

Research Article

An In-Depth Economic Inquiry into the Relationship of GDP Growth, Money Supply, and Budget Deficits on Inflationary Trends in Yemen

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Abstract

The economy of Yemen plays a central role in shaping the country's development path, yet it remains heavily constrained by conflict, structural weaknesses, and fiscal imbalances. Persistent challenges such as reliance on limited revenues, currency instability, and high inflation continue to hinder sustainable growth and economic stability. This study examines the persistent budget deficit in Yemen and its relationship with inflation, with a particular focus on the roles of money supply and global domestic product (GDP) growth. Using secondary quantitative data and time series analysis spanning the period from 1990 to 2023. The research employs the Autoregressive Distributed Lag (ARDL) methodology to investigate the interdependencies among key macroeconomic variables. The empirical findings reveal a positive and statistically significant relationship between money supply and inflation, suggesting that monetary expansion exerts upward pressure on price levels. Similarly, the budget deficit is found to contribute positively to inflation, reinforcing concerns about deficit-financed spending. In contrast, GDP growth exerts downward pressures. These results carry important policy implications for Yemen: namely, the need to prioritize productive public investment, implement comprehensive tax reforms, and adopt measures to curb excessive public expenditure. Additionally, fostering a supportive environment for innovation and entrepreneurship is essential for promoting sustainable economic growth and achieving long-term price stability. This study provides novel insights into the complex dynamics of fiscal and monetary policy within the context of a fragile and emerging economy.

Keywords

Money Supply, GDP Growth, Budget Deficit, Inflation, and Yemen

1. Introduction

Inflation remains a central concern in global economic discourse, particularly in developing and conflict-affected countries [1-3]. The interaction between GDP growth, money supply, and budget deficits has drawn significant scholarly attention due to its impact on price stability and macroeconomic performance [4, 5]. Globally, many countries have

shifted towards inflation-targeting frameworks, emphasizing monetary discipline and fiscal sustainability to ensure long-term growth (IMF, 2023). However, in fragile states such as Yemen, persistent inflation is driven by prolonged fiscal imbalances, currency depreciation, and weak institutional capacity. Yemen's economy has been severely dis-

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rupted by conflict, leading to a continuous budget deficit, erratic monetary expansion, and stagnating GDP [6, 7]. The industrial sector has declined substantially, with firms struggling to operate amid economic and political instability [8]. In this context, corporate governance plays a critical role in determining how firms respond to macroeconomic volatility [9]. Weak governance structures, often rooted in concentrated ownership and political affiliations, hinder transparent decision-making and contribute to inefficient capital allocation intensifying inflationary pressures [10]. Furthermore, in the current digital era, economic developments are rapidly disseminated, amplifying market reactions and public scrutiny [11]. Economic instability in Yemen does not only affect domestic welfare but also undermines international confidence. Therefore, it is crucial to understand the structural and policy-driven factors contributing to inflation. This study seeks to explore the relationship between GDP growth, money supply, and budget deficits on inflation in Yemen, offering insights into how macroeconomic management and corporate governance intersect in shaping inflationary trends in fragile economies.

Understanding the dynamics between GDP growth, money supply, and budget deficits is fundamental to grasping the root causes of inflation in fragile and underdeveloped economies [12]. In Yemen, where macroeconomic instability is chronic and inflation is a pressing concern, these variables interact in complex and often non-linear ways. Economic theory suggests that sustained GDP growth can stabilize prices by expanding productive capacity and improving fiscal revenues, while excessive money supply, particularly when not matched by real economic output, often leads to demand-pull inflation [13]. Simultaneously, persistent budget deficits may necessitate increased borrowing or monetization of debt, further expanding the money supply and exerting upward pressure on prices [5]. In Yemen's case, where fiscal sustainability is compromised and monetary control is weak, inflationary trends may not only reflect cyclical economic fluctuations but also structural distortions [14]. The interaction among these macroeconomic variables raises several critical inquiries. First, to what extent do GDP growth, money supply, and budget deficits individually and collectively influence inflationary trends in Yemen? Second, how do these variables interact over time, especially in a context of institutional weakness and economic fragmentation? Third, can GDP growth and money supply act as moderating mechanisms, either amplifying or mitigating the effect of budget deficits on inflation? In other words, does economic expansion or a controlled monetary environment buffer the inflationary impact of fiscal imbalances? Addressing these questions is essential for designing effective macroeconomic policies that can stabilize prices, promote growth, and strengthen the economic resilience of Yemen in the face of ongoing challenges.

A robust understanding of inflationary dynamics requires close examination of its fundamental drivers GDP growth, money supply, and budget deficits each of which plays a

distinct role in shaping price levels [15]. GDP growth is widely seen as a key indicator of economic health and productive capacity. According to Barro [16], higher economic growth often enhances supply-side capabilities, helping stabilize prices through increased output and improved resource utilization. However, in economies like those that Yemen where growth is inconsistent and often driven by volatile sectors such as agriculture or aid inflows, its impact on inflation may be limited or distorted [17]. Money supply, defined as the total amount of monetary assets available in an economy at a specific time, is another vital determinant of inflation [18]. The quantity theory of money posits a direct relationship between money supply and price levels, suggesting that inflation results when money grows faster than real output [19]. In weak monetary systems, such as Yemen's, uncontrolled monetary expansion often linked to fiscal financing has historically led to inflationary pressures. Budget deficits, the gap between government revenues and expenditures, can also significantly influence inflation. When governments resort to central bank financing to cover fiscal gaps, the resultant increase in money supply can be inflationary [20]. In Yemen, persistent fiscal deficits driven by conflict, institutional breakdown, and low revenue mobilization have fueled inflationary trends over the past decade. Understanding how these three variables interact and drive inflationary outcomes is essential for developing coherent macroeconomic and fiscal strategies in fragile economies.

