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Analyzing the Role of Key Macroeconomic Indicators relating to Pakistan's GDP Growth: A Time-Series Examination

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Abstract

Economic landscape of Pakistan is determined by an extremely complex interaction of domestic and global forces; navigating it successfully requires a clear understanding of its character. The paper explores the dynamic relationships between macroeconomic variables and GDP growth in Pakistan using the Autoregressive Distributed Lag (ARDL) model and other stability tests using time series data from 1980 to 2022. The analysis includes variables representing GDP per capita, inflation, imports, total debt as a percentage of GDP, total population, and forestry and agricultural output. The correlation matrix shows a positive association between GDP growth rate and GDP per capita, total debt service is inversely correlated with total population, and GDP demonstrates a significant negative correlation. The ARDL results indicate that GDP per capita and the agriculture and forestry sectors are significant drivers of economic growth. Over the period in question, inflation only marginally affected GDP growth showing how important it is to maintain price stability through effective policies. Imports provide short-term benefits by enhancing productivity through capital goods and technology inflows but they may pose long-term challenges due to trade imbalances. The influence of population growth appears to be ambivalent: in the short term it contributes to economic growth by increasing labor supply and consumption; in the long term, however, its effect may become detrimental owing to resource constraints. Public debt shows little influence in the short term but negatively impacts growth over time by increasing the fiscal burden of debt servicing. These findings suggest that to achieve long-term economic stability and growth, the country needs targeted

policy interventions that should help it control inflation, manage the debt sustainably, optimize imports, and invest in agriculture, which is an important determinant of GDP growth. Future research should concentrate on sector-specific studies and the effects of political stability on economic growth in order to provide deeper insights contributing to Pakistan's sustainable economic development.

Keywords
Macroeconomic Dynamics, Economic Stability, GDP Growth, Inflation, Agriculture and Forestry, ARDL Model, Pakistan

JEL: E31, E60, Q18, F10, H63, J11.

Introduction

The economy of Pakistan, with its complex economic landscape and serious potential for growth and development, has been subject to various forces, both domestic and global. The most pressing issues the country has been grappling with over the past decades include high inflation, energy shortage, water stress, and fiscal instability (Sherani, 2008). Pakistan's economic progress is also impeded by occasional inflation spikes, trade deficits, and low literacy levels (Sohail et al., 2023). The country needs comprehensive reform strategies to stabilize and then propel its economy towards sustainable growth and socioeconomic resilience. The macroeconomic dynamics of Pakistan's economy are determined by factors related to business cycles and long-term growth, trade balance, external debt, GDP deflator, and FDI (Khan & Jawed, 2019). The government of Pakistan also has to address various challenges like unemployment, inflation, and energy crisis to achieve sustainable growth (Zaheer et al., 2022). The interdependence between macroeconomic policies and industrial performance together with other macroeconomic factors significantly impacts Pakistan's manufacturing sector, private investment, growth, and competition among corporations (Mangla & Din, 2015).

Pakistan's economy has experienced significant fluctuations over the past four decades driven by a mix of domestic and international factors. There have been periods of economic growth but persistent challenges like inflation, external debt, trade deficits, and population pressures continue to hinder the country's sustained development. The existing literature mostly focuses on isolated variables or shorter timeframes so a critical gap remains in understanding how these macroeconomic variables together influence GDP growth over an extended period. Moreover, the bidirectional effects of population dynamics and contributions of certain key sectors, e.g. agriculture and forestry, to economic performance appear to be underexplored. This study aims to address these gaps by employing an integrated approach to the analysis of the dynamic relationships between Pakistan's GDP growth and other macroeconomic variables. Using ARDL model, it investigates their short-term and long-term impacts and offers comprehensive perspective on the factors that drive or impede economic stability and

growth. The findings should provide actionable insights for policymakers to formulate effective strategies that will promote sustained growth and enhance resilience against future economic challenges.

This research aims to investigate macroeconomic factors that influenced GDP growth in Pakistan between 1980 and 2022, including GDP per capita, imports, inflation, population growth, and public debt. One of the primary objectives is to assess how these variables interrelate to shape economic performance. The study evaluates the distinct short-term and long-term effects of targeted variables on economic growth and, based on the empirical findings, outlines possible measures for promoting sustainable economic growth in Pakistan. The research intends to answer the following key questions:

What were the major determinants of GDP growth in Pakistan over the last four decades? How did these factors affect the economic landscape? What were the differential impacts of inflation, agricultural output, and public debt on GDP growth in the short and long run? and how effectively does the ARDL model explain the interactions between these variables and their influence on economic growth?

The study hypothesizes a positive relationship between GDP per capita and GDP growth, suggesting that higher income levels contribute to broader economic expansion. This hypothesis is supported by empirical results indicating that GDP per capita significantly boosts economic growth. Inflation is expected to have a negative impact on GDP growth as high inflation erodes purchasing power and results in economic instability. The findings confirm that inflation negatively affects GDP growth, especially in the long run. The role of imports is hypothesized to be ambivalent. While imports can positively impact GDP growth by bringing in capital goods and technology, excessive reliance on imports may lead to trade deficits. The results indicate that imports have mixed effects, boosting growth in the short term but posing risks if not managed properly over time. Population growth is anticipated to a have bidirectional impact. It can enhance labor supply and consumption but unchecked growth may strain resources and infrastructure. The analysis reveals that population growth has a significant effect on GDP, with both positive and negative implications depending on the context. Public debt is hypothesized to have a detrimental impact on GDP growth due to the financial burden of debt servicing and subsequent reduction in fiscal space for productive investments. The research results confirm this hypothesis showing that high public debt, especially in the long run, adversely affects economic growth, which highlights the importance of effective debt management for sustained economic stability. By testing these hypotheses, the research provides a deeper understanding of the macroeconomic dynamics in Pakistan and offers valuable insights for policymakers to develop strategies that balance growth with economic stability.

Historically Pakistan's economy has been marked by volatility, with periods of growth followed by stagnation or decline because of fiscal deficits, inflationary pressures, and trade imbalances. Previous studies have highlighted a significant

impact of inflation, trade openness, and foreign direct investment (FDI) in shaping economic outcomes (Mansoor & Bibi, 2018; Bibi et al., 2014). However, such studies often lack an integrated approach that allows researchers to examine the simultaneous interaction of multiple macroeconomic variables over an extended period. The present paper addresses this gap by offering a comprehensive analysis spanning four decades, which captures the evolving nature of Pakistan's economy and provides a robust basis for policy guidelines. The ARDL model is particularly advantageous in this context as it allows for the distinction between short-term adjustments and long-term equilibrium relationships. This is crucial for policymakers who need to understand not only the immediate effects of economic policies but also their sustained impacts. Inflation, for instance, may have an immediate adverse effect on economic growth but its long-term consequences can be mitigated through sound monetary policies. Similarly, the relationship between imports and GDP growth is complex; while imports of capital goods can spur growth by enhancing productivity, excessive reliance on imports can lead to trade deficits and economic vulnerability.

Population dynamics, agriculture, and forestry are often critical yet underexplored areas in economic growth studies. Population growth, for instance, can impact the economy in two ways: it can drive growth through increasing labor force and consumer base but it can also strain resources and infrastructure if not managed properly. The study's insights into the bidirectional nature of its impact on GDP may prove valuable for formulating demographic and economic policies. For an agrarian economy like Pakistan, where a large share of the population depends on agriculture for livelihood, to achieve sustainable growth, it is absolutely essential to understand how this sector interacts with macroeconomic variables. The findings suggest that enhanced agricultural productivity and sustainable forestry practices can have a positive ripple effect on the whole economy, contributing to food security, employment, and export revenues. The study's conclusions on how to control inflation, optimize debt service, and foster export-oriented industries are grounded in empirical evidence, which should make them useful for resolving Pakistan's economic challenges. Future research directions suggested by the authors, such as sector-specific analyses and assessing the role of political stability in economic growth may become valuable contributions to economic studies and their potential to inform policy discourse in Pakistan.

