



# Modeling the Dynamic Relationship between Inflation, Oil Price, and Macroeconomic Variables: Evidence from Saudi Arabia

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## ABSTRACT

This paper investigates the dynamic relationship between inflation, economic growth, oil price, money supply, and current account in Saudi Arabia for the period 1980-2023. It employs the autoregressive distributed lag (ARDL) approach and error correction model (ECM) to examine the short-run and long-run dynamics. The bounds test of cointegration analysis confirms the existence of a long-term relationship between targeted variables. The ARDL model estimates suggested that gross domestic product (GDP), oil price, and money supply are negatively related to inflation. They also indicated that current accounts have a positive effect on price levels, GDP, and money supply, and a negative effect on oil prices and inflation levels. Therefore, enhancing regulatory quality and mobilizing more domestic resources can reduce inflation and accelerate economic growth.

**Keywords:** Economic Growth, Inflation, Oil Price, Current Account, Money Supply

**JEL Classifications:** C32, E31, E51, F32, O11

## 1. INTRODUCTION

For centuries, inflation has been a global economic phenomenon. Historical precedents demonstrate most successful economies in the world today have been vulnerable to inflation, the macroeconomic enemy, for over a century. Most economic decision making is based on agents' expectations of inflation given its impacts on social and economic development (Ahmed et al., 2023; Bernoth and Ider, 2021). The relationships between inflation and economic growth, money supply, and oil prices are ambiguous. Such macroeconomic variables are affected by other factors, such as momentum and output deviations from the natural level, whose unique policy implications and supply-side factors influence inflation.

In macroeconomics, it is generally accepted that a moderate rate of inflation will accelerate gross domestic product (GDP) growth. GDP can influence inflation through various channels, including demand-pull inflation, capacity constraints, monetary policy,

and fiscal policy (Lee et al., 2023; Xiong, 2023; Tien, 2021). Although the relationship between GDP and inflation is complex, empirical evidence indicates a positive correlation between GDP growth, particularly in the short term. Some researchers suggest the relationship between GDP and inflation is nonlinear, meaning that the impact of GDP growth on inflation varies depending on the level of growth (Fischer, 1993). Regarding country-specific factors, the relationship between GDP and inflation can also be influenced by country-specific factors, such as the level of economic development, the presence of price controls, and the effectiveness of monetary policy (Ashley et al., 2024; Huawei, 2022).

Oil prices can influence inflation through various channels, including production costs, transportation costs, energy prices, and food prices (Ahmed et al., 2023). Specifically, the potential mechanisms through which oil prices affect inflation include (1) central banks responding to oil price shocks or adjusting other monetary policy tools; (2) governments responding to oil price

shocks by adjusting fiscal policy, such as taxes or government spending; and (3) oil price shocks disrupting supply chains, leading to shortages and price increases.

The money supply can affect inflation through various channels, including monetary policy, demand-pull inflation, and the monetarist theory (Doan Van, 2020). Although the relationship between money supply and inflation is complex and influenced by various factors, empirical evidence indicates a positive correlation between money supply growth and inflation (Das et al., 2024; Madurapperuma, 2023; Van Dinh, 2020). Channels through which money supply can affect inflation include (1) interest rates increasing aggregate demand; (2) credit expansion, which increases the money supply, allowing consumers and businesses to borrow more and increase spending; and (3) an increase in asset prices such as stocks and real estate.

The current account can influence inflation through various channels, including exchange rates, trade deficits, capital flows, and domestic demand. Empirical evidence indicates a positive correlation between current account deficits and inflation. Numerous studies have examined the complex relationship between the current account and inflation (Kara, 2023). Some indicate that the relationship between the current account and inflation can be influenced by country-specific factors. Others suggest that the relationship between the current account and inflation varies over time. In the majority of emerging economies, exchange rate is the primary factor driving inflation. Oil prices, or reliance on energy, are another factor contributing to the current account deficit in emerging nations. Analyses of the empirical literature demonstrate that as prices rise, most emerging economies experience an increase in the burden of energy costs (Ebeke and Fouejieu, 2018; Kamugisha and Assoua, 2020).

This study's significance lies in its interest in examining the factors influencing inflation in Saudi Arabia, whether they be related to supply or demand. By addressing the Saudi Arabia case, the study will close the gap in applied research and contribute workable solutions for combatting inflation and maintaining long-term economic growth. In the following sections, this paper presents theoretical and empirical literature related to the issues addressed; explains the methodology and materials used; and discusses the findings, conclusions, and future policy recommendations.

## 2. LITERATURE REVIEW

### 2.1. Theoretical Literature

Many theories have explained the nature and causes of inflation. The principle of effective demand forms the most basic principle in this theory for the Keynesians, namely, the size of aggregate demand (i.e., aggregate demand on consumption demand and investment demand determines the amount of employment). In cases where the aggregate demand value is greater at the full employment level than the aggregate supply value, sources of demand include consumption, investment, and government expenditure, resulting in an inflationary gap. The faster the inflation, the larger the gap. However, inflation is attributed to changes in interest rates (Brochier, 2023; Ayisi and Afful-Mensah, 2023; Ogero, 2021).

