PressAcademia
www.pressacademia.org/journals/jefa
JEFA
ISSN 2148-6697
Journal of Economics, Finance and Accounting YEAR 2024 VOLUME 11 ISSUE 2

DETERMINANTS OF INFLATION IN ETHIOPIA: AN ECONOMETRIC ANALYSIS USING ARDL BOUNDS TESTING APPROACH

DOI: 10.17261/Pressacademia.2024.1956
JEFA- V.11-ISS.2-2024(3)-p.85-96

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Date Received: October 19, 2024 **Date Accepted:** November 30, 2024

To cite this document
Ayal, B.A., Aynalem, M.M., Bekalu, K.Y., (2024). Determinants of inflation in Ethiopia: an econometric analysis using ARDL bounds testing. Journal of Economics, Finance and Accounting (JEFA), 11(2), 85-96.
Permanent link to this document: http://doi.org/10.17261/Pressacademia.2024.1956

ABSTRACT

Purpose- The main purpose of this paper is to examine the macroeconomic factors that drive inflation in Ethiopia. Nonetheless even with different economic liberalization reforms and attempts on macroeconomic level, inflation stands as one of the most crucial issues affecting the Ethiopian economy. The purpose of this study is thus to investigate circumstances that trigged inflation during the period of 2003 to 2023 in an effort to identify key sources of sustained inflation and to determine the best ways of managing it.

Methodology- This study employs the ARDL technique to analyze the determinats of inflation through various macroeconomic variables in Ethiopia. The ARDL approach is particularly suitable for examining the short-run and long-run dynamics of the variables involved. Data for this research is sourced from reputable institutions, including the NBE, the EEA, the IMF, the WB, the CSA, and the MoFD, spanning from 2003 to 2023.

Findings- The study's findings indicated that exchange rate, broad money supply, import price, government expenditure, and budget deficit all have a positive and statistically significant impact on inflation in both the long and short run. On the other hand, interest rates and GDP growth exhibit a negative effect on inflation. While interest rates have an inflationary effect in the short run, they demonstrate a deflationary impact in the long run. In the short run, the budget deficit has a negative effect on inflation, suggesting that managing fiscal imbalances can contribute to lower inflation rates.

Conclusion- This study suggests that Ethiopian policymakers should improve fiscal and monetary policies by controlling money circulation, stabilizing exchange rates, ncreasing government spending efficiency. Moreover, reinforcing the institutions and adapting to global fluctuations can further reduce inflation.

Keywords: Macroeconomic drivers, time series, ARDL model, Bond test
JEL Codes: E31, C32, O55

1. INTRODUCTION

Inflation has emerged as a significant and persistent challenge to sustainable development across many African countries, exacerbating unemployment, amplifying poverty, and undermining financial stability (Dondashe & Phiri, 2018; Ngoma et al., 2019). Inflation involves an increase in the cost of consumer goods and erodes purchasing power, particularly affecting low-income populations, and can deepen poverty levels by increasing the cost of essential goods and services (Nguyen et al., 2017). Various inflationary tendencies have been observed in African countries during the last decades owing to numerous domestic and foreign factors (Afari et al., 2021). They include butt-shifting global commodity prices, exchange rate fluctuations, structural factors, and political risks (Ahmed, 2024). Some African countries have partly addressed the challenge of economic stability; however, inflation is still a major challenge (Asfuroğlu, 2021). Since most African countries depend more than 50% on imports of various necessary products, these economies are vulnerable to the global economic conditions that may enshrine or fuel inflationary forces (Charles et al., 2022) (Mavikela et al., 2019).

In sub-Saharan Africa, however, factors driving inflation rates bear features different from those seen in other regions, largely due to regional integration in trade, agricultural sector dependency, as well as the countries dependency on aid and foreign direct investment (Mavikela et al., 2019). SSA countries have, on average, been among the most affected by the situation, as they saw their inflation rates increasing constantly and unpredictably (Emeru, 2020; Musa & Yousif, 2018). Several cross-

sectional empirical studies have been conducted in different years to analyse the factors impacting inflation at the macroeconomic level in these countries. In SSA, inflation is the major problem faced by countries like Somalia, Kenya, Tanzania, Zimbabwe, Brundi, and, most importantly, Uganda (Ayebare, 2019; Maonga, 2022; Warsame et al., 2023).

Empirically, a number of studies, such as (Alehegn, 2021), identify key drivers of inflation in Sub-Saharan Africa, including increased money supply, exchange rate volatility, global commodity prices, and structural constraints like low agricultural productivity. Political instability and high external debt further exacerbate inflation, highlighting the need for a balanced approach to monetary, fiscal, and structural reforms. Similarly, (Nsafoah et al., 2024) use an empirical panel data approach to analyze post-COVID-19 inflation drivers in sub-Saharan Africa. Their study finds that inflation is influenced by factors such as currency depreciation, rising public debt, global commodity price surges, and disrupted supply chains, suggesting policy focus on stabilising exchange rates and reducing debt. (Melaku, 2021) employs a systematic review method, analyzing multiple econometric models from existing studies in sub-Saharan Africa to identify inflation determinants. Key drivers identified include increased money supply, exchange rate volatility, global commodity prices, and structural constraints. The review underscores the importance of monetary policy and structural reforms to curb inflation effectively.

