delta Y_{t-n+1} + U_t \qquad (6)$$

π = - (I_k – X_1 -X_2 -, - X_n) & τ = - (X_{i+1} + $X_{i+2,}$ + X_n) for i= 1,2,3 . . ., n-1)

The parameters τjs (1, 2, 3, ..., n-1) are identified as short-term components, while πV_(t-1) represents the long-term components. Equation (6) is referred to as VECM (n-1). Xj denotes the matrix of level parameters derived from the coefficients of the VECM, where X1 = τ_1 + π + IK, Xi = τ_i + τ_(i-1) for i= 2, 3, ..., n-1, and An = -τ_(n-1). In the case of a non-stationary VAR, the determinant of (IK – X1Z – X2Z – X3Z - ... – XnZn) equals 0, rendering the matrix π = -(IK - X1 - X2 - ... – Xn) singular. Let rK(π) = r. Thus, π can be expressed as π = αβ'. Multiplying an I(0) vector by a certain matrix result in an I(0) process. Consequently, β'Y_(t-1) is I(0) since it can be obtained by pre-multiplying πY_(t-1) = αβ'Y_(t-1) by (α'α) ^-1α^-1. Hence, β'Y_(t-1) encompasses a co-integration relationship. There exists r=rk(π) linearly independent co-integrating relations among the elements of Vt. The co-integrating rank of π is termed as the rank of co-integration, while β represents a co-integrating matrix. In our scenario with five variables, there are five co-integration relations (r = 5). The VECM can be represented in matrix form as follows.

$$\pi Y_{t-1} = \alpha\beta' Y_{t-1} = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} & \alpha_{14} & \alpha_{15} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} & \alpha_{24} & \alpha_{25} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} & \alpha_{34} & \alpha_{35} \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & \alpha_{44} & \alpha_{45} \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \alpha_{54} & \alpha_{55} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{21} & \beta_{31} & \beta_{41} & \beta_{51} \\ \beta_{12} & \beta_{22} & \beta_{32} & \beta_{42} & \beta_{52} \\ \beta_{13} & \beta_{23} & \beta_{33} & \beta_{43} & \beta_{53} \\ \beta_{14} & \beta_{24} & \beta_{34} & \beta_{44} & \beta_{54} \\ \beta_{15} & \beta_{25} & \beta_{35} & \beta_{45} & \beta_{55} \end{bmatrix} \begin{bmatrix} REER_{t-1} \\ G_{t-1} \\ T_{t-1} \\ M_{t-1} \\ R_{t-1} \end{bmatrix}$$

$$= \begin{bmatrix} \alpha_{11}\, ec_{1t-1} + \alpha_{12} ec_{2t-1} + \alpha_{13} ec_{3t-1} + \alpha_{14} ec_{4t-1} + \alpha_{15} ec_{5t-1} \\ \alpha_{21}\, ec_{1t-1} + \alpha_{22} ec_{2t-1} + \alpha_{23} ec_{3t-1} + \alpha_{24} ec_{4t-1} + \alpha_{25} ec_{5t-1} \\ \alpha_{31}\, ec_{1t-1} + \alpha_{32} ec_{2t-1} + \alpha_{33} ec_{3t-1} + \alpha_{34} ec_{4t-1} + \alpha_{35} ec_{5t-1} \\ \alpha_{41}\, ec_{1t-1} + \alpha_{42} ec_{2t-1} + \alpha_{43} ec_{3t-1} + \alpha_{44} ec_{4t-1} + \alpha_{45} ec_{5t-1} \\ \alpha_{51}\, ec_{1t-1} + \alpha_{52} ec_{2t-1} + \alpha_{53} ec_{3t-1} + \alpha_{54} ec_{4t-1} + \alpha_{55} ec_{5t-1} \end{bmatrix}$$

While,

$ec_{1t-1} = \pi_{11}REER_{t-1} + \pi_{21}G_{t-1} + \pi_{31}T_{t-1} + \pi_{41}M_{t-1} + \pi_{51}R_{t-1}$

$ec_{2t-1} = \pi_{12}REER_{t-1} + \pi_{22}G_{t-1} + \pi_{32}T_{t-1} + \pi_{42}M_{t-1} + \pi_{52}R_{t-1}$

$ec_{3t-1} = \pi_{13}REER_{t-1} + \pi_{23}G_{t-1} + \pi_{33}T_{t-1} + \pi_{43}M_{t-1} + \pi_{53}R_{t-1}$

