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## Article

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## MACROECONOMIC FACTORS DRIVING EXCHANGE RATE VOLATILITY AND ECONOMIC SUSTAINABILITY: CASE STUDY OF PAKISTAN

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### Abstract

Volatility increases the risk of exchange rate, and the risk of exchange rate refers to losing money due to fluctuations in the exchange rate. Thus, it significantly impacts the country's economic development stability or sustainability, as making investment and trade decisions under volatile exchange rates is complicated. The macroeconomic stability of the Sustainable Development Goals (SDGs) of the United Nations can only be achieved partially with the fluctuation of the exchange rate in a country. Therefore, to stabilise exchange rate fluctuations, Pakistan's policy makers are making determinations about the US dollar specifically, which is one of the main reasons why this research study aims to identify the macroeconomic factors that determine the volatility of exchange rates in Pakistan; therefore, for this research study, annual data is used. This study uses an Autoregressive distribution lag (ARDL) model, which assesses cointegration between variables to see their short- and long-term relationship. As a result, there is cointegration, according to the results of the ARDL bound test. Furthermore, in short- and long-period relationships, debt, interest rates, and political stability are revealed to have statistically significant consequences on currency rate volatility. Finally, the Granger causality test analyses that terms of trade, debt, political stability, and inflation cause fluctuations in the exchange rate. On the contrary, the volatility of the exchange rate affects the country's current account. As a result, it is stated that, except for current account balance and interest rate from Granger causality, all the macroeconomic factors selected in this study are drivers

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of exchange rate volatility. However, the vital common determinants from the ARDL and Granger test are debt and political stability, which influence exchange rate fluctuation and hamper the country's economic sustainability. This study implies that the government should also reduce its debt financing by reducing its non-productive expenditure and ensuring political stability, essential for stabilising the exchange rate. This macroeconomic stability can increase the impact of the market rate to influence foreign direct investment, leading to appreciation of the currency and sustainable economic growth of the country.

**Keywords:** volatility of exchange rate, macroeconomic determinants, economic sustainability, Granger causality test, ARDL bound test.

**JEL Classification:** F31, F40.

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### **Introduction**

Exchange rate volatility has become essential for investors, policymakers, and traders due to its impact on trade and investment decisions. Pakistan, a developing country, has experienced substantial volatility in its exchange rate, which poses a significant challenge to its sustainable economic development. Today, macroeconomic stability has become a significant concern around the world, even if it falls under the United Nations Sustainable Development Goal (SDG), a goal of 17.13 goal (United Nations, 2015). However, it is vulnerable to market fluctuations, including exchange rates. The insustainability of economic development consists of poor macroeconomic stability that is, inefficient policymaking, which is the product of volatile commodity prices and fluctuating capital flows, especially in developing countries. It creates a fluctuation in the exchange rate and, therefore, affects the country's economic sustainability (United Nations, 2015). This macroeconomic stability is measured with many variables, including GDP growth, current account and interest rate volatility, employment, and currency stability. In this regard, Achsani, Fauzi and Abdullah (2010) have measured macroeconomic stability with indicators like stable interest rates, low debt, stable inflation, minimum deficits, and stable exchange rates. From this, it is observed that fluctuation in the exchange rate is one of the factors for macroeconomic instability, poor policies, and unsustainable economic development (Ghauri et al., 2022; Kislovska and Tamosiuniene, 2022). For this purpose, Pakistan's government has been working hard to reduce the instability of the currency conversion rate, particularly with respect to the US dollar. Therefore, understanding the underlying macroeconomic variables that drive the volatility of the exchange rate is crucial for designing effective policies to stabilise the exchange rate and promote sustainable economic development of the country. In this regard, many studies and research have investigated the factors that influence the volatility of the currency rate in various nations, but only a few have focused on Pakistan. Therefore, this research aims to eliminate the research gap by determining the macroeconomic aspects that influence fluctuations in the exchange rate of Pakistan and hamper its economic sustainability. This study can help policymakers adopt strategies to reduce exchange rate volatility, stabilise the economy, and attract foreign investment. Because volatility is a phenomenon that largely influences investors' decisions, it is analysed for forecasting, measurement, and evaluation purposes. Furthermore, many previous studies have identified the relationship between economic and

financial variables and exchange rate fluctuations (Phuc and Duc, 2021; Flores-Sosa, Avilés-Ochoa and Merigó, 2022; Wu and You, 2022).