Similar to other Sub-Saharan nations, Ethiopia has faced persistent inflationary challenges. Ethiopia's inflation crisis has reached alarming levels, with rates exceeding 30% at times since 2014 (Bane, 2018). This persistent inflation affects various sectors, including food, housing, and transportation, significantly impacting the cost of living (Kuma & Gata, 2023). The scope of this crisis encompasses urban and rural populations, disproportionately affecting vulnerable communities and exacerbating poverty. Moreover, the inflationary pressures challenge government policies aimed at economic reform and stability, highlighting the urgent need for comprehensive monetary and fiscal strategies to address the underlying causes and restore economic equilibrium in the country. The widespread impact of inflation poses a serious threat to Ethiopia's overall socio-economic development (Fufa & Legese, 2020).

Several studies have attempted to address the underlying macroeconomic determinates of inflation in Africa, particularly in Ethiopia. For instance, research conducted by (Abate, 2020; Kahssay, 2017; Kerorsa, 2023) also investigated determinants of inflation in Ethiopia using the ordinary least squares technique. They discovered that many important variables that cause the differences in the inflation rates include public spending, exchange rate, money stock, and food production. Worthy of note is the fact that while money supply expansion increases the amount of money in circulation in the economy or expected to circulate in the economy, it increases inflation because more money is turned over in trade without a corresponding increase in the achievable purchasing power relative to goods and services.

The studies by (Abate, 2020; Melaku, 2020; Tolasa et al., 2022) provide important insights into the macroeconomic determinants of inflation in Ethiopia, with each identifying key drivers that influence inflationary trends. (Abate, 2020) discovered that the exchange rate, agricultural output, exchange rate fluctuations, and public expenditure significantly influence Ethiopian inflation. (Tolasa et al., 2022), using the ARDL approach, highlighted that import price, broad money supply, and interest rate play significant roles in shaping inflation dynamics, confirming long-term cointegration between these variables and inflation. similarly, (Melaku, 2020) emphasised the brade money supply, government spending, global oil price, and exchange rate have a positive and significant impact on inflation. Collectively, these works implied that the fiscal policy or money supply, the endogenous factors and exchange rates, and international commodity prices, the exogenous factors, must be recognised as prominent drivers of inflation in Ethiopia; hence, it requires both short-term and long-term policies to combat inflation.

Although there has been significant focus on identifying and quantifying the determinants of inflation in Ethiopia, the majority of the prior studies established regression models using time series data and OLS estimation methods. However, as a standard econometric method, OLS has its deficiencies, particularly when operationalizing the short-run and long-run effects of the determinants of inflation. This research intends to do so by using the autoregressive distributed lag (ARDL) modeling technique that is best suited for analysing both short-run and long-run effects of different macroeconomic variables on inflation.

However, since 2017, Ethiopia has been experiencing a critical inflation problem, including a hyperinflationary state, which has a deep impact on the nation and the people. The need to develop a stronger analytical framework for this situation stems from the fact that the inflation in this country is complex. However, using ARDL modeling, this research not only targets to present an empirical analysis of the determinants of inflation but also tries to draw policy insights into the appropriateness and feasibility of controlling this chronic problem through monetary and fiscal policy tools. By adopting the ARDL model in this paper, this research seeks to offer policymakers relevant information in minimizing inflation risks and developing a stable economy for development. Furthermore, this study brings into the pool of scholarly work regarding inflation in sub-Saharan Africa and is useful for comparison to similar contexts in other countries.

Therefore, the major aim of this study is to identify the key macroeconomic determinants of inflation in Ethiopia, focusing on variables such as global commodity price, public expenditure, exchange rate, real GDP, and money supply.

2. LITERATURE REVIEW

2.1. Theoretical Considerations and Empirical Evidence on Inflation

This section comprises the theoretical frameworks on determinants of inflation in the context of developing countries, particularly Ethiopia. In recent times, different theories have been proposed depending on the theoretical point of view, and we will be focusing on the most appropriate and research-proven ones. Some of these are the quality theory of money, structuralism theory, and monetary theory, which are some of the fiscal theories. It is noteworthy that some theories are developed on the basis of the primary concepts of the theories that are described above, while others offer other hypotheses. In the following sections, we explain the theoretical framework of the model in detail, discuss the hypotheses tested in this paper, and briefly discuss the main points of each theory.

2.1.1. Quantity Theory of Money

The quantity theory of money states that the total amount of money in a country's economy determines the price level of that economy, as demonstrated by the equation MV=PTMV = PTMV = PT, where M is the total money, V is the rate at which money changes hands, P is the price level, and T is the volume of transactions (Machaj, 2023). As the third reason for influencing the price level, in this theory, we have the money supply if the velocity of this money for carrying out transactions is fixed (Ball, 2017). QTM holds the view that inflation is predominantly a monetary event due to the efforts made by the central banks to reduce inflammation through the conduct of monetary policies. In this case, the QTM (Quantity Theory of Money) holds that inflation is experienced due to the central bank's reluctance to embark on controlling the money supply; it argues that change in money supply always leads to change in the price level in proportion to the variation (Castañeda & Cendejas, 2023). This theory has served to explain the tendencies of inflation, most especially where there is an establishment of rapid growth in the unit of money.

2.1.2. Monetarist Theory

Monetarists are economists who promote monetary policy as a more effective instrument for stabilizing the economy than fiscal policy, particularly regarding prices. According to them, an increase in the money supply beyond the rise of actual output results in inflation (Johnson, 1972). Monetarists argue that inflation results from excessive growth in the money supply relative to economic output. Consequently, they assert that "inflation is invariably a monetary phenomenon resulting from a more accelerated increase in the money supply than in overall output." According to (Friedman & Schwartz, 1963), price is primarily (but not solely) influenced by money supply in both the short and long run, whereas money supply impacts output only in the short run (Johnson, 2013). They contend that regulating the money supply is essential for preserving price stability and oppose interventionist fiscal policies, promoting a consistent and foreseeable increase in the money supply that corresponds with long-term economic growth. Monetarism has significantly shaped central banking policies, resulting in an increased emphasis on managing inflation via monetary policy instruments, including interest rates and open market operations.