The paper offers a thorough analysis of the macroeconomic factors affecting GDP growth but it is not without limitations. One key limitation is the reliance on secondary data sourced from international databases. Although these sources are generally reliable, discrepancies or gaps in their quality and availability could affect the robustness of the results. Moreover, the study covers a broad timeframe, and structural changes in the economy or external shocks such as global financial crises may not be fully accounted for in the model. Another limitation is the paper's focus on quantitative analysis: it may give insufficient attention to some of the qualitative factors, e.g. political stability, governance quality or institutional effectiveness. These elements play a critical role in economic performance but may be difficult

to quantify and integrate into econometric models. Additionally, the ARDL model, while suitable for capturing short-term and long-term relationships, has inherent limitations related to lag selection and potential model specification errors, which could influence the results. Lastly, the study is context-specific, which limits the generalizability of the findings to other developing countries with different economic structures.

Literature Review

The nexus between macroeconomic variables and economic growth has long intrigued economists and policymakers, especially in developing economies such as Pakistan. This section offers an overview of the key studies into this relationship within Pakistan's economic context, highlighting significant results and areas that require further investigation. Bibi, Ahmad, and Rashid (2014) conducted a comprehensive analysis of the effects of trade openness, foreign direct investment (FDI), exchange rates, and inflation on Pakistan's economic growth from 1980 to 2011. Employing unit root tests, cointegration techniques, and dynamic OLS regression, they found that imports, exports, and FDI positively influenced economic growth, although the impact of FDI was not statistically significant. Conversely, inflation and trade openness were shown to have negatively affected growth, with trade openness particularly harmful because of exchange rate depreciation and high import levels. Their research sheds light on the key macroeconomic factors affecting Pakistan's growth and provides valuable empirical evidence for policy-making aimed at promoting sustainable development. The paper also outlines areas for future investigation, such as the need for more precise policy interventions. In a later study, Mansoor and Bibi (2019) expanded the scope of analysis by exploring the relationships between inflation, exchange rates, FDI, and GDP in Pakistan in 1980-2016. Using unit root tests and ARDL regression analysis, they examined both bidirectional and unidirectional relationships between these variables. The results pointed to significant relationships in both long and short term; FDI and the real exchange rate (REF) positively influenced GDP in the short term. However, the link between GDP, the real exchange rate, and inflation was weaker. The study confirmed the stability of the model at a 5% significance level and enriched the understanding of the dynamic interplay between these macroeconomic factors, building on the findings of Bibi, Ahmad, and Rashid (2014).

Further exploring macroeconomic dynamics, Jadoon and Guang (2019) examined the effects of exchange rate fluctuations on Pakistan's trade balance, using annual time series data from 1971 to 2016. Their regression analysis focused on the relationships between the exchange rate, money supply, inflation, and the trade balance. These findings point to the importance of policy measures that can improve the trade balance and facilitate economic growth, complementing research on Pakistan's macroeconomic dynamics. Shaikh, Channa, and Bhutto (2019) added to this body of knowledge by

examining the relationship between the exchange rate and selected macroeconomic variables—imports, GDP, inflation, and exports—from 1992 to 2017. Their study employed secondary data and multiple regression models and found that imports and GDP had a significant negative impact on the exchange rate, while exports and inflation had a significant positive impact. The study suggested that government policies should focus on increasing production, promoting exports, reducing imports, and maintaining price stability to enhance the effectiveness of the exchange rates policy. This research provided further insights into the relationship between exchange rate and other macroeconomic variables in Pakistan. Khan, Zubair, Ullah, and Talal (2023) investigated how foreign debt influenced Pakistan's economic growth between 1990 and 2020, using dynamic ADL models and Granger causality tests. Their research revealed that economic growth in Pakistan was notably impacted by debt servicing, and fluctuations in exchange rates. Unlike earlier studies, their analysis detected no direct causal link between GDP and foreign debt. The researchers challenged the previous assumptions about the relationship between foreign debt and GDP showing that foreign debt adversely affected economic performance through inflation, exchange rate volatility and debt servicing challenges; they offer a deeper understanding of Pakistan's debt crisis and its effects on economic growth. In another study, Irshad, Hussain, and Baig (2022) examined the effects of foreign direct investment (FDI), trade volume, and exchange rates on Pakistan's GDP from 1972 to 2021. Their regression analysis showed that FDI had a positive effect on GDP, whereas exchange rate changes influenced it negatively. Additionally, the trade balance was found to have an insignificant impact on GDP. Their findings mean that Pakistan's economy needs a supportive environment for foreign investment and effectively managed currency fluctuations to promote economic growth, which reinforces broader themes in macroeconomic research concerning the country. In a more comprehensive analysis, Meraj, Ahmed, and Abbas (2024) examine how exchange rate fluctuations affect the key economic indicators in Pakistan, including GDP growth, inflation rates, FDI, CPI, trade balances, and export and import levels. By employing correlation, regression, and other analytical tools, the study uncovered the intricate relationships between exchange rate fluctuations and various economic indicators, emphasizing their implications for Pakistan's economic performance and trade dynamics. Their research contributes valuable insights into the specific impact of exchange rate fluctuations and thus furthers the understanding of Pakistan's macroeconomic framework. Ghauri et al. (2024) identify the key factors driving exchange rate volatility in Pakistan and assess their impact on economic sustainability. Their analysis, based on the ARDL model and Granger causality tests, reveals that factors such as debt, interest rates, and political stability significantly influence currency volatility. The terms of trade, amounts of debt, political instability, and inflation can also increase exchange rate volatility, which in turn negatively affects Pakistan's current account balance. Mehak and Waqas (2023) investigated the effects of inflation and foreign direct investment (FDI) on economic growth in Pakistan, analyzing time series data from 1973 to 2020. They employed Consumer Price Index

(CPI) to represent inflation and discovered a positive long-term relationship between both inflation and FDI on the one hand and economic growth on the other. The study found that the highest rates of economic growth occurred when inflation was kept below 2.80 percent. While FDI had a beneficial impact on growth at lower levels of inflation, its effect turned negative once inflation surpassed this threshold. Ahmed et al. (2018) investigated the relationship between inflation and exports/imports in Pakistan using monthly data from 2001 to 2017. Their error correction and cointegration models, along with Granger causality analysis, showed that a 1% increase in exports/imports led to a 0.63%/0.57% rise in inflation. The study's variance decomposition revealed that exports had most the significant impact on inflation. Nawaz et al. (2017) examined the correlation and causality between inflation and selected macroeconomic variables in Pakistan from 1990 to 2012. The study is based on empirical evidence; it utilizes regression analysis, correlation coefficients, and Granger causality tests to confirm positive associations between inflation and several macroeconomic variables. Results from regression analysis indicate that money supply, government expenditure, government revenue, foreign direct investment, and gross domestic product have a positive impact on inflation in Pakistan, while interest rate shows a negative impact. Naeem (2021) focused on the influence of the exchange rate, interest rate, and economic conditions on FDI in Pakistan from 1972 to 2019. Using time series data and applying unit root tests and ARDL cointegration analysis, the study found that economic conditions and political instability have a negative and insignificant impact on FDI. Conversely, the exchange rate exhibited a positive and significant relationship with FDI, while exports had a negative but insignificant impact. Interest rates and GDP also showed a positive and significant relationship with FDI. The study highlighted the need for further exploration of factors affecting FDI, particularly economic and political conditions. Agriculture and forestry are essential to Pakistan's economy as they substantially contribute to GDP, employment, and export revenues. These sectors are crucial for ensuring food security, supplying raw materials, and promoting environmental sustainability. Research into these areas can shed light on how advancements in agricultural productivity and sustainable forestry practices affect overall economic growth. Improving efficiency in these sectors can boost economic output and enhance livelihoods, especially in rural communities. Understanding the interactions between agriculture, forestry, and other macroeconomic factors can help to design comprehensive policies for sustainable development. Population growth is a fundamental variable that influences labor markets, consumption patterns, and economic growth. Changes in population dynamics can to a high degree determine economic policies and growth trajectories. Integrating population variables into economic analyses can offer a more holistic view of growth potential and challenges facing the economy. The examined literature provides a thorough overview of various relationships between macroeconomic factors and economic growth in Pakistan. However, there is a need for research that will take into account GDP rate, CPI, GDP per capita, total debt service, and population dynamics. The contribution of agriculture and forestry to economic growth should

also be further explored. By addressing these gaps, future studies can offer deeper insights into the complex dynamics at play, enabling policymakers to formulate more effective strategies for sustained economic growth, manage trade deficits and inflation, and leverage positive factors like imports, exports, and FDI for Pakistan's economic development.

