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Determinants of Inflation in Pakistan: A Comprehensive Analysis of Macroeconomic Variables (1991–2022)

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ABSTRACT

This research paper investigates the determinants of inflation in Pakistan from 1991 to 2022, focusing on key macroeconomic variables such as imports, GDP growth rate, GDP per capita, military expenditure, population growth, total debt service, and unemployment. The main objective is to analyse the impact of these variables on inflation and provide policymakers with actionable insights. Utilizing annual time series data from reliable source World Bank WDI, the study employs descriptive statistics, correlation analysis, ADF unit root tests, regression analysis, and the Autoregressive Distributed Lag (ARDL) model. The findings reveal significant interdependencies among the examined variables. The correlation analysis shows strong positive relationships between inflation and imports and military expenditure, while GDP per capita and population growth negatively correlate with inflation. OLS results confirm that imports, GDP growth, and total debt service significantly raise inflation, whereas GDP per capita, military expenditure, and population reduce inflation. The ARDL model reveals that, in the long run, imports, GDP growth, and debt service positively affect inflation, while GDP per capita, population growth, and unemployment exert downward pressure. Short-run dynamics indicate that inflation quickly adjusts to economic shocks, with imports and GDP growth having an immediate impact. These findings highlight the importance of managing imports and debt, while promoting economic growth to maintain price stability. The policy implications emphasize the need for targeted monetary policies to manage imports and optimize debt service strategies, as well as policies aimed at enhancing economic growth and increasing per capita income. Effective debt management and strategic military spending are also vital for maintaining price stability. Despite its comprehensive analysis, the study identifies gaps such as the need for further exploration of structural breaks and non-linear effects in inflation dynamics, and the impact of external factors like global oil prices. The significance of this research lies in its contribution to understanding the complex economic interactions influencing inflation in Pakistan, providing a crucial resource for policymakers to develop effective strategies for economic stability in developing economies.

Keywords: Inflation; Macroeconomic Variables; Imports; GDP Growth Rate; GDP per Capita; Military Expenditure; Population Growth; Total Debt Service; Unemployment; ARDL Model; Pakistan Economy

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1. INTRODUCTION

Inflation analysis is of critical importance due to its direct impact on the economy, businesses, and the overall standard of living. Inflation refers to the increase in the general price level of goods and services over a period, and it can have far-reaching consequences for the economy. In Pakistan, where a significant portion of the population lives below the poverty line, inflation can exacerbate the financial hardships faced by many households.

Federal government spending was the most significant determinant of the recent spike in inflation, aiding policymakers and investors in managing inflation [1].

The graph illustrates the trends of inflation alongside key macroeconomic variables in Pakistan from 1991 to 2022, highlighting significant fluctuations. Notably, inflation peaks correspond with increases in military expenditure, imports, and total debt service, reflecting their direct contribution to rising price levels. Meanwhile, population growth and GDP per capita appear to exert a stabilizing effect on inflation, as evidenced by their inverse correlation with inflationary trends. This visualization underscores the complex interplay

between these variables, which is further explored through econometric analysis in this study.

One of the key reasons why inflation analysis is crucial in Pakistan is its impact on the cost of living. As prices rise, the purchasing power of consumers diminishes, leading to a decrease in their standard of living. This can particularly affect low-income individuals and families who are already struggling to make ends meet. Additionally, businesses may also face challenges as rising costs can erode their profit margins, leading to potential layoffs and reduced investment. Furthermore, inflation analysis is essential for policymakers and central banks to make informed decisions about monetary policy. By closely monitoring inflation trends, authorities can implement measures to control inflation and stabilize prices. This can involve adjusting interest rates, managing money supply, and implementing fiscal policies to curb inflationary pressures. Without accurate and timely inflation analysis, policymakers may struggle to effectively address inflation and its negative consequences on the economy. Moreover, inflation analysis is crucial for investors and businesses to make sound financial decisions. Fluctuations in inflation can impact investment returns, interest rates, and borrowing costs, influencing investment strategies and business planning. By understanding inflation trends and their potential impact on the economy, businesses can adjust their pricing strategies and investment decisions to mitigate the effects of inflation. Foreign direct investment positively impacts Pakistan's GDP, while inflation has a negative relationship with GDP. The long-term impact of FDI on inflation depends on the sectors it is invested in and the overall economic environment [2]. the defence burden in Pakistan negatively impacts GDP growth, but when accounting for feedback and covariance, these effects diminish and become less significant. Increased military spending in Pakistan has been found to contribute to inflation by diverting resources from productive sectors and increasing government borrowing [3].

The economy of Pakistan, despite its potential for growth and development, has been subject to various forces, leading to a complex economic landscape. Over the past few decades, Pakistan's economy has experienced significant fluctuations and challenges, influenced by both domestic and global factors, most notable of which is high inflation. Additionally, occasional inflation spikes affect the country's economic progress. The urgent need for comprehensive strategies and reforms to stabilize and propel Pakistan's economy towards sustainable monetary policy are the main motivation of this research. In this rigorous study factors such as military expenditures, GDP per capita, imports, unemployment, GDP growth rate, total debt service, population will be analysed in dynamics to establish interrelations between those variables and their effects on the Consumer Price Index — main benchmark for the price level changes in the world. The study will explore how these different categories of factors interact and contribute to inflationary pressures, providing insights into the complexity and interplay of various economic forces. In Pakistan, factors such as durable goods, electricity, imports, natural gas, steel mill products, capital goods export, food import, and government borrowing influence inflation. Imports directly influence inflation through import prices, where higher import costs lead to higher domestic prices [4].

Despite previous studies shedding light on specific aspects of Pakistan's economy, there remains a notable absence of integrated analyses spanning multiple decades. The research on the inflation causes and consequences in Pakistan lacks an integrated analysis of key macroeconomic variables, as longitudinal perspectives investigating long-term trends are scarce. Developed countries research their economies plenty, while leaving developing volatile economies without a proper political and economic framework to tackle the issues of the excessive money supply. Consequently, this research endeavours to provide valuable insights for policymakers and stakeholders to formulate main factors stimulating and slowing inflation rates in the Pakistan.