2.1.3. Structuralism Theory

Structuralist theory emphasizes certain structures that cause inflation in developing countries, especially in sub-Saharan Africa. This theory assumes that structural factors inherent in these economies, including most notably institutional weaknesses, import dependency, reliance on agricultural market imperfections, supply-side constraints, and external vulnerabilities, primarily cause inflation (Canavese, 1982). Structuralists opine that inflation may originate from structural factors like physical constraints in the production processes, weak transportation and communication networks, and unexpected events taking place in the global economy (Kim, 2024). According to structural economists, a set of radical economic reforms should be implemented to help deal with these structural problems and curb inflation. This perspective is of particular relevance, especially in sub-Saharan countries, as is the case with Ethiopia, where inflation is not only driven by monetary factors but also driven more by structural issues, including overdependency on primary commodities and exports, weak institutions, constrained supplies, or import dependency.

2.2. Review of Empirical Studies

Following recent advances in econometrics techniques, the amount of empirical studies studying the relationship between institutions and growth has expanded dramatically in recent decades. This study includes selected most relevant and recent empirical evidence from developing countries and Ethiopia about how macroeconomic variables affect inflation.

2.2.1. Studies on Developing Countries

Using empirical evidence from African countries, the results of the research show that inflation is brought about by monetary, fiscal, and structural factors unique to the African economy. Several studies of SSA show that fluctuations in exchange rates,

government expenditure, and supply-side factors are key to inflation. For instance, (Alehegn, 2021) investigated and systematically reviewed the key determinants of inflation in SSA. He found that currency depreciation was a major cost-push factor, not only because most imported goods are expensive this year. Higher government expenditure unsupported by revenue usually implies inflation since most governments worldwide work towards minimizing their fiscal deficits, more so in countries with high fiscal deficits. (Melaku, 2021) also examined determinants of inflation in East Africa using the ordinary least squares method. They reveal that agricultural productivity constraints are a major determinant of inflation—an aspect that is structural given the region's agriculture-based economy. Fluctuations in the supply chain, extended climate change, and inadequate structural facilities also constrain supply, leading to food and associated inflation volatility.

A study by (Makena, 2020) investigates the determinants of inflation in Zimbabwe, a dollarised economy that understands how macroeconomic factors affect inflation. In this study, using the econometric analysis, it is revealed that import prices, money supply, and exchange rates are the significant determinants of inflation in Zimbabwe. Fluctuating exchange rates are considered relevant to inflation because most of Zimbabwe's imports are priced in the U.S. dollar, and local currency is also volatile. Also, in the light of the structure of the model, an increase in money supply has pronounced effects on inflation, thus supporting the factual evidence that when dollarization has taken place, liquidity expansion fuels or amplifies inflation. The study also indicates that import prices make a significant contribution given the fact that imports account for a major chunk of Zimbabwe's consumption basket; hence, any shift in global prices affects the inflation rate. The study concludes that in a dollarized economy such as Zimbabwe, the management of the exchange rate, alongside controlling the supply of money, replenishes the key approach to combating inflation.

In African countries, studies also indicate that both domestic and external factors influence inflation. (Charles et al., 2022) in Nigeria investigated the determinates of inflation; they found that exchange rate depreciation, broad money supply, and fiscal policy decisions have a significant role in inflationary trends. Furthermore, these studies hint at the quality of institutional frameworks because the absence of a governance structure leads to a spurt in inflation due to policy inconsistencies. In a study conducted by (Christian, 2023) the analysis of drivers of inflation using the ARDL model helps evaluate short- and long-run causality between key macroeconomic variables and inflation in the Democratic Republic of the Congo. The study also presents evidence to show that the major determinants of inflation in the DRC are public expenditure, exchange rate, and money supply. In particular, the paper proves that the money supply has a positive and significant impact on inflation, both in the short-run and long-run regressions.

In recent years, (Madito & Odhiambo, 2018) investigated the key drivers of inflation in South Africa. They employed the ARDL model in order to analyze the short-run and long-run relationship between macroeconomic variables and inflation. The main variables are such as exchange rate, broad money supply, and economic growth rate. Their findings reveal that the findings of the study show that money supply, as well as exchange rate depreciation, has positive and significant effects on inflation in the short run and the long run, while economic growth has negative and significant effects on inflation in South Africa. Nevertheless, by applying the ARDL model, it is shown that government expenditure has a positive effect on inflation, especially in the long run.

Similarly, studies in West Africa, such as those by (Nahoussé, 2019), examine a number of macroeconomic variables that have an impact on inflation in the seven West African countries, and the findings show that some of the most important variables are: This study establishes that money supply, exchange rates, and government spending mainly influence West African countries' inflation rates. Moreover, Nahoussé notes that fluctuations in global oil prices and trade imbalances significantly impact inflation, highlighting the region's sensitivity to global market conditions since most of the countries there import manufactured products.