Regarding the quantity theory of money, according to Friedman (1970, p. 24), "Inflation is always and everywhere a monetary phenomenon resulting from more rapid expansion in the quantity of money than in total output." The monetarists also primarily attribute inflation to excess demand and inappropriate monetary responses.

Inflation can be analyzed as either demand-pull or cost-push inflation. Firstly, demand-pull inflation refers to inflation caused by firms increasing prices in response to unsustainable levels of demand. Consequently, consumers have more money to spend despite paying more for the limited supply of the good, causing inflationary pressures. This type of inflation is often associated with periods of economic growth and increased consumer confidence (Kalu, 2023).

Secondly, cost-push inflation refers to inflation primarily impacted by supply; when production costs increase, the prices of most goods and services rise accordingly (Tolasa et al., 2022). Nugraha et al. (2023) establish that cost-push inflation occurs when the aggregate supply curve shifts toward the upper left. According to Chirat and Clerc (2024), the primary factor causing this shift is increased costs of production (both domestic and foreign) in the production factor market, thus causing an increase in commodity prices in the commodity market. It is worth mentioning that in Saudi Arabia, both supply and demand factors drive inflation (Albahouth, 2025; Naseem, 2018).

### 2.2. Empirical Literature

Alexander et al. (2015) investigated the main determinants of inflation in Nigeria from 1986 to 2011. All variables were found to be stationary at first and second differencing at a 5% significant level based on the augmented Dickey-Fuller (ADF) unit root test. The cointegration factor demonstrated a long-run equilibrium relationship between the rate of inflation and its determining factor. The Granger causality test indicated evidence of a feedback relationship between inflation and its determinants. The estimated VAR result demonstrated that fiscal deficit, import of goods and services, exchange rate, money supply, and agricultural output have long-run effects on inflation. In the short run, only lending rate was found to impact inflation. The "own-shocks" results of decomposition variance and impulse responses were the main cause for the variation and innovations among all the variables.

Lim and Sek (2015) used annual data from 1970 to 2011 to examine the factors influencing inflation in two groups of countries, namely, high- and low-inflation countries. They investigated the short- and long-run impacts of each variable on inflation using the autoregressive redistributed lag (ARDL) and error correction models. In the case of low-inflation countries, the results indicated that imports and GDP have a significant long-run impact on inflation. Results further indicated that the determinants of inflation in high-inflation countries, on which inflation had a long-run impact, include GDP growth, money supply, and public expenditure. In high-inflation countries, none of the variables were found to be significant determinants in the short run. By contrast, in low-inflation countries, inflation was found to have

a significant relationship with money supply, GDP growth, and imports of goods and services.

Naseem (2018) studied the macroeconomic determinants of inflation in Saudi Arabia using the regression model, wherein inflation was measured using consumer price index as a dependent variable and money supply, oil prices, import-export value, fixed exchange rate, and unemployment as independent variables. Findings revealed that independent variables have statistical significance with inflation in Saudi Arabia, but employment indirectly predicts the rates of inflation for Saudi Arabia. Within the last 13 years, the effect of domestic factors on Saudi inflation decreased as Saudi inflation became part of the global inflation phenomenon.

Alam and Alam (2016) examined the long- and short-run sources of inflation in India using Pesaran et al.'s (2000) cointegration method. Empirical results reveal that in the long run, money supply, rupee depreciation, and supply force domestic price level caused inflation to increase. In the short run, external factors were found to ensure a permanent increase in price level. In the long run, domestic factors, mainly the rate of monetary growth and supply bottlenecks, were found to impact inflation more significantly than external factors. While the supply bottlenecks are a major short-run reason to expect Indian inflation to remain high, their role in affecting inflation in the long run is much less important.

Alnefaee (2018) investigated the short- and long-run determinants of inflation in Saudi Arabia from 1987 to 2017. The Johansen-Julius cointegration test and the vector error correction model (VECM) were applied to determine the existence of short- and long-run relationships between inflation and domestic demand, money supply, exchange rate, and oil prices. It was found that in the long run, the money supply, domestic demand, and oil prices positively affect inflation, while exchange rate negatively affects inflation. In the short run, domestic factors govern the course of inflation, which is highly influenced by money supply and domestic demand. The Granger causality results demonstrate a bidirectional causality between inflation and money supply. The only unidirectional causality was that from domestic demand and oil prices to price levels. Regarding the impulse response analysis, money supply, domestic demand, and oil price shocks were found to positively affect inflation.