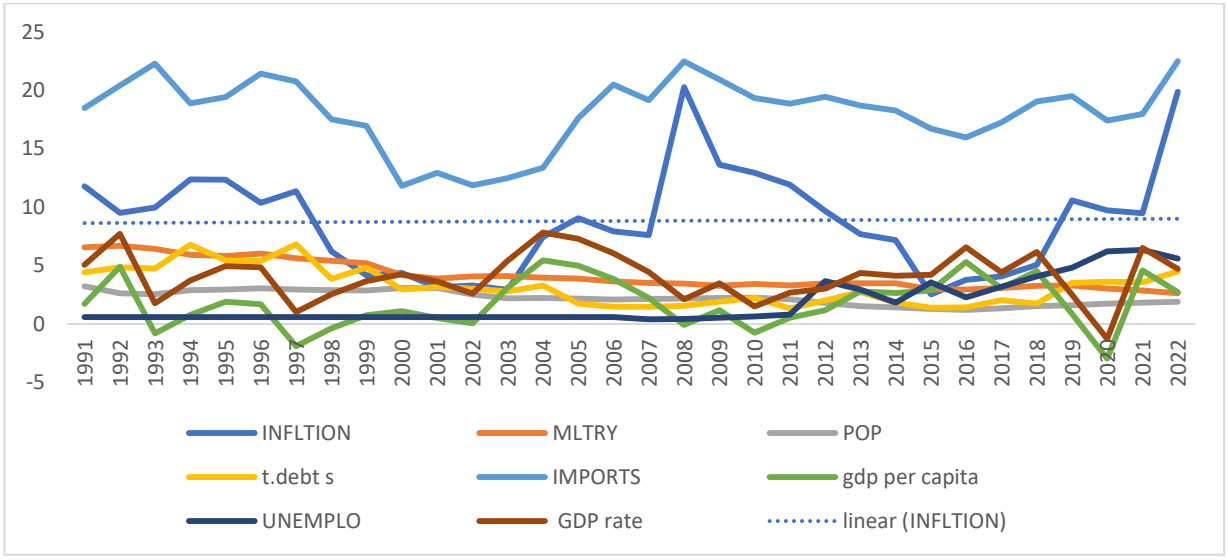

Fig. **Inflation and selected Macroeconomics variables Trends**

Source: Authors own estimations by using Excel charts

2. OBJECTIVES

Given the gaps in existing research, the study seeks to answer the following research questions: What are the key determinants of CPI inflation in Pakistan? How do fiscal, monetary, and external factors collectively influence CPI changes?

To answer the research question, the study poses several objectives:

1) To examine the long-term trends and patterns of military expenditures, GDP per capita, Consumer Price Index (CPI) as a proxy for inflation, imports, unemployment, GDP growth rate, total debt service, total population in Pakistan from 1980 to 2022 using ARDL;

2) To investigate the interdependencies and causal relationships between these macroeconomic variables and focus on CPI;

3) To provide evidence-based recommendations aimed at enhancing monetary stability by determining main factors affecting inflation rates.

3. LITERATURE REVIEW

The study provides a comprehensive analysis of the determinants of inflation in Pakistan, aligning closely with the objectives of our research. This paper investigates both demand-side and supply-side factors influencing inflation, examining key macroeconomic variables over the period from 1972 to 2010. Utilizing advanced econometric techniques, including Johansen Cointegration, Vector Error Correction, and Granger causality tests, the study identifies significant relationships between these variables and the Consumer Price Index (CPI). The findings reveal that in the long run, the money supply, GDP, imports, and government expenditures have a positive impact on CPI, indicating their role in driving inflationary pressures. Conversely, government revenue is found to exert a negative influence on CPI, suggesting its potential in mitigating inflation. By providing empirical evidence on the intricate dynamics of inflation determinants in Pakistan, this study contributes valuable insights into the formulation of effective economic policies aimed at controlling inflation [5].

The paper delves into the intricate relationship between inflation, money supply, interest rate, and unemployment in Pakistan over the period from 1987 to 2019. The study aims to discern both long-run and short-run effects of these macroeconomic variables on inflation. Employing the Autoregressive Distributed Lag (ARDL) cointegration approach, the research tests for long-run and short-run dynamics, while the Augmented

Dickey-Fuller (ADF) unit root test is utilized to ascertain the order of integration of the variables. The empirical results indicate the presence of both long-run and short-run relationships among the studied variables. Specifically, changes in money supply, interest rates, and unemployment are found to significantly influence inflation across different time horizons. Additionally, the study highlights that high-interest payments on debt can exacerbate inflationary pressures by increasing government expenditure, thereby constraining resources available for developmental purposes. This research offers critical insights into the complex interactions between key economic indicators and inflation in Pakistan, providing a robust foundation for policy interventions aimed at stabilizing the economy [6].

The study aims to elucidate the impact of tax revenue, government spending, inflation, gross fixed capital formation, and current account balance on Pakistan's GDP. Utilizing time series data spanning from 1985 to 2021, the research employs the Augmented Dickey-Fuller (ADF) test to ensure data stationarity and the Autoregressive Distributed Lag (ARDL) bound test to identify both long-term and short-term relationships among the variables. The findings indicate that increased government revenue can play a crucial role in controlling inflation by reducing the reliance on external borrowing, thereby contributing to economic stability. However, the study reveals that tax revenue and inflation have a negative impact on economic growth. Conversely, government expenditures and gross fixed capital formation are found to positively influence GDP, underscoring their importance in fostering economic development. This research provides valuable insights into the interplay between fiscal measures, macroeconomic stability, and economic growth, offering significant implications for policymakers in Pakistan [7].

This research aims to establish whether excess money supply growth is a key driver of inflation in Pakistan and examines how monetary policy impacts inflation and real GDP growth. Using correlation analysis, the study explores the association between money supply growth and inflation, and investigates the impact of money supply on real GDP growth. The results indicate that high debt servicing can lead to inflation through increased money supply and reduced investment in the productive sector. The study finds a positive association between money supply growth and inflation, supporting the monetarist view that excess money supply significantly contributes to rising inflation. It suggests that the State Bank of Pakistan's loose monetary policy has prioritized growth over controlling inflation. The key policy implication is that a tighter monetary policy could effectively manage inflation [8].