2.2.2. Empirical Studies on Ethiopia

A study by (Kahssay, 2017) also examined determinants of inflation in Ethiopia using the ordinary least squares method, and the data obtained spans from 1975 to 2014. The research identifies several key factors influencing inflation, including exchange rate fluctuations, agricultural production constraints, and money supply. His research emphasises that monetary expansion plays a significant role in driving inflation, whereas structural challenges, particularly in the agricultural sector, exacerbate price instability. A similar study by (Bedada et al., 2020) analyzed inflation determinants in Ethiopia from 1974/75 to 2014/15 using Johansen's cointegration and vector error correction methods. Findings show that in the long run, real GDP, money supply, and budget deficits have significantly impacted inflation, whereas only the previous year's budget deficit impacts short-run inflation.

The most recent paper, which was undertaken by (Abate, 2020), examines macroeconomic determinants of inflation in Ethiopia using annual data spanning from 1985 to 2018 using the OLS econometric model. The study's findings revealed that the real interest rate, real GDP, and real exchange rate are significant determinants of inflation during the study period, both in the long run and short run. On the other hand, a broad money supply affects inflation only in the long run, while gross

domestic savings are found to have an insignificant impact on price growth both in the short run and long run. The study, however, excludes important variables considered by other researchers, such as real GDP.

An empirical study was undertaken by (Tolasa et al., 2022) to examine macroeconomic determinants of inflation in Ethiopia. The study employed an ARDL model using annual data for the period 1981–2020. The study's findings revealed that the lending interest rate, real exchange rate, and real GDP are positive and significant drivers of inflation in the long run. On the other hand, population growth, broad money supply, gross national savings, broad money supply, and imports are found to be significant determinants of inflation in the short run. The findings suggest that, among other things, initiatives to reduce the real effective exchange rate and use the broad money supply in productive economic activities, as well as supply-side measures, should be implemented to keep inflation under control in Ethiopia.

Moreover, the recent study conducted by (Emeru, 2020) investigates the major sources of inflation in Ethiopia. The study presented a VAR, co-integration analysis, and the VECM allied with the descriptive analysis. In the short run, the broad money supply, real GDP, the imported inflation of international petroleum prices, and the nominal exchange rate have an insignificant effect on inflation. On the other hand, the nominal exchange rate, interest rate, real GDP, budget deficit, and broad money supply all have significant effects in the long run.

In conclusion, though there are many studies on inflation determinants in Ethiopia, a research void exists for analyzing the compressed factors using the ARDL econometric technique. Since inflation dynamics have changed significantly since 2016 moving from double-digit inflation to a series of hyperinflationary peaks and troughs—the ability to identify macroeconomic drivers here is critical. Most of the prior studies implemented less dynamic models or used less up-to-date data, making them less relevant to current inflationary trends, particularly due to the new macroeconomic policies implemented by the Ethiopian government. Most existing studies have relied on less dynamic models or outdated data, limiting their applicability to the current inflationary landscape shaped by these policy shifts. Therefore, this study employing the structural break and robust ARDL model and the theme autoregressive distributed lag model is expected to fulfill this research gap by capturing not only the short-run equations but also the long-run co-integration relationships of inflation and its determinants in Ethiopia. Therefore, not only has this research updated the empirical data utilizing the ARDL model, but it has also brought policy-relevant solutions to the policymakers managing the persistent inflation menace in the contemporary economic setting and policy environment.

3. METHODOLOGY OF THE STUDY

3.1. Model Specification and Variables

This study investigates the determinants of inflation in Ethiopia from 2003 to 2023, applying ARDL modeling analysis to examine key macroeconomic factors influencing inflation. The model identifies the consumer price index (inflation) as the dependent variable, and independent variables include budget deficit, broad money supply, GDP growth, government expenditure, exchange rate, and import price. This model aims to elucidate how these factors collectively influence inflation in Ethiopia over the specified period, with the ARDL approach determining the relative impact and significance of each factor.

The above regression model was translated into a regression equation as stated below:

$$LCPI = \beta 0 + \beta 1\,(LBMS) + \beta 2\,(LIM) + \beta 3\,(LGDP) + \beta 4\,(LINT) + \beta 5\,(LGOVEXP) + \beta 6\,(LEXR) + \beta 7\,(LBDEF) + \epsilon$$

3.2. Methods of Data Collection and Source of Data

The data used throughout this study is only secondary sources of annual time series data spanning the period of 2003 to 2023, which were obtained from reputable sources such as the International Monetary Fund (IMF), the World Bank (WB), the Ethiopian Central Statistical Agency (CSA), and the Ministry of Finance and Development (MoFD), which provide comprehensive economic indicators relevant to the study.

3.3. Methods of Data Processing and Analysis

The study employed quantitative methods to analyze data collected on the macroeconomic determinants of inflation in Ethiopia. Descriptive statistics were utilized to summarize the quantitative data obtained from various economic indicators. Calculations included mean, median, maximum, minimum, and standard deviation for each variable, such as consumer price index, budget deficit, broad money supply, GDP growth, government expenditure, exchange rate, interest rate, and import price, of each item using SPSS version 21 to perform the necessary analyses. Moreover, for this time series data, employed co-integration techniques based on ARDL modeling to examine the determinants of long-term inflation in Ethiopia.

4. RESULTS AND DISCUSSIONS

4.1. Descriptive Analysis

The descriptive statistics for the variables analysed in this study, encompassing inflation and related economic indicators in Ethiopia from 2003 to 2023, are presented in Table 1. This table summarises key statistical measures, including the minimum, maximum, mean, median, and standard deviation values for each variable.