Empirically investigates the interaction among these variables using annual time series data from 1991 to 2023. The data were obtained from the Central Bank of Yemen, World Bank Development Indicators, and the International Monetary Fund. Employing econometric techniques such as Vector Error Correction Model (VECM) and Granger causality tests, the study explores both the short- and long-run dynamics between macroeconomic indicators and inflation [21, 22]. The results reveal a significant positive long-run relationship between money supply and inflation, indicating that excessive monetary expansion has been a major driver of price instability in Yemen. Similarly, budget deficits were found to have a strong inflationary impact, particularly when financed through central bank borrowing, confirming the fiscal dominance hypothesis. In contrast, GDP growth exhibited a weak and statistically insignificant effect on inflation, suggesting that economic output in Yemen has not been strong enough to offset inflationary pressures. Furthermore, the results indicate that money supply partially mediates the impact of budget deficits on inflation, reinforcing the link between fiscal imbalance and monetary instability.

The findings of this study contribute meaningfully to theoretical, empirical, and practical domains. Theoretically, the study reinforces classical and monetarist economic theories that emphasize the central role of money supply and fiscal discipline in maintaining price stability [23, 24]. The significant long-run relationship between money supply, budget deficits, and inflation supports the Quantity Theory of Money

and the Fiscal Theory of the Price Level, particularly in the context of fragile states like Yemen [25, 26]. The study also provides insight into how limited GDP growth weakens the economy's capacity to absorb inflationary shocks, thus enriching the discourse on supply-side constraints in developing economies. Empirically, this research fills a gap in the literature on conflict-affected economies, where macroeconomic data is often scarce and underexplored. By using updated time series data from 1991 to 2023 and applying advanced econometric techniques, the study offers robust empirical evidence on the interdependence of fiscal and monetary factors in driving inflation. The identification of money supply as a mediator between budget deficits and inflation provides a nuanced understanding of Yemen's inflationary process [27]. Practically, the study offers timely policy implications for Yemeni policymakers, international donors, and development institutions. The results underscore the urgent need for monetary tightening, enhanced budgetary oversight, and structural reforms to improve revenue generation and public spending efficiency. A credible macroeconomic framework that aligns fiscal and monetary policies is essential for curbing inflation and promoting long-term economic stability in Yemen's fragile economic environment.

The remainder of this paper is structured as follows: Section 2 provides a comprehensive review of the relevant literature and formulates the research hypotheses based on theoretical and empirical insights. Section 3 outlines the research methodology, detailing the study design, sample selection, variable definitions, and model specification. Section 4 presents the descriptive statistics of the dataset and discusses the primary regression results. Section 5 conducts robustness checks to validate the reliability and consistency of the findings. Section 6 offers further analysis, focusing on the moderating effects and the underlying mechanisms linking budget deficits, money supply, and inflation. Finally, Section 7 summarizes the key conclusions, discusses policy implications, and suggests avenues for future research.

2. Theoretical Literature Review

In this study, five economic theories are employed to explain the relationship between GDP growth, money supply, budget deficits, and inflation in the context of Yemen: The Quantity Theory of Money (QTM), Keynesian Theory, and Fiscal Theory of the Price Level (FTPL), Monetarist Theory, and the Structuralize Theory of Inflation.

The Quantity Theory of Money (QTM) posits a direct and proportional relationship between the money supply and the general price level, assuming the velocity of money and real output remain constant. According to this theory, any increase in the money supply leads to a corresponding rise in inflation [28]. In contrast, the Keynesian Theory emphasizes aggregate demand as the primary driver of economic activity and inflation, particularly in the short run. It advocates for active government intervention to manage demand-side fluctuations

during periods of economic instability, such as recessions or inflationary pressures [29]. The Fiscal Theory of the Price Level (FTPL) shifts the focus from monetary aggregates to fiscal sustainability. It asserts that the price level is determined by the government's intertemporal budget constraint, specifically the present value of expected future primary surpluses. When fiscal deficits are persistent and lack a credible repayment path, inflation adjusts to reduce the real value of government debt [30]. Similarly, the Monetarist Theory, largely shaped by Milton Friedman, identifies the money supply as the central determinant of inflation in the long term. Monetarists argue that sustained inflation results from an excessive growth rate in the money supply relative to the growth of real economic output [31].

Finally, the Structuralize Theory of Inflation offers a perspective particularly relevant to developing economies. It contends that inflation arises not solely from monetary expansion but also from deep-rooted structural issues such as food shortages, foreign exchange constraints, income disparities, supply chain disruptions, and weak institutions. These supply-side rigidities contribute to persistent inflation, even in the absence of aggressive monetary expansion [32].

3. Literature Review and Hypothesis

3.1. GDP Growth and Inflation

Recent literature underscores a wide array of structural and external factors that shape global GDP growth trends. In the United States, a long-term decline in output growth has been prominently linked to a slowdown in labor productivity [33]. This pattern is not unique to the U.S., as other advanced economies have experienced similar trajectories. [34] Affirm that sophisticated modeling approaches can capture the intricate dynamics of global economic fluctuations, thereby facilitating more informed and responsive policymaking. In Russia, [35], report that while GDP recovered to pre-crisis levels by late 2021, the nation's growth prospects remain uncertain due to structural inefficiencies and intensified external risks. These conditions necessitate comprehensive fiscal strategies and labor market reforms. Similarly, [36], utilize satellite-recorded nighttime light data to refine estimates of economic activity, concluding that China's economy likely grew faster than official statistics suggested and did not experience the sharp downturn reported in late 2015. [37] find that the World Uncertainty Index particularly metrics specific to the United States can reliably forecast GDP growth, with greater predictive power during periods of heightened uncertainty such as the COVID-19 pandemic. Jakovljevic, Timofeyev [38] highlight the resilience of EM7 countries during the 2008 financial crisis compared to the G7, even as both groups faced rising out-of-pocket health expenditures. Despite notable growth in many developing countries, [39], emphasize that poverty alleviation has been limited, calling for more equitable growth strategies and population control

measures.

