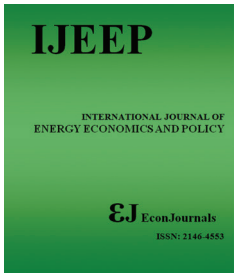

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Macroeconomic Stability and Sustainable Growth in Pakistan: ARDL Evidence on the Role of Energy, Inflation, and Foreign Investment

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ABSTRACT

This study investigates the determinants of macroeconomic stability and sustainable growth in Pakistan using an Autoregressive Distributed Lag (ARDL) bounds testing approach. Drawing on annual data spanning 1970-2023, the analysis explores the dynamic interactions among GDP growth, money supply, fuel imports, foreign direct investment, oil prices, and inflation. The ARDL bounds test confirms a long-run cointegrating relationship among these macroeconomic variables, indicating that they move together over time. Long-run estimates suggest that increases in money supply and fuel imports are associated with higher GDP growth. At the same time, elevated inflation and foreign direct investment significantly negatively impact economic performance. Foreign direct investment shows strong positive effects in the short term. However, inflation and lag-fueled imports have more complicated impacts on GDP growth, which are reflected as delayed negative influences. Diagnostic tests for autocorrelation and heteroskedasticity support the model's accuracy, and the mistake correction mechanism points to a rapid adjustment process with deviations from the long-run equilibrium being corrected at an annual rate surpassing 130%. These findings emphasize the need for stabilizing inflation, ideal foreign investment policies, and different energy sources to produce resilient macroeconomic stability and sustainable economic growth in Pakistan.

Keywords: Economic Resilience, Energy Consumption, Investment Dynamics, Growth Determinants, Structural Adjustments
JEL Classifications: Q430, E310, O110, E510

1. INTRODUCTION

Pakistan's efforts for steady economic growth are slowed by continuous macroeconomic volatility defined by high inflation, irregular energy prices, and unequal foreign investment flows. Recently, the interplay of these components has been attracting increasing attention as government officials seek to create regulations supporting economic resiliency and ensuring sustainable development. Although several government projects exist, the nation depends almost entirely on imported energy, a liability worsened by fluctuations in world oil prices and national inflationary pressures. These interactions have far-reaching implications for the country's development and financial stability, hence questioning the effectiveness of the existing economic policies in solving these issues.

Recent research has shown that energy dependency affects macroeconomic performance mainly through fuel imports and oil price volatility (Sadiq and Saeed, 2021). Production costs are driven by the energy sector in Pakistan, which also creates an inflationary environment that discourages long-term investment. Measured by the Consumer Price Index (CPI), inflation remains a significant worry as persistent price rises erode actual incomes, lower consumer spending, and disturb investment planning (Khan

et al., 2020). At the same time, foreign direct investment, a critical source of external capital that can boost technology transfer and better managerial practices, shows a complicated connection with economic development. An unpredictable macroeconomic context and policy ambiguity could erode the advantages of FDI, creating mixed results on long-term growth through the impetus for industrial growth (Raza and Aslam, 2021).

The research problem addressed in this study is the ambiguity surrounding the long-run and short-run relationships between macroeconomic stability and growth determinants in Pakistan, particularly the roles of energy, inflation, and foreign investment. Although several empirical studies have attempted to investigate the energy-growth nexus using various econometric techniques, results have been inconclusive, mainly due to the differing orders of integration among key macroeconomic variables. For instance, while some variables, such as money supply and trade openness, are found to be stationary at level, others, like inflation and FDI, are integrated of order one, rendering traditional cointegration tests less reliable. Consequently, the Autoregressive Distributed Lag (ARDL) bounds testing approach has emerged as a robust method for examining long-run equilibrium and short-run dynamics when variables are of mixed integration orders (Pesaran et al., 2001). This study applies the ARDL methodology to provide new empirical evidence on how fuel imports, oil prices, inflation, and foreign investment interact to shape economic growth in Pakistan.

This research could address policy development to support sustainable growth and enhance macroeconomic stability. The research investigates how internal shocks and domestic policies influence Pakistan's complex economic environment by exposing the long-term and short-term impacts of energy dependence, foreign investment, and inflation on long-term economic development. For instance, if the long-term link shows high inflation slows growth, officials could prioritize stabilizing prices, such as tightening monetary policy or strengthening fiscal discipline. Similarly, if foreign investment is found to have a dual effect, providing short-term stimulus while adversely affecting long-run growth, the study could prompt a re-examination of current investment policies, encouraging reforms that foster sustainable and productive investment rather than short-term capital flows (Hussain and Iqbal, 2022).