$ec_{4t-1} = \pi_{14}REER_{t-1} + \pi_{24}G_{t-1} + \pi_{34}T_{t-1} + \pi_{44}M_{t-1} + \pi_{54}R_{t-1}$

$ec_{5t-1} = \pi_{15}REER_{t-1} + \pi_{25}G_{t-1} + \pi_{35}T_{t-1} + \pi_{45}M_{t-1} + \pi_{55}R_{t-1}$

α - the loading matrix assigns significance to co-integrating relations in each equation of the model. There are certain instances, however, which are important and must be noted as seen in Model 6. The process is considered stationary for when all the variables are integrated of zero-order I (0) with rank r = number of variables k. If r = 0, the term πV_(t-1) disappears in (6), which means that Vt is a stationary VAR process.

Evidently this latter situation does not constitute a co-integrating process, although Model (6) has a co-integrating rank which is less than 0 and K.

RESULT AND ANALYSIS

Herewith, the passage highlights testing for stationarity when working with time series data. It further explains that if the variables happen to be non-stationary, the application of OLS estimation may result in spurious results, and checking for stationarity forms a very important step in time series modelling. In fact, according to this passage, it is possible to adapt the widely used ADF unit root test to this purpose. The results in Table-1 indicate that all the t-statistic values are below the t-critical values at the given level of significance. This means that the null hypothesis of "all series have a unit root" is not rejected at this level and, therefore, the variables under consideration are not stationary at level. Presumably, taking a first difference of variables, computed t-statistic values go beyond the critical t-value. This implies that all the series are first difference stationary. Based on the results of the ADF test, the researchers will estimate a simple VAR model using the first difference of the variables. Also, to explore the cointegration and long-run analysis, they would estimate a VECM. The general view is that the stationarity test, the order of integration obtained through the ADF test, and the successive modelling approaches-VAR and VECM for capturing short-run to long-run dynamics of the variables-are the highlights.

Table 1:ADF Test Result

Variable	Level		First Difference		Order
	With intercept	**With Intercept and Trend**	**With intercept**	**With Intercept and Trend**	**Result**
REER	-2.06818	-1.277516	-9.06584**	-9.177131**	I(1)
G	-2.0895	-1.9940	-3.9012**	-3.9622**	I(1)
T	-2.57373	-2.50111	-3.91527**	-3.946548**	I(1)
M	5.556451	5.760047	4.541900**	2.359567**	I(1)
R	-1.92247	-2.021627	-11.9644**	-11.96724**	I(1)

The significance levels of T-statistics are denoted by *** for 1%, ** for 5% and * for 10%.

Table 1 shows the variables used in their first difference form to estimate a VAR model once the unit root test results are obtained. Several factors were applied to identify the best VAR order.

Table 2: Lag Length Criteria

Lag	Likelihood function	LR	FPR	AIC	SIC	HQ
0	1282.094	NA	8.87e-14	-15.86453	-15.76883	-15.82567
1	1427.622	280.2091*	1.98e-14*	-17.3617*	-16.7879*	-17.1283*
2	1445.259	32.86335	2.18e-14	-17.27030	-16.21765	-16.84288

Note: Asterisk represents lag order chosen by the criteria.

Table 2 presents the results of these criteria. The SIC, AIC and other criteria recommends a VAR model with one lag.

Table 3: Serial LM Correlation

Lags	LRE Statistics	Probability
1	32.89215	0.1339

We run the LRE test with one lag in Table 3 to examine the serial correlation. It shows that the model does not have serial correlation.

Table 4: White Heteroskedasticity (joint test result, with cross term)

Chi-sq test statistics	Probability
323.6609	0.1663

The result of white heteroskedasticity (joint) with cross term was displayed in Table 4. There is no heteroskedasticity in the error terms, as evidenced by the identical variances of the residual

Table 5: Correlation Matrix

	REER	G	T	M	R
REER	1				
G	0.175252	1			
T	0.123667	0.59680	1		

M	0.156595	0.23089	0.41305	1	
R	0.016127	0.06445	0.12071	0.01463	1

The association between the explanatory variables was shown in Table 5. The outcome demonstrates that the variables do not have precise linear connections. It attests to multicollinearity's absence.