Ahmad et al. aims to determine the relationship between inflation and economic growth (GDP) in Pakistan, specifically examining whether GDP influences inflation and the nature of their relationship. Using time series data from 1971 to 2011, the study employs the Granger Causality test to explore causality between inflation and GDP, and the Ordinary Least Square (OLS) method to obtain empirical evidence on their relationship. The findings reveal that higher GDP per capita can lead to increased demand and inflationary pressures. The results of the Granger Causality test indicate that GDP causes inflation. Additionally, the OLS results demonstrate a positive relationship between inflation and economic growth, with a 1% increase in inflation raising GDP by 0.45%. This study provides valuable insights into the dynamic interaction between inflation and economic growth in Pakistan [9].

This study aims to determine the impact of inflation on GDP growth in Pakistan, focusing on how inflation influences economic growth and its implications for macroeconomic policy. Using time series data from 1990 to 2015, the study employs the Augmented Dickey-Fuller (ADF) test for data stationarity and the Engel Granger Co-integration test to examine short-run and long-run associations between inflation and GDP growth. The findings indicate a significant positive relationship between GDP growth and inflation, suggesting that higher economic activity can lead to higher prices. Specifically, the results show that a one-unit increase in the inflation rate causes a 0.27-unit increase in

GDP. This strong positive relationship highlights the complexity of inflation's role in macroeconomic stability, suggesting that inflation can positively influence economic growth in Pakistan [10].

Shah et al. aims to determine the impact of unemployment on GDP growth in Pakistan, exploring how unemployment, population growth rate, inflation, foreign direct investment (FDI), and government expenditure influence economic growth. Using the Autoregressive Distributed Lag (ARDL) technique, the study analyses time series data from 1974 to 2020. The GDP growth rate is the dependent variable, while unemployment, population growth rate, inflation, FDI, and government expenditure are the explanatory variables. The findings reveal that high unemployment can reduce inflationary pressures due to lower demand, whereas low unemployment can increase inflation. The study finds that both unemployment and inflation have a negative and statistically significant relationship with economic growth. Conversely, the population growth rate positively and significantly impacts economic growth. The results also indicate short-run cointegration among the variables. The study suggests that government measures to create employment opportunities can accelerate economic growth and reduce unemployment [11].

The selected paper, aims to identify the primary determinants of inflation in Pakistan and analyse how these factors, including money supply (M2), GDP, oil prices (OP), and exchange rate (ER), affect the inflation rate. The study utilizes annual time series data from 1989 to 2019. The Augmented Dickey-Fuller (ADF) test checks for stationarity, and the Autoregressive Distributed Lag (ARDL) model analyses both short-term and long-term relationships between variables. The CPI, GDP, and ER were found to be non-stationary at the first difference, while M2 and OP were stationary. Results, Current account deficits can lead to inflation due to higher foreign debt and currency devaluation pressures.

The ARDL results indicate significant lags for the exchange rate (ER) at lag 2, GDP at lags 2 and 4, and money supply (M2) at lag 2. Specifically:

ER at lag 2 has a negative coefficient (–0.471).

GDP at lag 2 has a negative coefficient (–1.163), and at lag 4, it has a positive coefficient (0.966).

M2 at lag 2 has a positive coefficient (0.473) [12].

The selected paper, aims to assess how real GDP, money supply, imports, government expenditure, and interest rates influence inflation in Pakistan. Using the OLS method and Granger non-causality test, the study analyses the time-series data to determine the effects and causal relationships of the variables on inflation. The results show that real GDP, money supply, imports, government expenditure, and lagged inflation positively affect inflation, while the interest rate has a negative impact. Bidirectional causality exists between money supply and inflation, and unidirectional causality from government expenditure and imports to inflation [13].

The selected paper, primary objective is to determine the impact of fiscal deficits on inflation in Pakistan and assess whether fiscal deficits generate inflation in the long term. The study employs co-integration and Granger-causality tests to analyse secondary data from 1960 to 2010. These methods help establish whether a long-term relationship exists between fiscal deficits and inflation. The study finds a strong relationship between fiscal deficits and inflation in Pakistan. Growth in fiscal deficits, whether measured by absolute amounts or deficit-output ratios, positively Granger-causes inflation. The results suggest that unsustainable fiscal deficits are a major contributor to inflationary pressures in Pakistan [14].

The selected paper, aims to analyse the impact of different fiscal policy instruments, including taxes and government expenditure, on inflation in Pakistan. The study employs the Bounds testing procedure and ARDL (Autoregressive Distributed Lag) approach for co-integration to analyse time series data from 1979 to 2012. These methods are chosen for their suitability in handling small sample sizes and assessing long-term relationships between variables. The study finds that both direct and indirect taxes significantly increase inflation in Pakistan. Additionally, fiscal deficits are identified as a contributing factor to inflation. In contrast,

investment is found to negatively affect the inflation rate, suggesting that promoting investment can help mitigate inflationary pressures [15].

The selected paper, primary objective of the paper is to analyse how budget deficits affect inflation in Pakistan, considering other macroeconomic variables such as money supply, GDP growth, unemployment, and the official exchange rate. The study uses data from 1985 to 2017, sourced from the World Development Indicators and Pakistan Economic Survey. To ensure data reliability, the Augmented Dickey-Fuller (ADF) test is applied to check for unit roots. The Autoregressive Distributed Lag (ARDL) model is used to analyse the long-term and short-term relationships between the variables. The study concludes that budget deficits, GDP growth, and money supply positively impact inflation in Pakistan. Conversely, unemployment and the official exchange rate negatively affect inflation. The findings suggest that addressing the budget deficit and managing money supply growth are crucial for controlling inflation [16].

Inflation in Pakistan is driven by fiscal deficits and money supply, with money supply being both endogenous and exogenous. Total reserves impact inflation indirectly by influencing the exchange rate and the stability of the financial system [17].

The current high rate of inflation in Pakistan is due to a combination of factors, including oil shocks, currency devaluation, and floods, that have exacerbated the country's economic problems. Exchange rate fluctuations significantly affect inflation, with devaluation leading to higher import prices and inflation [18]. Crude oil prices and real effective exchange rate significantly influence the inflation rate in Pakistan, with money supply, exports, and gross fixed capital formation also positively related to inflation. Exchange rate policies and their stability are crucial for controlling inflation [19].