Ahmed et al. (2019) examined the causes of inflation in Saudi Arabia from 1980 to 2018. The ARDL model was used to assess the short- and long-run relationships between inflation, broad money supply, the stock price index, real GDP, oil prices, and global inflation. In both the short and long run, money supply, oil prices, and real GDP were found to be positive determinants of inflation in Saudi Arabia, while stock price index was a negative determinant. The global inflation rate was found to have a statistically significant positive effect on domestic inflation in the long run and no effect in the short run; meanwhile, exchange rate has no effect on inflation in the short or long run. As an alternative approach, impulse response functions and variance decomposition analysis were performed to investigate determinants of inflation in Saudi Arabia in the long

run; the results of these tests revealed broad money supply and global inflation rate as the major determinants.

Melaku (2020) used triangular tests to identify the determinants of inflation in Ethiopia. To identify the short- and long-run determinants of inflation, the researcher used the ARDL cointegration model. In the long run, oil prices, government expenditure, and broad money supply were found to have a positive effect on inflation; external debt and real GDP exhibited a negative effect; and the real exchange rate was found to be insignificant. In the short run, exchange rate and government expenditure have a positive effect on inflation; real GDP has a negative effect; and external debt, money supply, and oil price have insignificant effects. Results indicated that Ethiopia's economy is undergoing both cost-push and demand-pull inflation. This study's findings demonstrate that inflation can be checked through money supply reduction, government expenditure, and oil price, as well as external debt and real output increase.

Čaklovica and Efendic's (2020) study presents an empirical analysis of determinants of inflation in 28 European transition countries. Using employed dynamic panel methodology, they established that economic and structural variables, such as openness, unemployment, real wages, and institutional effects, and external factors, such as prices of food and oil, determine short-run inflationary dynamics in these countries. The obtained results supported the proposition that the inflation rate is autoregressive over the observed period (2005-2015), meaning that the contemporaneous inflation rate is related to the whole history of these determinants, further revealing the long-term effects of most of these variables on price dynamics. Thus, the researchers made no distinction between the current European Union and transition countries in their model, and their conclusion did not change.

Adugna (2021) used VECM and data from annual time series from 1980 to 2019 to determine the factors causing inflation in Ethiopia. The researcher used the ADF unit root test, and the variables were integrated into order one; however, the first difference in the variables made them stationary. The results of the Johansen cointegration test indicated that the variables have a long-run relationship. Also, the coefficients of VECM demonstrated that inflation, budget deficit, and national debt have a significant positive effect on inflation in both the short and long run, whereas money supply positively affects inflation only in the short run.

Byanjankar (2020) studied the determinants of inflation in Nepal using the ARDL model, selecting price level as the dependent variable and Indian inflation, money supply, government deficit, nominal exchange rate, and crude oil price as the independent variables. Of the independent variables, Indian inflation transferred through exports to the Nepalese market was found to have the most significant positive impact on Nepalese inflation. In addition, exchange and government deficit were found to impact prices positively in both the long and short term.

Alsabban et al. (2023) investigated the determinants of inflation in Saudi Arabia and identified domestic factors (including domestic demand, government expenditure, and liquidity) and external

factors (including imported inflation and the exchange rate) driving inflation in the country. The ARDL model was used, the results of which revealed that in the case of Saudi Arabia, internal factors have a less significant impact on inflation than the external factors governing its movement.

Iqbal et al. (2022) examined the influence of money supply, GDP, oil prices, and exchange rate on inflation in Pakistan from 1989 to 2019. According to the results of the ADF test for stationarity, consumer price index, GDP, and exchange rate were nonstationary at first difference while money supply and oil price were stationary. The ARDL results revealed that exchange rate at lag 2, GDP at lags 2 and 4, and exchange rate at lag 2 were significant. The bounds test demonstrated a significant long-term relationship among those variables. Exchange rate had a negative long-run impact on consumer price index, while money supply had a positive long-run impact. At the first lag, it was found that the impact of exchange rate was positive in the short run. However, GDP had a positive impact at lag 1 and a negative impact at lag 3. At a lag of 1 year, exchange rate had a negative impact.

Adan et al. (2023) examined the factors driving inflation in Somalia in 2022 and investigated how inflation affects households' standard of living. They used the analytical descriptive approach to assess the causes and consequences of inflation for the Somali economy. A primary data questionnaire was conducted among different groups, such as merchants, household members, and bankers. The results identified droughts in the country, COVID-19, and the Russia-Ukraine war as the primary factors influencing the rise in inflation in Somalia. Moreover, inflation has been found to be negatively impacting various sectors of the Somali economy, especially purchasing power, commodity prices, and the economic condition of households; furthermore, it has hampered Somali business activity by creating uncertainty among companies, savers, and investors. The researchers recommended that the Somali government work hard to combat the rate of rise of inflation rates in the country by implementing economic policies that can increase productivity and inculcate public saving, while simultaneously providing support for people affected by droughts.