Table 5: VAR Stability Test

Roots	**Modulus**
0.808792	0.808792
0.731286	0.731286
0.688657	0.688657
0.282469	0.282469
0.083129	0.083129

The VAR model's stability is seen in Table 6. The VAR model is stable since every root is inside the unit root circle.

Granger Causality Test

Causality is a relationship in which, given other variables constant, the current and past values of "X" may more accurately predict the value of "Y, making "X" a GRANGER cause of "Y." We cannot reject H0 if lag values of 'Xt' have no effect on 'Yt'. We say "Xt does not granger cause Yt" in these situations. Table 7 Possible results from Granger causality. The results show that there are five cases of one-way causality in the endogenous variables, one case of two-way causality, and four cases where there is no causality at all.

First, it can be seen that fiscal policy Granger causes REER. In a situation where increased government expenditure tends to raise demand for domestic goods and services and therefore tends to drive up prices. This would also cause the appreciation of the exchange rate in the case where prices at home increase more rapidly compared to trading partner countries. Increased government spending may require additional borrowing, which hikes the rate of interest rates: higher interest rates can attract foreign investment and cause the currency to appreciate. Second is tax revenue, where the capability of the government in terms of spending is affected by tax revenue. Higher tax revenue gives the government more room to spend on infrastructure, education, and other areas that trigger economic activities. Increased government spending can increase the demand for domestic goods and services and may appreciate the exchange rate if domestic prices are rising more rapidly compared to that of the trading partner.

Third, REER has been influenced by Monetary policy. This is in line with the exchange rate based on money since an upward translation of the money supply may generate a downward move of the interest rates, cash flows abroad, leaving its country of origin, which decreases REER and depreciates the currency at home. Hence, monetary policy actively determines the currency rate.

Table 6: Granger Causality Test

Hypothesis	Chi Square	Probability	Significant Causality
G does not cause REER REER does not cause G	7.8906 0.021839	.019345 0.8825	G →REER One way Causality
T does not cause REER REER does not cause T	9.6784 0.103431	0.007913 0.7478	T →REER One way Causality
M does not cause REER REER does not cause M	17.345 0.579626	.000171 0.4465	M →REER One way Causality
R does not cause REER REER does not cause R	22.2134 8.67480	.000015 .013076	R →REER One way Causality
T does not cause G G does not cause T	33.2134 41.0096	.00001 .00001	T →G One way Causality
M does not cause G G does not cause M	0.919940 0.094830	0.3375 0.7581	No Causality
R does not cause G G does not cause R	0.127500 0.128157	0.7210 0.7204	No Causality
M does not cause T T does not cause M	0.000904 0.001379	0.9760 0.9704	No Causality
R does not cause T T does not cause R	0.142109 7.63E-05	0.7062 0.9930	No Causality
R does not cause M M does not cause R	21.2341 14.45621	0.00024 .000726	R ↔ M Two-way Causality

The money market equilibrates when the supply of money is equal to the demand for money. If the money supply increases or decreases relative to demand, the interest rate increases or decreases. this just shows that at least some changes in interest rates can be due to several causes, one of which is changes in the supply of money. Hahn 1980 and Brunner 1970, and Brunner and Meltzer 1972, 1973, and 1974. Lastly, it is observed that money supply and interest rate influence each other bi-directionally, hence showing a dynamic relationship between these two macro-economic variables. Increasing the money supply may be associated with a drop in interest rates-and vice versa-so that variations in the money supply may affect the level of interest rates. It could also affect the money supply, since a rise in interest rates would eventually reduce borrowing and spending, hence contracting the money supply. Since this would mean that the monetary policy actions against one variable-say, changes in the money supply-have possibly fed-back effects on the other variable-interest rates-it is an important aspect for policymakers in designing and conducting monetary policies.

Impulse Response Analysis

The analysis has used IRFs to check the effect of structural shocks on each variable considering the lag values in the incidence of these shocks. An attempt has been made to conduct Cholesky ordering for arranging the endogenous variables, as follows: REER, G, T, M, and R. Figures 1 to 5 depict the IRFs for the abovementioned Cholesky ordering. The blue line represents the IRF, and the red lines are the 95 percent confidence intervals. Note that the blue line, which plots the response of a variable to a shock, must always lie between the two red lines for its response to be considered statistically significant. The horizontal axis is time for the figures, shown in quarters, extending from quarter one to quarter ten. It is the measure of the magnitude of the response; the standard deviation, therefore, is taken along the vertical axis. IRF analysis provides ways of knowing the dynamic interaction and responses among the system's variables by considering the lag structure and statistical significance of the observed effects.