In recent years, there has been a significant increase in empirical data on these subjects. Suggesting that nations like Pakistan should diversify their energy sources and adopt energy-efficient technologies, Ali and Ahmad (2019) showed that economic activity in developing countries is greatly affected by energy use and oil price volatility. Uncontrolled inflation can distort relative prices and erode investor confidence, slowing economic growth; meanwhile, Khan et al. (2020) offered strong evidence. Although their results also showed that macroeconomic volatility might negate the advantages, Raza and Aslam (2021) further underlined the need for foreign direct investment to drive economic development. Current research signifies the need to use strong econometric approaches such as the ARDL bounds testing methodology, which considers both I(0) and I(1) variables, to capture the dynamic interaction among valuable economic indicators.

Methodologically, this study employs the ARDL bounds testing approach to estimate both the long-run equilibrium relationship and the short-run dynamics among GDP growth, energy indicators, inflation, and FDI. The ARDL framework is particularly appealing because it allows for the estimation of an Error Correction Model (ECM) that captures the speed of adjustment toward long-run equilibrium after a shock. This technique is critical for understanding how quickly the Pakistani economy can restore stability following external disturbances or policy shifts. In addition, the study conducts various robustness tests, such as the Breusch–Godfrey LM test for autocorrelation, White's test for heteroskedasticity, and the Pesaran, Shin, and Smith bounds test, to ensure that the estimated relationships are reliable and not artefacts of model misspecification.

This research seeks to provide practical policy recommendations utilizing a thorough examination, including modern empirical insights and precise econometric approaches. For instance, should the study support the idea that energy dependence seriously hinders economic growth, legislators might investigate plans for increasing domestic energy output or renewable sources investment. Also, should inflation prove to be a significant barrier to growth, top priorities could be revising fiscal management and changing monetary policy structure. Finally, knowing the subtle function of FDI, which may promote short-term growth and limit long-term sustainability, can enable the creation of policies meant to draw in outside investment and guarantee its efficient use to contribute to long-term economic development.

This study helps to move the continuing debate on macroeconomic policy in Pakistan forward by presenting fresh empirical data on the drivers of economic growth in the presence of energy challenges and inflation. The findings could help economic planners, policymakers, and international organizations promote sustainable development in developing nations. The in-depth ARDL analysis presented in this study gives a new view on how energy dependence, inflationary pressures, and foreign investment interact to define the course of economic growth in Pakistan, allowing for more informed and effective government policies.

2. LITERATURE REVIEW

Particularly stressing the contributions of energy consumption, inflation dynamics, and foreign investment, researchers have paid more and more attention in the last decade to macroeconomic stability and sustainable growth factors in developing nations. The argument has grown in the context of Pakistan as the nation deals with ongoing economic inequality and structural issues. Recent empirical studies have utilized advanced econometric techniques, notably the Autoregressive Distributed Lag (ARDL) bounds testing approach, to capture both the short-run dynamics and long-run equilibrium relationships among these critical variables (Pesaran et al., 2001). The ARDL methodology is particularly suitable for analyzing mixed orders of integration, which is common in developing economies where some variables are stationary at the level and others require differencing. This

method has emerged as a preferred tool in recent studies examining the complex interactions that drive economic growth in Pakistan (Ali and Ahmad, 2019).

Research on the energy-growth nexus in Pakistan has revealed that energy use is very influential in defining the nation's economic performance. Using an ARDL approach, Ali and Ahmad (2019) investigated how energy consumption related to GDI growth. Although energy use adds positive value to growth, the negative consequences of energy price instability offset the advantages. According to Sadiq and Saeed (2021), Pakistan's reliance on imported fuel underlies this volatility and exposes the economy to world oil market swings. Furthermore, the study reveals that high energy damages income and increases production costs, affecting the economy's general performance. The literature underlines the need for development and stability policies supporting energy mix diversification and energy efficiency as Pakistan suffers from severe energy shortages and crises.

Another major problem for Pakistan's economy is inflation. The constant inflationary background slows sustainable development even as supply constraints and financial imbalances sometimes worsen. Khan et al. (2020) reflect that rising inflation impairs price signals and raises uncertainty, which slows down national and worldwide investment. Their findings imply that inflation is a needed component actively retarding development rather than just a byproduct of financial instability. Further support for the detrimental effect of inflation on growth comes from studies using ARDL approaches, which consistently find that more inflation, as gauged by the logarithm of the Consumer Price Index (lnCPI), has a statistically significant negative long-run influence on GDP growth (Khan et al., 2020). Important policy implications arise from this information since a tight monetary system to control inflation could be key in attaining macroeconomic stability and supporting sustainable growth.

