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Pro-Cyclicality of Pakistan's Monetary Policy Under Global Financial Uncertainty

ABSTRACT

The study investigates the impact of external factors on the macroeconomic indicators of Pakistan and checks the cyclicality of monetary policy (MP) under global financial uncertainty and its factors. This study employed monthly data from January 2005 to December 2024. First, the study estimates the reaction function to check the cyclical behavior of monetary policy, and whether Pakistan exhibits fear of free fall through VAR and then by impulse response function found the impact of external shocks on key macroeconomic variables. Finally, through variance decomposition, we assess, if is there any external dominance. The result of the study shows that Pakistan's monetary policy initial response is counter-cyclical in the face of global financial risk but also exhibits fear of free fall behavior because SBP increases the policy rate when the currency depreciates. The variance decomposition analysis shows that about 62 percent of variation is explained by inflation in interest rate and 28 percent of variation is explained by its own lagged value. SBP does not response to output gap despite its importance in Taylor rule. SBP should incorporate the output gap more explicitly in monetary policy formulation to ensure balanced economic stabilization.

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1. INTRODUCTION

"When the US sneezes, the rest of the world catches a cold."

Clemens von Metternich

This emphasizes that the US economy plays an essential role in the global financial system; disturbances in the US economy, such as financial crises or policy changes, often have an impact on other countries, impacting their trade, capital inflows, and investments. Emerging countries, like Pakistan, are vulnerable to global spillover due to their reliance on external financing, trade dependencies, and fragile economic structure. The increasing significance of spillovers from shocks in other economies has prompted both academics and practitioners to intensify their efforts in comprehending the pertinent transmission channels.

Researchers extensively studied external shocks as a significant source of macroeconomic fluctuations, given their implications for central bank decisions. These uncertainties are regarded as external monetary restraints imposed by developed countries on developing countries such as Pakistan (Younas, 2018). These foreign shocks significantly affect developing countries. Significant external shocks such as oil prices, variations in world gold prices, exchange rate volatility, and changes in global food prices affect the macroeconomic performance of a country like Pakistan (Rizwan, 2019).

According to Horvath and Zhong (2019), external shocks significantly influence macroeconomic variations in developing economies, with a significant percentage of this effect conveyed through the domestic stock market. A decline in external demand, a rise in external interest rates, and heightened uncertainty result in increased unemployment, diminished stock market returns, and devaluation of the domestic currency in developing market economies. The 1MP of emerging market economies actively responds to external shocks, mitigating their effects on domestic economic activity.

Monetary policy takes two forms: contractionary monetary policy and expansionary monetary policy. Decreasing the money supply and increasing interest rate is known as contractionary monetary policy while increasing money supply and decrease the interest is referred to expansionary monetary policy. On the other hand, cyclicality is the movement of interest rate with the business cycle. The policy is pro-cyclical when the central bank increases interest rate when the output gap is below potential (recession), Counter-cyclical when the central bank decreases the interest rate when the output gap is above potential (expansion), and a-cyclical when the interest rate does not respond to the business cycle. Literature argues about two potential rationales about the cyclicality.

- External Dominance
- Fear of Free Fall

Fraga et al. (2003) emphasize the external dominance influence on the developing economy rate-setting process, as their economies are susceptible to abrupt disruptions in capital flows as a result of outside shocks. The authors contend that these disruptions decrease the value of developing countries' currencies, which in turn increases inflation. Consequently, the developing countries authorities are compelled to raise their policy rate in order to mitigate these pressure of inflation. They explain this occurrence as an example of external control over monetary policy conduct, telling that monetary policy of developing countries usually tighten up in reaction to outside disturbances.

[1] Monetary Policy

While Calvo and Reinhart (2002), underline the existence of fear of free fall on monetary policy in EMs2. EM policymakers dread currency depreciation, especially following external shocks, which undermines their credibility. As a result, they respond by raising interest rates. Fear is especially prevalent in financially weak economies with distinctive structures such high level of liability dollarization, deprived institutional integrity, and lack of credibility and independence of the central bank (Vegh & Vuletin, 2012). Currency depreciation may be costly for macroeconomic and financial stability, prompting central banks to prioritize exchange rate stability.

The volatility of the global economy often leads to fluctuations in the business cycle, affecting nations worldwide. Developing countries, which have liability dollarization, poor institutional quality, are particularly vulnerable to such economic shifts. Global economic imbalances can exacerbate these challenges, with policy decisions in major economies influencing economic activities in financial vulnerable economies.

This study investigates whether Pakistan's monetary policy exhibits cyclicality in response to global financial risks, while previous research has examined monetary policy using domestic factors and methodologies such as OLS and 2SLS; these studies are limited by their reliance on annual or quarterly data. Additionally, they overlook the role of global influences in shaping policy decisions. To address this gap, this study incorporates global financial factors and utilizes monthly data to identify the key drivers behind Pakistan's monetary policy cyclicality. Grounded in the concepts of external dominance and the fear of free fall, this study explores how the State Bank of Pakistan responds to external shocks in order to examine the cyclicality of monetary policy and identify the factors influencing its behavior.

2. LITERATURE REVIEW

2.1 Exploring the global spillovers to emerging market economies

Maćkowiak (2007) estimated the structural vector autoregressive model for eight countries, assuming that each country is a small open economy. This allows them to estimate the extent to which external shocks affect emerging markets' macroeconomic fluctuations, and their findings indicate that emerging economies' interest rates and exchange rates are quickly impacted by changes in US MP. If there is a contraction in the US MP, the emerging markets currency depreciates and cause inflation after sometime. MP shocks in the US have a greater impact on the changes in the aggregate price level and real aggregate production in emerging countries compared to their impact on the changes in the aggregate price level and aggregate output in the US.

Magud (2023) addresses movements in the distribution of the Real Effective Exchange Rate of SOE, using panel quantile regressions to put more emphasis on tail events rather than average changes. Global uncertainty, captured by the VIX, as well as U.S. monetary policy shocks, significantly influence the tails of the REER distribution. These effects are more pronounced in economies where foreign exchange markets are relatively less developed, central banks have lower credibility, and there is higher credit risk, thereby reflecting weaker macro fundamentals.

The author points out that foreign exchange intervention can dampen some of these shocks, particularly large depreciation events (left tail of the distribution), and the effectiveness of foreign exchange intervention is greater where the fundamentals are poorer and interventions are sparingly used. However, over-dependence on FXI may also aggravate pre-existing structural weaknesses, such as expanding FX markets, increasing central bank credibility, and macroeconomic fundamentals. Another relevant conclusion of the study is that, although capital flow management measures are quite ineffective in

[2] Emerging Market Economies

preventing significant REER movements, they might augment the effectiveness of FXI right after the external shocks. This would indicate dynamic trade-offs in policy responses to external shocks.