The fluctuation of the exchange rate has a significant influence on a variety of macroeconomic indicators and hampers the sustainable economic development of the country. Rising foreign currency rate volatility, in particular, shrinks government budget revenue, promotes inflation, and boosts net exports and total reserves (Yang et al., 2022). The main elements were accurate and nominal variables in the short run, which determined the real currency rate, while the actual variables were determinants in the long period (Ghauri et al., 2022). Elements such as terms of trade, inflation, interest rates, free trade, politics, current account balance, commodity prices, and foreign debt are used as determinants in studies that impact exchange rate fluctuations over a short and long period (Olulu-Briggs and Nwinee, 2015; Mpofu, 2021; Alexiou, Vogiazas and Kane, 2022; Flores-Sosa, Avilés-Ochoa and Merigó, 2022). This article examines the macroeconomic aspects that influence the volatility of the currency conversion rate in Pakistan. For this purpose, various essential factors such as current account balance, political stability, interest rates, inflation, trade terms, economic progress, and public debt from the literature are used to gauge the volatility of the dollar conversion rate in PKR, including inflation (Ghauri et al., 2019). This study uses annual data from 1981 to 2020. The ARDL model, an empirical approach, is taken in this study to analyse the relation of exchange rate fluctuation with chosen macroeconomic factors that drive volatility (Suhendra et al., 2022). These macroeconomic factors are also the country's leading indicators of economic sustainability. Economic sustainability can be measured by economic performance indicators, such as consumption, investment, international trade, and financial stability (central government budgets, prices, the money supply, and the balance of payment) (Chowdhury, Hamid and Akhi, 2019). Therefore, the financial aspects are the most crucial for our case study, as described below.

*Inflation:* A country with a low inflation rate is associated with currency appreciation because its consumers' purchasing power parity is high. Although countries with higher inflation are generally subject to currency depreciation compared to currencies from other countries. It is mainly due to the higher interest rates in that country (Akbar, 2021; Monfared and Akin, 2017).

*Interest Rates:* Currency exchange rates, interest rates, and inflation are all closely related. Volatility of interest rates impacts both inflation and currency exchange rates. The central bank of the country sets this interest rate with its monetary policy to affect exchange rates and inflation. Lenders in an economy will get a better return with higher interest rates compared to other nations, which attract an inflow of foreign investment in the domestic country, hence appreciating the exchange rate. However, this effect is minimised if the country faces significantly higher inflation than other nations. Higher interest rates typically lead to higher exchange rates, while lower interest rates typically result in higher exchange rates (Ghauri et al., 2019; Hacche, 2015).

*Current-Account Deficits:* It is an integral part of a country's trade; when the country has fewer exports, the low money inflow is called a currency account deficit. This factor is accompanied by more foreign currency demand, which results in the depreciation of the exchange rate until the exports are affordable and inflated foreign assets, further leading to lower domestic sales (Makin, 1984).

*Public Debt:* Nations with high public debt and deficits may not be a factor in foreign direct investment. High debt in the country results in significant inflation because the loan will eventually be serviced and repaid in future real dollars, will be expensive and will need large-scale financing. In the worst case, government policy consists of printing money to pay off debt, but this policy may create inflation in the country. The government policy here must include the factors that increase the number of domestic assets available to foreign buyers to cut prices if it cannot finance its deficit with local resources. Finally, foreign investors believe that a nation with a high debt will default on its responsibilities; therefore, they need more confidence to invest in that country as its risk of default is significant. Therefore, a vital indicator of the country's exchange rate is its debt rating (Štreimikienė et al., 2018).

*Trade terms:* The trade terms of the country can be better with increased export prices than with imported prices, and better terms of trade are related to domestic demand for goods. It boosts export earnings, raising domestic currency demand (and thus its value). Additionally, if export prices increase more slowly than import prices, the currency depreciates (Raza and Afshan, 2017).

*Political Stability and Economic Performance:* Foreign investors often look for stable countries with strong economies. A nation with such significant characteristics will divert capital away from nations thought to be more politically and economically unstable. For example, political unrest can lead to a loss of trust in a currency and a capital flight to more stable currencies (Ciurean-Moldovan, 2021).

*Economic sustainability* refers to economic well-being and is related to the UN Sustainable Development Goals, which envision building a sustainable and prosperous world by 2030. It is embraced by all nations, including developed and developing ones, by implementing efficient macroeconomic policies for GDP growth, eradicating poverty, maintaining macroeconomic stability, and many more in the economy (United Nations, 2015).