Figure 1 presents the IRF of REER to its own lag values. Starting from one lag, and up to quarter 10, it calculates the effect of a shock in REER on its own values. Starting from the first quarter up to the fifth quarter, REER will decrease because of a one-time standard deviation shock, response, impulse, or innovation supplied to REER, lag values. The impact of the shock becomes very small and negligible after the fifth quarter. Because of these shocks, the home currency greatly depreciates. This result is, to some degree, not astonishing because some macroeconomic variables have the tendency to return to their usual historical behaviours after a while (Lee & Tang, 2007). In this case, REER does show a strong tendency to stick with its historical trend.

The response of the REER to G is plotted in Figure 2. In this, the red line represents IRF showing variable time delay from one to quarter 10 consequences of a shock in REER caused by changes in the government expenditure. It studies the effect of one-time response of G on REER during the second to the ninth quarter. After the ninth quarter, the effects of the shock wear out and the REER returns to its original position Zahra (2023).

Figure 3 shows that, from the second quarter, there was one standard deviation or response of tax revenue in REER, which went down to quarter eight. The REER goes back to where it was before the eighth quarter. First, the shocks make the domestic currency stronger after making its value go down Munir (2019).

IRF set of REER are plotted against the interest rates as shown in Figure 4. First, REER will increase from the first to the second quarter due to a one-time response or innovation in interest rates. After that, there occurs a reversal of events that causes REER to fall until the fourth quarter and then rise again until the fifth. The REER returns to the level reached after the fifth quarter.

Similarly, Figure 5 shows how M responds to a one-time response or innovation shocks on the REER. The graph shows that such shocks demonstrate the effect of the REER to decline slowly from Q1 to Q4. After Q5 and onwards, the effect of the shock wears off, and the REER converges to the starting point. These findings imply that the M depreciates the local currency.

From here, we derive the conclusion that home currency can appreciate or devaluate against the other currencies because of the positive or negative shocks Shaheen (2015).