Data and Methodology

Table 1. Data Description

Economic variables	Indicators	Short name
Economic growth	Annual GDP growth rate %	GDP Rate
Inflation, Price Level	Annual Inflation, consumer prices %	CPI INF
Agricultural productivity	Agriculture, forestry, and fishing, value added (annual % growth)	A&F
GDP per capita	Annual GDP per capita growth %	GDP Per Capita
Debt Burden	Total debt service (% of GNI)	Total Debt Service
Population	Total Population Annual	Total Population
Imports	Annual Imports of goods and services % growth	Imports

Source: compiled by the author.

The analysis of macroeconomic variables in this paper uses the data obtained from the World Development Indicators (WDI) for the period between 1980 and 2022. The variables are GDP Rate, CPI INF, A&F, GDP Per Capita, Imports, Total Debt Service and Total Population. This dataset offers a valid foundation for the study of macroeconomic dynamics and provides a more rigorous understanding of Pakistan's economic trends and patterns. It contains 43 observations, covering the key economic indicators: GDP growth rate (GDP_RATE), GDP per capita (GDP_PER_CAPITA), inflation rate measured by the Consumer Price Index (CPI_INF), Agriculture and Forestry output (A_F), total imports (IMPORTS), total debt as a share of GDP (T_DEBT_S), and total population (T_POP). These variables were selected based on their relevance to the macroeconomic performance of Pakistan and their availability over the entire study period.

The analysis of macroeconomic dynamics employs Excel charts, descriptive statistics, Augmented Dickey-Fuller ADF, unit root tests, correlation analysis, and

econometric models such as ARDL Model by Using Excel, E views. Excel is used to create visual representations of the macroeconomic variables with charts. Descriptive statistics represent tendencies and variability of data, Subsequent ADF unit root tests reveal significant stationarity for most variables. Correlation analysis uncovers notable relationships and the Autoregressive Distributed Lag (ARDL) model captures long-term relationships. The F-bounds test helps confirm the stability of long-run relationships, while the Wald test validates the joint significance of coefficients in the ARDL model. Together, these methodologies provide a comprehensive understanding of the interconnected dynamics of macroeconomic variables in Pakistan.

Descriptive statistics are computed to provide an initial understanding of the dataset's characteristics, including central tendency, dispersion and distributional properties. It is crucial for identifying basic patterns and potential anomalies in the data which could affect the subsequent econometric analysis (Gujarati & Porter, 2009). By calculating measures like mean, standard deviation, skewness and kurtosis, the study attempts to capture data variability and distribution of the variables, providing a foundation for more complex analyses. The Augmented Dickey-Fuller (ADF) unit root test is employed to determine the stationarity of the time-series data. Stationarity is a critical assumption in time-series econometrics, as non-stationary data can lead to spurious regressions rendering results invalid (Enders, 2008). The ADF test is widely used in econometric studies to check whether a series is stationary at its level or requires differencing. This ensures that the data used in the model can be used for reliable estimation.

Econometric Model Specification

The ARDL model is a widely used tool of analysis (Ghauri et al., 2024; Khan et al., 2023). It proves particularly effective in capturing both long-term and short-term dynamics and so is an ideal choice for analyzing the intricate relationships between macroeconomic variables and growth. The Autoregressive Distributed Lag (ARDL) model introduced by Pesaran and Shin (1995) has become a popular econometric method for analyzing dynamic relationships between variables, particularly in macroeconomic studies. One of its principal advantages is its flexibility in accommodating variables integrated at different orders, specifically I(0) and I(1), without the need for pre-testing the order of integration. It is particularly useful for economic time-series data that often include variables with mixed integration orders, thus reducing the risk of pre-test biases and ensuring a robust analytical framework (Nkoro & Uko, 2016; Haug, 2002). The ARDL model also facilitates the estimation of short-run and long-run relationships in a single equation framework providing a comprehensive view of dynamic interactions between the variables. This dual estimation capability is critical for policymakers who need to understand not only the immediate effects of economic shocks but also their long-

term implications. The ARDL algorithm ability to separately estimate these effects enhances its utility in crafting effective economic policies (Pesaran et al., 2001; Salisu & Isah, 2017).

Another significant advantage is its good performance in small sample sizes, which makes it particularly suitable for studies with limited data, a common scenario in developing economies where long-term historical data may not be reliable or even available. The ARDL model produces reliable and consistent estimates, even when the sample size is not large enough to meet the asymptotic properties required by other cointegration techniques such as the Johansen approach (Narayan, 2005; Bahmani-Oskooee & Bohl, 2000). Furthermore, the ARDL model incorporates lags of both the dependent and independent variables, capturing the adjustment dynamics more effectively. This feature is particularly valuable in macroeconomic contexts where the effects of policy changes or external shocks on economic indicators may be delayed. The inclusion of lagged variables helps identify the speed and path of adjustment toward long-run equilibrium and offers insights into the persistence of economic phenomena (Laurenceson, 2003; Duasa, 2007).

Yet, the ARDL model has its limitations. One critical issue is the potential for misspecification, especially in the selection of appropriate lag lengths. The accuracy of ARDL estimates heavily depends on the correct identification of lag lengths for each variable since improper selection can lead to biased or inconsistent results. This challenge necessitates a precise application of lag selection criteria such as the Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) to ensure model reliability (Lütkepohl, 2005; Ahmad & Du, 2017). Another concern is the assumption of error term properties particularly needed for serially uncorrelated and homoscedastic residuals. Violations of these assumptions can lead to inefficiencies in the parameter estimates and unreliable testing of hypotheses. Thorough diagnostic checks, including the Breusch-Godfrey test for serial correlation and the Breusch-Pagan test for heteroscedasticity, are crucial in validating the robustness of the model (Gujarati & Porter, 2009; Shahbaz et al., 2015). While the ARDL model is proficient at identifying long-run relationships it does not inherently establish causality. The observed correlations between variables may still be subject to endogeneity issues where explanatory variables are correlated with error term, therefore challenging the causal interpretation of the results. To address this difficulty, researchers often complement the ARDL findings with additional causality tests like Granger tests or use instrumental variable approaches to provide a more rigorous causal analysis (Enders, 2008; Jalil & Ma, 2008). Furthermore, the reliance on bounds testing for cointegration in ARDL framework has been critisized for its sensitivity to the choice of critical values and sample size. The bounds test may yield inconclusive results if the computed F-statistic lies between the upper and lower critical values necessitating a more cautious interpretation of the cointegration results (Narayan & Narayan, 2006; Turner, 2006).

Recent literature has seen an increase in the applications of ARDL models in diverse economic contexts reflecting its adaptability and relevance. For instance,

studies on the impact of exchange rate volatility on trade balances, inflation dynamics and the nexus between energy consumption and economic growth have all employed the ARDL framework to provide nuanced insights into these complex relationships (Xu et al., 2018; Aye et al., 2014). Advancements in econometric software have facilitated the broader adoption of ARDL models by simplifying the estimation process and providing more reliable diagnostic tools. These improvements have enhanced the accessibility and accuracy of ARDL applications and enabled more sophisticated analyses of economic phenomena. Overall, the ARDL model is a powerful econometric tool for analyzing the dynamic relationships between macroeconomic variables; it has significant advantages in terms of flexibility, dual estimation capacity and suitability for small sample sizes. Yet, its application requires careful consideration of potential limitations, particularly regarding lag selection, residual diagnostics and interpretation of causality. By addressing these challenges through rigorous methodological practices and complementary analyses, researchers can leverage the ARDL model to derive robust and policy-relevant insights into complex dynamics of economic systems.