This research study is novel in its focus on exploring the macroeconomic aspects that drive the volatility of currency conversion prices, specifically in Pakistan. Although some studies have explored the volatility of the exchange rate in other countries, only a few studies have focused on Pakistan, which makes this study unique. The significance of this research lies in its potential to inform policymakers on how to stabilise exchange rate volatility and attract foreign investment. The study findings can help policy makers develop targeted policies that address the identified macroeconomic aspects driving the impulsiveness of the currency conversion rate in Pakistan. By stabilising the exchange rate, Pakistan's economy can become more attractive to foreign direct investment, which may help the economic development and progress of the country. Furthermore, with a stable exchange rate, the country can achieve the SDG goal of macroeconomic stability by implementing the proper economic policies. This study extends the current literature by providing empirical data on macroeconomic variables that influence the fluctuation of the exchange rate in Pakistan, as well as policy implications for policymakers seeking to stabilise the currency rate, achieve the goals of macroeconomic stability of the United Nations Sustainable Development, and encourage foreign investment. This study has different characteristics compared to previous studies conducted in Pakistan because the macroeconomic variables used in this investigation have yet to be included in a single model in the prior literature. At the same time, the yearly time series data used in this research span the most recent period (1981–2021). It is critical to determine what variables contribute to volatility in the US dollar

conversation rate in Pakistan; therefore, this research study attempted to investigate how the unpredictability of the exchange rate and economic unsustainability are determined by selected macroeconomic variables in Pakistan and how they are associated.

### **1. Review of the scientific literature**

It is essential to determine the factors that influence the volatility of the exchange rate so that policymakers can take action to stabilise the exchange rate and maintain economic stability. As a result, various scholars have investigated the factors that influence the volatility of the exchange rate. Most recently, Suhendra et al. (2022) investigated the long- and short-term implications of the Central Bank monetary policy rate on Indonesian exchange rate fluctuations, and the study showed that the long-term discount rate of the central bank significantly increased the instability of the country's exchange rate. Alexiou, Vogiazas and Kane (2022) found the implication of domestic politics on the instability of currencies of countries like the Japanese yen, British Pound, and Canadian Dollar. According to the research, there are fewer fluctuations in the exchange rate during a Democratic administration, contradicting earlier research on political leanings. Even economic stability and sustainability are related to a stable exchange rate. Thus, it is essential to notify the macroeconomic factors that determine exchange rate variability to predict better future economic policies and achieve macroeconomic stability (Korol, 2014). Another study has found the relation of macroeconomic policies with economic sustainability in emerging economies. It is observed that many countries face ups and downs in economic sustainability because they need to implement better fiscal policies. Countries with appropriate macroeconomic policies such as innovation, human development, and fiscal and monetary policies are on the way to approach economic sustainability and growth (Jima and Makoni, 2022). Additionally, Chowdhury, Hamid and Akhi (2019) observed the impact of macroeconomic variables on economic growth in Bangladesh, and the study results showed that macroeconomic variables (GDP, labour force, technology, exports, and market volatility) can influence economic sustainability. Stable macroeconomic factors lead to production, economic growth, and development.

Furthermore, during periods of divided administration and one month before an election, the volatility of the currency rate has increased. In this regard, Ciurean-Moldovan (2021), in his dissertation, has found the relationship between political aspects, inflation and the country's exchange rate with the help of models such as ARDL, VAR and VECM estimation. He concluded that political stability causes volatility in the exchange rate and inflation. Almag (2020) investigated factors influencing exchange rates in Ethiopia. As a result, he claimed that Ethiopia's nominal exchange rate is adversely associated with the balance of payments and current account but positively related to government spending, the money supply, inflation, economic growth, and interest rates. Furthermore, it was found that the main factors affecting Ethiopia's exchange rate are public spending, ample money supply, and the nominal interest rate. Additionally, Williams and Prasad (2019) chose four Asian nations, China, India, Japan, and South Korea, with sizable GDP in PPP terms, to examine the factors that influence the exchange rates of some selected Asian currencies. After employing multiple regressions, researchers discovered that CAB, net trade, and remittances significantly affect the exchange rates of Japan and India, but only marginally so for China and South Korea. Sharma and Pal (2019) investigated the relationship between the exchange rate and imports of 73 commodities in India between 2013 and 2016. This

relationship was tested using the heteroskedasticity and time series models. In the long run, all commodity imports decreased by 12%. Moreover, the agricultural sector is more sensitive to this than manufacturing. In addition, Purwono, Mucha and Mubin (2018) studied the relationship between currency conversion rate volatility and current account balance in Indonesia from 2005-2014. As a result, they concluded that an increase in the currency conversion price caused an increase in the current account deficit and an unstable economy. Moreover, another study by Ali, Mahmood and Bashir (2015) studied the impact of interest rates, price increases, and money flow on a country's exchange rate. The study applied the Johansen test for cointegration with VECM to estimate short- and long-period associations.