In Yemen, chronic political instability and protracted conflict have severely hindered GDP growth, pushing the economy into a prolonged state of crisis. Parallel to GDP concerns, the growth in money supply is widely acknowledged as a key determinant of long-term inflation, though short-term inflationary effects may not always materialize proportionally a notion aligned with the Quantity Theory of Money [18]. In South Asian economies, recent studies show that an expanding money supply positively influences bank stock returns and is associated with inflation, interest rate spreads, and exchange rate differentials. These findings lend support to the Post-Keynesian view of endogenous money and highlight the importance of sound financial policies for sustaining growth [40]. Hirota [41] also stresses the significance of money supply in determining stock prices, showing that investor heterogeneity and market frictions can lead to price deviations from fundamental values, potentially widening the disconnect between financial markets and the real economy. Similarly, [42], find that both money supply and foreign direct investment (FDI) significantly boost economic growth, while inflation exerts a negative impact. Their findings suggest that fiscal spending has a limited short-term effect, reinforcing the importance of inflation control and FDI as pillars of long-term economic development. [43], demonstrate that in developing economies, inflation is significantly influenced by the money supply and market rates, while central bank refinancing rates have limited effects. Additionally, previous inflation trends appear to negatively correlate with future inflation. In the case of Yemen, ongoing instability has undermined the management of the money supply, weakening central bank capacity and contributing to high inflation and diminished monetary policy effectiveness. These dynamics have intensified economic hardship and constrained growth prospects.

Achieving sustainable GDP growth while maintaining low inflation remains a core objective of macroeconomic policy. Bon Nguyen [44], using the Pooled Mean Group (PMG) estimation technique, found that fiscal deficits and broad money supply significantly influence inflation in Asian countries. Likewise, [45], investigated the fiscal deficit-inflation nexus in Nigeria and concluded that the budget deficit increases the money supply and drives inflation. The study advocates for a reduction in administrative costs and improved fiscal discipline to keep deficits within a manageable threshold. [46], established a bidirectional causal relationship between Egypt's budget deficit and inflation from 1991 to 2021. They recommend anti-corruption reforms, improved tax collection, and currency stabilization to enhance fiscal management and mitigate inflationary pressures. In the context of Yemen, a comprehensive literature review would encompass theoretical foundations and empirical evidence on the interplay between GDP and inflation. This includes defining both indicators, their measurement methodologies, and their significance in evaluating economic performance. Yemen's economic background marked by dependence on oil

exports, widespread poverty, political instability, and high unemployment provides essential context for examining this relationship. Research on Yemen's GDP growth focuses on drivers such as oil price volatility, public and private investment, and foreign aid. Analyses often explore the sectoral composition of GDP to assess contributions across industries. Studies on inflation in Yemen address trends in consumer and producer prices and examine root causes including supply-side disruptions, currency depreciation, and structural inefficiencies.

Empirical investigations typically employ econometric tools such as time-series analysis, vector auto regression (VAR), and co-integration techniques to analyze the GDP inflation relationship. These methods help identify short and medium-term dynamics, as well as structural breaks or non-linear interactions. From a policy perspective, the literature highlights the challenges policymakers face in balancing growth and price stability. Evaluating the effectiveness of fiscal and monetary policies in controlling inflation and supporting growth is essential for designing sustainable economic strategies. Furthermore, scholars have examined the social implications of macroeconomic trends, noting how inflation and stagnating GDP disproportionately affect vulnerable and marginalized populations in Yemen. Although several studies explore the relationship between GDP growth and inflation in other developing or fragile economies, few have addressed this nexus in Yemen with a comprehensive approach that includes structural changes, external shocks, and policy variables. Existing analyses using data from the Yemen Economic Survey and World Development Indicators tend to be narrow in scope, underscoring the need for broader and deeper research. This study aims to fill that gap by adopting a holistic analytical framework. By integrating data from reliable international sources and applying robust empirical methods, the research offers new insights into Yemen's macroeconomic challenges. Its contribution lies in contextualizing GDP and inflation dynamics within Yemen's unique socioeconomic conditions and providing evidence-based guidance for policy reform.

H1: There is a statistically significant causal relationship between gross domestic product (GDP) growth and inflation in the context of Yemen's economy.

3.2. Inflation and Budget

Economists hold diverse perspectives on inflation, but they all agree on its primary cause: inflation is fundamentally a monetary phenomenon [47]. Budget deficits can lead to inflation only if they are reflected in monetary aggregates. When a central bank finances a budget deficit, it increases liquidity in the economy, which in turn drives inflation. Empirical evidence suggests that the impact of budget deficits on inflation depends on the methods used to finance those deficits. For instance, a study analyzing the relationship between Turkey's overall inflation rate and its budget deficit, using

time-series data, found significant correlations [48]. Similarly, [49], argue that growing inflation and expanding budget deficits are often indicators of an expanding economy. In their analysis, the expansion of the money supply was identified as the key factor driving inflation, while GDP growth, the unemployment rate, the official exchange rate, and the government-spending deficit were considered independent variables. This study relies on data from the Yemen Economic Survey and the World Development Indicators to analyze these relationships. The findings reveal that GDP growth, the budget deficit, and the money supply have a strong positive impact on inflation. In contrast, unemployment and the official exchange rate exert a significant negative effect. The study recommends that policymakers focus on developing new revenue streams to address budgetary challenges, rather than relying on foreign financing.