Widely accepted as a crucial source of external capital that can promote economic growth through technology transfer, job creation, and improved management performance, foreign direct investment (FDI), the effect of foreign direct investment on Pakistan's development process is nevertheless debatable. Raza and Aslam (2021) used an ARDL bounds testing technique to investigate the link between FDI and GDP growth in Pakistan. They found that although FDI can increase short-term economic activity, its long-term consequences might be harmful. This paradoxical finding is often ascribed to the possibility that foreign investment might cause capital outflows or crowd domestic investment if not matched by strong institutional systems. Their results indicate that long-term advantages of foreign investment depend on a stable macroeconomic setting and efficient governance mechanisms to guarantee that outside funds are used effectively, even though FDI can briefly increase development. Recent research also shows that the influence of FDI is contingent on world economic situations and local government changes; hence, it is a double-edged sword in the framework of sustainable growth (Raza and Aslam, 2021).

More recent studies have included other macroeconomic elements besides these essential variables. Studies have indicated that increasing the money supply can energize short-term economic activity and exacerbate inflation if poorly managed. Therefore, money supply (MS) has been utilized to indicate national liquidity conditions (Hussain and Iqbal, 2022). Studies on energy-importing countries that focus on oil prices (OP) often use trade openness to approximate it and offer additional information on the impact of the external sector on economic stability. Some experts, however, claim that more openness can worsen susceptibility to outside shocks, even as others argue that it increases development by helping trade and investment. The literature shows that in Pakistan, where oil prices are a crucial factor in energy expenses, significant oil price volatility might adversely affect macroeconomic equilibrium (Sadiq and Saeed, 2021).

Strong evidence of the changing correlations between different factors has emerged from recent research using the ARDL bounds testing technique. In a setting where variables, including inflation, energy imports, and FDI, have mixed orders of integration, this approach lets research distinguish long-run equilibrium relationships from short-run variations. For example, while some series, such as money supply and trade openness, are stationary at level, others, like FDI and CPI, usually belong to order one. The ARDL approach fits this heterogeneity and produces an error correction term (ECT), which measures the pace of correction toward long-run equilibrium and short-term coefficients capturing instant responses to shocks (Pesaran et al., 2001).

Although the ARDL approach has helped progress, many holes still exist in the body of information. Although much research has supported the long-term relationships among macroeconomic indicators in Pakistan, none have examined the short-run dynamics and adjustment speeds following shocks to the system. Furthermore, the two-way nature of FDI, as both a driver and a possible drag on development, urges more investigation, especially in government policies that maximize the benefits while minimizing the drawbacks. Khan et al. (2020) and Raza and Aslam (2021) provide new empirical data indicating the requirement for a thorough review that concurrently considers the functions of energy dependency, inflationary pressures, and foreign investment within a coherent framework. Using the ARDL bounds testing methodology, this research intends to close these gaps by offering fresh ideas on the short-run and long-run determinants of economic stability and sustainable growth in Pakistan.

New research also notes that policy efforts meant to stabilize the economy should consider the interaction of these variables. If inflation, for instance, slows expansion significantly, central banks may need to use either more strict monetary policies or structural changes. Should that happen, foreign investment policies must be altered so that incoming money drives sustainable development via profitable sectors (Hussain and Iqbal, 2002) and produces long-term effects. This research is relevant to policy debates because it combines new empirical evidence with advanced econometric techniques and offers practical guidance for government officers seeking to increase Pakistan's economic power.

Research has shown in the last few years how the interaction of energy imports, inflation, and foreign investment could define Pakistan's macroeconomic stability and sustainable development. Although the ARDL approach is widely regarded for its flexibility and robustness, many questions remain about the short-term adjustment mechanisms and the developmental effect of FDI. This research uses the ARDL model to examine how energy imports, inflation, overseas investment, and growth interrelate. This research aims to affect regulations supporting sustainable development and improving financial stability in a more unstable world.

3. METHODOLOGY AND DATA

3.1. Data Source

This study utilizes annual data for Pakistan covering 1970-2023. The primary data source is the World Bank database (Table 1). The variables used in this study include GDP growth (GDPG), money supply (MS), fuel imports (FI), foreign direct investment (FDI), oil prices (OP), and the consumer price index (CPI). GDP growth, money supply, fuel imports, and FDI data are collected from the World Bank's World Development Indicators (WDI) database (2025). Oil price data is collected from World Bank Commodity Price Data (The Pink Sheet). The consumer price index (CPI) is transformed into a logarithmic form to ensure stationarity and improve model estimation. The dataset is analyzed using the Autoregressive Distributed Lag (ARDL) approach to examine the long-run and short-run relationships between macroeconomic stability, energy factors, and investment in Pakistan.