Depreciation of the exchange rate and increase in imports contribute to inflation in Pakistan, while budget deficits do not play a role in boosting inflation indicators over the long run. Increased imports, coupled with a depreciating exchange rate, significantly raise CPI inflation [20].

The study examines the impact of fiscal policy on economic growth in Pakistan. It finds that government expenditure positively affects economic growth, particularly when directed towards infrastructure and social services. Higher tax revenue is also associated with economic growth, underscoring the importance of efficient tax collection. The effects of budget deficits are mixed: moderate deficits can stimulate growth, while high deficits may hinder growth by increasing inflation and interest rates [21].

In Pakistan, military expenditures are insignificant, but the number of military personnel positively

Table 1

Detail of Variables and data sources

Variable	Indicator	Source
Inflation	Inflation, consumer prices (annual %)	WDI
Military Expenditure	Military expenditure (% of GDP)	WDI
GDP per capita	GDP per capita growth	WDI
Imports	Imports of goods and services (% of GDP)	WDI
Unemployment	Unemployment, total (% of total labour force ILO est.)	WDI
GDP growth Rate	GDP growth (annual%)	WDI
Total Debt Service	Total debt service (% of GNI)	WDI
Population	Annual population Growth Rate (annual%)	WDI

Source: compiled by the authors.

and significantly impacts economic growth in the long run. The relationship between military spending and inflation is significant, with higher defence budgets often resulting in higher inflation rates due to increased money supply and decreased investment in social and economic development [22].

4. DATA AND METHODOLOGY

4.1. Data Collection

Table 1 provides the general information on the variables used in the analysis. Annual frequency is used in this paper and the main data source is the WDI, World Bank from 1991 to 2022. The dependent variable is CPI, while independent variables include military expenditures, GDP per capita, GDP growth, imports, unemployment, total debt service and total population.

4.2. Methodology

This study adopts a quantitative research design to investigate the determinants of inflation in Pakistan from 1991 to 2022. The primary objective is to explore the relationships between inflation, as the dependent variable, and several key macroeconomic factors, including military expenditure, GDP per capita, GDP growth rate, imports, unemployment, total debt service, and population growth. A combination of statistical and econometric methods is used to examine these relationships over time.

4.2.1. Econometric Methods

This study adopts a rigorous multi-step econometric approach to examine the relationship between inflation and its determinants, using descriptive statistics, correlation analysis, unit root tests, the Ordinary Least Squares (OLS) method, and the Autoregressive Distributed Lag (ARDL) model.

Initially, descriptive statistics are computed to summarize the central tendencies and variability of the variables used in the analysis. This includes measures like mean, standard deviation, minimum and maximum values, as well as the skewness of the distribution.

Subsequently, **correlation analysis** is performed to assess the degree of linear association between inflation and other macroeconomic variables. The study finds strong positive correlations between inflation and imports, as well as military expenditure. These high correlations suggest that higher import prices and defense spending may drive inflationary pressures. Conversely, GDP per capita and population growth exhibit negative correlations with inflation, implying that economic prosperity and demographic factors contribute to price stability.

Before conducting regression analysis, the **Augmented Dickey-Fuller (ADF) test** is applied to check for stationarity in the time series data. This step is crucial as non-stationary variables can produce misleading results in time series regression. The results indicate that inflation, GDP growth rate, and GDP per capita are stationary at level, while other variables become stationary after first differencing. These findings validate the inclusion of both $I(0)$ and $I(1)$ variables in the ARDL model, which accommodates this mix of integration orders.

The **OLS method** is used to estimate the relationship between inflation and the independent variables. This method provides unbiased and efficient parameter estimates under the assumption of no multicollinearity, autocorrelation, or heteroscedasticity. The results of the OLS regression reveal that imports, GDP growth rate, and total debt service have a positive and statistically significant impact on inflation. Conversely, GDP per capita, military expenditure, and population growth negatively affect inflation. Unemployment, while having a negative coefficient, is not statistically significant.

The high **R-squared** value (0.776) indicates that approximately 77.65% of the variation in inflation is explained by the independent variables, signifying a robust model fit. The significant **F-statistic** ($p < 0.001$) confirms that the overall regression model is statistically significant, and the **Durbin-Watson statistic** (close to 2.0) suggests no serious issues with autocorrelation.

Given the mixture of $I(0)$ and $I(1)$ variables, the study employs the **Autoregressive Distributed Lag (ARDL) model** to capture both short-term and long-term dynamics in the relationship be-

Table 2

Descriptive Statistics Table

Variable and statistic	INF.	Imports	GDP, CAP	POP	GDP. Rate	T. Debt Service	Unemployment
Mean	8.823	18.140	1.825	2.233	4.122	3.199	1.772
Median	9.279	18.796	1.711	2.184	4.239	2.982	0.586
Max	20.286	22.502	5.447	3.230	7.831	6.814	6.340
Min.	2.529	11.830	−2.970	1.204	−1.274	1.327	0.400
Std. Dev	4.432	2.964	2.131	0.603	2.027	1.586	1.887
Probability	0.217	0.223	0.803	0.412	0.814	0.252	0.012
observations	32	32	32	32	32	32	32
	MLTRY. Expend.						
Mean	4.153						
Median	3.578						
Max	6.698						
Min.	2.630						
Std. Dev	1.235						
Probability	0.1020						
observations	32						

Source: compiled by the authors.

Note: Table 2. Explains the descriptive statistics, The Descriptive Statistics results were computed using EViews 12 software.

Table 3

ADF Unit Root Test

Variable	At Level		At First Difference	
	T-Statistic	Probability	T-Statistic	Probability
Inflation (INF)	−4.716	0.001		
Imports	−1.842	0.354	−4.771	0.0006
GDP per Capita	−3.990	0.004		
Population (POP)	−1.526	0.505	−4.379	0.0024
GDP Growth Rate	−4.449	0.001		
Military Expenditure	−1.677	0.432	−4.753	0.0006
Total Debt Service	−1.825	0.361	−8.470	0.0000
Unemployment	−0.318	0.910	−6.692	0.0000

Source: compiled by the authors.

Note: The ADF unit root Test results were computed using EViews 12 software.

tween inflation and its determinants. The ARDL model is particularly suitable for small samples and does not require the variables to be integrated at the same order, making it an ideal choice for this study's dataset.