Table 1: Summery of Descriptive Statistics

Statistics	LCPI	LBMS	LGDP	LGOVEXP	LINT	LIM	LEXR	LBDEF
Mean	16.5111	10.4917	9.3382	8.2766	2.4846	5.6729	2.5836	1.7319
Median	16.2220	11.0170	9.3518	8.4128	2.6213	5.9231	3.2428	1.6503
Maximum	17.8110	11.7279	9.4267	9.1003	3.1028	6.4023	4.5038	2.5124
Minimum	15.000	8.5911	9.2227	7.5329	1.7613	4.9821	0.7981	1.1290
Std. Dev.	0.5000	1.0826	0.0618	0.4803	0.4990	0.6173	1.4831	0.4722

Table 1 shows the results of the statistics for the variables examined in this study, encompassing inflation (LCPI), money supply (LBMS), GDP (LGDP), government expenditure (LGOVEXP), lending interest rates (LINT), imports (LIM), exchange rate (LEXR), and budget deficit (LBDEF). The mean values reveal that inflation averages 16.5 money supply is 10.49, GDP stands at 9.34, government expenditure is 8.28, lending interest rates average 2.48, imports are at 5.67, the exchange rate is 2.58, and the budget deficit averages 1.73. Notably, the money supply (LBMS) and GDP (LGDP) exhibit the highest maximum values, reaching 11.73 and 9.43, respectively, indicating that these variables have seen significant peaks during the study period. Conversely, the minimum values highlight the lowest recorded levels for each variable, with the exchange rate (LEXR) dropping to 0.80, suggesting periods of currency depreciation.

From the above table, we can infer that the standard deviation values indicate variability within each variable. The exchange rate (LEXR) shows the highest standard deviation (1.48), indicating substantial fluctuations and potential sensitivity to external economic conditions.

4.2. Unit Root Test

The analysis is begun where the lag length is determined, and stationarity tests are used to prepare the time series variables for co-integration analysis. Spurious results may occur without a unit root test being conducted. All model variables are made sure to be integrated of order I(0), or I(1) by this test thus enabling the use of bounds testing in the ARDL framework. The ADF and PP unit root tests were used in the study. The Akaike Information Criterion (AIC) was selected for the ADF test for small sample accuracy, and automatic lag selection using Newey-West bandwidth was applied for the PP test. These test results are summarized in the following table.

Table 2: ADF and PP Unit Root Test

Variables	At Level			At First Difference			
Series	**Intercept**	**Intercept & Trend**	**ADF Unit Root Test**	**Intercept**	**Intercept & Trend**	**Phillips-Perron**	
LCPI	1.602	-0.799	-5.351***	-5.800***	-5.204***	1.687	-0.903
LBMS	-0.241	-3.222	-3.998***	-3.911**	-3.785**	-0.586	-2.07
LGDP	2.388	-1.432	-4.989***	-5.242***	-5.137***	2.441	-1.400
LGOVEXP	0.247	-1.802	-5.101***	-4.896***	-4.719***	1.358	-1.682
LINT	-1.231	-2.132	-4.688***	-4.302***	-4.207***	-1.802	-2.455
LIM	0.278	-1.504	-2.202*	-8.934***	-8.799***	-0.066	-1.827
LEXR	-0.481	-2.283	-4.112***	-4.641***	-4.522***	-0.632	-1.883

Note: ** and * indicate level of significance at 1% and 5%.

It has been shown by the ADF and PP unit root tests that all model variables, other than LIM, are non-stationary at their levels. It has been revealed by the ADF test results that, when the first difference is taken at a 5% importance level, stationarity is achieved for all variables except LIM in the intercept-only, and intercept-trend models. In the intercept-trend model, only at the fourth difference does LIM become stationary. These observations are further validated by the PP test which confirms that nearly all variables are integrated of order one, I(1).

4.2.1. Result of Bound Test for Co-Integration

A co-integration bounds test is used to determine whether a long-run equilibrium relationship exists among variables in a

model, particularly in cases where variables may be non-stationary. This test is crucial in analyzing whether changes in one variable have a lasting impact on others, which would imply a stable, long-term connection among them. By applying the bounds test, we can confirm if the variables are co-integrated, meaning they share a consistent relationship over time. This finding enables us to proceed with both long-run and short-run estimations, as co-integration confirms that despite short-term fluctuations, the variables do not diverge indefinitely.

Table 3: Bound test for co-integration

Table: Bounds Co-integration Testing Result		
Null Hypothesis: No long run relationship exists (No level relationship)		
Test Statistic	**Value**	**K**
F-statistic	5.87	**7.12**
Critical Value Bounds	Lower bound	**Upper bound**
Significance	I0 Bound	**I1 Bound**
10%	2.08	**3.23**
5%	2.36	**3.55**
2.5%	2.5	**3.84**
1%	**2.89**	**4.3**

In Table 3, the important values at the 1% importance level are exceeded by the F-statistic value of 5.87. The alternative hypothesis is supported by this result, indicating that a long-run relationship among the variables is suggested. Thus, the null hypothesis of no level relationship is rejected. Strong evidence of co-integration is provided by this finding, allowing both long-run, and short-run relationships to be estimated reliably.

4.2.2. Diagnostics Testing Result

Before applying any statistical regression analysis, the first step is always to diagnose the presence of model assumptions. Various diagnostic tests used in this study include the Breusch-Godfrey LM test for serial correlation, the Ramsey's RESET test for functional form, the Jarque-Bera for normality and Breusch-Pagan for heteroscedasticity. The recognition or refusal of the null hypothesis in each test results from the p-value of the-test-statistics; if the p-value is less than 5%, the null hypothesis is rejected.