Azad and Serletis (2022) explores the role of inflation targeting (IT) as a monetary policy framework in emerging economies, focusing on 26 European and Central Asian nations between 1997 and 2019. The research utilizes dynamic panel modeling and propensity score matching to assess IT influence on inflation control, GDP growth, and macroeconomic stability. A particular emphasis is placed on the post-2008 period, allowing for an evaluation of IT resilience during times of economic uncertainty. The empirical findings of this study indicate that IT has played a significant role in reducing inflation levels and minimizing inflation volatility. The impact appears particularly pronounced in the period following 2008, where IT-adopting nations demonstrated greater inflation stability compared to those using alternative monetary strategies. Furthermore, the study provides evidence that IT is associated with reduced macroeconomic volatility, particularly in GDP fluctuations, suggesting its role in fostering a more predictable economic environment. However, the research does not establish a strong link between IT adoption and GDP growth, indicating that while IT is effective in maintaining price stability, it does not inherently drive economic expansion.

A key aspect of the study is its acknowledgment of the challenges faced by emerging economies in implementing IT. High financial dollarization, exposure to external shocks, and underdeveloped financial markets remain barriers to its effectiveness. Despite these hurdles, the findings suggest that IT remains a viable policy tool, even in economies that do not fully satisfy the traditional prerequisites for its successful implementation.

Ma et al. (2022) explores the monetary policies of major Asian economies in response to the economic dislocations caused by the COVID-19 pandemic. As a frame of reference, the study looks at the responses to the global financial crisis of 2007–2009, setting the stage for the previously unseen and seemingly very different financial shock that occurred in 2020. The authors analyze eight major Asian economies — China, India, Indonesia, Pakistan, Bangladesh, Japan, the Philippines and South Korea. The countries were chosen based on their population size and the severity of the pandemic's economic impact. By applying the Autoregressive Distributed Lag (ARDL) approach to quarterly data from 2005Q3 to 2020Q3 the study facilitates the comparison of the monetary policy responses to the financial crisis and the pandemic.

The study finds that monetary authorities are less aggressive in their interest rate cuts during the global financial crisis era. During the COVID-19 pandemic, however, central banks adopted more flexible, expansionary policies, with sustained cuts in policy rates and greater liquidity injections to ease financial market tensions. Evidence from this paper that the pandemic recession led to larger than financial crisis cuts to interest rates by central banks. Central banks of many Asian countries like the Reserve Bank of India, State Bank of Pakistan, and People's Bank of China had made moderate rate cuts and open market operations to bolster financial stability.

Mosser (2020) examines the swift and large-scale actions taken by central banks worldwide to counteract the economic disruptions caused by the COVID-19 pandemic. The paper explores various monetary policies, liquidity provisions, and targeted credit initiatives implemented to stabilize financial markets and sustain economic activity.

One of the key observations of the study is that, unlike previous financial crises such as the 2007–2009 global financial crisis, the COVID-19 shock originated from a combination of sudden supply and demand disruptions rather than financial sector instability. As a result, central banks had to act quickly to prevent a deeper economic downturn. The paper emphasizes that the Federal Reserve introduced a range of

emergency measures within a short period in March 2020 comparable in number to those launched over the entire 2008 crisis—highlighting the urgency of the response.

2.2 Exploring the cyclicality of monetary policy

In the past 25 years, extensive research has explored how macroeconomic policies behave throughout economic cycles, especially across different countries. This includes understanding how central banks adjust their measures in response to these cycles. Monetary policy can either be pro-cyclical or countercyclical. Pro-cyclical policies see interest rates move inversely to the output gap, lowering during expansions and rising during recessions. Conversely, countercyclical policies move in tandem with the output gap, raising rates during expansions and lowering them during downturns. Policies that don't show clear correlation are deemed a-cyclical. Countercyclical monetary policy is widely seen as beneficial for stimulating economic growth and stabilizing economies. It's believed to soften both the peaks and troughs of economic cycles. Since 1994, there's been growing agreement on the importance of countercyclical measures in stabilizing the South African economy (Wu, 2021).

According to Carneiro and Garrido (2015), some developing countries have been able to shift away from pro-cyclical fiscal policies, but many are still characterized by fiscal behavior that amplifies the effects of economic fluctuations. Compared to industrialized economies, developing nations are more likely to adopt fiscal policies that intensify business cycle volatility during both booms and downturns. The "when-it-rains-it-pours" phenomenon is supported, as documented before (Kaminsky et al., 2004). The inference holds well for different methods of smoothing fiscal policy cyclicality and across country-specific structural break tests in groupings economies for comparative analysis. Institutional quality is a factor significantly influencing cyclicality in fiscal policy. Countries with stronger institutions are better positioned to implement counter-cyclical policies, as they can save during economic growth and set aside fiscal buffers for use in downturns. The study holds that efforts at reducing the pro-cyclicality of fiscal policy must be complemented with institutional reforms.

The covid-19 was a major shock all over the world and slowed down the economic and social progress of most countries. The Chinese government put in place several macroeconomic policies to deal with this shock. To help the real economy, the People's Bank of China decrease interest rates, reserve requirements, and lending fees. M2, loans, and social finance capital all grew as a result, giving businesses important liquidity and timely support during the pandemic. By the end of 2020, China's GDP had increased by 0.7% year over year, along with fixed asset investment and retail sales of consumer products. The third quarter saw significant growth in the service sector as it recovered as well. The following is the monetary policy effect transmission pathway for the countercyclical adjustment: The central bank increases the money supply rises, the interest rate, more money is invested in the real economy (I increases), and more money is earned nationally (y increases) (Wu, 2021).

Lane (2003) empirical study reveals a fundamental vulnerability of emerging market economies to economic cycles compared to industrial economies. The study provides verification of countercyclical fiscal policy in OECD countries, contrasting with evidence of pro-cyclical policy tendencies in developing countries. Additionally, loose monetary policy, as suggested by (De Leo et al., 2022) can bolster domestic liquidity, potentially offsetting weaknesses in the domestic financial sector and restricted access to foreign capital markets.

Those countries which have strong institutions usually adopt countercyclical macroeconomics policies and vice versa. According to (Calderón, 2016) findings institutional quality plays a predominant role in the execution of countercyclical macroeconomics policies. Clarida et al. (1998) found that the inflation coefficient was above 1 which means that with an increase in expected inflation, central banks in for US, Japan, and Germany raised the nominal interest rates which elevated real interest rates. Except US the coefficient of output gap was positive for other countries, which indicates that Japan and Germany

adopted countercyclical monetary policy, adjusting interest rates decreases during bad times and increases during good times.

However, US post-1997 period monetary policy was described as cyclical. Macroeconomic cycles and capital flow cycles reinforce each other in the context of emerging nations, especially those with middle-high income status. This reinforcement is comparable to the "when it rains, it pours" phenomenon. When money enters a nation, the economy expands, encouraging spending and development. On the other hand, decreased capital inflows during economic downturns aggravate downturns. Positive or negative trends in capital flows and macroeconomic cycles reinforce one another because of this interaction, which adds to the cyclicality and interdependence of a country's economic trajectory (Kaminsky et al., 2004).

In OECD countries, macroeconomic policies aim to stabilize the business cycle, with interest rates decreasing during contractions and increasing during expansions (Kaminsky et al., 2004). However, in developing countries, macroeconomic policies tend to exacerbate the cycle, with interest rates decreasing during expansions and increasing during contractions, leading to extreme economic fluctuations ("Turning sunny days into scorching infernos and rainy days into torrential downpours").