A review of the literature on Yemen's inflation and budget would probably cover a wide range of subjects, such as the country's economic situation, governmental initiatives, societal effects, and possible remedies. Scholarly publications may differ in topic and perspective due to the complexity of the situation in Yemen, which has been made worse by violence and political instability. A review of Yemen's economic status, including its historical background, important economic indicators, and structural issues, would probably constitute the first section of the literature. This section could examine elements like the nation's high unemployment rate, poverty levels, and dependency on foreign aid, as well as its strong reliance on oil exports [6]. Researchers would look at things like fluctuations in global commodity prices, devaluation of the currency, disruptions in the supply chain, and fiscal deficits as causes of Yemen's inflation. They might examine historical patterns of inflation, particularly hyperinflationary times, and evaluate how inflation affects consumers, companies, and the economy as a whole. The fiscal issues facing Yemen, such as revenue collection, government spending, and budget deficits, will be covered in this section. Academics may examine the breakdown of government expenditures, resource allocation, and the effectiveness of public finance management systems.

They might also talk about how foreign aid affects Yemen's economic stability and how it finances the country's budget. Researchers would look into the societal effects of Yemen's inflation and financial limitations, such as food insecurity, poverty, and access to essential services like healthcare and education. They might look at how vulnerable people are disproportionately affected by inflation, and how it exacerbates already-existing socioeconomic disparities. The effectiveness of monetary policy measures, fiscal reforms, and international assistance programs as well as other policy responses to Yemen's inflation and budgetary issues will be evaluated through a study of the literature [50]. Academics can assess the effectiveness of structural reforms and austerity measures in reducing budget deficits, as well as the role played by central banks in controlling inflation expectations

and maintaining currency stability. The assessment of Yemen's inflation and fiscal stability would round out the literature study, taking into account the country's continuous conflicts, political developments, and outside influences like humanitarian help and worldwide economic trends. Scholars may put forth ideas for policies that support Yemen's budgetary sustainability, ease inflationary pressures, and encourage economic recovery [6]. Overall, an examination of the literature on Yemen's budget and inflation would offer a thorough grasp of the issues the nation is experiencing economically and possible solutions. To provide insights and viewpoints on this important topic, it would consult a wide range of academic works from the fields of political science, development studies, economics, and other pertinent fields.

H2: There is a significant relationship between inflation and budget deficit.

3.3. Money Supply and Inflation

The COVID-19 outbreak caused economic problems in several countries. An investigation carried out in Indonesia aims to ascertain how Bank Indonesia's monetary policy contributes to the fight against the COVID-19 pandemic. The research methodology employed in this study is descriptive qualitative research, and a significant portion of the data was gathered through library research and extracted from reports and publications written by Bank Indonesia. According to [51], the study concludes that Bank Indonesia is treating economic concerns during the COVID-19 outbreak seriously. According to [52], at a significance level of 5%, the money supply has no effect in the medium or long term, and as such, it cannot be used as a suitable benchmark for monetary policy to influence inflation in Zambia. Researchers regarding the variables influencing inflation have discovered divergent views. All economists agree, though, that sustained inflation results from a rise in the money supply faster than the expansion of the economy. [53] Examined the elements that influence Indonesian inflation. The data showed that the short-term rate of inflation in Indonesia was not significantly affected by the money supply, GDP, imports, or exports. Nonetheless, the outcomes demonstrated that there was a significant relationship between the inflation rate and the exchange rate. Over time, the money supply, the exchange rate, and exports all have a significant impact on Indonesian inflation; in contrast, the country's gross domestic product and imports have very little effect.

A review of the literature on Yemen's money supply and inflation would examine several facets of the connection between the two occurrences while taking into consideration the nation's distinct political, social, and economic circumstances. An introduction to the terms money supply and inflation, including definitions, methods of measurement, and theoretical underpinnings, is given in this section. Additionally, it would highlight the need to research the dynamics of the money supply and inflationary pressures and their impli-

cations for policy and economic stability. By giving background information about Yemen's economy, such as its reliance on oil exports, its need for foreign aid, its structural difficulties, and the effects of political unrest and conflict on economic performance, the literature review would put the topic in context [6]. Researchers will examine the elements that influence Yemen's money supply, such as foreign exchange reserves, remittances, central bank policy, and inflows of international aid. They could look at patterns in the increase of the money supply over time, evaluate the significance of monetary aggregates (such as M1, M2, and M3), and investigate the pathways by which adjustments to the money supply influence inflationary pressures.

The dynamics of inflation in Yemen will be covered in this section, along with trends in producer and consumer price inflation and other pertinent inflation indices. The causes of inflation would be examined by academics, and they would include changes in the currency rate, demand-side variables like household spending and investment, and supply-side shocks like the price of food and gasoline. Using econometric methods such as time-series analysis, vector auto regression (VAR) models, and co-integration tests, researchers would examine empirical studies that looked into the connection between Yemen's money supply and inflation. They might evaluate the dynamics of the money supply expansion and inflation over the short and long terms, as well as whether there are any structural breaks or non-linearities in the relationship. The literature review will review the findings' policy implications, stressing the difficulties policymakers have in controlling the expansion of the money supply and reining in inflationary pressures in Yemen. Researchers can evaluate how well fiscal policies, exchange rate policies, and monetary policy tools stabilize prices and advance economic stability. Lastly, the evaluation of the literature would point out any gaps in the knowledge base and suggest directions for further study of Yemen's money supply and inflation. This could cover topics including the development of the financial sector, the function of exchange rate controls, and the efficiency of frameworks for inflation targeting in reducing the risk of inflation.

A study of the literature on money supply and inflation in Yemen will help us better understand the economic dynamics and difficulties facing the nation by combining existing research and highlighting important themes and insights. It would also help shape policy discussions and decision-making procedures.