Table 4: Diagnosing testing results for ARDL Model

Test Type	**Null Hypothesis (H_o)**	**Alternative Hypothesis (H_1)**	**Test Used**	**F-statistics (p-value)**	**Decision (P ≥ 0.05)**
Serial Correlation	No serial correlation	Serial correlation	Breusch-Godfrey Serial Correlation LM Test	0.045 (0.83)	Accept H_o
Homoscedasticity	Homoscedastic	Heteroscedastic	Breusch-Pagan Test	1.32 (0.27)	Accept H_o
Omitted Variable	No omitted variable	Omitted variable	Ramsey RESET Test	1.75 (0.25)	Accept H_o
Normality of Residuals	Residuals are normally distributed	Not normally distributed	Jarque-Bera Test	1.15 (0.61)	Accept H_o

As shown in Table 4, the diagnostic tests conducted on the estimated ARDL model confirm that the model meets all necessary assumptions. The serial correlation test shows no presence of serial correlation, with a p-value of 0.83, well above the 0.05 significance threshold. The Breusch-Pagan test for heteroscedasticity indicates homoscedasticity, with a p-value of 0.27, suggesting that the error variance remains constant. Additionally, Ramsey's RESET test, with a p-value of 0.25, suggests no omitted variable bias in the model. Lastly, the Jarque-Bera test confirms normally distributed residuals, with a p-value of 0.61, which also exceeds the 0.05 significance level. Overall, the model is statistically sound, having successfully passed all key diagnostic tests.

4.2.3. Stability of the Model

Following the short-run and long-run estimations, model stability is checked. Based on these results, the constancy of the parameters of the long-run and short-run form is checked using CUSUM and CUSUMSQ. These tests enable the identification of whether the parameter coefficients vary in a systematically or abruptly manner or not. The null hypothesis which postulates parameter instability is accepted when the blue line crosses the red critical line without going back to the upper critical line. On the other hand, if the cumulated sum stays in the lower and upper critical lines then the null hypothesis is rejected signifying it that the parameters are stable in the long but not in the short run.

Figure 1: Model stability testing results

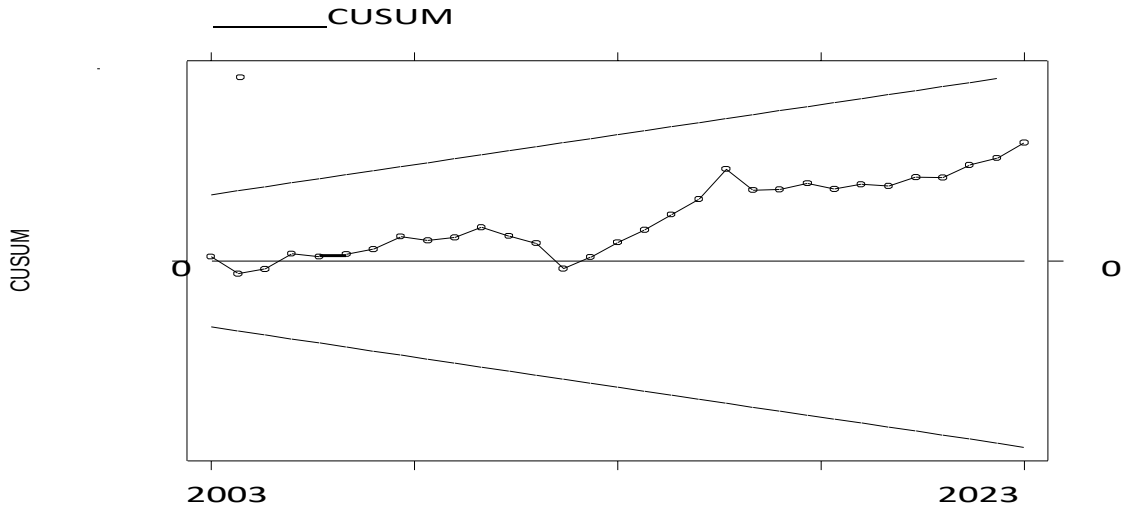
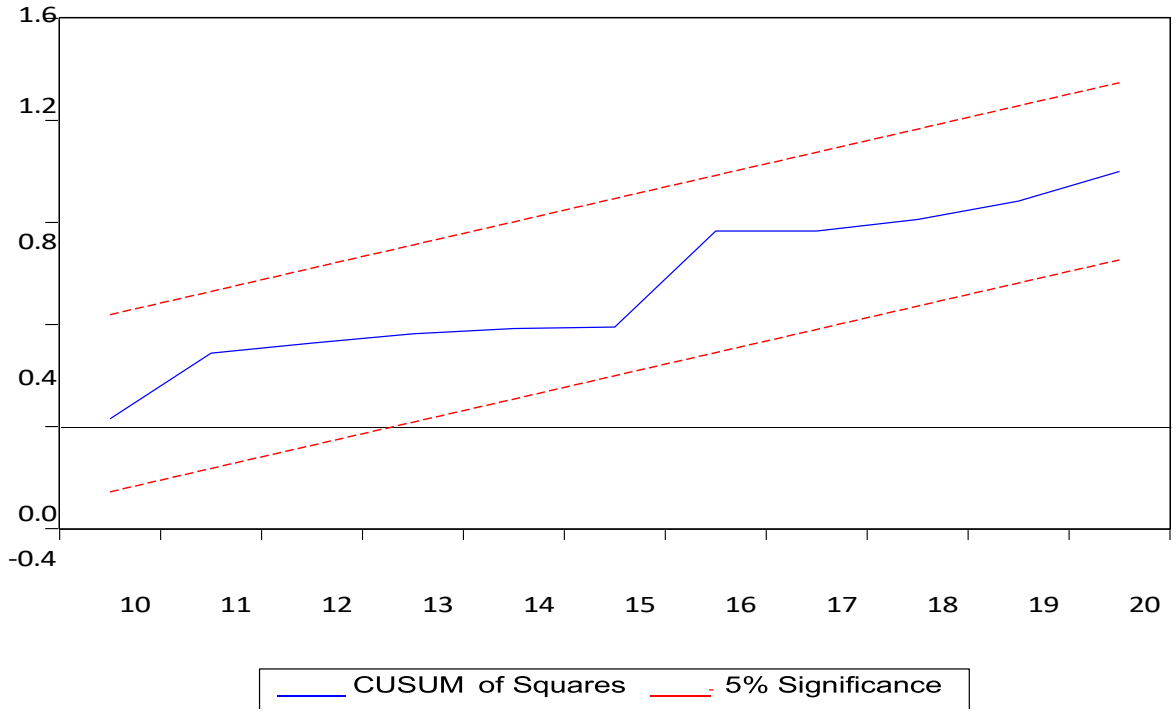