Many countries have shifted away from pro-cyclical policies due to overcoming the fear of free-falling. Historically, during currency depreciations, policymakers raised interest rates to defend the currency, fearing further capital outflows and widespread bankruptcy among firms with dollar-dominated debts. However, as many emerging markets adopted market-friendly reforms and improved macroeconomic policies, policymakers have become more inclined to adopt countercyclical monetary policies (Vegh & Vuletin, 2012).

The literature also argues about what kind of policies were adopted by the countries during the (2007-2008) financial crisis, (Ghalayini, 2018) and reveals that one of the key determinants of counter-cyclical monetary policy during the crisis is the enforcement of inflation targeting before the crisis. Inflation targeting does serve as a stand-in for the credibility and transparency of central banks. During the 2008-2009 financial crisis, emerging market economies (EMEs) significantly eased monetary policy to act as buffer against the global financial shock and promote economic recovery. This is a significant change from prior crisis experiences when EMEs were often forced to hike interest rates to enhance monetary policy credibility, preserve the value of their currencies, and restrict capital flight (Coulibaly, 2012).

Before the Great Financial Crisis, the United States economy went through 25 years of “Great moderation”. The new systemic Approach keeps the US economy always one step ahead when risks caused by inflation or recession by keeping its effort on contractionary monetary policy during expansion and expansionary monetary policy when the situation is reversed (Fischer, 2021).

2.3 Exploring Pakistan’s literary landscape

Monetary policy in Pakistan has been a critical tool in the country's economic landscape, much like the ebb and flow of a river. It has changed over time to meet the changing demands of a growing country. Pakistan's monetary policy path shows the country's search for stability and prosperity, from the days of fixed exchange rates to the more recent adoption of flexible inflation targeting. As the country's central bank, the State Bank of Pakistan has played a critical role in defining this narrative. It must strike a difficult balance between managing inflation, promoting economic growth, and preserving currency stability.

The literature on monetary policy in Pakistan is filled with arguments on its efficiency, transmission mechanisms, and influence on economic well-being. Hussain et al. (2022) tried to evaluate the transmission mechanism efficiency by autoregressive took data from 1991 to 2019 and concluded that the

monetary policy credit channel is more effective as compared to the exchange rate and asset price channel.

Younas, (2018) explores the constraints imposed by external shocks on the monetary policy in Pakistan. It analyzes the impact of global food prices, oil prices, and foreign interest rate changes on the macroeconomic variables and highlights challenges created by these shocks for a central bank in achieving its monetary policy objectives of stable inflation and full employment. The study employed a SVAR model, along with IRF and variance decomposition the study showed that global oil and food prices exert significant inflationary pressure. Production costs are increased by these shocks, specifically in the industrial sector which results in higher domestic prices and makes it difficult for the SBP efforts to stabilize inflation and support growth. Additionally, the foreign interest rate has a significant impact on exchange rates and inflation but minimal impact on macroeconomic variables.

In the realm of Pakistani monetary policy, there are studies that explore different channels of monetary policy, a pro-cyclical monetary policy by employing OLS and 2SLS method, only considering the domestic variables and using annual or quarterly data, there remains a dearth of investigation into what the factors are behind it, which is causing it. Consequently, our study seeks to address this gap by identifying and analyzing the drivers influencing the cyclical nature of monetary policy in Pakistan by utilizing monthly data, also incorporating the global factor.

3. THEORETICAL FRAMEWORK

The Taylor-type rule is one method of characterizing a country's monetary policy, which suggests that the policy rate should be raised when the output gap exceeds the target, and it should be lowered when recession appears to be a greater concern. The Taylor rule operates under the presumption that the interest rate channel of monetary policy is highly effective (Taylor, 1993).

The Taylor rule's success relies on the interest rate channel, which follows a new Keynesian framework for monetary policy transmission. The Taylor rule can be derived using the new Keynesian framework, which involves three equations: the central bank's loss function, the IS curve, and the Phillips curve.

3.1 Reaction Function

Given that the central bank complies with an interest rate-based reaction function, the standard reaction function is as follows:

$$i_t = f(\pi_t, X_t) \quad (1)$$

The reaction function represents positive relationship between inflation and output gap. It is obtained by minimizing the loss function in relation to the IS curve and the Phillips curve. This reaction function shows that the central bank establishes its policy rate in accordance with the inflation and output gap.

3.2 External Shocks and their Transmission to Developing Countries

This transmission mechanism based on the literature (Bhattarai et al., 2021), holds that the flight to quality channel collapses the global risk appetite and creates a risk-off environment with capital outflows, thus transmitting the global financial risk shocks to the financial markets of developing countries. As a result, the flight to quality mechanism increases the realized volatility and EM sovereign risk. This is because it not only changes investors' perceptions of developing economies' risk but also affects capital flows, which causes a significant depreciation in currency values.

During the second phase of transmission, the exchange rate risk-taking channel starts to become active. The devaluation of currencies compels central banks in emerging markets to confront a challenging decision between maintaining financial stability and achieving macroeconomic stabilization, all while handling global financial shock. This situation poses a risk to financial stability via the channel of increased risk-taking.

The procedure is outlined as follows: global financial risk creates currency devaluation, which has a negative impact on the financial balance sheets of both developing economies borrowers and foreign lenders. The valuation impacts have two outcomes. For starters, they boost the former's perceived riskiness, reducing their creditworthiness. Second, they eventually lead to increased sovereign risk, resulting in a drop in capital inflows and extra devaluation pressure.

Conversely, these consequences diminish the ability of the latter to borrow money, compelling them to reduce the amount of credit they provide, and thus leading to a further decrease in the amount of money coming into the country. Consequently, the increased cautiousness of global investors, which arises internally from currency devaluations, leads to a significant increase in the risk faced by governments and a substantial decrease in the amount of money flowing into the country. This presents an immediate danger to the stability of the financial system by additional weakening of the local currency and intensifying financial strain (Carstens & Shin, 2019).

Due to global financial risk uncertainty increase, and investors seeks safe heaven assets so it declines capital inflow.

$$\text{Global Financial Risk increase} \uparrow \rightarrow \text{Capital Inflow} \downarrow$$

Decline in capital inflow cause the domestic currency to depreciate, which affect real effective exchange rate reducing external competitiveness.

$$\text{Global Financial Risk} \uparrow \rightarrow \text{Capital Inflow} \downarrow \rightarrow \text{Exchange rate} \uparrow \rightarrow \text{REER} \downarrow$$

Depreciation in domestic currency increases the cost of imports, which worsen the trade deficit due to higher risk global demand may decline further deteriorate the trade balance.

$$\text{Global Financial Risk} \uparrow \rightarrow \text{ER} \uparrow \rightarrow \text{Cost of Imports} \uparrow \rightarrow \text{Trade Balance} \uparrow$$

Depreciation of currency leads to higher cost of imports, fueling cost push inflation and higher inflation increase the cost of living.

$$\text{ER} \uparrow \rightarrow \pi \uparrow$$

When inflation increase it raises the interest rate to control the inflation, due to tight monetary policy borrowing cost increases, which reduce the private and aggregate demand.

$$\pi \uparrow \rightarrow i_t \uparrow \rightarrow \text{Investment} \downarrow \rightarrow \text{AD} \downarrow$$

Higher interest rate increase lending rates which reduce the investment and consumption so the lower aggregate demand leads to negative output gap.

$$i_t \uparrow \rightarrow \text{lending rate} \uparrow \rightarrow \text{Investment} \downarrow \rightarrow \text{AD} \downarrow$$

3.3 Inclusion of Exchange rate in Reaction Function

The channel that connects the domestic and global economies is the exchange rate channel. For example, when domestic interest rates rise, local currency financial assets like bonds and deposits denominated in rupees become comparatively more appealing than those denominated in foreign currencies. It raises the relative demand for local currency relative to foreign money, which could result in either a rise in local currency value or less pressure on it to depreciate. Because local goods are now more expensive than foreign goods due to the relative increase in the value of the home currency, net exports and, consequently, aggregate demand decline. Additionally, by affecting the costs of imported products and services, interest rate fluctuations may directly affect inflation.