The ARDL model is specified as follows, utilizing the OLS method for parameter estimation:

$$\Delta Y_t = \alpha_0 + \sum I = 1 p \alpha i \Delta Y_{t-i} + \sum_j = 0 q \beta_j X_{t-j} + \epsilon t, \quad (1)$$

where ΔY_t represents the change in inflation; α_0 — is the constant term; X_t — represents the independent variables; ϵ_t — is the error term.

The dynamic relationship among the variables is examined using the bounds testing approach within the ARDL framework. The F-bounds test is employed to determine the existence of a level relationship. A significant F-statistic indicates a stable long-run relationship among the variables.

For short-run dynamics, the error correction model (ECM) derived from the ARDL model is estimated using OLS. The ECM integrates the short-run adjustments with long-run equilibrium without losing long-run information, specified as:

Table 4

Correlation results

Variable	INF	IMPORT	GDP RATE	GDP.CAP	MLTRY	POP	T. DEBT	UNEMPL
INF	1.000	0.745	−0.230	−0.252	0.643	0.126	0.239	0.061
IMPORT	0.745	1.000	−0.168	−0.137	0.161	−0.068	0.184	0.117
GDP RATE	−0.230	−0.168	1.000	0.957	0.033	−0.092	−0.143	−0.094
GDP.CAP	−0.252	−0.137	0.957	1.000	−0.193	−0.374	−0.321	0.097
MLTRY	0.643	0.161	0.033	−0.193	1.000	0.778	0.744	−0.566
POP	0.126	−0.068	−0.092	−0.374	0.778	1.000	0.648	−0.646
T. DEBT	0.239	0.184	−0.143	−0.321	0.744	0.648	1.000	−0.112
UNEMPL	0.061	0.117	−0.094	0.097	−0.566	−0.646	−0.112	1.000

Source: compiled by the authors.
Note: The Correlation results were computed using EViews 12 software.

Table 5

Least Squares Method

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IMPORTS	1.264	0.160	7.872	0.000
GDP_RATE	113.022	46.595	2.425	0.023
GDP_PER_CAPITA	−115.417	47.602	−2.424	0.023
MLTRY	−3.148	0.822	−3.829	0.000
POP	−114.604	48.868	−2.345	0.027
T_DEBT_S	1.264	0.599	2.108	0.045
UNEMPLO	−0.588	0.441	−1.332	0.195
C	−3.295	6.570	−0.501	0.620
R-squared	0.776 Mean dependent var			8.823
Adjusted R-squared	0.711 S.D. dependent var			4.432
S.E. of regression	2.381 Akaike info criterion			4.785
Sum squared resid	136.128 Schwarz criterion			5.152
Log likelihood	−68.571 Hannan-Quinn critter.			4.907
F-statistic	11.910 Durbin-Watson stat			2.148
Prob(F-statistic)	0.000002			

Source: compiled by the authors.
Note: The Least Square Test results were computed using EViews 12 software.

$$\Delta Y_t = \gamma_0 + \sum I = 1 p \gamma_i \Delta Y_{t-I} + \sum_j = \\ = 0 q \delta j \Delta X_{t-j} + \lambda \mathrm{ECM}_{t-1} + \epsilon_t, \quad (2)$$

where ΔY_t — the change (or first difference) of the dependent variable ΔY_t; γ_0 — the intercept term or constant; $\sum I$ — the sum of the lagged differences of the dependent variable Y_{t-1}; $\sum_j$ — the sum of the lagged differences of the independent variable; ECM_{t-1} — the error correction term from the cointegration equation; ϵ_t — The error term, representing the unexplained part of the model.

To ensure the reliability and robustness of the results, several diagnostic tests are conducted:

R-Squared and Adjusted R-Squared: These indicate how much of the variability in inflation is explained by the independent variables, with a high value confirming a good fit.

Durbin-Watson Statistic: This statistic checks for autocorrelation in the residuals, confirming that the model is free from serial correlation issues.

F-Statistic: This test assesses the overall significance of the regression model, indicating whether the included variables collectively explain a significant portion of inflation's variation.

5. RESULTS AND DISCUSSION

5.1. Main Findings

ADF tests in *Table 3* show that only inflation, GDP per capita and GDP growth are stationary, while other variables become stationary after taking a difference. It means that those regressors either have time-dependent mean, variance or autocorrelation function.

In our research endogeneity is a huge issue and that is why the correlation is less relevant, but several important observations have been made in the *Table 4*. Mainly, there is high positive correlation between inflation and imports and military expenditures, 0.74 and 0.64 respectively. This phenomenon can be mainly explained through the increase of the demand, which changes the equilibrium output with a higher price level. It is also worth noting that GDP growth and GDP per capita have a small negative association coefficient, which can imply that the wealthier and the more economically successful a country is, the lower is the inflation rates. Inflation usually represents uncertainty and risk in the economy and in stable countries those factors are generally lower compared to the developing world.

The regression analysis investigates the impact of macroeconomic factors on inflation by using the least squares method (*Table 5*). The dependent variable is inflation (INFLTION), and the independent variables include imports (IMPORTS), GDP growth rate (GDP_RATE), GDP per capita (GDP_PER_CAPITA), military expenditure (MLTRY), population (POP), total debt service (T_DEBT_S), and unemployment (UNEMPLO). The regression analysis of inflation determinants reveals that imports, GDP growth rate, GDP per capita, military expenditure, population, and total debt service significantly impact inflation. Imports (1.264164) and total debt service (1.264538) positively correlate with inflation, while GDP per capita (–115.4178), military expenditure (–3.148854), and population (–114.6041) show negative correlations. GDP growth rate (113.0222) also positively affects inflation. Although unemployment has a negative coefficient (–0.588657), it is not statistically significant. The model, with an R-squared of 0.776480, suggests that about 77.65% of the variation in inflation is explained by these variables. The significant F-statistic (11.91040, $p = 0.000002$) indicates a robust overall model fit, with the Durbin–Watson statistic (2.148244) showing no significant autocorrelation.