In addition, they used Granger causality and IRF. As a result, they discovered both short- and long-term relationships between them. An expansion of the money supply brings on high interest rates and inflation, further exacerbating the exchange rate's impulsiveness and economic insustainability. Furthermore, Parveen, Qayyum and Ismail (2012) assess the relative relevance of Pakistan's main drivers of exchange rate volatility, including inflation, growth rate, imports, and exports from 1975 to 2010. The results are tested with the OLS-Ordinary least squares and straightforward linear regression methods. According to the report, inflation significantly affects Pakistan's exchange rate, with economic growth at 2. Exports and imports are ranked third and fourth in volatility in the study's list of factors influencing exchange rates, respectively, and thus affect economic sustainability. A study in Iran analysed the effect of external shocks such as exchange rates and inflation on macroeconomic policies. Using the new Keynesian DSGE framework, the study found a significant positive relation between the exchange rate shock on GDP growth and economic sustainability compared to inflation (Boroumand et al., 2020). Achسانی, Fauzi and Abdullah (2010) studied the relationship between exchange rates and inflation in ASEAN countries in North America and the European Union; they used the exploratory statistical method and the Causality test of Granger for the study. As a result, they discovered a significant relationship between exchange rate fluctuations and inflation. According to the Granger Causality Test, there is a one-way causality from exchange rate to inflation in Asia, but a one-way causality in the reverse direction in other continents.

## **2. Research Methodology**

### **2.1. Data collection from the study**

This study has taken annual data on the US dollar exchange rate from 1981 to 2021 to identify the impact of variables such as debt, inflation, terms of trade, market interest rate, political stability, and current account balance on exchange rate fluctuation and economic sustainability. The data series has been taken from the website of the Economic Survey of Pakistan, the World Bank, and the SBP-State Bank of Pakistan, the Pakistan Statistical Bureau, and global governance indicators. The findings of Table no. 1 showed the variables' names, types, measures, and data collection sources.

Table no. 1. Data Collection and Sources

Variables	Abbreviation	Measure	Source	Variable type
Exchange rate volatility	VER	Standard Deviation of Monthly ER	Author's Calculation	Dependent Variable
Inflation	INF	PKR	SBP	Independent Variable
Debt	DEBT	PKR	Economic Survey of Pakistan	Independent Variable
Interest Rate	IR	PKR	World Bank	Independent Variable
Terms of Trade	TOT	PKR	Pakistan Bureau of Statistics	Independent variable
Current account balance	CAB	PKR	World Bank	Independent variable
Political stability	POL	Index	Worldwide Governance Indicators	Independent Variable

Note: PKR=Pakistani Rupee

Source: Authors' Compilation

## 2.2. Models of the Research Study

### 2.2.1. ARDL and ECM model:

The study uses the ARDL-Autoregressive distributed lag and ECM-Error correction model to identify the long and short-run affiliations between exchange rate impulsiveness and macroeconomic factors in Pakistan. The ARDL and ECM models are widely used econometric techniques for analysing the relationships between variables when the data are non-stationary, a common characteristic of macroeconomic time series data.

The ARDL and ECM models used in this study have the following general Eq (1):

$$\begin{aligned}
 lver_t = & c + \beta_0 lver_{t-1} + \beta_1 linflation_{t-1} + \beta_2 ldebt_{t-1} + \beta_3 lir_{t-1} + \beta_4 tot_{t-1} + \beta_5 cab_{t-1} \\
 & + \beta_6 lpol_{t-1} + \sum \beta_{11} dlinflation_{t-1} + \sum \beta_{22} dldebt_{t-1} \\
 & + \sum \beta_{33} dlir_{t-1} + \sum \beta_{44} dtot_{t-1} + \sum \beta_{55} dcab_{t-1} + \sum \beta_{66} dlpol_{t-1} \\
 & + \lambda ECT_{t-1} + \varepsilon_t
 \end{aligned} \tag{1}$$

To explain the volatility of Pakistan's currency rate, the Error Correction Model (ECM) combines lagged values of six macroeconomic variables, including trade, inflation, debt, current account balance interest rates, and political stability. The model's variables are logarithmic, integrating at both levels and first differences, and the subscript t denotes the period. The model contains variable levels and first differences to capture short- and long-term effects. The coefficients  $\beta_1$  to  $\beta_6$  represent the long-period effects of the respective variables, while the coefficients  $\beta_{11}$  to  $\beta_{66}$  represent the short-term effects. The ECT error correction term shows the long-term relation rate of adjustment to deviations. Moreover,  $\lambda$ -Coefficient is the rate of adjustment parameter; its negative value indicates that the model is stable in the long run and will converge to the equilibrium relationship.