The ARDL model is specified as follows:

$$\Delta GDP\_RATE_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta GDP\_RATE_{t-i} + \sum_{j=0}^{q} \gamma_j \Delta X_{t-j} + \phi G$$

Selecting the optimal lag length is essential for capturing the true dynamics of the variables without overfitting the model. The VAR Lag Order Selection Criteria including Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ) are used to determine the appropriate lag structure for the ARDL model. Among these, the AIC is often preferred for its ability to balance model fit and complexity especially in small samples (Lütkepohl, 2005). The chosen lag length is crucial for ensuring that the model accurately reflects the underlying economic processes. The ARDL bounds testing approach is chosen to test for the existence of a long-run relationship among the variables. This method involves comparing calculated F-statistic with critical values to determine if cointegration exists (Pesaran et al., 2001). The bound's testing approach is particularly versatile and robust because it does not require all variables to be integrated in the same order when analyzing long-run relationships in time-series data. Upon confirming the existence of cointegration, the ARDL model is used to estimate both short-run and long-run dynamics of relationships between the variables. The short-run coefficients reveal the immediate impact of changes in independent variables on GDP growth, while long-run coefficients provide insights into equilibrium relationships. This dual analysis promotes a better understanding of how macroeconomic factors influence GDP growth over different time horizons (Pesaran & Shin, 1995).

The long-run equation can be expressed as:

$$GDP\_RATE_t = \mu + \sum_{k=1}^{n} \delta_k X_{t-k} + u_t$$

To ensure the validity of the ARDL model, various diagnostic tests are conducted to check for autocorrelation, heteroscedasticity and model stability. These tests are essential for verifying the reliability of the model's estimates and ensuring that the results are not driven by violations of key econometric assumptions (Gujarati & Porter, 2009). Robustness checks are performed to confirm the consistency of the findings by estimating alternative model specifications, including different lag lengths and excluding trends.

Analysis, Results and Discussion

Graphical Representation

The visualizations provide a clear and concise summary of the data representing the dynamics of GDP Rate, CPI INF, A&F, GDP Per Capita, Imports, Total Debt Service, and Total Population over the study period. Figure 1 shows the trends of CPI Inflation, Agriculture & Forestry (A&F), GDP Rate, and Imports in Pakistan between 1980 and 2022. GDP Rate and Imports vary significantly, reflecting economic cycles in the economy. While CPI Inflation shows high volatility, indicating instability, Agriculture & Forestry exhibit stable growth, highlighting their consistent economic contribution.

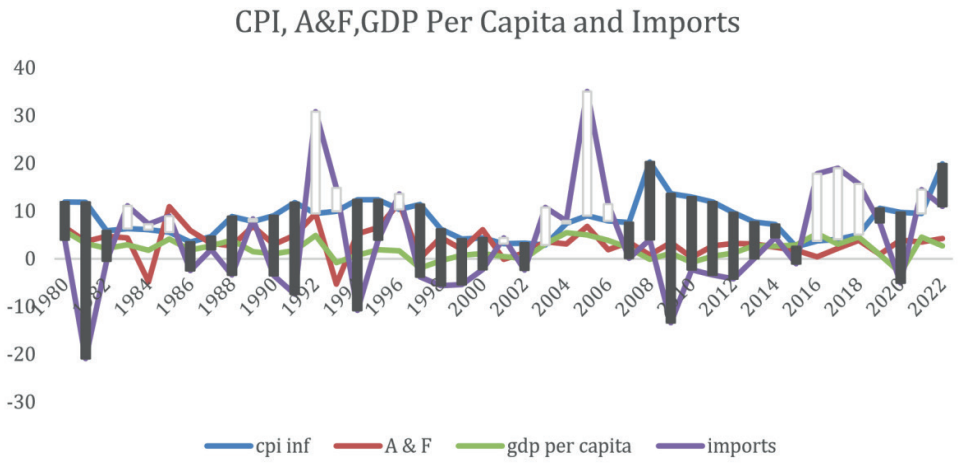

Figure 1. Graphic representation of CPI INF, A & F, GDP Rate, and Imports. *Source*: Author's compilation from excel output

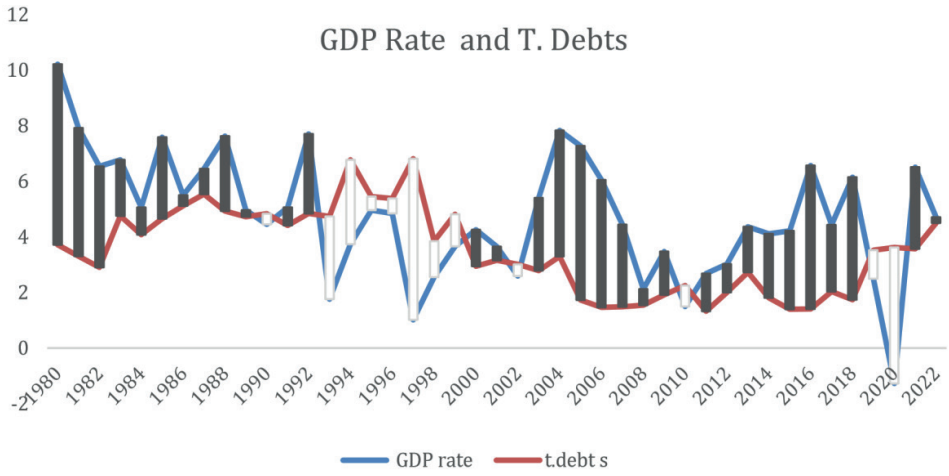

Figure 2. Graphic representation of GDP Rate and T. DEBTS. *Source*: Author's compilation from Excel output

Figure 2 shows the annual GDP rate and annual total debt service (T. DEBTS) in Pakistan from 1980 to 2022. GDP rate fluctuates, with peaks indicating growth and dips showing downturns. Total debt service also varies, with higher debt service often coinciding with lower GDP growth, suggesting an inverse relationship between debt burden and economic performance in the economy.

Table 2. Descriptive statistics

Statistic	GDP_RATE	GDP_PER_CAPITA	CPI_INF	A_F	IMPORTS	T_DEBT_S	T_POP
Mean	4.767	2.085	8.466	3.480	3.983	3.510	1.58×10^{8}
Median	4.705	1.909	7.927	3.412	3.997	3.520	1.59×10^{8}
Maximum	10.215	5.813	20.281	11.723	35.605	6.814	2.36×10^{8}
Minimum	-1.274	-2.970	2.529	-5.280	-20.892	1.327	80624057
Std. Dev.	2.221	2.003	4.086	3.235	10.811	1.517	47331810
Skewness	0.141	-0.195	0.844	-0.075	0.586	0.222	-0.612
Kurtosis	3.258	2.762	3.935	4.541	3.910	2.137	1.709
Jarque-Bera	0.262	0.376	6.873	4.278	3.950	1.687	2.985
Probability	0.876	0.828	0.035	0.117	0.138	0.430	0.224
Sum	205.020	89.669	364.059	149.672	171.291	150.972	6.79×10^{9}
Sum Sq. Dev.	207.338	168.638	701.391	444.008	4909290	96.743	9.41×101^{6}
Observations	43	43	43	43	43	43	43

Source: Author's compilation from EViews output

These data provide a comprehensive statistical summary of the chosen economic indicators across 43 observations. The GDP growth rate (GDP_RATE) averaged 4.77% with a relatively low standard deviation of 2.22, suggesting moderate variability around this mean. The GDP per capita (GDP_PER_CAPITA) had a mean of 2.09 and displayed slightly less variability, as indicated by its standard deviation of 2.00. The inflation rate (CPI_INF) exhibited a higher mean of 8.47% with significant volatility, evidenced by a standard deviation of 4.09. The A_F variable, possibly representing some financial measure, had a mean of 3.48 and higher variability (std. dev. of 3.24), with skewness slightly negative, indicating a longer tail on the left. Imports averaged 3.98, with a large standard deviation (10.81), reflecting substantial disparities among the data points. Total Debt as a Share of GDP (T_DEBT_S) averaged 3.51 with moderate variability (std. dev. 1.52), while Total Population (T_POP) exhibited an enormous mean of approximately 158 million with considerable variance. The skewness and kurtosis values for most variables suggest slight deviations from a normal distribution, with some variables exhibiting positive skewness and others negative. Overall, the dataset reflects diverse economic conditions with varying degrees of volatility across different indicators.