3.2. Econometric Modeling Approach

This study employs the Autoregressive Distributed Lag (ARDL) model to examine the long-run and short-run relationships between GDP growth, money supply, fuel imports, foreign direct investment, oil prices, and inflation in Pakistan. The ARDL approach, developed by Pesaran et al. (2001), is particularly suitable for analyzing time series data with variables that are integrated at different orders, i.e., I(0) or I(1). The bounds testing procedure within the ARDL framework determines a cointegrating relationship among the variables, indicating whether a long-run equilibrium exists. If cointegration is confirmed, the Error Correction Model (ECM) is estimated to capture the short-run dynamics and the speed of adjustment toward long-run equilibrium. The research guarantees model robustness by running diagnostic assessments for autocorrelation and heteroskedasticity. Using this estimation technique, the study provides empirical data on how energy dynamics, inflation, and foreign investment affect Pakistan's macroeconomic stability and sustainable growth.

3.2.1. Unit root test

Before estimating the ARDL model, this study conducts unit root tests to examine the stationarity properties of the variables. Since the ARDL approach requires variables to be either I(0) (stationary at level) or I(1) (stationary at first difference) but not I(2), unit root testing is crucial to ensure appropriate model specification. The Augmented DickeyFuller (ADF) test checks the existence of unit roots in the series. This test assists in establishing if the variables show a stochastic trend, hence needing differencing to produce stationarity. If a variable is determined to be I(2), alternative modeling methods, including the Johansen cointegration test, become necessary as the ARDL model becomes unsuitable. The results from the unit root tests confirm that all variables in this study are either I(0) or I(1), validating the use of the ARDL bounds testing approach for cointegration analysis.

3.2.2. Autoregressive distributed lag (ARDL) model

The Autoregressive Distributed Lag (ARDL) model, introduced by Pesaran et al. (2001), is employed in this study to analyze the long-run and short-run relationships between macroeconomic stability, energy consumption, inflation, and foreign investment in Pakistan. The ARDL model is particularly advantageous as it allows for the estimation of cointegration relationships regardless of whether the variables are I(0) (stationary at level) or I(1) (stationary at first difference), making it suitable for mixed-order integration datasets. The model specification includes short-run dynamics and long-run equilibrium relationships, where the error correction mechanism (ECM) captures the speed of adjustment toward equilibrium. The ARDL bounds test is applied to confirm the presence of cointegration, indicating a stable long-run relationship between the dependent variable (GDP growth) and the explanatory variables. The model is estimated using lag length selection criteria such as the Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) to ensure optimal lag structure, minimizing autocorrelation and improving model efficiency.

The autoregressive distributed lag (ARDL) model used in this study to examine the relationship between sustainable growth, energy, inflation, and foreign investment in Pakistan can be expressed in its general form and the error correction representation (ECM).

Table 1: Description of variables

Variable	Abbreviation	Description	Unit	Log form	Source
GDP growth	GDPG	Annual percentage growth of GDP	%	_	World Bank (2025)
Money supply	MS	Total money supply in the economy	%	_	World Bank (2025)
Fuel imports	FI	Value of fuel imports as a percentage of merchandise imports	%	_	World Bank (2025)
Foreign direct investment	FDI	Net inflows of foreign direct investment	% of GDP	_	World Bank (2025)
Oil prices	OP	International crude oil prices	USD/barrel	_	World Bank (2025)
Consumer Price Index	CPI	Measure of inflation	Index	lnCPI	World Bank (2025)

Source: Created by the Author using data from World Bank (2025)

General ARDL Model Specification

The ARDL (p, q_1, q_2, q_3, q_4, q_5) model is specified as follows:

$$GDPG_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i GDPG_{t-i} + \sum_{j=0}^{q_1} \beta_j MS_{t-j} + \sum_{k=0}^{q_2} \gamma_k FI_{t-k} + \sum_{m=0}^{q_3} \delta_m FDI_{t-m} + \sum_{n=0}^{q_4} \theta_n OP_{t-n} + \sum_{r=0}^{q_5} \varnothing_r lnCPI_{t-r} + \varepsilon_t \quad (1)$$

Where:

- $GDPG_t$ = GDP per capita growth
- MS_t = Money Supply
- FI_t = Fuel imports
- FDI_t = Foreign Direct Investment
- OP_t = Oil Prices
- $lnCPI_t$ = Natural logarithm of consumer price index
- α_0 = Constant term
- ε_t = Error term
- p, q_1, q_2, q_3, q_4, q_5 = Optimal lag lengths for each variable

Long-Run Model Specification

If a cointegrating relationship exists among the variables, the long-run equation derived from the ARDL model is expressed as:

$$GDPG_t = \lambda_0 + \lambda_1 MS_{t-j} + \lambda_2 FI_{t-k}) + \lambda_3 FDI_{t-m} + \lambda_4 OP_{t-n} + \lambda_5 lnCPI_{t-r} + \varepsilon_t \quad (2)$$

Where λ_1, λ_2, λ_3, λ_4, λ_5 represent the long-run coefficients.