H3: There is a significant relationship between money supply and inflation.

$$\text{The inflation rate} = \alpha + b_1 (BD) + b_2 (MS) + b_3 (GDP) + e^-$$

In this context, MS refers to the money supply, BD denotes budget deficit, and GDP refers to gross domestic product. Consequently, the equation presented above represents the standard specification of the model under investigation, aimed at understanding the phenomenon of inflation in Yemen, *ceteris paribus*, with BD, MS, and GDP remaining key components.

4. Material and Methods

4.1. Sample

A robust research methodology enhances the credibility of a study by ensuring that conclusions are supported by reliable scientific data (Daniel & Sam, 2011). This methodology incorporates a comprehensive plan that streamlines and optimizes researchers' efforts while maintaining organization and adherence to timelines. The methodology employed assists readers in comprehending the strategies and techniques utilized to derive the results (Pandey & Pandey, 2021). This analysis utilized time series data from Yemen from 1990 to 2023, incorporating both quantitative and secondary data. The independent variables examined include money supply (MS), GDP growth, and budget deficit (BD), with inflation serving as the dependent variable. The study analyzed data expressed as percentages, including GDP (annual percentage growth), MS (broad money yearly percentage growth), BD (fiscal deficit), and CPI (consumer price yearly percentage index). CPI, MS, and GDP data were sourced from the World Bank's official "World Development Indicator" website, while BD data was obtained from the State Bank of Yemen, the central bank's website. In addition to descriptive statistics, a two-stage least squares method was employed to assess regression among the variables. The analysis incorporated a "unit root test" (ADF & PP) to evaluate data stationarity. A causal relationship among selected variables was identified using the "Granger causality test," along with the "LM test" and tests for heteroscedasticity to ascertain whether the data exhibited heteroscedasticity or multicollinearity. Furthermore, the Ramsey reset test was applied, and a correlation matrix was constructed to support the findings.

4.2. Model of the Study

In the current study, we examine the effects of GDP, the budget deficit (BD), and money supply (MS) on inflation. The data was presented in percentage form, and the model specification was adapted from the reviewed literature to establish a more conventional model definition.

5. Results and Analysis

Descriptive statistics provide a detailed explanation of the computation of coefficients. Unlike inferential statistics, descriptive statistics are not grounded in probability theory [54]. The primary objective of descriptive statistics is to offer a

concise summary of a sample rather than conclude the broader population that the sample is intended to represent. This distinction indicates that, in contrast to inferential statistics, descriptive statistics are typically nonparametric and independent of probability theory [55].

Table 1 reports the results of descriptive statistics. The mean value of GDP is 18.656, with a standard deviation of 11.814, indicating substantial variation in gross domestic product across the observations. The average value of bank deposits (BD) is 8.400, with a relatively higher standard deviation of 13.513, suggesting significant dispersion. Money supply (MS) has a mean of 3.277 and a standard deviation of 1.811, while inflation (Inf) averages 5.328, with a standard deviation of 13.420. These results highlight notable hetero-

geneity in the macroeconomic indicators considered. The median values of GDP and BD are 19.160 and 9.070, respectively, whereas the median values of MS and Inf are 2.921 and 3.901. The Jarque-Bera (JB) test is employed to assess the normality of the data distribution [56]. The results show JB statistics of 6.443 for BD, 30.927 for Inf, 114.112 for MS, and 2.370 for GDP, all with p-values equal to 0.000, indicating that the distributions deviate significantly from normality. These findings align with previous literature that cautions against assuming normality in macroeconomic data [54, 55]. Furthermore, as descriptive statistics are not rooted in probability theory and serve primarily to summarize the sample data, no inference about the broader population is made.

Table 1. Descriptive Statistic.

Variables	Inflation	MS	BD	GDP
Mean	5.327765	3.276824	8.399706	18.65559
Median	3.900700	2.921000	9.070000	19.16000
Maximum	45.000	10.70000	50.00000	43.23000
Minimum	-27.99450	1.608000	-9.200000	4.167000
Std. Dev.	13.42027	1.811294	13.51327	11.81429
Skewness	1.314852	2.611817	0.979608	0.512419
Kurtosis	6.862045	10.29816	3.838015	2.211089
Jarque-Bera	30.92688	114.1118	6.4432791	2.369620
Probability	0.000	0.0000	0.040099	0.305804
Sum	181.1440	111.4120	285.5900	634.2900
Sum Sq. Dev.	5943.417	108.2659	6026.076	4606.056
Observations	34	34	34	34

Source: Author's calculation

Table 2. Augmented Dicky Fuller.

Variables	ADF		1st diff	
	Level			
	P-value	T-value	P-value	T-value
Inflation	0.1604	-1.346574	0.0000	-6.347945
GDP	0.5570	-0.333738	0.0005	-3.731210
MS	0.9254	1.098165	0.0277	-2.219578
BD	0.3047	-0.933681	0.00063	-2.821026

Source: Author's calculation

Table 2 presents the results of the Augmented Dickey-Fuller (ADF) unit root test, which is used to examine the stationarity of the variables. The null hypothesis of the ADF test states that a time series has a unit root, implying non-stationarity. At the level form, none of the variables Inflation, GDP, Money Supply (MS), or Bank Deposits (BD) are stationary, as indicated by p-values greater than 0.05. Specifically, inflation has a p-value of 0.1604, GDP has 0.5570, MS shows 0.9254, and BD registers 0.3047. However, after first differencing, all variables reject the null hypothesis of a unit root at the 5% significance level, indicating that they become stationary. For example, inflation shows a p-value of 0.0000 with a t-value of -6.348, and GDP shows a p-value of 0.0005 with a t-value of -3.731. These results suggest that all

four variables are integrated of order one, i.e., $I(1)$.