There is a statistically significant correlation between Agriculture & Foresting and the GDP growth rate in Pakistan, which indicates the pre-industrial nature of its economy, meaning that agricultural sectors majorly contribute to the national income. The population has a negative relationship with GDP growth due to its bidirectional nature, which cannot be described by this preliminary analysis. Imports are positively correlated with both GDP_PER_CAPITA (0.50) and GDP_RATE (0.33), i.e. countries with higher GDP and GDP per capita tend to import more.

Table 3. Correlation matrix

	GDP_ RATE	GDP_PER_ CAPITA	CPI_INF	A_F	IMPORTS	T_DEBT_S	T_POP
GDP_RATE	1,00	0,92	-0,18	0,42	0,33	0,04	-0,44
GDP_PER_CAPITA	0,92	1,00	-0,20	0,34	0,50	-0,20	-0,07
CPI_INF	-0,18	-0,20	1,00	0,05	-0,13	0,11	0,12
A_F	0,42	0,34	0,05	1,00	0,14	0,23	-0,23
IMPORTS	0,33	0,50	-0,13	0,14	1,00	-0,13	0,18
T_DEBT_S	0,04	-0,20	0,11	0,23	-0,13	1,00	-0,60
T_POP	-0,44	-0,07	0,12	-0,23	0,18	-0,60	1,00

Source: Author's compilation from EViews output

Total Debt as a Share of GDP (T_DEBT_S) has weak and mixed correlations with other variables, but a notable negative correlation with Total Population (T_POP) (-0.60), implying that higher debt ratios are somehow associated with lower population

sizes. Total Population (T_POP) is negatively correlated with GDP_RATE (-0.44) and T_DEBT_S (-0.60), indicating that countries with larger populations might experience lower GDP growth and lower debt ratios.

Table 4. ADF Unit Root test

	At Level		At First Difference	
Variables	T- Statistics	Probability	T- Statistics	Probability
GDP R.	-4.762164	0.0004		
CPI INF	-5.191298	0.0001		
T. Debt Service	-1.242154	0.6469	-9.898890	0.0000
GDP PC.	-4.981139	0.0002		
Imports	-5.150521	0.0001		
Total POP.	0.233749	0.9715	-3.138339	0.0316
A&F	-8.359080	0.0000		

Source: Author's compilation from EViews output

The ADF unit root test confirms the stationarity of most variables. GDP rate, CPI inflation, GDP per capita, Imports, and Agriculture and Forestry showed significant stationarity. A&F demonstrates high significance with a t-statistic of 8.359080. Total Debt Service is non-stationary at level but becomes stationary at first difference. Total Population shows non-significant at level but became significant at first difference, suggesting stationarity post-differencing.

Table 5. Lag criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1252.86	NA	5.37×10^{18}	62.993	63.288	63.100
1	-975.576	443.659	6.16×10^{13}	51.578	53.943	52.433
2	-881.60	117.469*	8.19×10^{12}*	49.330*	53.763*	50.933
3	-816.03	59.008	7.12×10^{12}	48.501	55.003	50.852*

Source: Author's compilation from EViews output

To determine the most fitting lag with which macroeconomic variables can explain the constant term we use the VAR Lag Order Selection Criteria test, where endogenous variables are GDP_RATE, GDP_PER_CAPITA, CPI_INF, A_F, IMPORTS, T_DEBT_S, T_POP and the exogenous one is a constant C. Using AIC criteria, we reveal that the first-order lag provides the highest amount of information, but due to the variability in different test metrics, we use multiple lag criteria in the ARDL model.

Table 6. ARDL Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDP_RATE (-1)	0.763586	0.059212	12.89576	0.0000
GDP_RATE (-2)	-0.062372	0.039780	-1.567940	0.1318
GDP_RATE (-3)	-0.005771	0.004875	-1.183749	0.2497
GDP_PER_CAPITA	1.023864	0.005663	180.7978	0.0000
GDP_PER_CAPITA (-1)	-0.770842	0.062421	-12.34900	0.0000
GDP_PER_CAPITA (-2)	0.060694	0.039735	1.527476	0.1416
CPI_INF	0.000405	0.002713	0.149193	0.8828
CPI_INF (-1)	-0.008096	0.003076	-2.632159	0.0156
CPI_INF (-2)	0.002881	0.002668	1.079946	0.2924
A_F	0.008239	0.002621	3.143011	0.0049
IMPORTS	-0.004789	0.000967	-4.951751	0.0001
T_DEBT_S	0.000813	0.009817	0.082847	0.9348
T_DEBT_S (-1)	0.009366	0.010483	0.893396	0.3818
T_DEBT_S (-2)	0.008081	0.009913	0.815241	0.4241
T_DEBT_S (-3)	-0.024152	0.009876	-2.445512	0.0234
T_POP	5.96×10^{7}	3.00×10^{8}	19.81924	0.0000
T_POP (-1)	-1.09×10^{6}	6.88×10^{8}	-15.85566	0.0000
T_POP (-2)	4.90×10^{7}	4.75×10^{8}	10.32808	0.0000
C	1.080960	0.226102	4.780859	0.0001
R-squared	0.999796	Mean dependent var	4.508670	
Adjusted R-squared	0.999621	S. D. dependent var	2.037466	
S.E of regression	0.039651	Akaike info criterion	-3.311738	
Sum squared resid	0.033017	Schwarz criterion	-2.509520	
Log-likelihood	85.23476	Hannan-Quinn criterion	-3.021681	
F-statistic	5719.620	Durbin-Watson stat	2.165064	
Prob(F-statistic)	0.000000			

Source: Author's compilation from EViews output

Next, we run ARDL regression on 40 observations with GDP_RATE being a dependent variable that is explained by 3 lags. We investigate the impact of macroeconomic factors on inflation by using the least squares method. The dependent variable is GDP growth rate (GDP_RATE), and the independent variables include imports (IMPORTS), GDP per capita (GDP_PER CAPITA), inflation rate (CPI_INF), population (T_POP), total debt service (T_DEBT_S), unemployment and Agriculture & Forestry. The regression analysis of GDP growth determinants shows that its lagged term (-1), A&F and total population have a marginal impact. The Agricultural sector (0.082) positively correlates with inflation, while imports (-0.048) show negative correlations. GDP growth rate with lag 1 (0.76) also positively affects present growth. Although the total population has a positive coefficient (8*10-6), it is almost zero but statistically significant. The model, with an R-squared of 0,99, suggests that almost all of the variation in GDP growth is explained by these variables. The significant F-statistic (5719, $p = 0$) indicates a robust overall model fit, with the Durbin-Watson statistic (2.165) showing no significant autocorrelation.