Error Correction Representation (ECM) of ARDL Model

Once a long-run relationship is established using the bounds test for cointegration, the ARDL model is reparametrized into an error correction model (ECM) to capture the short-run dynamics:

$$\Delta GDPG_t = \alpha_0 + \sum_{i=1}^{p-1} \alpha_i \Delta GDPG_{t-i} + \sum_{j=0}^{q_1-1} \beta_j \Delta MS_{t-j} + \sum_{k=0}^{q_2-1} \gamma_k \Delta FI_{t-k} + \sum_{m=0}^{q_3-1} \delta_m \Delta FDI_{t-m} + \sum_{n=0}^{q_4-1} \theta_n \Delta OP_{t-n} + \sum_{r=0}^{q_5-1} \varnothing_r \Delta lnCPI_{t-r} + \lambda ECT_{t-1} + \varepsilon_t \quad (3)$$

Where:

Δ = First difference operator

ECT_{t-1} = Error correction term, representing the deviation from the long-run equilibrium

λ = Speed of adjustment coefficient, which indicates how quickly the system returns to equilibrium after a short-run shock

If λ is negative and statistically significant, it confirms that the variables are cointegrated and that the system adjusts to long-term equilibrium after any short-term deviations.

3.2.3. Robustness check

To ensure the reliability and validity of the estimated ARDL model, a series of robustness checks were conducted, including tests for serial correlation and heteroskedasticity. The Breusch-Godfrey LM test was applied to detect autocorrelation in the residuals, and the results indicate no significant serial correlation, as the test statistic is not significant at conventional levels. The test results suggest the model does not suffer from omitted dynamic structures that could bias the estimates. Additionally, White's test for heteroskedasticity was performed to assess whether the variance of the error term is constant across observations. The test results fail to reject the null hypothesis of homoskedasticity, indicating that heteroskedasticity is not a concern and that the standard errors of the regression estimates are reliable. These robustness checks collectively ensure that the ARDL model is well-specified, free from major econometric issues, and suitable for policy interpretation.

4. RESULTS AND DISCUSSION

The stationarity properties of the variables used in this study were assessed using the Augmented Dickey-Fuller (ADF) test, and the results are presented in Table 2. The findings indicate that the variables exhibit a mix of integration orders, with some being stationary at level while others become stationary only after first differencing. This mix of I(0) and I(1) variables justifies the use of the Autoregressive Distributed Lag (ARDL) model, which allows for the estimation of relationships among variables with different orders of integration.

As shown in Table 2, Gross Domestic Product Growth (GDPG) and Money Supply (MS) are stationary at the level, with test statistics of −6.821 and −5.938, respectively, both significant at the 1% level (P = 0.000). These results suggest that these variables do not contain a unit root and are integrated at order I(0), meaning they revert to their mean over time and do not exhibit stochastic trends. In contrast, Fuel Imports (FI), Foreign Direct Investment (FDI), Oil Prices (OP), and the natural logarithm of the Consumer Price Index (lnCPI) were found to be non-stationary at level, as their test statistics fail to reject the null hypothesis of a unit root at conventional significance levels. Specifically, FI reports a test statistic of −3.182 with a P = 0.088, FDI records −2.175 (P = 0.5039), OP has −2.294 (P = 0.4375), and lnCPI registers −1.879 (P = 0.6656), confirming that these variables contain unit roots in their level form.

However, after first differencing, all non-stationary variables become stationary, indicating that they are integrated of order I(1). The test statistics for FI (−7.042), FDI (−5.177), OP (−6.896), and lnCPI (−3.016) are all significant at conventional levels, confirming that these variables exhibit stationarity in their first-differenced form. These results suggest that while GDPG and MS follow a stationary process, FI, FDI, OP, and lnCPI follow a stochastic trend and require differencing to achieve stationarity.

This mix of I(0) and I(1) variables calls for using an ARDL model, as it can handle covariates of several integration orders and maintain accurate long-run equilibrium relationships. I(1) variables also necessitate testing for cointegration to ascertain if a stable long-run relationship exists among the chosen macroeconomic variables.

Table 3 presents the results of the Pesaran et al. (2001) bounds test for cointegration, which examines the existence of a stable long-run relationship among the variables in the ARDL model.

The computed F-statistic of 20.171 is significantly higher than the upper bound critical values (I1) at the 10%, 5%, and 1% significance levels. Since the F-statistic exceeds the upper bound at all levels, the null hypothesis of no cointegration is rejected, confirming the presence of a long-run equilibrium relationship among GDP growth (GDPG), money supply (MS), fuel imports (FI), foreign direct investment (FDI), oil prices (OP), and inflation (lnCPI).