Figure 2: CUSUM of Squares for model stability test



Using the CUSUM, the stability of the model parameter is analyzed and this is presented in the first and second Stata data graph. As shown in figure 1, the CUSUM chart is within critical limits which show that the model is stable with no flunctuations. Same to the outcome of CUSUM of squared residuals (CUSUMSQ) test, the plots of the residuals involved do not violate the lower and upper boundary limits. Moreover, this finding also carrying an implication that there is no presence of structural breaks and therefore in the long run the coefficients of the model are constant. Figure 1 and 2 demonstrate that the estimated model meets the stability condition, as all roots lie within the significance level, indicating a stable model.

4.3. Long Run ARDL Model Estimation

Given that real inflation and its determinants are cointegrated, we proceed to estimate the long-run parameters of the ARDL model. The results of this estimation are presented in the table below:

Table 5: Long Run Coefficients Co Integrating Equation

Variables	Coefficients	Std. Error	t-statistics	P-value
LBMS	0.5022	0.0501	10.022***	0.000
LEXR	1.1322	0.0455	24.876***	0.000
LGDP	-0.4124	0.1243	-3.317**	0.002
LGOVEXP	0.2785	0.0857	3.250**	0.003
LIM	0.3301	0.1012	3.261**	0.003
LBDEF	0.4987	0.0914	5.455***	0.000
LINT	-0.2674	0.0809	-3.305**	0.002
N(obs)	37			

Note: The dependent variable is DINFI*t* over the sample period 2012-2023. The asterisks ***, ** and * marks statistical significance of coefficients at, 1, 5 and 10 percent level of significance, respectively

Table .5 presents long-run result of ARDL model illustrate the significant determinants of long-term consumer price index (inflation. The broad money supply (LBMS) therefore confirms high positive effect on inflation with a coefficient of 0.5022, t-statistic of 10.022, p-value of 0.000 hence, reject the null hypothesis at 1% significance level. This means that expansion in the total money stock is in a causative relationship with inflation rates. Similarly, the exchange rate which statistically has a strong positive effect on inflation with the coefficient equaled to 1.1322, the t-statistic equals 24.876 and p- value equals 0.000, which also confirms the effect of fluctuations in the exchange rate on the inflation process.

Table 5 provides information on the determinants of long-run inflation and suggests that the government expenditure is also positively correlated with inflation, reflected in a coefficient of 0.2785, a t-statistic of 3.250, and a p-value of 0.003, signifying a significant impact at the 5% level. This indicates that heightened government spending can further exacerbate inflationary pressures. Similarly, the imports rate shows a positive and significant effect on inflation, with a coefficient of 0.3301, a t-statistic of 3.261, and a p-value of 0.003, suggesting that higher import levels may contribute to rising inflation. Moreover, the budget deficit reinforces this trend, revealing a significant positive effect on inflation, with a coefficient of 0.4987, a t-statistic of 5.455, and a p-value of 0.000. This highlights the budget deficit's role as a contributing factor to inflationary dynamics.

On the other hand, the coefficient estimate of real GDP growth is negative (-0.4124) and statistically significant with the t-statistic of -3.317 and p= 0.002 hence establishing a negative relation with inflation. The implication of this is that greater GDP growth can play a moderating role in the level of inflationary pressures in the economy, and may in fact provide stability to the growth environment. Similarly, interest rate has a negative coefficient of -0.2674 and it is statistically significant with t-statistic of -3.305 and p-value of 0.002 for the argument that increased interest rate has a depressing effect on inflation.

4.4. The Short Run ARDL Model Estimation

Within the multiple time series framework for the short-run empirical analysis, the error correction model (ECM) is perhaps the most commonly employed technique for the analysis of data with co-integrated, that is, with non-stationary stochastic trends. The term error correction indicates that the deviation from long-run equilibrium in the previous period affects the short-run behaviour of the model. Therefore, the ECMs give some measure of how fast the dependent variable; in this case the general inflation rate, moves back to the equilibrium having been affected by other variables. The results of the short-run model estimation are summarized in the following table.