Table 3 reports the results of the Phillips-Perron (PP) test, an alternative test for unit roots that adjusts for serial correlation and heteroskedasticity. Consistent with the ADF test, the PP test results confirm that the variables are non-stationary at level but stationary at first difference. Inflation shows a p-value of 0.0100 at level and becomes highly significant after first differencing ($p = 0.0000$, $t = -5.084$). GDP, MS, and BD also become stationary at the first difference level, with respective p-values of 0.0005, 0.0000, and 0.0063. These findings reinforce the conclusion that all variables are $I(1)$, making them suitable for counteraction analysis and regression models requiring stationary time series.

Table 3. Philip and Perron (PP).

Variables	PP			
	Level		1 st diff	
	P-value	T-value	P-value	T-value
Inflation	0.0100	-2.635777	0.0000	-5.084047
GDP	0.5989	-0.221401	0.0005	-3.765559
MS	0.9805	1.800900	0.0000	-6.660621
BD	0.3670	-0.788074	0.0063	-2.821026

Source: Author's calculation

Table 4 presents the results of the Chow structural break test, used to examine the presence of a structural break in the regression model. The F-statistic value is 1.794 with a p-value of 0.1603, which is above the conventional 0.05 threshold, indicating that the null hypothesis of no structural break cannot be rejected. Similarly, the log-likelihood ratio test

yields a p-value of 0.0816, and the Wald test produces a p-value of 0.1268. Both results also fail to reject the null hypothesis. Consequently, there is no statistically significant evidence of structural breaks in the sample during the studied period. This suggests the stability of the estimated relationships over time.

Table 4. Chow test.

F-statistic	1.794347	Prob. (4.26)	0.1603
Log-likelihood rate	8.288247	Prob. chi-square (4)	0.0816
Wald statistics	7.177387	Prob. chi-square (4)	0.1268

Source: Author's calculation

In summary, the unit root tests confirm that all variables become stationary after first differencing, justifying their use in further econometric modeling. Moreover, the Chow test results indicate no structural instability in the model, sup-

porting the reliability of the dataset for subsequent analysis.

Table 5 presents the results of the Bai-Perron multiple structural break test, which detects unknown structural changes in the regression model. The comparison between 0

versus 1 break yields a scaled F-statistic of 22.849, which exceeds the critical value of 16.19, indicating the presence of one significant structural break in the dataset. However, the comparison between 1 versus 2 breaks yields a scaled F-statistic of 4.815, which is lower than the critical value of

18.10, suggesting that there is no evidence to support the existence of a second structural break. These results imply that only one major structural shift is present during the study period, which may have influenced the relationship among the key macroeconomic variables.

Table 5. Bai-Perron test.

Break test	f-statistic	Scaled f-statistic	Critical value
0 vs 1*	5.712173	22.848869	16.19
1 vs 2	1.203744	4.814926	18.1

Figure 1 displays the results of the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests, which assess the stability of the regression coefficients over time. Both plots show that the cumulative test statistics remain within the 5% significance bounds, indicating that the model is stable and there is no evidence of parameter instability throughout the sample period.

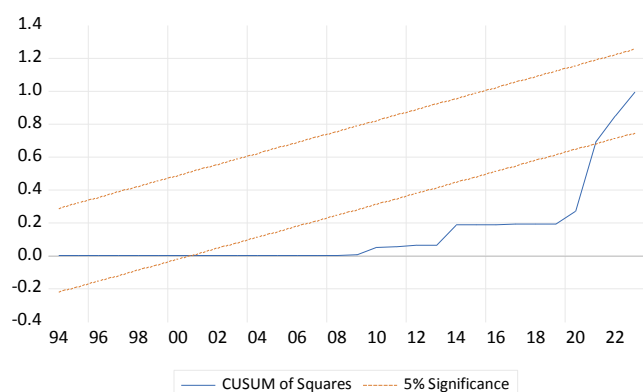
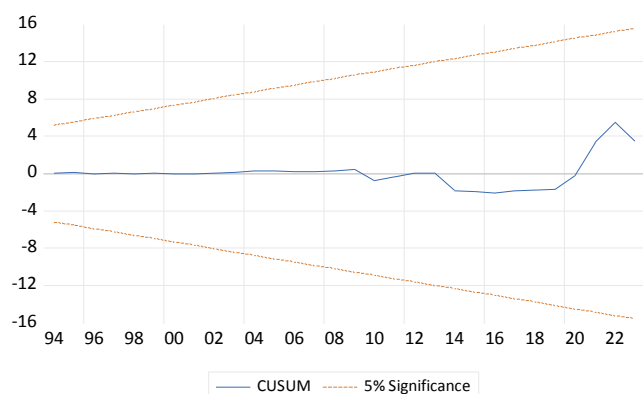


Figure 1. Test shows CUSUM and CUSUMSQ.

Table 6 reports the results of the Granger causality test, which evaluates whether one time series can predict another.

The null hypothesis that money supply (MS) does not Granger-cause inflation is rejected at the 1% significance level (F-statistic = 5.181; $p = 0.0067$), indicating that changes in MS significantly precede changes in inflation. However, bank deposits (BD) and gross domestic product (GDP) do not Granger-cause inflation, as their respective p-values (0.9452 and 0.3695) are not statistically significant. These findings suggest that among the tested variables, only the money supply exerts predictive power over inflation within the sample period.

Table 6. Granger Causality Test.

Null hypotheses	F-statistic	P-value
MS doesn't cause Inflation	5.18052	0.0067
BD doesn't cause Inflation.	0.12367	0.9452
GDP doesn't cause Inflation	1.09710	0.3695

Source: Authors' calculation

Table 7. Breusch Godfrey Serial Test.

F-statistic	5.238662	Prob. F (3, 29)	0.0056
Obs	12.50922	Prob. chi-square (3)	0.0058
*R-square			

Source: Authors own calculations

Table 7 presents the results of the Breusch-Godfrey serial correlation LM test, used to detect autocorrelation in the residuals of the regression model. The F-statistic (5.239) and the corresponding p-value (0.0056) reject the null hypothesis of no serial correlation at the 1% level. Similarly, the chi-square statistic (Obs*R-squared = 12.509; $p = 0.0058$) confirms the

presence of serial correlation. This indicates that the model residuals are not independent; suggesting that lagged effects should be carefully addressed in further model specification.