### 2.3. Estimation techniques

To achieve the objectives, this study has investigated the drivers of the volatility of currency rates and the causality between them. For this purpose, Phillip-Perron and Augmented Dickey fuller unit root tests are used to identify series integration so that all elements would be stationary at order 0 or 1. The study uses the ARDL model to check cointegration. Thus, the ARDL- Autoregressive distributed lag and ECM-Error correction model examine the short- and long-run relation of exchange rate volatility and macroeconomic factors in Pakistan. The ARDL and ECM models are widely used econometric techniques for analysing the relationships among variables when the data are non-stationary, a common characteristic of macroeconomic time-series data. Moreover, this study identifies the causality of elements with the help of the Granger causality test. Finally, a diagnostic test of the model will be applied to check the stability of the model.

## 3. Results and discussion

### 3.1. ADF unit root and Phillip Perron Tests

ADF-Augmented Dickey fuller unit root (1981) and Phillip-Perron (1988) tests are employed to recognise if the variables have stationary levels of order 0 or 1. Table 2 shows ADF and PP test results, which depicts that the level of integration of the LDEBT, LTOT, and LPOL series are more significant in the first difference, as their p-values are more than 0.05 in both unit root tests, while for the other series LVER, LINFLATION, IR, and CAB the level of integration is at a level as well as at the first difference since their p-values are less than 0.05 in both or any one unit root tests. Hence, some variables are stationary at first difference, while others are integrated at the level, so the ARDL test is feasible for this model.

**Table no. 2. ADF and Phillip Perron test**

Variables of the study	Augmented dickey-fuller test			Phillip-Perron test		
	At Level	At 1 <sup>st</sup> Difference	Stationarity Level	P-Value	P-Value	Stationarity Level
	P-Value	P-Value				
LVER	0.002	0.000	I(0)	0.002	0.000	I(0)
LINFLATION	0.002	0.000	I(0)	0.002	0.000	I(0)
LDEBT	0.844	0.000	I(1)	0.802	0.000	I(1)
IR	0.037	0.000	I(0)	0.133	0.001	I(1)
LTOT	0.857	0.000	I(1)	0.847	0.000	I(1)
CAB	0.008	0.001	I(0)	0.135	0.004	I(1)
LPOL	0.910	0.000	I(1)	0.685	0.000	I(1)

*Source: Authors' Estimation*

### 3.2. ARDL and ECM model

The model presented in Eq. (2) is an ARDL model that helps to examine the influence of macroeconomic variables on the fluctuation of Pakistan's exchange rate. The ARDL results indicated that inflation has a significant inverse influence on the volatility of the currency conversion rate according to the coefficient of  $\text{linf}_{(t-1)}$ , which is -1.191; therefore, inflationary pressures reduce currency volatility. External debt significantly influences the volatility of the currency conversion rate according to the coefficient of debt (t), which is

0.661; therefore, external debt increases the volatility of the exchange rate. The IR coefficient ( $\alpha_1$ ) is 0.224, showing that interest rates have a significant positive impact on currency volatility; therefore, as interest rates rise, so does the fluctuation of the exchange rate. Terms of trade have a significant negative influence on exchange rate fluctuation according to the coefficient of  $\alpha_2$ , which is -1.623; therefore, an increase in trade decreases the volatility of the exchange rate. The  $\alpha_3$  coefficient is -0.018, which shows that the current account significantly negatively influences the fluctuation of the exchange rate. The coefficient of  $\alpha_4$  is 0.448, showing that political instability has a positive and statistically notable impact on the volatility of the currency rate volatility; therefore, increased political instability leads to increased instability of the currency rate. The coefficients of the first set of differenced variables ( $\Delta \ln f_{t-1}$ ,  $\Delta \text{debt}_t$ ,  $\Delta \text{ir}_t$ ,  $\Delta \text{tot}_t$ ,  $\Delta \text{cab}_t$ , and  $\Delta \text{pol}_t$ ) indicate the short-term impact of the respective variables on the volatility of the currency conversion rate. The coefficient of  $\text{ECT}_{t-1}$  is -1.228, suggesting that the error correction term is significantly negative. This means that the variables have a relationship for an extended period and that the deviations from the long-term relationship will be repaired in subsequent periods. The model reveals that inflation, foreign debt, interest rates, terms of trade, and political instability are significant determinants of the volatility of Pakistani currencies.

$$\begin{aligned}
 lver_t = & 0.546 (0.07202) - 0.191 \ln f_{t-1} (-0.250) + 0.661 \text{debt}_t (1.871) \\
 & + 0.224 \text{ir}_t (3.021) - 1.623 \text{tot}_t (-1.060) - 0.018 \text{cab}_t (-0.347) \\
 & + 0.448 \text{pol}_t (1.888) - \sum 0.234 \Delta \ln f_{t-1} (-0.251) + \sum 0.750 \Delta \text{debt}_t (1.916) \\
 & + \sum 0.275 \Delta \text{ir}_t (2.502) - \sum 1.994 \Delta \text{tot}_t (-1.000) - \sum 0.022 \Delta \text{cab}_t (-0.359) \\
 & + \sum 0.550 \Delta \text{pol}_t (1.683) - 1.228 \text{ECT}_{t-1} (-5.525) + \varepsilon_t
 \end{aligned} \tag{2}$$