Laourari and Abderrahim (2022) investigated the determinants of inflation in Algeria from 2011 to 2021. Analyses of monthly data demonstrated that money supply, import price index, and nominal effective exchange rate influence inflation in the long run. Also, the attribution of annual variations of each variable to inflation demonstrated that money supply and import price index are its main determinants, with an average attribution of 91%.

Humagai (2023) examined the impacts of macroeconomic variables on inflation in Nepal from 1975 to 2022. The selected variables included broad money supply, real GDP, and Indian prices. All variables were found to be significant in the long run, thus suggesting that they are the determinants of inflation in Nepal. The monetary theory is consistent with its results. The ordinary least squares regression model demonstrated that in the long run, inflation is primarily caused by the money supply and Indian prices. In addition, Indian inflation, real income, and exchange rate were identified as the prime determinants of inflation

in Nepal in the long run, while Indian inflation, exchange rate, and deficit have considerable impact in the short run. Finally, the results demonstrated that the error correction term is negative and statistically significant, suggesting that short-run disequilibrium is corrected within 2 years.

Jackson et al. (2023) examined the determinants of inflation in Sierra Leone using monthly time series for the period 2010-2021 and the ARDL model. Exchange rate, the fiscal balance, the currency in circulation, and the lending rate were found to be the major determinants of inflation in the Sierra Leone economy. Empirical results revealed that in the long run, the main determinants of inflation in Sierra Leone are exchange rate, real GDP, fiscal balance, money supply, and lending rate. Real GDP and exchange rate were statistically insignificant in the short run, whereas other variables were statistically significant in the short run. Moreover, it was proved that the error correction term was negative and statistically significant and that it adjusted its long-run state very rapidly.

Yahya and Pamuncak (2023) analyzed the determinants of inflation in Malaysia and Indonesia in the long run. This study examines the geopolitical risk (GPR) index as a proxy for uncertainty as another determinant of inflation in Malaysia and Indonesia using macroeconomic variables, covering the period 2014-2023. The long-run relationship was determined using the ARDL model. The main findings of this study revealed that the main determinants of inflation in the long run are money supply and GPR in Malaysia. On the contrary, only the money supply induces inflation in Indonesia. The results also showed that money supply and GPR play a role in inflation management. Therefore, this study argued that monetary authorities must aggressively address money supply and GPR issues.

Walusaga (2024) analyzed the factors leading to inflation in Uganda, focusing especially on the relationship between inflation and four key macroeconomic variables: Exchange rate, GDP per capita, central bank rates, and balance of trade. The study adopted a quantitative approach using secondary data from the Bank of Uganda and international financial institutions. It therefore considered the determinants of inflation in Uganda using time series data and multiple regression analysis to test for them. A positive relationship was found between inflation rates and GDP per capita, exchange rates, and central bank rates in Uganda. Based on those findings, the study provided several measures intended to control inflation: stabilizing exchange rates through an appropriate set of monetary policies and interventions, encouraging sustainable economic growth by investing in infrastructure and human capital, and employing policies for central bank rates to achieve inflation without crowding out economic growth. Moreover, it recommended substituting imports to improve the balance of trade, thereby reducing dependency on imports and increasing the capacity of domestic production, thus reducing pressures of inflation.

Having reviewed previous studies and discussed their most important results, we conclude that the current study differs from the existing literature in that it deals with the analysis of factors that affect inflation in the short and long term, using the joint



integration methodology, and includes four explanatory factors. It also contributes research in the Saudi Arabian context to the relevant literature, particularly regarding policy recommendations to fight inflation in developing countries with similar economies to that of Saudi Arabia.

### 3. METHODOLOGY AND DATA DESCRIPTION

This study used time series analysis to analyze the relationship of variables such as inflation, GDP, money supply, oil price, and current account. Inflation was selected as the dependent variable, while the other variables were selected as independent variables. The equation for an endogenous variable inflation is given as follows:

$$CPI = \beta_0 + \beta_1 GDP + \beta_2 MS + \beta_3 OP + \beta_4 CA + \varepsilon \quad (1)$$

Where

$CPI$  = inflation (measured in consumer price index)

$GDP$  = gross domestic product per capita

$MS$  = broad money

$OP$  = price of oil per barrel

$CA$  = current account

$\varepsilon$  = the error term.