Fabris and Lazić (2022) stated that the increased levels of exchange rate pass-through, recent hyperinflation episodes and crises, and, consequently, less stable inflation expectations all support the significance of the exchange rate in the monetary policy reaction function of emerging market countries. However, it is anticipated that the strengthening of monetary policy credibility and anchoring inflation expectations will be positively impacted by the positive trend of inflation targeting adoption and experience gained following the transition period (South-Eastern European countries) or economic and financial turmoil.

4. METHODOLOGY

The Vector Autoregressive model is broadly used in time series analysis due to its ability to capture the dynamic relationships among multiple variables simultaneously. Unlike traditional single-equation models, each variable in the vector autoregressive model is a function of both its own lagged values and the lagged values of the other variables. This feature makes VAR particularly valuable when studying macroeconomic indicators, where variables such as GDP, inflation, interest rates, and exchange rates are often interconnected.

VAR models are effective in assessing the impact of economic shocks through tools like IRF, which trace the effects of a one-time disturbance in one variable on the rest of the system over time. They also allow for variance decomposition, which helps identify the proportion of fluctuations in a variable that can be attributed to shocks in other variables. This makes VAR particularly useful for policy analysis, enabling economists to evaluate how changes in monetary or fiscal policy influence various aspects of the economy. Moreover, by accounting for the interdependencies between variables, VAR models help mitigate issues related to simultaneity and endogeneity that can bias results in traditional regression models. Chushman and Zha (1997) and (Maćkowiak, 2007) has utilized Vector Autoregressive (VAR) models to identify and analyze the dynamic effects of external shocks.

To examine the impact of external shock, consider the seven variable structural where GFR is the global financial risk, Y_t is the output gap, π_t is the inflation, tb_t is the trade balance,ci_t represents the capital inflows, i_t is the call money rate and ER_t shows the exchange rate.

$$gfr_t = \beta_{10} - \beta_{12}y_t - \beta_{13}\pi_t - \beta_{14}tb_t - \beta_{15}ci_t - \beta_{16}i_t - \beta_{17}ER_t + \alpha_{11}gfr_{t-i} + \alpha_{12}y_{t-i} + \alpha_{13}\pi_{t-i} + \alpha_{14}tb_{t-i} + \alpha_{15}ci_{t-i} + \alpha_{16}i_{t-i} + \alpha_{17}ER_{t-i} + \varepsilon_{gfr} \quad (2)$$

$$y_t = \beta_{20} - \beta_{21}gfr_t - \beta_{23}\pi_t - \beta_{24}tb_t - \beta_{25}ci_t - \beta_{26}i_t - \beta_{27}ER_t + \alpha_{21}gfr_{t-i} + \alpha_{22}y_{t-i} + \alpha_{23}\pi_{t-i} + \alpha_{24}tb_{t-i} + \alpha_{25}ci_{t-i} + \alpha_{26}i_{t-i} + \alpha_{27}ER_{t-i} + \varepsilon_y \quad (3)$$

$$\pi_t = \beta_{30} - \beta_{31}gfr_t - \beta_{32}y_t - \beta_{34}tb_t - \beta_{35}ci_t - \beta_{36}i_t - \beta_{37}ER_t + \alpha_{31}gfr_{t-i} + \alpha_{32}y_{t-i} + \alpha_{33}\pi_{t-i} + \alpha_{34}tb_{t-i} + \alpha_{35}ci_{t-i} + \alpha_{36}i_{t-i} + \alpha_{37}ER_{t-i} + \varepsilon_\pi \quad (4)$$

$$tb_t = \beta_{40} - \beta_{41}gfr_t - \beta_{42}y_t - \beta_{43}\pi_t - \beta_{45}ci_t - \beta_{46}i_t - \beta_{47}ER_t + \alpha_{41}gfr_{t-i} + \alpha_{42}y_{t-i} + \alpha_{43}\pi_{t-i} + \alpha_{44}tb_{t-i} + \alpha_{45}ci_{t-i} + \alpha_{46}i_{t-i} + \alpha_{47}ER_{t-i} + \varepsilon_{tb} \quad (5)$$

$$Ci_t = \beta_{50} - \beta_{51}gfr_t - \beta_{52}y_t - \beta_{53}\pi_t - \beta_{54}tb_t - \beta_{56}i_t - \beta_{57}ER_t + \alpha_{51}gfr_{t-i} + \alpha_{52}y_{t-i} + \alpha_{53}\pi_{t-i} + \alpha_{54}tb_{t-i} + \alpha_{55}ci_{t-i} + \alpha_{56}i_{t-i} + \alpha_{57}ER_{t-i} + \varepsilon_{ci} \quad (6)$$

$$i_t = \beta_{60} - \beta_{61}gfr_t - \beta_{62}y_t - \beta_{63}\pi_t - \beta_{64}tb_t - \beta_{65}ci_t - \beta_{67}ER_t + \alpha_{61}gfr_{t-i} + \alpha_{62}y_{t-i} + \alpha_{63}\pi_{t-i} + \alpha_{64}tb_{t-i} + \alpha_{65}ci_{t-i} + \alpha_{66}i_{t-i} + \alpha_{67}ER_{t-i} + \varepsilon_i \quad (7)$$

$$ER_t = \beta_{70} - \beta_{71}gfr_t - \beta_{72}y_t - \beta_{73}\pi_t - \beta_{74}tb_t - \beta_{75}ci_t - \beta_{77}ER_t + \alpha_{71}gfr_{t-i} + \alpha_{72}y_{t-i} + \alpha_{73}\pi_{t-i} + \alpha_{74}tb_{t-i} + \alpha_{75}ci_{t-i} + \alpha_{76}i_{t-i} + \alpha_{77}ER_{t-i} + \varepsilon_{ER} \quad (8)$$

The equations 2 to 8 cannot be estimated by OLS when contemporaneous effect is present between variables, the OLS estimated would be biased due to simultaneous equation bias because the explanatory variables and error terms becomes correlated, violating the basic assumption of OLS. It is possible to convert the system of equations into a more usable form. we can write the system in the compact form using matrix algebra.