The ARDL model analysis reveals that the current GDP growth rate is significantly influenced by its lagged value from the previous period, with a strong positive coefficient of 0.76 ($p < 0.0001$), indicating persistent momentum in GDP growth. However, the influence of GDP growth rates from two and three periods ago is negligible, as their coefficients are negative at -0.06 and -0.0058 respectively, but statistically insignificant ($p = 0.1318$ and $p = 0.2497$). GDP per capita plays a critical role, exhibiting a substantial positive impact on GDP growth with a coefficient of 1.02 ($p < 0.0001$), although the first lag shows a significant negative impact with a coefficient of -0.77 ($p < 0.0001$), suggesting some adjustment or correction over time. Inflation (CPI_INF) has a mixed effect, with the first lag showing a significant negative impact (-0.0081, $p = 0.0156$), while the other lags are insignificant. The variable A_F contributes positively to GDP growth with a coefficient of 0.0082 ($p = 0.0049$), while Imports have a significant negative effect with a coefficient of -0.0048 ($p < 0.0001$). Total Debt as a Share of GDP (T_DEBT_S) has limited influence, with only the third lag showing a significant negative impact (-0.0242, $p = 0.0234$). Lastly, Total Population (T_POP) has a complex effect, with significant positive and negative impacts from different lags, such as 5.96e-07 ($p < 0.0001$) for the current period and -1.09e-06 ($p < 0.0001$) for the first lag, indicating dynamic population effects on GDP growth. The model fits the data exceptionally well, with an R-squared of 0.9998, and the F-statistic of 5719.620 confirms the model's overall significance ($p < 0.0001$).

Table 7. ARDL Long Run Form Output

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.080960	0.226102	4.780859	0.0001
GDP_RATE (-1) *	-0.304557	0.049991	-6.092172	0.0000
GDP_PER_CAPITA (-1)	0.313716	0.054977	5.706311	0.0000
CPI_INF (-1)	-0.004810	0.002645	-1.818943	0.0832
A F**	0.008239	0.002621	3.143011	0.0049
IMPORTS**	-0.004789	0.000967	-4.951751	0.0001
T_DEBT_S (-1)	-0.005892	0.009731	-0.605465	0.5514
T_POP (-1)	-4.41E-09	8.83E-10	-4.993297	0.0001
D (GDP_RATE (-1))	0.068143	0.040692	1.674600	0.1088
D (GDP_RATE (-2))	0.005771	0.004875	1.183749	0.2497
D(GDP_PER_CAPITA)	1.023864	0.005663	180.7978	0.0000
D (GDP_PER_CAPITA (-1))	-0.060694	0.039735	-1.527476	0.1416
D(CPI_INF)	0.000405	0.002713	0.149193	0.8828
D (CPI_INF (-1))	-0.002881	0.002668	-1.079946	0.2924
D(T_DEBT_S)	0.000813	0.009817	0.082847	0.9348
D (T_DEBT_S (-1))	0.016071	0.012383	1.297856	0.2084
D (T_DEBT_S (-2))	0.024152	0.009876	2.445512	0.0234
D(T_POP)	5.96E-07	3.00E-08	19.81924	0.0000
D (T_POP (-1))	-4.90E-07	4.75E-08	-10.32808	0.0000

Source: Author's compilation from EViews output

The constant term (C) has a coefficient of 1.081 with a p-value of 0.0001, showing a statistically significant positive baseline effect on the dependent variable. The lagged GDP growth rate (GDP_RATE (-1)) has a coefficient of -0.305 and a p-value of 0.0000, indicating a significant negative impact on the dependent variable. This suggests that an increase in GDP growth rate from the previous period is associated with a decrease in the dependent variable. In contrast, the lagged GDP per capita (GDP_PER_CAPITA (-1)) has a positive coefficient of 0.314 and a p-value of 0.0000, reflecting a strong and significant positive effect. This implies that a higher GDP per capita in the previous period leads to an increase in the dependent variable. The Consumer Price Index inflation (CPI_INF (-1)) has a coefficient of -0.0048 with a p-value of 0.0832, suggesting a weak negative effect that is only marginally significant at the 10% level. The variable 'A F' has a coefficient of 0.0082 and a p-value of 0.0049, indicating a significant positive effect on the dependent variable. Imports, with a coefficient of -0.0048 and a p-value

of 0.0001, also have a significant negative impact, showing that increased imports are associated with a decrease in the dependent variable. The government debt-to-GDP ratio (T_DEBT_S (-1)) has a coefficient of -0.0059 and a p-value of 0.5514, indicating that it does not significantly affect the dependent variable. The lagged population (T_POP (-1)) shows a coefficient of -4.41E-09 with a p-value of 0.0001, reflecting a significant negative effect on the dependent variable. In the short run, the first differences (D) of GDP_RATE (-1) and GDP_RATE (-2) are not significant, with p-values of 0.1088 and 0.2497, respectively. However, the first difference of GDP_PER_CAPITA (D(GDP_PER_CAPITA)) has a coefficient of 1.024 and a p-value of 0.0000, indicating a highly significant positive effect. CPI_INF changes (D(CPI_INF)) and lagged CPI_INF changes (D (CPI_INF (-1))) are not significant, with p-values of 0.8828 and 0.2924, respectively. The changes in government debt (D(T_DEBT_S)) do not significantly affect the dependent variable (p-value of 0.9348), whereas the change in the government debt-to-GDP ratio from two periods ago (D (T_DEBT_S (-2))) has a coefficient of 0.0242 and a p-value of 0.0234, indicating a significant positive impact. Finally, population changes (D(T_POP)) show a substantial positive effect with a coefficient of 5.96E-07 and a p-value of 0.0000, while the lagged change in population (D (T_POP (-1))) has a significant negative effect with a coefficient of -4.90E-07 and a p-value of 0.0000.

Overall, the significant variables that impact the dependent variable in the long run include lagged GDP growth rate, GDP per capita, imports and population, while CPI inflation and government debt ratios have mixed and less consistent effects.

Table 8. ARDL Long Run Output, Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP_PER_CAPITA	1.030074	0.041215	24.99252	0.0000
CPI_INF	-0.015795	0.008325	-1.897359	0.0716
A F	0.027052	0.009442	2.865172	0.0093
IMPORTS	-0.015725	0.004078	-3.856003	0.0009
T_DEBT_S	-0.019345	0.032222	-0.600365	0.5547
T POP	-1.45×10^{8}	1.10×10^{09}	-13.17583	0.0000
C	3.549290	0.550620	6.445990	0.0000

Source: Author's compilation from EViews output

In the ARDL model with a restricted constant and no trend, GDP_PER_CAPITA has a highly significant positive effect on the dependent variable, increasing it by approximately 1.03 units for each unit increase in GDP per capita. CPI_INF shows a marginally significant negative effect, suggesting that higher inflation slightly decreases the dependent variable. 'A F' has a significant positive impact, with each unit increase in 'A F' raising the dependent variable by 0.027 units. Imports also have a significant negative effect, decreasing the dependent variable by 0.0157 units for each

unit increase in imports. The population variable (T_POP) significantly decreases the dependent variable by a very small amount for each unit increase in population. The government debt-to-GDP ratio (T_DEBT_S) is not significant, indicating that it does not meaningfully impact the dependent variable. The constant term is significant, providing a baseline level for the dependent variable.