Figure 1 : Response of REER to REER

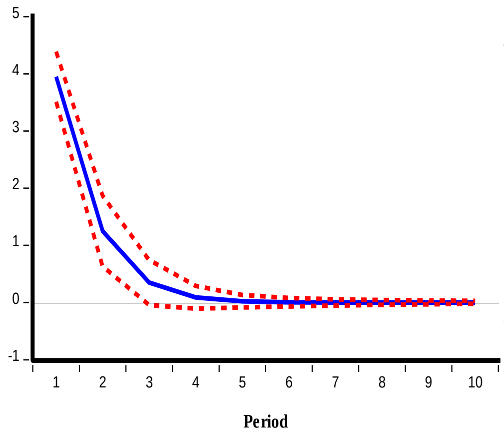


Figure 2: Response of REER to G

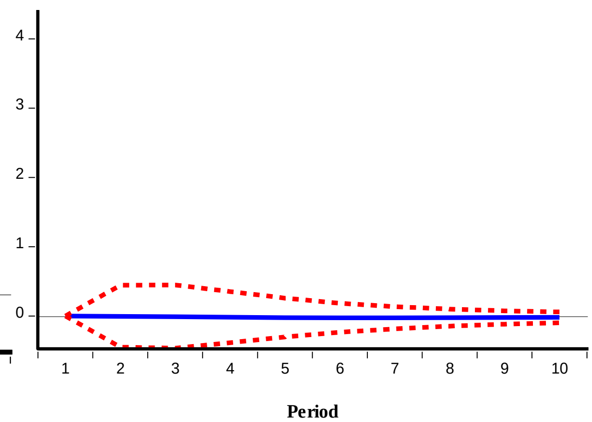


Figure 3: Response of REER to T

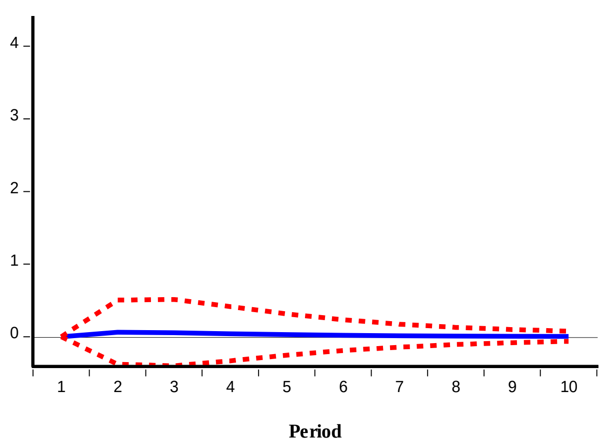


Figure 4: Response of REER to R

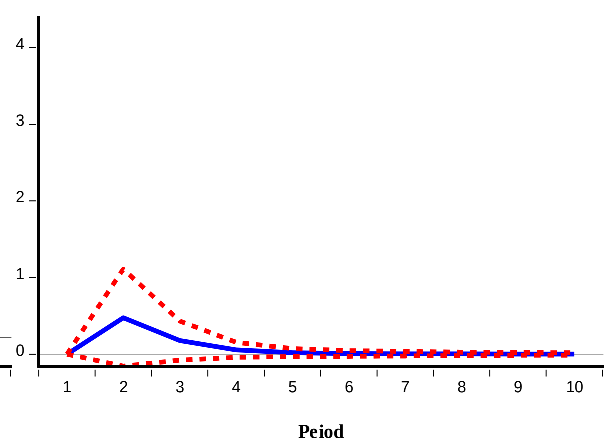
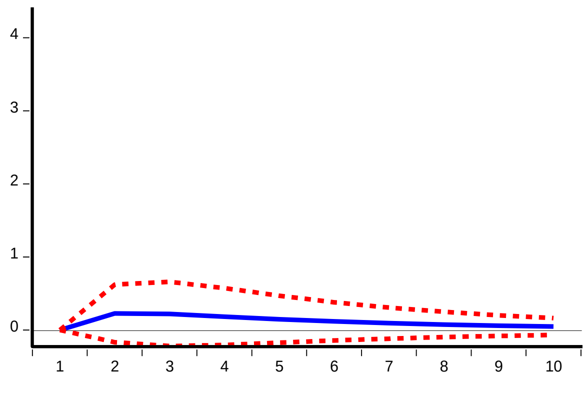


Figure 5: Response of REER to M



Variance Decomposition Analysis

VDA is done to consider the issue of how structural shocks in each variable contribute to the overall variance of the variable. Table 5.8 shows the percentage of forecast errors variance decomposed by the government expenditure, tax revenue, Money supply and policy rate. Table 5.8 the five columns in the table represent the percentage contribution of each of the five variables' shock to the accumulated forecast errors variance of REER from first period to the tenth period. VDA for the REER reveals the following: the monetary policy variables are the M and R that considerably provide a high contribution to the forecast error variance of REER Hussain (2009). This tends to suggest that the changes in monetary policy are likely to be the decisive factors contributing to variation in the REER. The contribution of G and T to the forecast error variances of REER are relatively small compared to the monetary policy variables.

In the first period, REER itself accounts for 100% of the forecast error variance in REER, which means there is complete and instantaneous transmission of a shock to REER in its own variance. Contributions of other variables G, T, M, and R are negligible in this initial period.

In the second period, about 87% of the forecast error variance in REER is contributed by itself, while the remaining 13% is contributed by the other four variables, G, T, M, and R. It shows that the contribution of the other variables to the fluctuations in REER becomes stronger in the subsequent periods. Putting it precisely, the monetary policy shocks over the seven-quarter lag explain more than 37 percent of the variance in REER, while government expenditure and tax revenue shocks explain more than about 11 and 8 percent of variance, correspondingly. The implication of this is that a shock in monetary policy contributes more significantly to REER compared to fiscal shocks. The finding coincides with the works of Ali (2015), Beetsma, et al. (2008).

Table 7: Variance Decomposition Analysis

Period	REER	G	T	M	R
1	100.0000	0.000000	0.000000	0.000000	0.000000

2	87.385137	2.015297	1.374063	4.925641	4.299862
3	81.254254	4.042207	2.614075	6.148619	5.449353
4	75.324423	5.093370	4.736555	8.173037	6.672615
5	64.18896	7.134499	5.795437	14.176472	8.704632
6	50.134979	9.160172	7.822847	20.176841	12.705161
7	42.110162	11.174421	8.835313	22.176678	15.703426
8	33.098012	13.181799	10.840881	25.176484	17.702824
9	26.091992	14.185443	12.843332	27.176352	19.702881
10	21.089041	16.187183	13.844399	28.176276	20.703101

Long Run Analysis

To examine the long-term relationship between variables, the Johansen Co-integration technique is applied. Table 5.9 displays the estimated outcomes. Co-integration is present because the trace test demonstrates that the p-value is significant for rank (r = 0 to 4). At the 5% level of significance, the test also verifies the existence of five co-integrating equations, which show the long-term relationships between all variables.