Our analysis utilizing the Autoregressive Distributed Lag (ARDL) model showed dynamics and significant relationships between inflation and macroeconomic variables (*Table 6*). The dependent variable is inflation, and the independent variables include imports, GDP growth rate, GDP per capita, military expenditure, population, total debt service, and unemployment. the coefficient for lagged inflation (INFLTION (–1)) is –0.809456, indicating a significant negative autocorrelation ($p = 0.0003$). This suggests that higher past inflation tends to reduce current inflation, possibly due to corrective economic measures taken in response to prior inflation spikes. Imports showing a substantial immediate positive impact on inflation, with a coefficient of 2.575389 ($p = 0.0000$). However, the effect of imports re-

verses at the second lag (–1.572327, p = 0.0014), highlighting the complex short-term dynamics where initial increases in import prices may be offset by adjustments in subsequent periods. the GDP growth rate positively influences inflation both contemporaneously (128.9903, p = 0.0007) and with lags, underscoring the strong linkage between economic growth and inflationary pressures. This finding aligns with Fischer's study, which found a positive correlation between GDP growth and inflation in developing economies. and, GDP per capita consistently shows a significant negative relationship with inflation [23]. The coefficients for the current period (–133.3364, p = 0.0007) and lagged periods shows that higher living standards, represented by GDP per capita, tend to lower inflation. This supports the results of Barro [24], who suggested that higher income levels are associated with better economic stability and lower inflation rates. Military expenditure has a nuanced impact on inflation. The immediate effect is significantly negative (–4.710493, p = 0.0047), but the second lag reveals a positive effect (4.216175, p = 0.0175), suggesting initial reductions in inflation due to increased military spending may be followed by inflationary pressures in the longer term. This

Table 6

ARDL MODEL Test (Dependent Variable — INFLATION)

Variable and statistic	Coefficient	Std. Error	t-Statistic	Prob.*
INFLTION (–1)	–0.809	0.122	–6.587	0.000
IMPORTS	2.575	0.199	12.919	0.000
IMPORTS (–1)	–0.072	0.203	–0.356	0.732
IMPORTS (–2)	–1.572	0.308	–5.101	0.001
GDP_RATE	128.990	22.460	5.743	0.000
GDP_RATE (–1)	69.694	23.056	3.022	0.019
GDP_RATE (–2)	139.723	31.107	4.491	0.002
GDP_PER_CAPITA	–133.336	22.954	–5.808	0.000
GDP_PER_CAPITA (–1)	–73.046	23.616	–3.092	0.017
GDP_PER_CAPITA (–2)	–144.436	31.872	–4.531	0.002
MLTRY	–4.710	1.152	–4.086	0.004
MLTRY (–1)	–1.551	1.599	–0.969	0.364
MLTRY (–2)	4.216	1.364	3.090	0.017
POP	–129.625	23.954	–5.411	0.001
POP (–1)	–81.679	24.741	–3.301	0.013
POP (–2)	–153.299	33.529	–4.572	0.002
T_DEBT_S	0.789	0.428	1.840	0.108
T_DEBT_S (–1)	1.974	0.403	4.896	0.001
T_DEBT_S (–2)	–0.729	0.349	–2.088	0.075
UNEMPLO	–1.790	0.329	–5.438	0.001
UNEMPLO (–1)	–0.573	0.373	–1.535	0.168
UNEMPLO (–2)	–1.422	0.416	–3.413	0.011
C	65.562	10.89238	6.019091	0.0005
R-squared	0.991	Mean dependent var		8.701
Adjusted R-squared	0.966	S.D. dependent var		4.545
S.E. of regression	0.827	Akaike info criterion		2.538
Sum squared resid	4.797	Schwarz criterion		3.612
Log likelihood	–15.071	Hannan–Quinn critter.		2.881
F-statistic	39.428	Durbin–Watson stat		2.693
Prob(F-statistic)	0.000			

Source: compiled by the authors.

Note: The ARDL Test results were computed using EViews 12 software.

Table 7

ARDL Long Run Form and Bounds Test (Dependent Variable — D (INFLTION)

Conditional Error Correction Regression				
Variable	**Coefficient**	**Std. Error**	**t–Statistic**	**Prob.**
C	65.562	10.892	6.019	0.000
INFLTION (–1) *	–1.809	0.122	–14.725	0.000
IMPORTS (–1)	0.930	0.221	4.193	0.004
GDP_RATE (–1)	338.408	47.808	7.078	0.000
GDP_PER_CAPITA (–1)	–350.819	49.162	–7.135	0.000
MLTRY (–1)	–2.045	1.112	–1.839	0.108
POP (–1)	–364.605	51.053	–7.141	0.000
T_DEBT_S (–1)	2.0334	0.780	2.605	0.035
UNEMPLO (–1)	–3.786	0.563	–6.725	0.000
D (IMPORTS)	2.575	0.199	12.919	0.000
D (IMPORTS (–1))	1.572	0.308	5.101	0.001
D (GDP_RATE)	128.990	22.460	5.743	0.000
D (GDP_RATE (–1))	–139.723	31.107	–4.491	0.002
D (GDP_PER_CAPITA)	–133.336	22.954	–5.808	0.000
D (GDP_PER_CAPITA (–1))	144.436	31.872	4.531	0.002
D (MLTRY)	–4.710	1.152	–4.086	0.004
D (MLTRY (–1))	–4.216	1.364	–3.090	0.017
D(POP)	–129.625	23.954	–5.411	0.001
D (POP (–1))	153.299	33.529	4.571	0.002
D (T_DEBT_S)	0.789	0.428	1.840	0.108
D (T_DEBT_S (–1))	0.729	0.349	2.088	0.075
D (UNEMPLO)	–1.790	0.329	–5.438	0.001
D (UNEMPLO (–1))	1.422	0.416	3.413	0.011
* p-value incompatible with t-Bounds distribution				
Levels Equation Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
IMPORTS	0.514	0.116	4.402	0.003
GDP_RATE	187.022	22.348	8.368	0.000
GDP_PER_CAPITA	–193.881	22.904	–8.464	0.000
MLTRY	–1.130	0.606	–1.863	0.104
POP	–201.499	23.686	–8.506	0.000
T_DEBT_S	1.123	0.411	2.730	0.029
UNEMPLO	–2.092	0.255	–8.183	0.000
C	36.233	5.262	6.884	0.000