Table 8 shows the results of the heteroscedasticity test, which checks whether the variance of the residuals is constant. All p-values associated with the F-statistic (0.3669), Obs*R-squared (0.3405), and Scaled Explained Sum of Squares (0.0606) are greater than 0.05, suggesting that the null hypothesis of homoscedasticity cannot be rejected. Therefore, the residuals exhibit constant variance, and heteroscedasticity does not pose a significant problem in the model.

Table 8. Heteroscedasticity Test.

F-statistic	1.093744	Prob. (3.30)	0.3669
Obs *R-square	3.352096	Prob. chi-square (3)	0.3405
Scaled explained SS	7.384737	Prob. chi-square (3)	0.0606

Source: Author's own calculation

Table 9 presents the results of the Ramsey RESET test, which examines the model for functional form misspecification. Both the F-statistic (1.964) with a p-value of 0.4239 and the likelihood ratio test ($p = 0.3260$) indicate that the model does not suffer from omitted variable bias or incorrect functional form. These results confirm the model's structural adequacy and specification correctness.

Table 9. Ramsey Reset Test.

F-statistic	1.964151	Prob. (3.27)	0.4239
Likelihood ratio	3.460150	Prob. (3)	0.3260

Source: Authors own calculations

Figure 2 illustrates the time-series trends of four key macroeconomic variables used in the VAR (Vector Autoregression) analysis from 1990 to 2023: Budget Deficit (BD), Gross Domestic Product (GDP), Economic Growth Rate, and Money Supply (MS). The BD graph shows significant volatility, with sharp increases in the mid-1990s and post-2020, reflecting periods of fiscal instability, likely influenced by political unrest and conflict. GDP displays a steady upward trend from 1990 until around 2014, after which it declines sharply indicative of the economic consequences of conflict and war, especially following the escalation in 2015. The economic growth rate remains relatively stable until 2010, followed by large fluctuations and a severe downturn around 2015, corresponding to conflict-driven economic disruption. However, some recovery is observed post-2017, peaking near 2021 before dropping again. Money supply (MS) shows a gradual rise until 2015, then a sharp increase and volatility afterward, particularly after 2020, possibly due to expansionary monetary policy or inflationary pressures. These patterns reflect strong interdependence and structural shifts among the variables, justifying the application of VAR modeling to assess their dynamic interactions and causal relationships over time. The observed economic trends likely highlight the effects of war, policy changes, and global shocks on Yemen's macroeconomic performance.

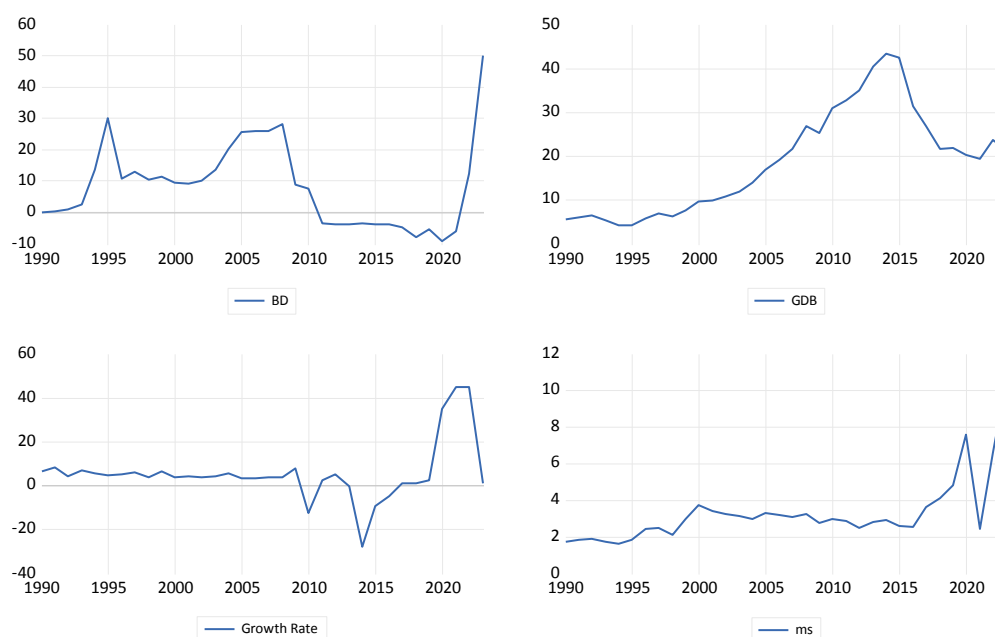


Figure 2. shows the VAR test.

Table 10 reports the estimates of the Two-Stage Least Squares (2SLS) regression, which is used to address potential endogeneity issues among the independent variables. The coefficient of money supply (MS) is positive and statistically significant at the 5% level ($\beta = 3.438$; $p = 0.0112$), suggesting a strong positive influence on inflation. The coefficient for bank deposits (BD) is negative and marginally significant at the 10% level ($\beta = -0.332$; $p = 0.0675$), while the coefficient for GDP is also negative and significant at the 1% level ($\beta =$

-0.539 ; $p = 0.0095$), indicating an inverse relationship with inflation. The model reports an R-squared value of 0.278 and an adjusted R-squared of 0.206, showing a moderate explanatory power. The Durbin-Watson statistic is 1.242, which suggests the presence of some positive autocorrelation. The p-value of 0.019 further confirms the joint significance of the model. The J-statistic is zero, suggesting that the over identifying restrictions are valid, supporting the use of instruments in the model.