### 3.3. ARDL Bound Test

The ARDL-bound test has been applied to determine the degree of dependency among a model's dependent and independent variables (Pesaran et al., 2001). As exhibited in Table no. 3, the results of the ARDL bound test, where the order of lag is 1, and the F-stats value is greater than the higher bound at all the confidence intervals, showing cointegration in the model. Because of the cointegration in the model, further ARDL-short-term and ECM-long-term models have been specified.

Table no. 3. ARDL Bound Test

Model	Order of Lag	ARDL Bound Test (*F-stats)	Significance level	Lower Bounds	Upper Bounds	Cointegration
LVER = c - LINFLATION + LDEBT + IR - LTOT + CAB + LPOL	1	6.556541	10%	2.12	3.23	Yes
			5%	2.45	3.61	
			2.50%	2.75	3.99	
			1%	3.15	4.43	

Note: \*No long-run relationships exist with a confidence interval of 10%

Source: Authors' Estimation

### 3.4. ARDL-short-term and ECM-long-term models

ARDL-short-term and ECM-long-term model results are shown in Table no. 4. The ARDL model findings indicate that, at the 10% significance level, debt, political instability, and interest rates positively impact exchange rate volatility. On the contrary, other factors do not impact the short and long term. The results of the ARDL model indicate that debt, political instability, and interest rates are critical determinants because countries like Pakistan with high deficit financing through foreign debt face currency depreciation, exchange rate volatility, high inflation, and economic unsustainable (Akbar, 2021). However, political instability is another major cause of volatility in exchange rates because a currency's value may decline due to political unrest. Capital moves to economies with more stable currencies (Elhussein and Ahmed, 2019; Ciurean-Moldovan, 2021), and Pakistan has been facing political instability since it appeared on the world map. It has made the country move toward unstable macroeconomic policies and restricts its SDG. At this time, it is getting worse. However, a higher domestic interest rate attracts investments from other countries, leading to instability but appreciation in the domestic currency. Higher inflation, like in Pakistan, eliminates appreciation of the currency and economic sustainability (Hacche, 2015; Ahmed et al., 2018; Suhendra et al., 2022). Additionally, for cointegration equations (ECMs), the coefficient value signifies the adjustment rate and the coefficient sign signifies the conjunction or deviation from equilibrium. The coefficient of the integration equation is significant at a confidence level of 5%. It is negative, which shows the presence of convergence to equilibrium with a 122% adjustment speed and a robust long-term relationship of variables.

**Table no. 4. ARDL Co-integration and Long Run form ARDL(1, 0, 0, 0, 0, 0, 1)**

ARDL Short-run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINFLATION)	-0.234736	0.933177	-0.251545	0.8031
D(LDEBT)	0.750939	0.391902	1.916139	0.0649
D(IR)	0.275773	0.110189	2.502728	0.018
D(LTOT)	-1.994059	1.992567	-1.000749	0.325
D(CAB)	-0.022715	0.063169	-0.35959	0.7217
D(LPOL)	0.550391	0.326961	1.683355	0.1027
CointEq(-1)	-1.228136	0.222286	-5.525029	0.000
Cointeq = LVER - (-0.1911*LINFLATION + 0.6114*LDEBT + 0.2245*IR - 1.6236*LTOT - 0.0185*CAB + 0.4482*LPOL + 0.5467 )				
ARDL Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LINFLATION	-0.191132	0.761931	-0.250853	0.8036
LDEBT	0.611446	0.326728	1.871423	0.0711
IR	0.224546	0.074305	3.021959	0.0051

ARDL Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTOT	-1.623647	1.530532	-1.060838	0.2972
CAB	-0.018496	0.053219	-0.347536	0.7306
LPOL	0.448152	0.237366	1.888023	0.0687
C	0.546731	7.591367	0.07202	0.9431

Note: \*, \*\*, \*\*\* indicates the level of significance at 1%, 5%, and 10% respectively.

Source: Authors' Estimation

**3.5. Residual Diagnostics:**

The results of ARCH-Heteroskedasticity test is shown in Table no. 5, which suggests that in the 5% significance model, there is no evidence of heteroskedasticity in the framework. It is indicated that the observed R-squared p-value is more significant than the value of 0.05, which leads to accepting the null hypothesis. Therefore, the assumption of constant variance or homoskedasticity is not violated in the model, and the errors have a constant variance over time.