Table 9. F-Bound Test

Test Statistic	Value	Significance Level	I(0)	I(1)
Asymptotic: n = 1000				
F-statistic	12.96675	10%	1.99	2.94
K	6	5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99
Actual Sample Size	40	Finite Sample: n = 40		
		10%	2.218	3.314
		5%	2.618	3.863
		1%	3.505	5.121

Source: Author's compilation from EViews output

Next, we run ARDL Error Correction Regression with GDP growth as a dependent variable

Table 10. ARDL Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP_RATE(-1))	0.068143	0.026842	2.538653	0.0191
D(GDP_RATE(-2))	0.005771	0.003205	1.800303	0.0862
D(GDP_PER_CAPITA)	1.023864	0.002930	349.4883	0.0000
D(GDP_PER_CAPITA(-1))	-0.060694	0.027208	-2.230754	0.0367
D(CPI_INF)	0.000405	0.001830	0.221235	0.8270
D(CPI_INF(-1))	-0.002881	0.001885	-1.528511	0.1413
D(T_DEBT_S)	0.000813	0.007030	0.115688	0.9090
D(T_DEBT_S(-1))	0.016071	0.008063	1.993023	0.0594
D(T_DEBT_S(-2))	0.024152	0.007327	3.296089	0.0034
D(T_POP)	5.96×10^{7}	2.25×10^{8}	26.47154	0.0000
D(T_POP(-1))	-4.90×10^{7}	2.82×10^{8}	-17.38672	0.0000
CointEq(-1)*	-0.304557	0.025896	-11.76061	0.0000

Source: Author's compilation from EViews output

The Error Correction Model (ECM) results highlight both short-term dynamics and the long-term adjustment mechanism. The coefficient for the first lag of GDP growth rate, 0.068143, is statistically significant with a p-value of 0.0191, indicating a positive short-term impact on the dependent variable. In contrast, the coefficient for GDP growth rate from two periods ago is 0.005771 with a marginal p-value of 0.0862, suggesting a less significant but still positive effect. The coefficient for the change in GDP per capita is strikingly high at 1.023864, with an extremely low p-value of 0.0000, reflecting a strong and highly significant positive effect. However, the lagged change in GDP per capita has a coefficient of -0.060694 and is significant at the 5% level (p-value = 0.0367), indicating a negative adjustment in the short term. The CPI variables show minimal impact; the current change in CPI has a coefficient of 0.000405 (p-value = 0.8270), and the lagged CPI has a coefficient of -0.002881 (p-value = 0.1413), both of which are not statistically significant. The coefficients for total debt stock are mixed, with the first lagged change having a coefficient of 0.016071 and a p-value of 0.0594, while the second lagged change is significant with a coefficient of 0.024152 and a p-value of 0.0034. The population change coefficients are highly significant, with the current period showing a coefficient of 5.96E-07 (p-value = 0.0000) and the lagged change showing -4.90E-07 (p-value = 0.0000). Lastly, the cointegration term (CointEq(-1)) has a coefficient of -0.304557 and is highly significant (p-value = 0.0000), indicating a strong correction mechanism towards the long-term equilibrium.

Diagnostic Tests

There is no consistent relationship between variables as the variable fluctuates across the period.

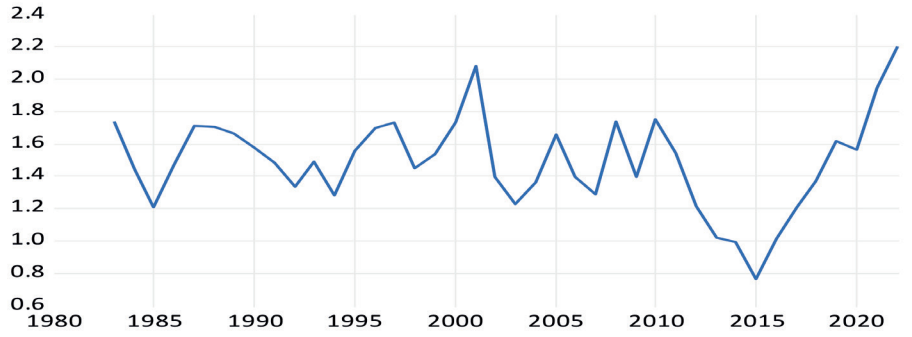

Figure 3. Cointegration graph. *Source*: Author's compilation from EViews output

The null hypothesis of JB test is that the distribution resembles normal and this is the case in our data: p-value of the test is 0,87, which means that the hypothesis cannot be rejected.

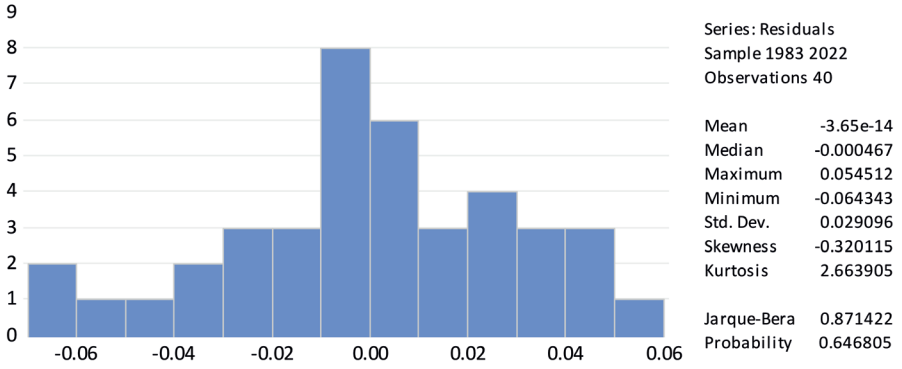

Figure 4. Normality test. *Source*: Author's compilation from EViews output

Table 11. Serial correlation Breusch-Godfrey test

F-statistic	1.100240	Prob. F (3,18)	0.3747
Obs* R-squared	6.198326	Prob. Chi-Square (3)	0.1023

Source: Author's compilation from EViews output

Breusch-Godfrey test reveals that there is no serial correlation in the data, given the F-test p-value of 0.37 and the null hypothesis rejection. Next, we conduct the heteroskedasticity Breusch-Pagan test that has proven there is statistically significant homoskedasticity in the data as the F-test has a p-value of 0.59.

Table 12. Heteroskedasticity test

F-statistic	0.888989	Prob. F (18,21)	0.5962
Obs* R-squared	17.29840	Prob. Chi-Square (18)	0.0.5027
Scaled Explained SS	3.966643		

Source: Author's compilation from EViews output

The Breusch-Pagan test has proven that there is statistically significant homoskedasticity in the data as the F-test has a p-value of 0.59. To determine whether the constructed model is stable when changing the sample, we use CUMSUM test, which provides information on the insignificance of cumulative residuals. Insignificance has also been proven for the CUMSUM of squares. The main conclusion is that errors are not statistically significant

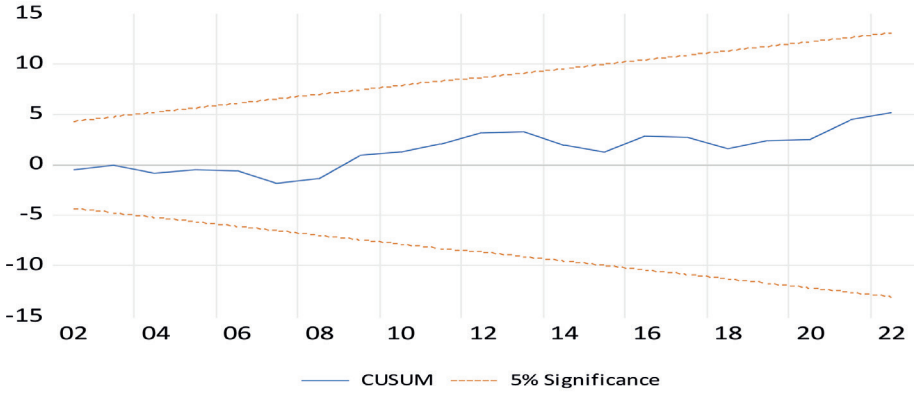

Figure 5. CUMSUM test. *Source*: Author's compilation from EViews output

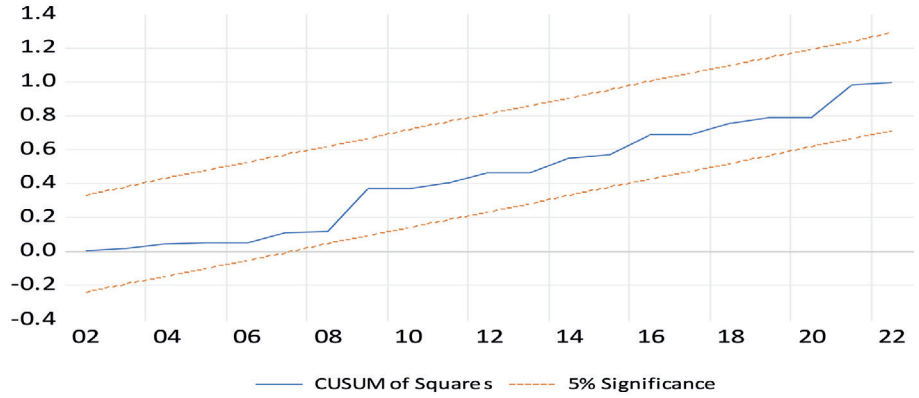

Figure 6. CUMSUM of squares test. *Source*: Author's compilation from EViews output