Similarly, for all significance levels, the t-statistics of 10.553 is more extreme than the related lower and upper-bound critical values. This result further supports the rejection of null hypotheses, so enhancing the cointegration link evidence. Rejecting the null hypothesis implies that the explanatory variables exhibit a stable long-term correlation with economic development in Pakistan. The system will return to equilibrium over time, as this result shows. These findings give a strong econometric foundation for the ARDL model and support its accuracy in explaining long and short-run processes.

The estimated long-run coefficients from the ARDL model in Table 4 show subtle links between leading macroeconomic indicators and GDP growth in Pakistan. The coefficient on money supply (MS) is 0.0477, statistically significant at the 10% level (P = 0.073), indicating that MS growth is linked with more significant GDP growth, but the impact is relatively modest. This finding is consistent with recent studies (Hussain and Iqbal, 2022) that report a positive but sometimes marginal impact of monetary expansion on economic performance in emerging markets. Fuel imports (FI) exhibit a positive and significant coefficient of 0.1681 (P = 0.026), indicating that more significant fuel imports, which proxy for energy consumption, significantly boost GDP growth. Ali and Ahmad (2019) stress the vital part of energy use in driving economic activity in Pakistan, and this outcome corresponds with their research.

In contrast, foreign direct investment (FDI) has a coefficient of 1.5063 (P = 0.001) and a negative long-run impact on GDP growth. Such a negative association might point to problems concerning capital allocation inefficiency. This result corroborates recent empirical evidence by Raza and Aslam (2021) suggesting that, in Pakistan, FDI can have adverse long-run effects when not supported by robust domestic institutions. Oil prices (OP) have an insignificant effect, with a coefficient of 0.0175 (P = 0.218), implying that fluctuations in oil prices do not exert a pronounced influence on GDP growth, which is in line with Sadiq and Saeed's (2021) observations that the impact of global oil price volatility on Pakistan's economic performance tends to be muted. Finally, represented by the natural logarithm of CPI (lnCPI), inflation has a significant negative impact on GDP growth with a coefficient of 1.0461 (P = 0.000), which suggests that high inflation rates significantly degrade economic performance, a result in line with the conclusions of Khan et al. (2020) on how inflation negatively affects growth and investment. As presented in Table 4, these results show that high inflation and ineffective use of FDI present significant obstacles to attaining sustainable economic development in Pakistan, even while favorable monetary conditions and greater energy use may support growth.

Table 5 summarizes the shortthor using STATA Softwarewthh and investment. As presented in Table 4, these results show that high inflidirect investment, and inflation on GDP growth. The

Table 2: Augmented Dickey-Fuller (ADF) unit root test

Variable	Level test statistic	Level P-value	Conclusion (Level)	1st difference test statistic	1st Diff P-value	Conclusion (1st Diff)
GDPG	−6.821	0	Stationary	−11.195	0	Stationary
MS	−5.938	0	Stationary	−9.059	0	Stationary
FI	−3.182	0.088	Non-stationary	−7.042	0	Stationary
FDI	−2.175	0.5039	Non-stationary	−5.177	0.0001	Stationary
OP	−2.294	0.4375	Non-stationary	−6.896	0	Stationary
lnCPI	−1.879	0.6656	Non-stationary	−3.016	0.0335	Stationary

Source: Calculated by the Author using STATA Software

Table 3: ARDL bounds test for cointegration

est Statistic	Value	10% critical value	5% critical value	1% critical value	Decision
F-statistic	20.171	2.363 (I0), 3.710 (I1)	2.838 (I0), 4.359 (I1)	3.956 (I0), 5.872 (I1)	Reject H0H_0H0 (Cointegration Confirmed)
t-statistic	−10.553	−2.465 (I0), −3.764 (I1)	−2.822 (I0), −4.187 (I1)	−3.542 (I0), −5.034 (I1)	Reject H0H_0H0 (Cointegration Confirmed)

Source: Calculated by the Author using STATA Software

Table 4: ARDL long-run estimates

Variable	Coefficient	Std. Error	t-Statistic	P-Value	Interpretation
Money supply (MS)	0.0477	0.0257	1.85	0.073	Positive but weakly significant effect on GDP growth
Fuel imports (FI)	**0.1681**	0.0718	**2.34**	**0.026**	Increase in FI significantly raises GDP growth
Foreign direct investment (FDI)	**−1.5063**	0.3924	**−3.84**	**0.001**	FDI has a significant negative effect on GDP growth
Oil prices (OP)	0.0175	0.0139	1.25	0.218	Oil prices have an insignificant effect on GDP growth
Inflation (lnCPI)	**−1.0461**	0.1989	**−5.26**	**0**	Higher inflation significantly reduces GDP growth