**Table no. 5. Heteroskedasticity Test: ARCH**

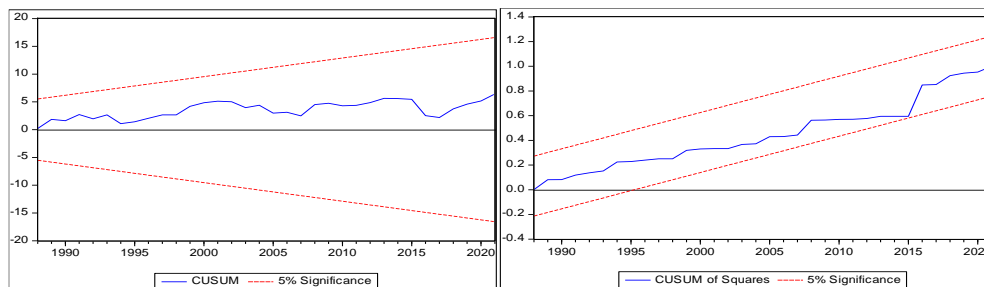
<b>F-statistic</b>	1.192	<b>Prob. F(1,22)</b>	0.316
<b>Obs*R-squared</b>	2.426	<b>*Prob. Chi-Square(1)</b>	0.297

Note: \*There is no heteroskedasticity with a 5% level of significance.

Source: Authors' Estimation

**3.6. Stability Diagnostics: CUSUM and CUSUMSQ Stability Test**

This study has used CUSUM and CUSUMSQ to identify the stability of the ARDL model. The results are revealed in Figure no. 1, which illustrates that the model is stable at a 5% significance level in both the CUSUM and CUSUMSQ approaches. It shows that ARDL is a stable and reliable model for evaluating the association of Pakistani exchange rate volatility and its variables. The stability of the model over time and the capacity to forecast future outcomes are crucial indicators provided by the CUSUM and CUSUMSQ tests. The findings of these tests are crucial for policymakers and researchers, who need to rely on the model's predictions to make informed decisions.



**Figure no. 1. CUSUM and CUSUMSQ Stability Test**

Source: Authors' Estimation

### 3.7. The Breusch-Godfrey serial correlation LM test

The Breusch-Godfrey serial correlation LM test is performed to ascertain whether the model contains autocorrelation (Breusch and Godfrey, 1981). The findings in Table no. 6 show that the observed R-squared has a p-value greater than 0.05, suggesting that there is no autocorrelation. Moreover, the model is autocorrelation-free at a confidence level of 5%. As a result, the test findings indicate that the assumptions of the absence of autocorrelation in the ARDL model are met and that the parameter estimates are unbiased and efficient.

**Table no. 6. Breusch-Godfrey Serial Correlation LM Test**

<b>F-statistic</b>	0.865	<b>*Prob. F(1,17)</b>	0.437
<b>Obs*R-squared</b>	3.173	<b>Prob. Chi-Square(1)</b>	0.205

Note: \*There is no autocorrelation at a 5% level of significance.

Source: Authors' Estimation

### 3.8. Granger Causality Test

Granger (1969) created the Granger causality test to determine the causality between variables in this study. This method reveals whether a variable helps to predict another variable. There is a possibility of causation because the ARDL bound test concluded the existence of cointegration. To determine whether causation existed, the Granger causality test is applied. The findings of Table no. 7 demonstrates that inflation (LINF), debt (LDEBT), terms of trade (LTOT), and political stability (POL) have one-way causal links to exchange rate volatility (LVER). Furthermore, exchange rate volatility has one-way causality to the current account balance at a 5% or 10% significance level. From the test, it is found that inflation, debt, terms of trade, current account balance, and political stability have Granger causality between exchange rate volatility and selected determinants at the 5 and 10% level of significance. The Granger causality test found that other variables of the study, which include inflation, debt, terms of trade, and political stability, have a significant causal impact on currency conversion rate volatility; therefore, this study can consider them as determinants of currency conversion rate instability and economic sustainability. Likewise, according to the research of Achsani, Fauzi and Abdullah (2010), inflation does cause exchange rate fluctuation, as higher inflation causes exchange rate appreciation. Furthermore, terms of trade have causality with currency conversion rate volatility, which means that a change in import and export prices causes changes in exchange rates.