After checking the stationarity of the series, the above model, the dynamic relationship among the variables was estimated using the ARDL approach (also known as the bounds testing approach) formulated by Pesaran and Shin (1995). A normal error-correction model (ECM) is denoted as follows:

$$\Delta CPI_t = \alpha_0 + \sum_{i=1}^n \beta_1 \Delta GDP_{t-i} + \sum_{i=1}^n \beta_2 \Delta MS_{t-i} + \sum_{i=1}^n \beta_3 \Delta OP_{t-i} + \sum_{i=1}^n \beta_4 \Delta CA_{t-i} + \theta_1 EC_{t-1} + \mu_t \quad (2)$$

Where  $EC_{t-1}$  denotes the error-correction term, which lags behind one period. The CPI determinants explain that an ECM was executed using the cointegration test. To analyze the inflation determinations, the short-run dynamics should be executed using an ECM, i.e., a long-run model (Pesaran et al., 2001). With annual observations, the maximum order of lags in ARDL (1980 and 2023) was analyzed. The error-correction ARDL about variables in Equation 1 can be defined as follows:

$$\begin{aligned} \Delta \ln CPI_t = & \beta_0 + \sum_{i=1}^n \beta_1 \Delta \ln CPI_{t-i} + \sum_{i=1}^n \beta_2 \Delta \ln GDP_{t-i} \\ & + \sum_{i=1}^n \beta_3 \Delta \ln MS_{t-i} + \sum_{i=1}^n \beta_4 \Delta \ln OP_{t-i} + \sum_{i=1}^n \beta_5 \Delta \ln CA_{t-i} \\ & + \delta_1 \ln CPI_{t-1} + \delta_2 \ln GDP_{t-1} + \delta_3 \ln MS_{t-1} \\ & + \delta_4 \ln OP_{t-1} + \delta_5 \ln CA_{t-1} + \mu_t \end{aligned} \quad (3)$$

If  $(\delta_1 - \delta_5)$  are jointly significant, this confirms the variable cointegration. The estimates of  $\delta_i$  infer the determinants of CPI affected by the short term.

Table 1 presents a detailed description of variables, measurements, and sources. Absolute values of each variable were converted to logarithm form. The World Bank database was a major source of information for this study due to its extensive coverage of global economic indicators and reputation for dependability. The variables utilized are reliable and comparable, which offers a strong basis for examining the intricate connections between these economic indicators and inflation.

### 4. RESULTS AND DISCUSSION

Descriptive analysis provides an important function in statistical analysis, namely, facilitating the detection of outliers. It is divided into the measures of central tendency and variability. Table 2 presents descriptive statistics related to each of the variables involved in the study. As shown in the table, the maximum, minimum, and mean values of CPI were 9.87, -3.20, and 1.56, respectively; those of GDP were 782, 231, and 442; those of money supply were 72.37, 14.15, and 48.89; those of oil price were 111.63, 12.80, and 46.89; and those of the current account were 28.12, -20.81, and 3.99.

Correlation analysis was used to examine the relationship between dependent and independent variables, the results of which are shown in Table 3. The dependent variable selected for this study was CPI, while the independent variables included GDP, MS, OP, and CA. All independent variables exhibited a moderate to weak positive relationship with each other. The hypothesis is accepted at a 95% confidence interval with a 5% margin of error.

#### 4.1. Unit Root Test Results

Two unit root tests, namely, the ADF and Phillips-Perron (PP) tests, were used to examine the order of integration related to the variables selected. As shown in Tables 4 and 5, besides CPI and MS, which are stationary at level, none of the other variables are stationary. The ARDL bounds testing approach is used when the unit root test yields a mixed result for the order of integration, such as I(0) and I(1) (Bashir and Ibrahim, 2024).

#### 4.2. ARDL Bounds Test of Cointegration

The study determined the unit roots (nonstationarity) of given variables and then performed the cointegration tests. The cointegration test is designed for nonstationary series. Short- and long-run dynamics were founded on the existence of a cointegrating relation in the ARDL model. Table 5 presents the  $F$  statistics of the cointegration test from the bounds test,

**Table 1: Variables description**

Variable	Symbol	Measurement	Data source
Inflation	CPI	Consumer price index	World Bank
Gross Domestic Product	GDP	GDP (per capita growth (annual %))	World Bank
Money supply	MS	Broad money (% of GDP)	World Bank
Oil price	OP	Crude oil per barrel (Constant US\$)	World Bank
Current account	CA	Current account balance (% of GDP)	World Bank

**Table 2: Descriptive statistics**

Statistic	CPI	GDP	MS	OP	CA
Mean	1.556848	4.42E + 11	48.89416	46.85180	3.987832
Median	1.130934	3.55E + 11	49.79840	34.45000	3.888360
Maximum	9.870248	7.82E + 11	72.37043	111.6300	28.12464
Minimum	-3.203331	2.31E + 11	14.14698	12.80000	-20.80522
Std. Dev.	2.592407	1.75E + 11	12.24741	30.87174	13.79954
Skewness	0.629524	0.584036	-0.708605	0.757306	0.228633
Kurtosis	3.905033	1.899144	4.308445	2.292441	1.942536
Jarque-Bera	4.407857	4.723171	6.820939	5.123603	2.433424
Probability	0.110369	0.094271	0.033026	0.077166	0.296202
Sum	68.50131	1.95E + 13	2151.343	2061.479	175.4646
Sum Sq. Dev.	288.9846	1.32E + 24	6449.957	40981.76	8188.377
Observations	44	44	44	44	44