$$\begin{bmatrix} 1 & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} & \beta_{16} & \beta_{17} \\ \beta_{21} & 1 & \beta_{23} & \beta_{24} & \beta_{25} & \beta_{26} & \beta_{27} \\ \beta_{31} & \beta_{32} & 1 & \beta_{34} & \beta_{35} & \beta_{36} & \beta_{37} \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & \beta_{45} & \beta_{46} & \beta_{47} \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 & \beta_{56} & \beta_{57} \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & 1 & \beta_{67} \\ \beta_{71} & \beta_{72} & \beta_{73} & \beta_{74} & \beta_{75} & \beta_{76} & 1 \end{bmatrix} \begin{bmatrix} gfr_t \\ y_t \\ \pi_t \\ tb_t \\ Ci_t \\ i_t \\ ER_t \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \\ \beta_{30} \\ \beta_{40} \\ \beta_{50} \\ \beta_{61} \\ \beta_{71} \end{bmatrix} + \begin{bmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} & \alpha_{14} & \alpha_{15} & \alpha_{16} & \alpha_{17} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} & \alpha_{24} & \alpha_{25} & \alpha_{26} & \alpha_{27} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} & \alpha_{34} & \alpha_{35} & \alpha_{36} & \alpha_{37} \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & \alpha_{44} & \alpha_{45} & \alpha_{46} & \alpha_{47} \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \alpha_{54} & \alpha_{55} & \alpha_{56} & \alpha_{57} \\ \alpha_{61} & \alpha_{62} & \alpha_{63} & \alpha_{64} & \alpha_{65} & \alpha_{66} & \alpha_{67} \\ \alpha_{71} & \alpha_{72} & \alpha_{73} & \alpha_{74} & \alpha_{75} & \alpha_{76} & \alpha_{77} \end{bmatrix} \begin{bmatrix} gfr_{t-i} \\ y_{t-i} \\ \pi_{t-i} \\ tb_{t-i} \\ ci_{t-i} \\ i_{t-i} \\ ER_{t-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{gfr} \\ \varepsilon_y \\ \varepsilon_\pi \\ \varepsilon_{tb} \\ \varepsilon_{ci} \\ \varepsilon_i \\ \varepsilon_{ER} \end{bmatrix}$$

or

$$\beta X_t = \beta_0 + \alpha X_{t-i} + \varepsilon_t$$

Where,

$$\beta = \begin{bmatrix} 1 & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} & \beta_{16} & \beta_{17} \\ \beta_{21} & 1 & \beta_{23} & \beta_{24} & \beta_{25} & \beta_{26} & \beta_{27} \\ \beta_{31} & \beta_{32} & 1 & \beta_{34} & \beta_{35} & \beta_{36} & \beta_{37} \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & \beta_{45} & \beta_{46} & \beta_{47} \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 & \beta_{56} & \beta_{57} \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & 1 & \beta_{67} \\ \beta_{71} & \beta_{72} & \beta_{73} & \beta_{74} & \beta_{75} & \beta_{76} & 1 \end{bmatrix}, X_t = \begin{bmatrix} gfr_t \\ y_t \\ \pi_t \\ tb_t \\ Ci_t \\ i_t \\ ER_t \end{bmatrix}, \beta_0 = \begin{bmatrix} \beta_{10} \\ \beta_{20} \\ \beta_{30} \\ \beta_{40} \\ \beta_{50} \\ \beta_{61} \\ \beta_{71} \end{bmatrix},$$

$$\alpha = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} & \alpha_{14} & \alpha_{15} & \alpha_{16} & \alpha_{17} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} & \alpha_{24} & \alpha_{25} & \alpha_{26} & \alpha_{27} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} & \alpha_{34} & \alpha_{35} & \alpha_{36} & \alpha_{37} \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & \alpha_{44} & \alpha_{45} & \alpha_{46} & \alpha_{47} \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \alpha_{54} & \alpha_{55} & \alpha_{56} & \alpha_{57} \\ \alpha_{61} & \alpha_{62} & \alpha_{63} & \alpha_{64} & \alpha_{65} & \alpha_{66} & \alpha_{67} \\ \alpha_{71} & \alpha_{72} & \alpha_{73} & \alpha_{74} & \alpha_{75} & \alpha_{76} & \alpha_{77} \end{bmatrix}, \varepsilon_t = \begin{bmatrix} \varepsilon_{gfr} \\ \varepsilon_y \\ \varepsilon_\pi \\ \varepsilon_{tb} \\ \varepsilon_{ci} \\ \varepsilon_i \\ \varepsilon_{ER} \end{bmatrix}$$

The co-efficient matrix (β) captures the contemporaneous effect of variables on each other, while β0 is the intercept matrix. The coefficient matrix (α) measures the lagged effects of variables on each other, and structural errors (ε_t) include zero mean, constant variance, serially and cross-uncorrelated innovations. Pre-multiplication of β^{-1} allows us to obtain the VAR model in standard form:

$$X_t = A_o + A_1 X_{t-i} + e_t \quad (9)$$

Where, $A_o = \beta_0\beta^{-1}$, $A_1 = \beta^{-1}\alpha$, and $e_t = \beta^{-1}\varepsilon_t$ with the assumption that E (e_{jt}) = 0, Var (e_{jt}) = 0, and Cov (e_{jt}, e_{jt-1}) = 0, but Cov (e_{jt}, e_{jt-1}) may or may not be equal to zero.

4.1 Recursive identification

According to (Sims et al., 1990) one way to identify the model is to use the type of recursive system. The identification of the structural form requires at least $n(n-1)/2$ restrictions so our model contains seven variables; the minimum number of restrictions required is 21. This study used a recursive Cholesky decomposition method with the order of global and domestic variables to find shocks and their impact on our domestic variables. So, the order of the variables is very important and could change the dynamics of the model.

4.2 Ordering of variables

The study's particular arrangement of the global and domestic variables is predicated on the presumptions drawn from the literature, as stated in (Maćkowiak, 2007). In a SOE, the financial stress index responds to its shock and domestic variables do not affect the financial stress index. Therefore, domestic variables do not enter the global variable equation, either with a lag or instantaneously. The sequencing of variables is predicated on this assumption; the domestic variables are positioned after the global variables. Comparatively, domestic macroeconomic indicators respond slower than domestic financial variables. As a result, changes in the macroeconomic aggregates quickly affect the financial variables, including exchange rate and interest rate. However, the macro aggregates don't respond to financial shocks contemporaneously. Moreover, central banks set the short-term interest rate, which is used as an instrument for policy. Hence, the other financial variable's exchange rate responds more quickly than the interest rate. The ordering of the variables is consistent with the recent work of (Yildirim, 2022).

4.3 Data source and variables

This study relies on secondary data obtained from reliable sources. We gathered monthly statistics from January-2005 until Decmeber-2024.

Table 1: Description of Variables

Variables	Measuring	Sources
Global Financial Risk	Financial Stress Index	FRED
Policy Rate	Call Money rate	SBP
Output Gap	Large Scale Manufacturing	SBP
Inflation	Inflation rate	SBP
Capital Inflows	FDI inflows + Private Portfolio Investment + other investment	SBP
Trade Balance	Export minus Imports	SBP
Exchange rate	Rupee/US dollar	SBP

4.4 Key variables

This study used six variables some of which are observed and their data is available while some variables are unobserved and created for the analysis.

Global Financial Risk: According to the definition of Office of financial research,3 the financial stress index measures financial market stress by incorporating 33 financial market variables which include yield spread, volatility, credit spreads, etc. It incorporates five categories, credit, equity valuation, funding, safe assets, and volatility. The index shows stress contribution by United States, Euro Zone, Japan, and other emerging economies as well. The index provides policymakers, central banks, and financial institutions with a real-time, forward-looking measure of financial conditions to allow them to track systemic risk.