Table 8: Co-integration Rank Test

Co-integrating Equations	Eigenvalues	Trace Stat	Critical Values	Prob
0*	0.368736	186.7136	69.81889	0.0000
1*	0.274766	112.6486	47.85613	0.0000
2*	0.172393	60.92550	29.79707	0.0000
3*	0.153822	30.46161	15.49471	0.0001
4*	0.021932	3.570409	3.841466	0.0588

Note 5% level of significant.

The residuals' stationarity test results are shown in Table 10, which shows that residuals are stationarity at a certain level. This demonstrates the validity of the model and the long-term correlations between the variables REER, G, T, M, and R. The two requirements for co-integration are fulfilled by table 5.9 and

5.10. There is a linear combination of REER, G, T, M, and R if (a) all variables are I (1) and (b) residuals are I (0).

Table 9: ADF Test for Residual

Critical Values			t-stat	P-Value
1%	5%	10%		
-4.0153	-3.4376	-3.1430	-5.401	0.0001

Table 10: VECM Test Result

Variables	Coefficients	Standard error	T-statistics
REER (-1)	1.000000		
G (-1)	-0.094033	0.03759	-2.50147
T (-1)	-0.014889	0.04632	-0.32148
M (-1)	0.366187	0.06562	5.58038
R (-1)	-0.005303	0.00026	-20.4195
C	-0.619696		

There are two steps involved in estimating a VECM. Initially, the cointegration relation is estimated using the Johansen technique. Second, the cointegration relation and VAR in first difference are used to estimate the error correction terms. The outcomes for the long-term co-integration and ECT are displayed in Table 11 and Table 12. The co-integration estimated equation is shown below.

REER - 0.094033G – 0.014889T + 0.366187M – 0.005303R = 0

Rearrange the above equation.

REER = 0.094033G + 0.014889T – 0.366187M + 0.005303R

The coefficients in table 11 represent the long-run relationship among REER, G, T, M, and R, while the coefficients in table 12 represent the deviation from the long run relation which affects variation in the coming period. The coefficients are long-run elasticities because these variables are taken in log form. Fiscal shocks, particularly increases in government spending, have been found to raise inflationary pressures and cause the exchange rate to appreciate (Ferrara, 2020, 2021). This effect has been observed in both developed countries like the US and emerging countries like China (Chen, 2018). Government expenditure increases have a strong correlation with trade balance deficits, suggesting that these shocks also affect the trade balance (Ferrara, 2020, 2021; Chen, 2018). These findings suggest that the exchange rate is significantly influenced by fiscal policy. Exchange rates increase when government purchases rise in underdeveloped nations but decrease in developed nations, according to Miyamoto (2019).

A rise in REER shows strong home currency, making strengthen in global trade (Bahmani-Oskooee & Ratha, 2004; Coudert & Couharde, 2013; Choudhry & Hassan, 2015). The central bank of a country can raises the money supply by altering the needed reserves ratio or by conducting open market operations. The increase in the money supply can have a significant impact on REER since it increases the amount of money available to the economy (Forbes, 2019). A rise in the money supply lowers interest rates because there are more funds available for investment than are needed. This causes capital to start leaving the country and depreciates the value of the home currency relative to its trading partners (Kose et al., 2018; Bussiere et al., 2018; Kim & Mohsin, 2020). Increases in the money supply lead higher national prices, which again results in a decline in domestic currency (Adeoye, 2015).

My findings are in accordance with the findings of the abovementioned investigations. Consequently, I can interpret my findings considering the previously described research in the following way: Expansionary fiscal policy causes home currency to appreciate, and tight monetary policy causes home currency to appreciate, whereas loose monetary policy causes home currency to devalue.

The coefficient is 0.094033, which indicates that a 1% increase in government expenditure is associated with a 0.094033% increase in the exchange rate. Similarly, tax revenue and Interest rate have positive impact on exchange rate. When a 1% increase occurs in tax revenue and interest rate will increase REER by 0.014889% and 0.005303% respectively. The money supply relation is negative with REER. A 1% increase in money supply will decrease the REER by 0.366187%.