GDP: Gross domestic product

**Table 3: Correlation matrix**

Variable	CPI	GDP	MS	OP	CA
CPI	1.000000	0.331754	0.037724	0.539666	0.487287
GDP	0.331754	1.000000	0.622608	0.761248	0.399374
MS	0.037724	0.622608	1.000000	0.365956	-0.054780
OP	0.539666	0.761248	0.365956	1.000000	0.690727
CA	0.487287	0.399374	-0.054780	0.690727	1.000000

GDP: Gross domestic product

where the null hypothesis of no cointegration is canceled to the critical values of the statistics. This indicates that in the long run, the variables tend to move together. Finally, a cointegration test is needed to confirm the existence of a long-term relationship between variables.

### 4.3. Lag Length Selection

In the first step in the analysis, the information criteria of the pre- and post-Varisoc were used for the appropriate lag length in the ARDL model and the stationarity tests. As shown in Table 6, the lag order of  $p$  and  $qi$  was analyzed by standard VAR model results with the Akaike information criterion (AIC) and Schwarz information criterion (SIC). The results yielded optimal lag order (1) for the study.

As shown in Table 7, the ARDL bounds testing results were favorable in that the computed  $F$ -statistic (5.30) was greater than the upper bound 5.06 for a 1% level of significance. This demonstrates a cointegrating relationship among the variables, which supports the finding and confirms a stable long-run relationship between variables. Second, the influence of GDP, MS, OP, and CA on inflation was investigated. Therefore, the model was based on the Akaike info criterion, which estimates the long- and short-run relations.

### 4.4. Short-Run and Long-Run Relationships

As shown in Table 8, the results of unit root and cointegration tests revealed long-run relationships between the targeted variables, inflation, GDP, money supply, and current account. Consequently, the short- and long-run dynamics were investigated through estimating the error correction model, the results of which are presented in Table 6. All results related to estimation findings indicated that GDP, MS, OP, and CA have a significant and enduring effect on inflation in Saudi Arabia.

Results demonstrated that OP has an insignificant negative impact on the inflation rate, while  $OP_{t-1}$  lagged significantly negatively affects it (at a 5% level of significance). Meanwhile, OP and  $OP_{t-3}$  were found to have a significant negative impact (at a 1% level of significance). These findings are inconsistent with Shaikh et al. (2014), Moazam and Kemal (2015), and Iqbal et al. (2022), who identified a positive relationship between OP and overall prices of commodities.

MS has an insignificant negative impact on the inflation rate,  $MS_{t-1}$  lagged has a significant negative impact (at a 1% significance level), and  $MS_{t-2}$  has a significant negative impact (at a 10% significance level). These results are somewhat in line with the results of International Monetary Fund (IMF), which demonstrated that MS is insignificant in Saudi Arabia. Similarly, Alsabban et al. (2023) claimed that Saudi Arabia's velocity of money, which measures the speed of circulation of money in the economy, was low at 0.9 compared to 1.5 in the US; this indicates that the portion of the liquidity is not being spent in the economy but instead is perhaps being saved or invested in the financial market as stocks. The reason for the low velocity of money may be that the money is drained outside the economy since remittance is very high. This result also conflicts with those obtained by Yahya and Pamuncak (2023), who found that MS has a negative impact on inflation. In addition, this result is contrary to the theoretical view supporting the impact of volatility of money through the quantity of money theory (Mankiw et al., 2023), where according to Ascarya (2017) and Akbar and al Faizin (2019), MS has a significant positive impact on inflation.

If the situation is so, CA has an insignificant positive impact on the inflation rate, while lag CA1 t1 has a significant negative impact (at a 1% significant level). Secondly, from the lag coefficients of results, we could infer that if the previous year's current account deficit increases by 1%, then the current year's inflation decreases by 0.13%. This result confirms the findings of Alawin and Oqaily (2017), who attributed their results to the fact that the current account deficit absorbs a large portion of the excess in the domestic demand, in addition to the long-run flexibility of the economy to produce substitutes for imported goods.

Imported inflation can be a reason for the increase in CA, specifically due to an increase in imports. Alternatively, if import

**Table 4: Phillips-Perron (PP) test**

At level						
Test condition	Statistic	CPI	LGDP	LOP	MS	CA
With constant	t-statistic	-3.4630	0.3988	-1.1156	-2.7832	-2.4524
	Prob.	0.0140**	0.9807	0.7011	0.0691*	0.1341
With constant and trend	t-statistic	-3.7512	-4.3273	-2.4590	-3.2938	-2.9584
	Prob.	0.0293**	0.0069***	0.3459	0.0809*	0.1555
At first difference						
Test condition	Statistic	d (CPI)	d (LGDP)	d (LOP)	d (MS)	d (CA)
With constant	t-statistic	-9.3997	-4.1181	-7.0669	-5.3480	-5.8064
	Prob.	0.0000***	0.0024***	0.0000***	0.0001***	0.0000***
With constant and trend	t-statistic	-9.3072	-4.6998	-7.0782	-5.3450	-5.7355
	Prob.	0.0000***	0.0026***	0.0000***	0.0004***	0.0001***