Source: compiled by the authors.
Note: The ARDL and Bounds Test results were computed using EViews 12 software.

aligns with Benoit [25] who found mixed effects of military spending on economic growth and inflation across different countries and time periods. Population size reveal a strong negative impact on inflation, both in the current period (–129.6258, $p = 0.0010$) and with lags. This could indicate econo-

mies of scale in larger populations leading to lower inflation, consistent with studies such as that by [26], which highlighted the demographic influences on economic performance. Total debt service presents mixed effects on inflation. While the immediate impact is positive (0.789089, $p = 0.1083$), the second lag shows a negative effect (–0.729762, $p = 0.0752$). This suggests that while initial debt servicing might be inflationary due to increased financial burden, over time, fiscal adjustments and debt repayments can lead to reduced inflationary pressures. Unemployment shows a consistently negative relationship with inflation, with significant coefficients across different lags. This supports the traditional Phillips curve relationship, suggesting that higher unemployment rates are associated with lower inflation. The constant term is significantly positive (65.56226, $p = 0.0005$), reflecting other unobserved factors influencing inflation. The ARDL model's high R-squared (0.991995) and adjusted R-squared (0.966836) values shows a strong explanatory power, suggesting that the included variables effectively capture the variability in inflation. The F-statistic (39.42880, $p = 0.000024$) confirms the overall significance of the model. Additionally, the Durbin–Watson statistic (2.693144) suggests no serious autocorrelation issues, indicating reliable model estimates.

EC = INFLTION — (0.5144*IMPORTS + +187.0221*GDP_RATE — 193.8810 * *GDP_PER_CAPITA — 1.1305*MLTRY– –201.4998*POP + + 1.1238 *T_DEBT_S– –2.0928*UNEMPLO + 36.2331).

The results of the ARDL (Autoregressive Distributed Lag) model presented in the *Table 7* offer significant results into the determinants of inflation. The analysis employs the bounds testing approach to cointegration, revealing both short-run and long-run relationships between inflation and targeted economic variables. The long-run equation indicates a significant cointegration relationship among the variables, as evidenced by the F-bounds test (F-statistic = 27.96033) in the *Table 8*, which surpasses the critical values at the 1% significance level. The null hypothesis of no levels relationship is rejected, confirming a stable long-term equilibrium among the variables.

5.2. Key Long-Run Coefficients

1. Imports (IMPORTS): The coefficient of 0.514354 ($p = 0.0031$) showed a positive long-run relationship with inflation. This aligns with existing literature indicating that higher import prices can lead to increased inflationary pressures through cost-push inflation mechanisms [27].

Table 8

F-Bounds Test (Null Hypothesis: No levels relationship)

Test Statistic	Value	Signify I(0) I(1)		
		Asymptotic: n = 1000		
F-statistic	27.96033	10%	1.92	2.89
k	7	5%	2.17	3.21
		2.5%	2.43	3.51
		1%	2.73	3.9
Actual Sample Size	30	Finite Sample: n = 30 10% 2.277 3.498		
		5%	2.73 4.163	
		1%	3.864 5.694	

Source: compiled by the authors.

Note: The ARDL and Bounds Test results were computed using EViews 12 software.

2. GDP Growth Rate (GDP_RATE): The coefficient of 187.0221 ($p < 0.0001$) highlights a substantial positive impact on inflation. This is consistent with demand-pull inflation theories, where increased economic activity and demand lead to higher price levels [28].

3. GDP Per Capita (GDP_PER_CAPITA): The negative coefficient of −193.8810 ($p < 0.0001$) suggests that higher per capita GDP reduces inflation, possibly reflecting improved productivity and efficiency in the economy, which counteracts inflationary pressures.

4. Military Expenditure (MLTRY): With a coefficient of −1.130526 ($p = 0.1047$), the impact is negative but not statistically significant. This might indicate that military spending does not have a direct inflationary impact in the studied context, aligning with some studies that show mixed results on the relationship between military expenditure and inflation [29].

5. Population (POP): The coefficient of −201.4998 ($p < 0.0001$) suggests a significant negative relationship with inflation. This could reflect demographic dynamics where a larger working-age population can enhance economic output and reduce inflationary pressures (Bloom & Canning, [30].

6. Total Debt Service (T_DEBT_S): The coefficient of 1.123796 ($p = 0.0293$) indicates a positive relationship with inflation, implying that higher debt servicing costs may lead to higher inflation, possibly due to fiscal deficits and monetary expansion [31].

7. Unemployment (UNEMPLO): The negative coefficient of −2.092778 ($p < 0.0001$) confirms the inverse relationship between unemployment and inflation, consistent with the Phillips curve theory [32].

5.3. Short-Run Dynamics

The short-run error correction model highlights how deviations from the long-run equilibrium are corrected over time. The error correction term (EC) has a coefficient of −1.809456 ($p < 0.0000$), indicating a strong and significant speed of adjustment back to equilibrium.

1. Imports (D(IMPORTS)): The positive coefficients for the contemporaneous (2.575389, $p < 0.0000$) and lagged (1.572327, $p = 0.0014$) terms indicate that changes in imports have immediate and lasting inflationary effects in the short run.

2. GDP Growth Rate (D(GDP_RATE)): The mixed signs of the contemporaneous (128.9903, $p = 0.0007$) and lagged (−139.7235, $p = 0.0028$) terms reflect the dynamic and potentially cyclical nature of GDP growth's impact on inflation.

3. GDP Per Capita (D(GDP_PER_CAPITA)): Similar to the GDP growth rate, the negative contemporaneous (−133.3364, $p = 0.0007$) and positive lagged (144.4364, $p = 0.0027$) coefficients suggest complex short-term effects on inflation.

4. Military Expenditure (D(MLTRY)): The negative coefficients for both the contemporaneous (−4.710493, $p = 0.0047$) and lagged (−4.216175, $p = 0.0175$) terms indicate that increases in military spending reduce inflation in the short run.

5. Population (D(POP)): The negative contemporaneous (−129.6258, $p = 0.0010$) and positive lagged (153.2999, $p = 0.0026$) coefficients again point to complex short-term demographic effects on inflation.

6. Total Debt Service (D(T_DEBT_S)): The short-run impact is positive but less significant, suggesting that debt servicing has a more pronounced long-term effect on inflation.