[3] OFR Financial Stress Index | Office of Financial Research

The FSI is used as a proxy for global financial risk because it captures shocks and vulnerabilities that have the potential to affect financial stability worldwide. As the data is available on daily basis this study aggregates it to a monthly frequency by taking averages of each month.

Interest Rate: This study utilized the call money rate, the short-term interest rate used as a tool for MP. One key advantage of using this variable over the discount rate is that the discount rate is just one policy tool to reach operating goals for the instrument, which can also be accomplished through other policy tools such as open market operations and adjustments in the required reserve ratio. According to the SBP, the call money rate denotes the overnight interest rate at which financial institutions extend and receive loans of funds from each other. Our choice of variable is consistent with many recent literature such as (Malik, 2007).

Output Gap: This Study utilized large scale manufacturing as a proxy for gross domestic product because the monthly data of GDP is not available. Large-scale manufacturing has a significant contribution to the industrial sector, which is a core component of GDP in many economies. LSM encompasses large, formal industrial enterprises producing high-volume goods such as textiles, chemicals, steel, and automobiles. In the existing literature, annual data of GDP is used to determine the output gap, researchers used different methods such as the HP-filter and Quadratic trend to find the output gap. HP-filter separates the cyclical component of the time series from raw data, providing smooth representation that is more sensitive to long-term trends and Quadratic trends capture the same idea as linear trends, with a fluctuating component around them, but it uses a quadratic function fitted to the GDP data to pick up the underlying trend. Since the data used in this study is monthly and it exhibit seasonal patterns, to remove these patterns we introduced dummies and regress the actual variable (LSM) by trend, square o trend and seasonal dummy variables. This helps to isolate the effects of seasonality and trend allows us to analyze the variation in the data.

$$lsm = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \alpha_3 D_1 \dots + \alpha_{13} D_{11} + \varepsilon_t \qquad (10)$$

Where t shows the trend and D shows the dummy variables.

Inflation: This study used inflation rate in our analysis because the state bank adjusts interest rate keeping inflation rate in target to maintain the price stability.

Exchange Rate: The price of one currency in relation to another is known as the exchange rate. The data of exchange rate is Rupee/US dollar and utilized from the official website of the State bank of Pakistan. This study used the deviation of the exchange rate which is computed through HP-filter which separates the series into its cyclical and trend components. After applying HP-filter we subtract the actual exchange rate from its trend and use it in the analysis because it provides a clear measure of exchange rate volatility and its impact on variables. Engel and West (2005) argues that deviation provides better insights into short-term exchange rate behavior and speculative movements.

Capital Inflow: The total flow of financial capital to a country is referred to as capital inflows. In our analysis, capital inflow is the sum of foreign private investment which include foreign direct investment (FDI) inflow, foreign portfolio investment (FPI) which includes equities securities and debt securities, and other investment includes foreign public investment consist of equity securities and debt securities.

Trade Balance: The balance of trade is the gap between what a country sells to other countries (its exports) and what it buys from other countries (its imports), during a certain time, generally a year.

5. RESULTS

5.1 Unit Root Test

The purpose of the augmented Dickey-Fuller test is to decide whether variables are stationary or not. Many pertinent studies and the textbook method would advise us to eliminate non-stationarity by modeling the co-integrating connection or by differencing the variables. However, we have calculated the VAR system in levels by adhering to (Sims et al., 1990), They have proposed that determining the relationships between the variables should be the primary goal of a VAR model. Variable differentiation could lead to model misspecification and the omission of crucial details about the co-movements in the data (Enders, 2008).This is the method used in most empirical literature. The following are the causes. First, it might be challenging to ascertain whether or not there is a co-integrating connection between variables in small samples. Second, incorrect inference is likely to result from improperly imposing the co-integration limitations. Our primary focus is on the short-term impact of shocks on other variables; we are not particularly interested in the structure of co-integration; instead, we will assume it implicitly between the variables in level without explicitly modelling it (Jawadi et al., 2016).

5.2 Lag length selection criteria

Second lag is optimal so this study selected AIC because of its minimum value.

Table 2: Lag Length Criteria

Lag	Log-L	LR	FPE	AIC	SC	HQ
0	-3932.827	NA	1147523.	33.81826	33.92193	33.86006
1	-2785.304	2216.246	92.19675	24.38888	25.21831*	24.72334
2	-2691.082	176.3115	62.60320*	24.00071*	25.55590	24.62783*
3	-2648.953	76.30240	66.58609	24.05969	26.34063	24.97946
4	-2606.814	73.78967	70.98832	24.11857	27.12527	25.33101
5	-2545.600	103.5122*	64.46065	24.01373	27.74618	25.51882
6	-2505.614	65.21327	70.52105	24.09110	28.54931	25.88885

Note: * indicates to select maximum lags

5.3 Stability condition

A VAR model must satisfy the stability condition; all the Eigenvalues must be inside the unit circle. If this condition is violated, the model may exhibit explosive behavior misleading impulse response function, may diverge instead of converging, and unreliable inferences. Results are shown in table 3, which shows no roots outside the unit circle, so the VAR model satisfies the stability condition.

Table 3: VAR Stability Test

Root	Modulus
0.943142	0.943142
0.932343 - 0.062376i	0.934428
0.932343 + 0.062376i	0.934428
0.891134	0.891134
0.217478 - 0.493402i	0.539205
0.217478 + 0.493402i	0.539205
-0.449381	0.449381
0.393246 - 0.123674i	0.412234
0.393246 + 0.123674i	0.412234
0.410478	0.410478
-0.071367 - 0.207160i	0.219109
-0.071367 + 0.207160i	0.219109
-0.010790 - 0.085712i	0.086388
-0.010790 + 0.085712i	0.086388

5.4 Empirical results

As the objective of the study is to check cyclical behavior of monetary policy and its response to global financial risk therefore the study only presents the results of reaction function here from the estimated reduced form VAR.

Table 4: Results of Reaction Function

Variables	Co-efficient	t-statistics
Gfrt-1	-0.136	-3.407
It-1	0.78	12.33
Yt-1	-0.0025	-0.368
πt-1	0.068	1.91
Ert-1	0.04	2.69
Cit-1	-0.035	-0.26
Tbt-1	-0.05	-0.48
Adjusted R-Squared	0.965	

Table 4 shows the results of the reaction function. Here, all the parameters except for the output gap, capital inflows, and trade balance are statistically significant. The effects of global financial risk, lagged interest rate, inflation, and exchange rate are significant at the 5% level. Global financial risk has a negative effect on the short-term interest rate it means that SBP follows expansionary monetary policy. The effect of lagged interest rate is positive and the coefficient is quite high (0.78) which shows significant inertia these findings show a strong resemblance to the findings of (Saghir et al., 2017) suggesting similar conclusions. The coefficient of output gap is negative which shows pro-cyclicality but statistically insignificant. Inflation has a positive effect and statistically significant coefficient but its magnitude is small, similar to the findings of (Malik, 2007). According to Taylor's rule if the coefficient is less than 1 the system will be unstable it happens only if the central bank responds pro-cyclically to inflation deviation from the target.