Notes: 1. (\*) Significant at 10%; (\*\*) Significant at 5%; (\*\*\*) Significant at 1%. 2. MacKinnon (1996) one-sided P-values

**Table 5: Augmented Dickey-Fuller (ADF) unit root test**

At level						
Test condition	Statistic	CPI	LGDP	LOP	MS	CA
With constant	t-statistic	-2.3467	1.0342	-1.2375	-2.4762	-2.3663
	Prob.	0.1628	0.9963	0.6495	0.1289	0.1570
With constant and trend	t-statistic	-2.7435	-7.0220	-2.5787	-4.1331	-2.9584
	Prob.	0.2255	0.0000***	0.2914	0.0116**	0.1555
At first difference						
Test condition	Statistic	d (CPI)	d (LGDP)	d (LOP)	d (MS)	d (CA)
With constant	t-statistic	-9.4189	-3.8971	-5.7856	-4.4446	-5.8430
	Prob.	0.0000***	0.0045***	0.0000***	0.0010***	0.0000***
With constant and trend	t-statistic	-9.3291	-3.6118	-5.8225	-4.4058	-5.7955
	Prob.	0.0000***	0.0411**	0.0001***	0.0061***	0.0001***

Notes: 1. (\*) Significant at 10%; (\*\*) Significant at 5%; (\*\*\*) Significant at 1%. 2. MacKinnon (1996) one-sided P-values

**Table 6: Selection criteria for lag order**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-407.2384	NA	372.3575	20.10919	20.31816	20.18529
1	-245.8475	275.5455*	0.485378*	13.45598*	14.70981*	13.91255*
2	-225.4285	29.88151	0.642336	13.67944	15.97813	14.51649
3	-209.4529	19.48245	1.160330	14.11965	17.46321	15.33719

Notes: \*Indicates lag order selected by the criterion as follows: LR: Sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

**Table 7: Bounds test results**

F-bounds test		Null hypothesis: No levels relationship		
Test statistic	Value	Significance (%)	I (0)	I (1)
F-statistic	5.302066	10	2.45	3.52
K	4	5	2.86	4.01
		2.5	3.25	4.49
		1	3.74	5.06

increases then it can help to reduce domestic demand, resulting in decreased inflation pressure. However, the decreased exports eventually result in reduced economic growth and lower prices. Ultimately, all these factors contribute jointly to the final impact on inflation.

Meanwhile, GDP was found to negatively affect the inflation rate at a 1% level of significance. This finding concurs with the empirical findings of Fekadu (2012) and Abdo (2024), among others. This result similarly resonates with the prediction that inflation and growth are negatively related, as proposed in classical growth theory. The second objective is to further

elucidate business cycles through additional consideration of the negative relationship between growth and inflation. Moreover, according to Fisher's statement, the prima facie evidence of a negative relationship between growth and inflation is prima facie evidence that macroeconomics matters for growth (Binder and Kamdar, 2022).

The coefficient for error correction (ECM [-1]), which is estimated at 0.70, was found to be significantly relevant at a 1% level and has the correct sign suggesting a fast restoration to equilibrium, as shown in Table 7. Any short-run deviations of the consumer price index tend to approach the long run by 70% per year.

#### 4.5. Diagnostic Tests

Diagnostic tests are used in econometrics analysis to investigate model consistency and data assumptions. The validity of the chosen model was checked using the Jarque-Bera normality test, the multicollinearity test, and the CUSUM and CUSUMSQ tests. Table 9 presents the results of the model's various diagnostic tests.

**Table 8: ARDL error correction regression**

Variable	Coefficient	Standard error	t-statistic	Prob.
C	198.2549	35.60264	5.568545	0.0000
LGDP	-7.840512	3.573567	-2.194029	0.0382
D(LOP)	-0.680663	1.390440	-0.489530	0.6289
D(LOP[-1])	-3.674741	1.402555	-2.620034	0.0150
D(LOP[-2])	-4.831512	1.617579	-2.986879	0.0064
D(LOP[-3])	-5.943737	1.678769	-3.540532	0.0017
D(MS)	-0.036943	0.069429	-0.532104	0.5995
D(MS[-1])	-0.237202	0.079574	-2.980919	0.0065
D(MS[-2])	-0.137144	0.073589	-1.863636	0.0747
D(MS[-3])	-0.330264	0.077305	-4.272242	0.0003
D(CA)	0.025678	0.063225	0.406145	0.6882
D(CA[-1])	-0.126029	0.066656	-1.890729	0.0708
CointEq(-1)*	-0.695648	0.125086	-5.561359	0.0000
R-squared	0.582845	Mean dependent var		0.053392
Adjusted R-squared	0.418963	S.D. dependent var		2.438202
S.E. of regression	1.858538	Akaike info criterion		4.320783
Sum squared resid	96.71662	Schwarz criterion		4.827447
Log likelihood	-74.41566	Hannan-Quinn criterion		4.503977
F-statistic	3.556491	Durbin-Watson stat		2.166012
Prob (F-statistic)	0.003239			