Table 11: Error Correction Term

	REER	**G**	**T**	**M**	**R**
Coefficients	-0.118221	-0.388262	-0.158699	-0.550909	-0.13159
Std error	0.026544	(0.16859)	0.13153	0.15613	(0.0402)
T-statistic	-7.98014	-2.30297	-1.20656	-3.52862	-3.27388

Error correction values should be in the range of 0 and 1. When the coefficients exhibit negative signs, it indicates that the variables are moving closer to equilibrium. According to our research, all variables have correct signs for ECT, and each variable's value falls between zero and one (Robert 1987, Engle & Granger 1987, Johansen 1988). It displays a convergence in the direction of equilibrium. The ability of ECT to restore disequilibrium brought on by system shocks is one of its key features. If disequilibrium is present, ECT corrects it and indicates how quickly the variable returns to its initial state of equilibrium. Additionally, each quarter, adjustments of 11%, 38%, 15%, 55%, and 13% of disequilibrium are made via adjustments to REER, T, G, M, and R.

CONCLUSION AND POLICY SUGGESTIONS

This study uses quarterly data from 1980 to 2020 and standard econometric methodologies to illustrate how REER responds to fiscal and monetary shocks within the context of Pakistan.

The VAR model can be explained through the granger causality, IRF and VDA. The results show that there are five cases of endogenous variable one-way causality, one case of two-way causality, and four cases of no causality at all. The government expenditure, tax revenue, money supply, interest rate, and real effective exchange rates may all be found to be causally related in one way or another, and REER being the root cause of money supply. Two-way causality is demonstrated by the relationship between the money supply and interest rates, and the money supply also drives inflation. Impulse response analysis, by using Cholesky ordering of endogenous variables, has unravelled the dynamic effects of shocks on government expenditure, tax revenue, policy rate, money supply, and REER. The result showed that the shocking of various variables influences REER differently and at different times. The results depict that home currency appreciates or depreciates in response to positive or negative shocks. Each of these variables responds to it, in due course, in its own peculiar manner; that of the money supply, even inversely-the positive shocks of money supplies decrease home currency and vice-versa. These findings further our analysis into the complex linkages among key macroeconomic variables and exactly how they impinge upon the evolution of exchange rates.

The variance decomposition analysis of REER reflects that the monetary policy-related variables, M and R, are stronger in explaining the forecast error variances of REER compared to government expenditure and tax revenue. First, the large part of the forecast error variance of REER is self-explained, with little influence of other variables. However, for the recent period, monetary policy shocks have become the most dominant in explaining REER dynamics, more than government spending and tax revenue shocks. Moreover, this also reflects that greater monetary policy leads to more pronounced REER movements compared to other macroeconomic variables, signalling that monetary policy indeed plays a crucial role in determining the movement of REER.

Long-run effects of fiscal and monetary variables are considered for REER in this study. The present study, therefore, considers the Johanson co-integration rank (trace) test to identify whether there is any co-integration among these variables. Because of the trace test result showing a significant p-value for rank zero through four, it has established the existence of co-integration among the variables and identified four cointegrating equations. This allows the holistic approach to better understand the long-run linkages and interactions between fiscal factors, monetary factors, and REER, while providing considerable insights into the long-run impact these variables exert on exchange rate dynamics.

The coefficients of the VECM reflect the long-run relations of REER, G, T, M, and R. At a higher value of REER, an appreciation of home currency is indicated. Three examples of determinants influencing REER are the rise in the level of government expenditure, tax revenue, and policy rate. An increase in the fiscal variables can appreciate the home currency, and interest have also positive impact on REER which means that an increase in the interest rate can appreciates the home currency due to increased capital inflow. An increase in the money supply depreciates domestic currency due to increased capital outflow and rising prices, while changes in export and import volumes can have a positive or negative impact on the relationship between output and REER.

The study uses ECT to lead variables towards equilibrium. The values of ECT lie between zero and one, signifying convergence and adjustment speed. According to our research, each quarter, REER, G, T, M, and R correct about 11%, 38%, 15%, 55%, and 13% of disequilibrium, respectively.

Overall, Pakistani policymakers can learn a lot from the study's conclusions. The findings indicate that monetary and fiscal policies are equally important in determining the REER and, in turn, the competitiveness of the Pakistani economy. Macroeconomic policy makers should consider the exchange rate impact of the decisions they make when establishing and carrying out macroeconomic policies.

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