**Table no. 7. Pairwise Granger Causality Test**

<b>Null Hypothesis:</b>	<b>Obs.</b>	<b>F-Statistic</b>	<b>Prob.</b>
LINF does not Granger Cause LVER	39	9.649	0.004
LVER does not Granger Cause LINF		0.027	0.871
LDEBT does not Granger Cause LVER	39	11.657	0.002
LVER does not Granger Cause LDEBT		0.577	0.453
IR does not Granger Cause LVER	39	0.043	0.836
LVER does not Granger Cause IR		0.500	0.484
LTOT does not Granger Cause LVER	39	4.172	0.049

Null Hypothesis:	Obs.	F-Statistic	Prob.
LVER does not Granger Cause LTOT		0.100	0.754
CAB does not Granger Cause LVER	39	0.682	0.414
LVER does not Granger Cause CAB		17.724	0.000
POL does not Granger Cause LVER	39	3.149	0.084
LVER does not Granger Cause POL		0.220	0.642

*Source: Authors' Estimation*

**Conclusion**

Based on the results of the ADF and PPT test, it was found that some of the variables in the model are integrated at level and others are stationary at the <sup>first</sup> (why is first written like that????) difference. The ARDL findings of this study reveal a positive relationship between debt, interest rate, and political stability, with the volatility of the exchange rate at a significance level of 10%. Furthermore, the rest of the variables affect the impulsiveness of currency exchange prices in short and long periods. Additionally, cointegration equations (ECM) indicate that the coefficient value signifies the rate of adjustment and the coefficient sign signifies the conjunction or deviation from equilibrium. The cointegration coefficient equation is significant at a 5% level of confidence. Moreover, it has a negative value indicating convergence to equilibrium with a speed of adjustment of 122% and a robust long-term relation of variables. Furthermore, stability tests such as CUSUM and CUSUMSQ have shown that the ARDL model is stable at a 5% significance level in both approaches. The results of the Granger causality test suggest that there is a one-way causality from inflation, debt, terms of trade, and political stability to the exchange rate volatility and a one-way causality from the volatility of the currency exchange rate to the current account balance at the significance levels of 5% and 10%. Moreover, from the significance levels, inflation, terms of trade, political stability, and debt are important determinants of exchange rate fluctuation in Pakistan. Therefore, all the selected macroeconomic variables in this investigation, except the current account balance and interest rate according to the Granger test, are the determinants of the fluctuation of the exchange rate. Furthermore, by combining the results of the ARDL and Granger test, debt, political stability, interest rate, terms of trade, and inflation are observed as key determinants of exchange rate fluctuation and economic unsustainable. Thus, it is observed from ARDL and Granger that two common variables, debt and political stability, appeared to have the most significant influence on the volatility of the exchange rate in Pakistan. More debt and political instability in Pakistan have allowed the economy to adopt poor macroeconomic policies that result in exchange rate volatility, thus altering economic sustainability and achieving the SDG in the country. The results of this research and various other studies suggest that interest rates, inflation, public debt, and terms of trade are the determinants of Pakistan's volatile currency exchange rate. Therefore, it is suggested that the public debt be reduced because it affects fiscal budget expenditures. It is non-productive and expensive; therefore, policymakers can divert revenues toward more productive expenditure, which may lead to a stable exchange rate and current account balance. A second major determinant of exchange rate volatility is political instability, a

significant disruption of the whole economy, which should be reduced to attract foreign investments, leading to currency appreciation.

#### *Theoretical and Managerial implications*

This research and other studies suggest that interest rates, inflation, trade, political instability, and public debt are the determinants of exchange rate volatility in Pakistan. However, the significant common determinants of the ARDL and Granger test are public debt and political stability. Therefore, policymakers should reduce and stabilise inflation through monetary policy, as it is a monetary phenomenon, and by reducing public debt, as it causes inflation to increase and macroeconomic instability. Additionally, unstable terms of trade affect the stability of the exchange rate and therefore reduce efforts to achieve the 17.13 goal of the SDG and economic sustainability in the country. In conclusion, the study suggests that Pakistani policymakers should focus on reducing the country's debt burden, promoting political stability, and implementing policies that control discount rates and inflation to stabilise the country's exchange rate and achieve economic sustainability. The findings also have implications for other countries that face similar economic challenges. The study has several theoretical implications, first, by studying the influence of macroeconomic factors on Pakistan's exchange rate fluctuation. Studies add to future research on the determinant of exchange rate fluctuation, which hampers the sustainability of economic development. The study advances our understanding by highlighting political unrest in debt as a significant determinant of fluctuation of the exchange rate that contributes to macroeconomic instability. This study identifies that terms of trade, interest rate, and inflation significantly contribute to the volatility of the exchange rate and hamper the country's economic sustainability. Second, the study contributes to the literature by employing the ARDL method to see the long- and short-term behaviour of the chosen macroeconomic variables and their influence on the volatility of the exchange rate.

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