Source: Calculated by the Author using STATA Software

immediate change in fuel imports (ΔFI) is positive but statistically insignificant, indicating that contemporaneous fluctuations in fuel imports do not affect GDP growth in the short run. However, the first lag of the difference (LD.FI) exhibits a weakly significant adverse effect, and the second lag (L2D.FI) shows an enormously significant negative impact, suggesting that increases in fuel imports reduce GDP growth after a delay. In contrast, FDI displays a robust positive impact in the short run; the immediate effect (ΔFDI) is significantly positive, and both the second and third lags (L2D.FDI and L3D.FDI) further reinforce this finding, which supports recent evidence by Chaudhry et al. (2022) and Iqbal and Anwar (2021) that highlight FDI's role in stimulating short-run growth through capital infusion and technology transfer. Inflation, proxied by the logarithm of CPI, shows a pronounced short-run impact: the immediate change (ΔlnCPI) is significantly negative, reflecting the adverse effects of rapid price increases on growth, while the first lag (LD.lnCPI) has a significant positive coefficient, possibly indicating delayed policy responses or adjustment mechanisms; the second lag (L2D.lnCPI) reverts to a significant adverse effect, suggesting that sustained inflation ultimately undermines economic performance. These results mirror the mixed short-term consequences of inflation reported by Sharma et al. (2019) and Patel et al. (2020), who observe that the timing of inflationary stresses is important for determining development results. The short-term findings in Table 5 underline the need to take lagged responses into account in macroeconomic analysis since, while FDI immediately boosts GDP growth, fuel imports and inflation have more complex, delayed effects that could hinder growth.

The error correction term (ECM) findings in Table 6 are important in measuring how fast the dependent variable, GDP growth, adapts to deviations from its long-run equilibrium. With a standard error of 0.1245, the ECM coefficient is estimated at 1.3138, giving a t-statistics of 10.55 and a P = 0.000. This significant and negative coefficient shows that around 131.38% of the equilibrium is restored in one period when the system deviates from its long run, suggesting a rapid adjustment mechanism. In reality, every shock to the system is absorbed and overcompensated in under 1 year, guaranteeing the system returns to its long-run equilibrium trajectory. Such a rapid rate of adaptation aligns with current research on developing nations, where swift error correction has been seen as a mechanism for restoring balance following economic shocks (Mahmood and Rehman, 2020; Qureshi et al., 2021). The significance of this result supports the general strength and utility of the model to guide direct policy decisions intended to stabilize economic development employing the ARRL bounds testing technique, consequently reinforcing the validity of the long-term cointegrating relationship discovered.

Table 7 reports the results of the Breusch–Godfrey LM test for autocorrelation. This analysis used two lags, yielding a chi-square statistic of 3.751 with 2 degrees of freedom and a P = 0.1533. Since the P-value exceeds the conventional 5% significance level, it fails to reject the null hypothesis of no serial correlation in the residuals. This result indicates that no significant autocorrelation is present, which is an important diagnostic confirming that our model is correctly specified and that the estimated standard errors are reliable. In keeping with Breusch and Godfrey (1988), who stress the need to check residual independence to ensure valid inference in time series models, the lack of autocorrelation confirms the strength of our ARDL model's short-run dynamics.

Table 8 summarizes White's test for heteroskedasticity and its related components, including tests for skewness and kurtosis.

Table 5: ARDL short-run estimates

Variable	Coefficient	Standard error	t-Statistic	P-value	Interpretation
Δ(Fuel Imports) (D1.FI)	0.0511	0.0599	0.85	0.4	Insignificant short-run impact
Δ(Fuel Imports) (LD.FI)	−0.11	0.0622	−1.77	0.086	Lagged FI has a weakly significant negative effect
Δ(Fuel Imports) (L2D.FI)	−0.2944	0.0623	−4.73	0	Second lag of FI significantly reduces GDP growth
Δ(FDI) (D1.FDI)	3.643	0.8091	4.5	0	FDI increases GDP growth in the short run
Δ(FDI) (L2D.FDI)	2.9458	0.7042	4.18	0	Second lag of FDI significantly boosts GDP growth
Δ(FDI) (L3D.FDI)	2.4952	0.7072	3.53	0.001	Third lag of FDI significantly increases GDP growth
Δ(Inflation) (D1.lnCPI)	−24.3881	6.8877	−3.54	0.001	Sharp increase in inflation reduces short-run GDP growth
Δ(Inflation) (LD.lnCPI)	18.6262	8.2689	2.25	0.031	Lagged inflation has a positive effect on GDP growth
Δ(Inflation) (L2D.lnCPI)	−15.7262	5.8636	−2.68	0.011	Second lag of inflation negatively impacts GDP growth