Note: \*P-value incompatible with t-bounds distribution

**Table 9: Diagnostic tests**

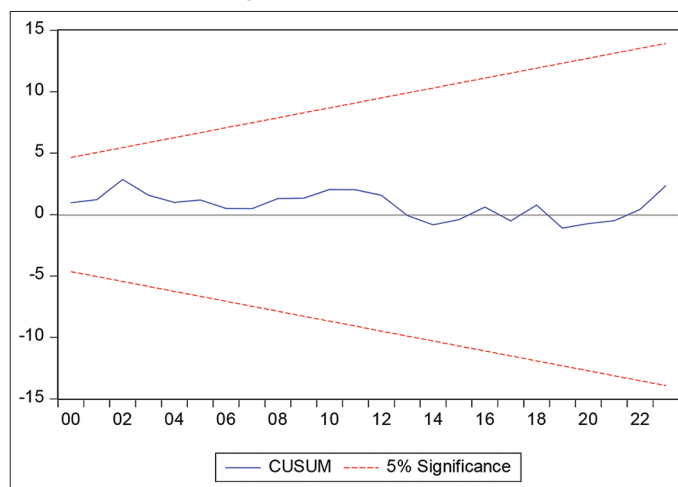
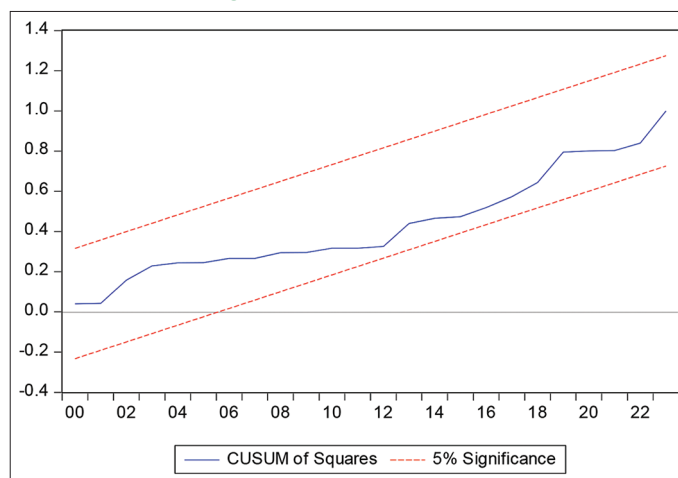
Normality test			
Jarque-Bera		1.028122	
Probability		0.598062	
Breusch-Godfrey serial correlation LM test			
F-statistic	0.515797	Prob. F (2,22)	0.6041
Obs* R-squared	1.791614	Prob. Chi-square (2)	0.4083
Heteroskedasticity test: Breusch-Pagan-Godfrey			
F-statistic	0.983149	Prob. F (15,24)	0.5000
Obs* R-squared	15.22404	Prob. Chi-square (15)	0.4354
Scaled explained SS	7.449222	Prob. Chi-square (15)	0.9440

#### 4.5.1. Stability tests

To confirm the stability of the model at 5% significance, CUSUM and CUSUMSQ tests were performed. As shown in Figures 1 and 2, the model was stable without any structural break.

## 5. CONCLUSION AND POLICY IMPLICATIONS

This research paper examined the relationship between inflation and selected macroeconomic variables. Specifically, it found that inflation is affected by GDP, money supply, oil price, and current account. This research suggested that GDP, oil prices, and money supply have a negative relationship with the consumer price index. It can be noted that the negative impact of oil prices on inflation in the case of Saudi Arabia as top oil-exporter country is due to the monetary policy followed by the Saudi Central Bank to raise the interest rate to combat inflation. However, from the perspective of fiscal policy, the increase in oil revenues on the Saudi treasury did not positively affect the reduction of taxes, which explains the inverse relationship presented in this study's findings. Therefore,

**Figure 1: Plot of CUSUM****Figure 2: Plot of CUSUMSQ**

policymakers should emphasize the importance of maintaining economic growth to combat rising inflation rates, and monetary policy should complement fiscal policy to support long-term economic growth initiatives.

The practical significance of this study lies in its in-depth analysis of the dynamic interactions between inflation and its causes, which offers insightful information to policymakers. Understanding the complex effects of different macroeconomic factors on inflation, the study makes specific recommendations for ways to keep prices stable and promote long-term economic growth in Saudi Arabia. In an extremely unstable global environment, this all-encompassing strategy is essential for preserving economic stability.

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