The exchange rate has also a significant and positive effect on the interest rate SBP follows tight monetary policy whenever the exchange rate depreciates, these findings answer the research question of our study does Pakistan exhibit fear of free fall as developing countries fear currency depreciation after any financial risk due to this fear they increase the interest rate to defend their currency which is according to the transmission mechanism discussed in theoretical framework. Capital inflows and trade balance have negative co-efficient and are statistically insignificant.

5.5 Impulse response function

Any systematic and dynamic response of any variable in the reaction due to some change in external shock refers to the IRF. Additionally, the impulse response function enables us to understand how variables respond after giving one standard deviation shock in any variable.

The impulse response of output gap to GFR is positive and sharply decline after third month and starting moves towards zero, by 12 months it reach its equilibrium state. The impact of Global Financial Risk on monetary policy occurs with a lag because financial shocks take time to transmit through the economy. When global risk increases, it initially affects investor sentiment, capital flows, and exchange rate volatility. Over time, these effects tighten credit conditions, slow economic activity, and influence inflation expectations, prompting the central bank to adjust interest rates with a delayed response. The response of inflation is insignificant initially and then begins to increase after 6 months but stays stable and positive with no major fluctuations and shows convergence in the twenty-fourth month. The response of trade balance is negative for first two months and shows positive and sharp increase after 2nd month

but then start decreasing and moves towards equilibrium in twenty-fourth month. Capital inflows shows highly negative response in first three months after sixth month it converge to equilibrium and stabilize. Given one standard deviation shock in GFR, the response of call money rate is positive for the first two months but after the second month it starts decreasing and the negative effect is persistent for ten months after eleven months the decline slows and starts converging towards the equilibrium. The exchange rate also shows a positive response for the first two months then stabilizes between 4th months and then again shows an increasing pattern which indicates that the value of the Pakistani Rupee decreased against the US dollar.

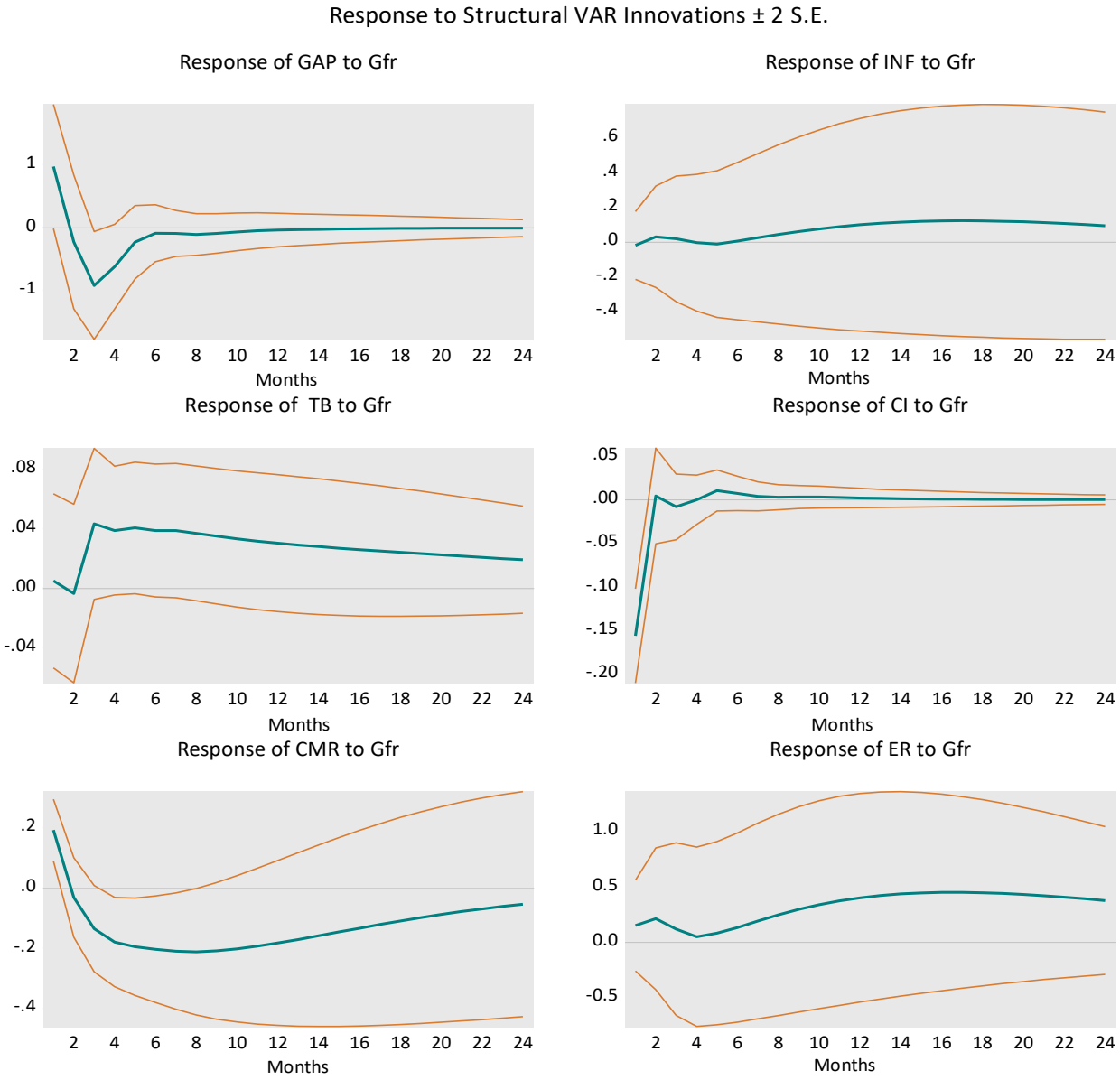

Figure 1: Impulse Response Function

In the case of an external shock, this usually leads to capital flight as investors repatriate to safer markets. This outflow creates pressure on the local currency, causing it to depreciate. Imports therefore become more expensive, and as the currency weakens, key imports from fuel, machinery, and raw materials also

become expensive, increasing the overall import bill. Countries like Pakistan, which rely entirely on these types of imports, result in a sharp increase in trade deficit.

5.6 Variance decomposition

Finally, to determine the percentage explanation for each variable in the system, we decomposed the forecast error variance of interest rate. The study used the same Cholesky ordering of data as the impulse response.

Table 5: Variance Decomposition of Interest Rate

Period	S.E.	GFR	GAP	INF	TB	CI	CMR	ER
1	1.393	5.716	0.459	0.855	1.912	6.267	86.701	0.000
2	2.138	3.524	0.577	4.013	0.051	5.199	84.884	1.749
3	2.599	3.759	1.311	10.88	0.079	4.161	77.823	1.978
4	2.918	4.583	1.695	18.67	0.079	3.279	69.716	1.973
5	3.150	5.298	1.566	26.44	0.064	2.652	62.089	1.877
6	3.329	5.820	1.331	33.83	0.071	2.196	55.033	1.711
7	3.476	6.188	1.129	40.53	0.110	1.851	48.667	1.513
8	3.601	6.420	0.969	46.42	0.181	1.586	43.102	1.317
9	3.708	6.531	0.842	51.46	0.284	1.380	38.347	1.146
10	3.799	6.541	0.743	55.73	0.411	1.218	34.330	1.017
11	3.877	6.476	0.667	59.31	0.556	1.092	30.948	0.945
12	3.946	6.359	0.609	62.27	0.713	0.993	28.102	0.940

The result shows that much of the variation is explained by its own lagged value (86.7 percent), the second variable is capital inflows which explain 6.2 percent variation in the first month, and the third global financial risk is 5.7 percent. Interestingly the variation of interest rate decreased with time and reached 28.10 percent. But the percentage of inflation and GFR increased with time and reached 62.2 percent and 6.3 percent in the last period.