The correlogram of the squared residuals shows the autocorrelation (AC) and partial autocorrelation (PAC) values at various lags, alongside the Ljung-Box Q-statistic and its p-value. At most lags, the autocorrelation values are close to zero, with none being statistically significant, as indicated by the high p-values for the Q-statistic (ranging from 0.480 to 0.897). This suggests that there are no significant patterns or systematic relationships in the variance of the residuals over time, implying that the residuals are behaving independently. The lack of significant autocorrelation at multiple lags confirms the absence of heteroscedasticity or structural patterns in the residuals, indicating that the model is capturing the underlying data dynamics effectively without evident issues of non-constant variance.

Table 13. Correlogram of residuals squared

AC	PAC	Q-stat	Prob
1	-0.108	0.4997	0.480
2	0,038	0,6069	0,738
3	-0,033	0,6851	0,877
4	-0,195	22487	0,69
5,00	-0,117	25,153	0,774
6	0,109	31,067	0,795
7	-0,072	34,668	0,839
8	0,046	41,966	0,839
9	-0,035	42,583	0,894
10	-0,183	60,478	0,811
11	0,024	62,511	0,856
13	-0,005	71,066	0,897
14	0,047	86,265	0,854
15	-0,144	10,474	0,789
16	-0,202	13,223	0,656
17	-0,056	13,299	0,716
18	0,054	13,314	0,773
19	0,069	14,003	0,784
20	0,006	15,968	0,719

Source: Author's compilation from EViews output

Discussion

The paper contributes to the existing research into the interplay between macroeconomic variables and economic growth in Pakistan, shedding light on previously underexplored areas. The results are contextualized within a broader body of research in the current section highlighting both consistencies and deviations from established studies, and discussing their implications for policy.

The analysis demonstrates that GDP growth in Pakistan is significantly influenced by several key macroeconomic factors, including GDP per capita, inflation (CPI), imports, and the Agriculture and Forestry (A&F) sector. These findings are in line with previous research, particularly the work of Mansoor and Bibi (2019) and Bibi, Ahmad, and Rashid (2014), who identified inflation and trade openness as critical

determinants of economic growth. However, this study brings to the forefront the substantial positive impact of the A&F sector on GDP growth—an area that has not been sufficiently emphasized in prior research. While earlier studies, such as those by Shaikh, Channa, and Bhutto (2019), primarily focused on trade and exchange rates, the current findings underscore the vital role of the A&F sector. Given its significance in terms of direct GDP contribution, employment, and export revenues, these empirical results reveal that economic growth is much improved by policies focused on boosting agricultural productivity and implementing sustainable forestry practices.

The study's findings on inflation align with the conclusions drawn by Mehak and Waqas (2023), who observed that economic growth benefits from controlled inflation, particularly when it remains below a certain threshold. The present study reinforces the notion that a properly managed inflation can have a positive effect on economic growth. These findings do not support the earlier work of Bibi, Ahmad, and Rashid (2014), who considered inflation to be always detrimental to growth. This difference in opinion may result from specific economic contexts that determined the impact of inflation on economic growth in Pakistan in different periods of its recent history.

The positive impact of imports on GDP growth identified in this study is consistent with the findings of Bibi, Ahmad, and Rashid (2014), who noted that imports, along with exports, contribute positively to economic expansion. The current study suggests that the growth-enhancing effect of imports may be caused by the inflow of capital goods and technology, which enhance productivity and innovation, further stimulating economic growth.

In contrast to studies such as Khan et al. (2023), which emphasize the negative impact of external debt due to the burden of debt servicing, this study finds that total debt service becomes significant only after differencing, indicating its relevance primarily in the long run. This suggests that while debt servicing presents a financial burden, its immediate effects on GDP growth may be limited or contingent upon the use of borrowed funds and the effectiveness of broader economic management strategies.

The population growth significantly impacts economic growth, as revealed in the study, though its effects become evident only after first differencing. The empirical results support economic theories that posit population growth to be a driver of economic activity through increased labor supply and consumption, though these effects may unfold over time rather than manifest immediately. This observation is consistent with the literature that underscores the role of demographic shifts in shaping long-term economic growth trajectories, as suggested by Naeem (2021).

The pronounced significance of the Agriculture and Forestry sector in this study underscores its critical role within Pakistan's economic landscape, supporting the argument that A&F sectors are essential for achieving sustainable economic development. The study highlights the need for incorporating sectoral analyses into broader macroeconomic models, given that the prevailing body of the existing literature mostly emphasizes trade-related and industrial variables. Such an approach is necessary to fully understand the dynamics of growth in an agrarian-based economy

like Pakistan. Future research should continue to explore these interrelationships to provide a more comprehensive understanding of the drivers of economic growth.

Conclusion

This study offers important insights into the determinants of economic growth in Pakistan, focusing on the impact of key macroeconomic variables such as inflation, imports, GDP per capita, total debt service, population growth, and the Agriculture and Forestry (A&F) sector. Using the Autoregressive Distributed Lag (ARDL) model, the research finds that inflation and imports have a positive effect on GDP growth, while the impacts of debt service and population growth are more nuanced. The significant role of the A&F sector implies the need for targeted policies to harness its potential for driving economic development. The results support the findings of existing literature, particularly regarding the importance of trade openness and foreign investment, while also offering a brand-new perspective on the complexities surrounding debt service and population dynamics. The literature on the nexus between macroeconomic variables and economic growth in Pakistan reveals a complex interplay of factors, each exerting significant influence on the country's economic trajectory. Studies such as those by Bibi, Ahmad, and Rashid (2014) and Mansoor and Bibi (2019) underscore the positive impact of FDI and trade-related factors on economic growth, albeit with varying degrees of statistical significance. Meanwhile, inflation and exchange rate volatility emerge as critical determinants with mostly negative effects on economic growth, as highlighted by research from Jadoon and Guang (2019) and Shaikh, Channa, and Bhutto (2019). To bolster economic stability and growth, policymakers should prioritize several key areas. Control over inflation through stringent monetary policies and fiscal discipline is essential for stabilizing the economy and enhancing investor confidence. Promoting export-oriented industries and regulating imports will help manage trade deficits and support GDP growth. Effective debt management through optimized debt servicing and increased revenue generation is vital for mitigating the adverse effects of high debt levels. Investment in the Agriculture and Forestry sector, supported by subsidies and technological advancements, can significantly boost productivity and contribute to overall economic development. Addressing rapid population growth through policies centered on education, healthcare, and employment will further support sustainable long-term economic growth. Future research should delve deeper into sector-specific analyses, especially of the agriculture and forestry sectors, to explore their broader impact on economic performance. Moreover, investigating the roles of political stability and governance, as well as the implications of foreign and domestic debt, will provide a more nuanced understanding of Pakistan's economic landscape. Employing advanced econometric models and conducting longitudinal studies will enhance the analysis of dynamic interactions among inflation, GDP growth, trade, and investment, offering a more comprehensive view of macroeconomic policy effects over time. In this way, future research can contribute to a more holistic understanding of

Pakistan's economic challenges and opportunities, ultimately guiding the economy toward sustainable economic growth.

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