7. Unemployment (D(UNEMPLO)): The significant negative contemporaneous (−1.790149, $p = 0.0010$) and positive lagged (1.422841, $p = 0.0112$) terms reflect the immediate deflationary impact of rising unemployment, with some delayed inflationary pressures possibly due to decreased production costs.

The ARDL model's findings underscore the multifaceted nature of inflation, influenced by both demand and supply-side factors. The significant long-term relationships align with theoretical expectations and previous empirical studies, while the short-term dynamics reveal the complexity of economic interactions affecting inflation. Future research could further explore these relationships, considering potential structural breaks and non-linear effects for a more comprehensive understanding.

6. DISCUSSION

Addressing the research question regarding the main factors that influence inflation in Pakistan

between 2018–2022, there have been uncovered significant interdependencies and intercorrelations between considered variables. The findings of the study uncover the intricate dynamics of macroeconomic variables in Pakistan, providing valuable insights into the main influences of the inflation rates in the country.

Firstly, the application of descriptive statistics offers a comprehensive overview of the central tendencies and variability of the macroeconomic indicators. Despite moderate economic growth, disparities exist across variables, with notable variability observed in GDP per capita, GDP growth rate, CPI, and imports. Such insights underscore the need for nuanced monetary policy as those variables may influence price level change spikes. The ADF unit root test confirms the stationarity of most variables, indicating that most are stationary at level while others become stationary at first difference, which is essential for robust econometric analysis.

Correlation analysis reveals relationships between macroeconomic variables, with CPI exhibiting strong positive correlations with military expenditures and imports, underscoring their pivotal role in driving demand and economic activity in general. On the other hand, GDP per capita shows an inverse correlation with inflation, suggesting that the wealthier countries are on average, the smaller the price inflation there is. The conclusion about government expenditures have also been proven to be statistically significant [5]. In the paper studying economic growth [7] negative association between inflation of GDP have been established, which confirms results of this paper.

The Autoregressive Distributed Lag (ARDL) model further investigates the long-term relationships between CPI and other macroeconomic variables. Inflation has high autocorrelation, as the lagged term is significant on any confidence level with the negative coefficient, meaning that inflation has a general decreasing trend in the Pakistan. Furthermore, the ARDL model highlights the impact of same–time and lagged imports, GDP per capita, total population, unemployment and GDP growth. The stability of long-run relationships, confirmed by the F-bounds test, increases confidence in the reliability of our results.

In summary, this study contributes to the existing literature by offering a comprehensive analysis of macroeconomic dynamics in Pakistan to determine main factors that influence inflation. By investigating the interconnected relationships between key economic indicators, it provides valuable insights for policymakers and stakeholders to formulate evidence–based strategies aimed at enhancing monetary stability and fostering stable economic growth. Moving forward, continued monitoring and proactive policy interventions will be essential to navigate evolving economic challenges and capitalize on emerging opportunities in Pakistan's dynamic economic landscape.

7. CONCLUSION

The analysis of this study has provided valuable insights into the complex dynamics influencing inflation in Pakistan between 1991 to 2022. By Utilizing a comprehensive set of macroeconomic variables, including imports, GDP growth rate, GDP per capita, military expenditure, population, total debt service, and unemployment, this research investigates the multifaceted nature of inflation and its determinants in Pakistan. The results showed significant interdependencies and correlations among these variables.

Descriptive statistics reveal substantial variability in key economic indicators, highlighting the disparities in GDP per capita, GDP growth rate, CPI, and imports. These findings emphasize the necessity for nuanced and targeted monetary policies to manage the intricate interplay of these variables and their influence on inflation. The ADF unit root test results indicate that inflation, GDP per capita, and GDP growth are stationary at level, while other variables become stationary after taking the first difference. This distinction is crucial for ensuring robust econometric analyses and reliable conclusions. The correlation results shows that CPI has strong positive correlations with military expenditures and imports, suggesting their pivotal role in driving demand and economic activity. and GDP per capita shows an inverse correlation with inflation, indicating that wealthier nations typically experience lower inflation

rates. These correlations align with previous empirical studies and theoretical expectations, reinforcing the validity of the findings.

The regression analysis reveals that imports and total debt service positively correlate with inflation, while GDP per capita, military expenditure, and population show negative correlations. Although unemployment has a negative coefficient, it is not statistically significant. The model's R-squared value of 0.776480 suggests that approximately 77.65% of the variation in inflation is explained by these variables, indicating a robust overall model fit. The Autoregressive Distributed Lag (ARDL) model demonstrate the significant long-term relationships between CPI and other macroeconomic variables.

The findings reveal that inflation exhibits high autocorrelation, with a significant negative coefficient for the lagged term, indicating a general decreasing trend in Pakistan. The model also underscores the impact of same-time and lagged imports, GDP per capita, total population, unemployment, and GDP growth on inflation. The ARDL model's short-term dynamics reveal the complexity of economic interactions affecting inflation. Imports, GDP growth rate, and GDP per capita have significant short-term effects on inflation, with contemporaneous and lagged coefficients indicating intricate relationships. Military expenditure, population, total debt service, and unemployment also exhibit significant short-term impacts, reflecting both demand and supply-side influences on inflation. The findings of this study have several important implications for policymakers and stakeholders in Pakistan. Given the significant correlations and causal relationships identified, policymakers should consider targeted monetary policies that address the specific drivers of inflation. For instance, managing imports and military expenditures could be crucial for stabilizing prices. The inverse relationship between GDP per capita and inflation suggests that policies aimed at enhancing economic growth and increasing per capita income could help mitigate inflationary pressures. The positive correlation between total debt service and inflation highlights the need for effective debt management strategies. Reducing the burden of debt servicing could help alleviate inflationary pressures in the long term.

The study underscores the necessity for comprehensive economic reforms that address the multifaceted nature of inflation. Policies should consider both demand and supply-side factors, ensuring a balanced approach to economic stability. Continuous monitoring of macroeconomic variables and further research into their dynamic interactions are essential for developing effective policy interventions. Future research could explore potential structural breaks and non-linear effects to provide a more comprehensive understanding of inflation dynamics in Pakistan.

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S. Kumar – sources' selection.
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