In conclusion, the organization of variables in the explanation of the utmost variation is the lagged interest rate, global financial risk, and inflation. Inflation has the most explanatory power for the interest rate these findings are also similar to (Malik, 2007).

5.7 Response of interest rate to domestic variables

To check the impact of domestic variables on the interest rate we give shock in the output gap, inflation, and exchange rate. After giving one standard deviation shock in the output gap the interest rate responds negatively but after the second month this effect dies out after the sixth month this shows the pro-cyclical behavior as well because when there is expansion State Bank of Pakistan decreases the interest.

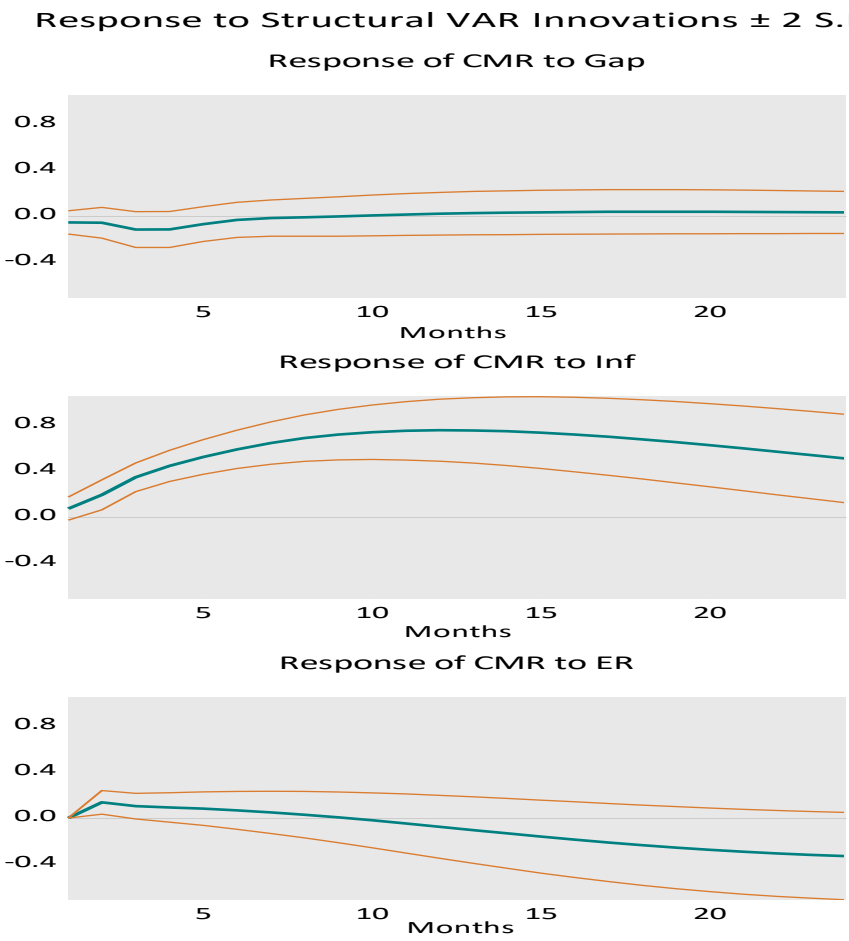

Figure 2: Response of Interest Rate to Domestic Variables

Giving one standard deviation shock to inflation the interest rate immediately increases and shows stable pattern between tenth and fifteenth month and moves towards equilibrium after twenty-third month. Therefore, inflation forces the monetary authority to alter its policy position for an extended length of time.

The response of interest rate is positive and significant after giving shock to exchange rate it means SBP adopt tight monetary policy when exchange rate depreciate which is consistent with the literature also that developing countries exhibits fear of free fall. The effect becomes zero in the tenth month. In conclusion we can say that monetary policy responds pro-cyclically to output gap and counter cyclically to inflation and exchange rate. All the results are in accordance with economic theory except the output gap because Taylor rule says that central bank should increase interest rate when the economy is performing above its potential and decrease the interest rate when economy is below its potential.

6. CONCLUSION AND POLICY IMPLICATIONS

This study provides a comprehensive analysis of the interplay between external shocks and monetary policy in relation to exchange rate fluctuations. The study utilized the vector auto-regressive (VAR) model, which is frequently used in monetary policy analysis and takes care of endogeneity issues as well, analysis indicates that external shocks exert significant effects on key economic variables.

First the study presented the reaction function which shows that, lagged interest rate, inflation and exchange rate has positive and significant effect on the policy rate, as SBP consider all these variables in their objective, global financial risk has negative effect in, which shows that the monetary policy is counter-cyclical in the face of global financial risk because it initially decreases the interest rate. How these shocks effect the macroeconomic variables of Pakistan the study computed the impulse response function the results show that interest rate, output gap, Inflation and exchange rate respond positively to external shock, while the capital inflows decrease immediately. The study performed forecast error variance decomposition to check external dominance which shows that at first most of the variation in inflation is explained by lagged interest rate, global financial risk and inflation.

The study also checked how interest rate responds to the output gap, inflation, and exchange rate. The interest responds negatively to shock in the output gap after two months which indicates the pro-cyclical nature of monetary policy as well, there is immediate increase in response to inflation and exchange rate but the effect of exchange rate vanishes after tenth month. Our results confirm that SBP does care about global financial risk, lagged interest rate, inflation and exchange rate but do not respond to output gap which is the important variable in Taylor rule. Policy implication: SBP does not response to output gap despite its importance in Taylor rule. SBP should incorporate the output gap more explicitly in monetary policy formulation to ensure balanced economic stabilization.

Notwithstanding the solidity of the findings, some limitations are to be noted. First, the Large-Scale Manufacturing (LSM) index serves as a proxy for aggregate economic activity, which, though convenient, would not necessarily capture all variations in the overall economy. Second, the Cholesky identification scheme, though extensively used, is based on binding assumptions that could impose biases on the ordering of the shocks. Future studies can overcome these limitations by using alternative indicators of the output gap, e.g., capacity utilization or structural models, and by checking results' sensitivity for various identification strategies. Further, the extension of the analysis by cross-country comparisons with other emerging countries would be highly informative regarding the overall applicability of Pakistan's experience.

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Appendix A: Variance Inflation Factor

Variable	Coefficient	Un-centered	Centered
	Variance	VIF	VIF
GAP	0.000916	1.079131	1.079107
INF	0.004023	10.82843	3.239541
TB	1.26E-07	12.86144	1.194238
CI	3.56E-07	21.97473	1.061797
CMR	0.010181	20.71861	2.817495
ER	0.001147	1.564864	1.564708
C	2.475433	40.10830	NA