Table 10. Two Stage Least Square Statistics.

Variables	Coefficient	Standard error	t-statistics	p-values
MS	3.438247	1.271109	2.704920	0.0112
BD	-0.332471	0.175235	-1.897285	0.0675
GDP	-0.538616	0.194359	-2.771242	0.0095
R-Squared	0.277835			
j-statistics	0.00000			
Durbin-Watson stat	1.241824			
Adjusted R-Squared	0.205618			
p-value	0.019248			

Abbreviations: MS= Money supply, BD= budget deficiency, GDP= gross domestic product

Source: Author's calculation

In summary, the empirical tests provide a robust foundation for the regression analysis. The data are structurally stable with no signs of heteroscedasticity or functional form misspecification, though some serial correlation is present. The 2SLS results reveal that money supply significantly influences inflation, while GDP exerts a negative impact. The findings emphasize the importance of monetary variables in shaping inflationary dynamics in the studied economy.

The coefficient value is -0.332471 with a standard error of 0.175235, the T-value is -1.897285, and the probability of BD is 0.0675. Ceteris paribus (CP), inflation would rise in Yemen when BD rises; this relationship is both statistically and positively significant. In particular, the t-value the standard deviation of the correlation between MS and inflation is 2.704920 (significant at 0.0112). The coefficient's inaccuracy is 3.438247. For the GDP coefficient ($t = -2.771242$, $p = 0.0095$, coefficient = -0.538616), the standard error is 0.194359. Given that there is a greater than 0.0056 chance that GDP will have a negative impact on inflation. The dependent variable's 47% variance may be attributed to the independent factors, according to the dependent variable's R-square value of 0.277835. The model as a whole has a p-value of 0.019248, a J statistic value of 0.00000, and a significance level $> 0.56\%$.

6. Conclusion and Policy Implications

Price stability is one of the most significant macroeconomic objectives for emerging nations like Yemen. The preservation of price stability is significantly impacted by the fiscal and monetary policies of individual countries. Part of the reason public sector deficits are seen negatively is that people assume the government would print money to close the gap, which will generate inflation. Monetary expansion and inflation are therefore often associated. High inflation is the outcome of the money supply's positive flow if the indicators are not kept under control. However, since there is less need for Labour, growth and expansion are also impeded by the limited supply, making the situation even direr. Inflationary pressures have fluctuated during the past sixty years in Yemen. While monetary policy changes are a good indicator of what is happening in other areas of the economy, money growth is the direct cause of inflation. It is widely acknowledged in Yemen that budget deficits could have played a significant role in explaining price variations.

Based on the findings from this study, it can be concluded that there is a significant relationship between money supply (MS), budget deficit (BD), and inflation in Yemen. Using

annual data from 1990 to 2023 and employing the Autoregressive Distributed Lag (ARDL) method, the study revealed that MS has a direct and substantial impact on inflation. This result aligns with the findings of [57], who also identified a significant relationship between MS and inflation. Additionally, the Ordinary Least Squares (OLS) test indicated that BD positively influences inflation, a finding that supports the research of [58], who demonstrated a similar effect of BD and MS on inflation across 47 countries. Furthermore, the study corroborates the findings of, which established a positive correlation between BD and inflation in both the short and long term. On the other hand, the study found a negative relationship between GDP and inflation, indicating that inflation in Yemen tends to decrease as GDP growth rates increase by [59]. However, the policy implications presented in the original analysis were somewhat generic. To provide more actionable recommendations, the study should suggest targeted fiscal and monetary policy interventions to control inflation of [58]. For example, Yemen's policymakers could focus on reducing budget deficits by improving fiscal discipline and diversifying revenue sources. Additionally, controlling money supply growth through tighter monetary policies could help mitigate inflationary pressures. Promoting sustainable economic growth through investments in infrastructure, human capital, and private sector development could further contribute to reducing inflation in the long term. These specific recommendations could better guide policymakers in addressing inflation in Yemen effectively [60].

7. Recommendations

The government of Yemen must prioritize productive public investment to alleviate inflationary pressures and foster economic growth in the nation. To reduce its reliance on deficit financing, the Yemeni government has the opportunity to implement tax reforms. Additionally, it could adopt a clear and effective monetary policy aimed at simultaneously promoting price stability and economic expansion. Furthermore, the Yemeni government should cultivate a conducive business environment that encourages innovation and entrepreneurship throughout the country. The Yemeni government needs to rein in its supplemental spending to balance its budget and prevent a deficit. The State Bank of Yemen and the government should exercise caution when implementing fiscal and monetary policies, as these factors can all lead to inflationary pressure in the nation. These factors include the money supply, the fiscal deficit, government spending, and interest rates. The government of Yemen should implement policies that promote economic growth and raise tax revenue.

Abbreviations

ARDL	Autoregressive Distributed Lag
GDP	Gross Domestic Product
MS	Money Supply
BD	Budget Deficit
CPI	Consumer Price Index
ADF	Augmented Dickey-Fuller
PP	Phillips-Perron
VAR	Vector Autoregression
2SLS	Two-Stage Least Squares
LM	Lagrange Multiplier
JB	Jarque-Bera
FTPL	Fiscal Theory of the Price Level
QTM	Quantity Theory of Money
IMF	International Monetary Fund
OLS	Ordinary Least Squares

Author Contributions

Mohammed Ahmed Yousef Alqadhi: Data curation, Investigation, Methodology, Resources, Visualization

Syed Zamin Shah: Conceptualization, Formal Analysis, Methodology, Project administration, Resources, Software, Supervision, Validation, Writing – original draft, Writing – review & editing

Ethical Considerations

We consider all the ethical considerations while conducting this study.

Clinical Trial Number

Not applicable.

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Data Availability

Data will be provided on request.

Conflicts of Interest

There is no conflict of interest between authors.

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