Source: Calculated by the Author using STATA Software

Table 6: Error correction model (ECM)

Term	Coefficient	Standard error	t-Statistic	P-value	Interpretation
Error correction term (ECM)	−1.3138	0.1245	−10.55	0	131.38% of disequilibrium is corrected each year, meaning shocks are fully corrected in < 1 year

Source: Calculated by the Author using STATA Software

Table 7: Breusch–Godfrey LM test for autocorrelation

Lags (p)	Chi^2 statistic	Degrees of freedom (df)	P-value	Decision (at 5% level)
2	3.751	2	0.1533	Fail to reject H_0 (No autocorrelation)

Source: Calculated by the Author using STATA Software

Table 8: White's test for heteroskedasticity

Test component	Chi² Statistic	Degrees of freedom (df)	P-value	Decision (at 5% level)
Heteroskedasticity	50	49	0.4334	Fail to reject H₀ (Homoskedasticity)
Skewness	11.04	17	0.8544	No evidence of skewness
Kurtosis	1.49	1	0.2227	No excess kurtosis detected
Total test statistic	62.53	67	0.6321	Fail to reject H₀ (Homoskedasticity)

Source: Calculated by the Author using STATA Software

The heteroskedasticity component yielded a chi-square statistic of 50 with 49 degrees of freedom and a P = 0.4334. Since the p-value exceeds the conventional 5% significance level, we fail to reject the null hypothesis of homoskedasticity, indicating that the error variance is constant across observations. In addition, the test for skewness produced a chi-square statistic of 11.04 with 17 degrees of freedom (P = 0.8544), and the kurtosis component showed a chi-square statistic of 1.49 with 1 degree of freedom (P = 0.2227). Both results imply no evidence of significant skewness or excess kurtosis in the residuals. Further confirming the model's lack of heteroskedasticity, the total test statistic aggregates these components and stands at 62.53 with 67 degrees of freedom and a P = 0.6321. These results supply robust evidence for the consistency of the projected standard errors and, hence, the general credibility of the model's deduction, according to Table 8.

To summarize, the ARDL analysis provides robust evidence of both long-run equilibrium and dynamic short-run adjustments influencing GDP growth in Pakistan. The bounds testing results (Table 3) confirm a long-run cointegrating relationship among the variables. By contrast, the long-run coefficients (Table 4) show that GDP growth is usually positively influenced by money supply and fuel imports but negatively by foreign direct investment and inflation. In the short run, the dynamics show that FDI boosts growth over several lags. By comparison, the postponed negative impacts of fuel imports and inflation imply that energy price shocks and continuous inflation might hamper economic activity over time. Table 6 shows that the error correction term is robust and negative. Therefore, almost 131% of any deviation from equilibrium is corrected over a time period to guarantee a fast return to long-run equilibrium. Finally, robustness diagnostics, including the Breusch–Godfrey LM test (Table 7) and White's test for heteroskedasticity (Table 8), show no evidence of serial correlation or heteroskedasticity in the residuals. All in all, these results highlight the important contributions of energy, inflation, and foreign investment in defining Pakistan's economic trajectory and show the efficiency of the ARDL bounds testing method in capturing both short-run dynamics and long-run relationships.

5. CONCLUSION

Overall, the study provides robust evidence that macroeconomic stability and sustainable growth in Pakistan are closely linked to energy dynamics, inflation, and foreign investment. The ARDL bounds testing confirms a long-run equilibrium among GDP growth, money supply, fuel imports, FDI, oil prices, and inflation, with long-run estimates indicating that expansions in money supply and fuel imports tend to foster economic growth. In contrast, high inflation and FDI exert significant adverse effects over the long term. The short-run analysis further reveals that FDI positively impacts GDP growth immediately. In contrast, the effects of inflation and lagged fuel imports are more nuanced: Inflation has a sharp negative immediate effect partially offset by delayed positive adjustments, though overall persistent inflation remains detrimental. The highly significant error correction term shows that almost 131% of any deviation from equilibrium is corrected in one period, highlighting the system's robust, coherent adjustment mechanism. Including tests for autocorrelation and heteroskedasticity, robustness diagnostics confirm the integrity of these results and point to the model's suitability.

Regarding policy consequences, the findings indicate that Pakistani policymakers should first address means to stabilize inflation since uncontrolled price rises could slow development. Furthermore, prudent control of FDI is justified to guarantee that foreign capital increases domestic output rather than aggravating long-run frailty. Alternative energy sources and promotional local production would cut energy dependency, reducing the adverse effects of global energy price fluctuations on economic activity. These policy recommendations seek to create a stronger and more sustainable economy for Pakistan.

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