Table 6: The Determinants of Short-Term Inflation Estimation Result

Variables	Coefficients	Std. Error	t-statistics	P-value
D(LBMS)	0.5022	0.0501	10.022***	0.000
D(LEXR)	1.1322	0.0455	24.876***	0.000
D(LGDP)	-0.4124	0.1243	-3.317**	0.002
D(LGOVEXP)	0.2785	0.0857	3.250**	0.003
D(LIM)	0.3301	0.1012	3.261**	0.003
D(LBDEF)	0.4987	0.0914	5.455***	0.000
D(LINT)	-0.2674	0.0809	-3.305**	0.002
ECM(-1)	-1.0245	0.1521	-6.735***	0.000
N(obs)	37			

*Note: The dependent variable is DINFI t over the sample period 2012-2023. The asterisks ***, **, and * mark the statistical significance of coefficients at the 1, 5, and 10 percent level of significance, respectively.*

The result from the error correction model (ECM) in Table .6 reveals that the broad money supply has a positive and highly significant effect on inflation, with a coefficient of 0.50, a t-statistic of 10.02, and a p-value of 0.000, indicating significance at the 1% level. Similarly, the exchange rate (LEXR) is positively associated with inflation, showing a coefficient of 1.13 and a very high significance level (t = 24.88, p = 0.000). Government expenditure also exerts a positive and statistically significant influence on inflation, with a coefficient of 0.28, a t-statistic of 3.25, and a p-value of 0.003, all of which are significant at the 5% level. Imports rate follow a similar trend, contributing to inflation with a coefficient of 0.33, t-statistic of 3.26, and a p-value of 0.003, also significant at the 5% level. Furthermore, the budget deficit is positively related to inflation, with a coefficient of 0.50, a t-statistic of 5.46, and a p-value of 0.000, underscoring its strong inflationary effect at the 1% significance level.

On the other hand, the interest rate is deemed to have negative effects on inflation, although the coefficient is statistically insignificant (-0.27, t = -3.31, and p = 0.002) if inflation slows down at the 5% significance level through the effect of a high interest rate. The error correction term (ECM) in the long-run equation has a coefficient estimate of -1.02 and is significant at the 1% level (t = -6.74, p = 0.00). This suggests a high speed of return to equilibrium each time there are shocks. Consequently, empirical findings suggest that factors such as government spending, exchange rate, budgetary deficits, imports, and broad money are influential for inflation while interest rates can be influencingly used as modulating factors.

5. CONCLSION AND RECOMMENDATIONS

5.1. Conclusion

The main objective of this study was to analyze the determinants of inflation in Ethiopia using annual time series data from 2003–2023. Considering the effects of structural change in Ethiopia's economy, especially during the last seven years of the launch of economic reforms and trade liberalization initiatives, an econometric model was constructed and estimated using the co-integration techniques based on ARDL modeling. The results of ADF and PP unit tests reveal that all variables in the model, except for LIM, are non-stationary at level. However, the results of the ADF test reveal that all variables except for LIM become stationary after the first difference, integrated of order one (I(1)). This indicates that the series exhibits mixed orders of integration, I(1) and I(0), thereby rendering the ARDL methodology suitable for application to the specified time series.

In the long run, the results reveal that the exchange rate, imports, budget deficit, public expenditure, and broad money supply all exhibit positive and significant coefficients for inflation, indicating that increases in any of these variables lead to higher inflation levels. On the other hand, interest rates and real GDP growth demonstrate a negative relationship with inflation, suggesting that higher GDP growth and interest rates may effectively mitigate inflationary pressures.

In the short run, the findings further reinforce many of the long-run results, as the exchange rate and broad money supply have as significant positive influences on inflation. This observation aligns with the idea that expansionary monetary policy can lead to inflationary outcomes. Moreover, the significant positive effect of imports on GDP highlights the interplay between trade dynamics and inflation fluctuations. Moreover, the budget deficit exhibits a negative effect on inflation, suggesting that effective management of fiscal imbalances can contribute to lower inflation rates in the short term.

5.2. Recommendations and Policy Implications

Based on the findings, this study recommends a multi-pronged approach to curb inflation in Ethiopia through effective fiscal, monetary, and trade policies. In order to mitigate this position, a high level of money supply should be attended to by sound monetary policy approaches and controls by the National Bank of Ethiopia so as to contain the inflationary effects of a high

money supply. This approach would be achieved by fine-tuning the broad money by eventually controlling monetary policies like interest rates. Together with the growth of money control, one can predict the tendency towards an inflationary spree and ensure the main goal of setting the price level in the long run. However, it will ensure that efforts are made not only to stabilise the inflation rate but also to contribute to enhancing the predictability of the economic environment by providing credible support to the longer-run steady economic growth and by sustaining the public's confidence in the monetary system.

Exchange rate sophistication is relevant since it controls one of the leading indicators: inflation. The government should follow the rate of depreciation of currency effectively to prevent inflationary consequences emanating from fluctuations in exchange rates. A policy to gradually depreciate or appreciate the foreign exchange rate, with policies aimed at cutting the dependence on imported goods, can help contain pass-through in its pursuit of inflation. Through actions to steady the exchange rate and promote home production, the government can develop an economy that is less sensitive to foreign prices, which, in turn, stimulates the process of long-term price stability and overall economic protection.

In order to check inflation and reduction of the fiscal deficit problem in spending, only the betterment of fiscal discipline is required. Efficient investments in capital equipment and workforce resources can solve the inflation problem and, at the same time, foster sustainable economic development. Besides, prudent implementation of fiscal measures that improve tax competence and boost the level of budget openness would curb the inflationary effects of the budget deficit.

High levels of imports increase the inflation rate, and therefore, policies that support local production and reduce import dependency must be exercised. The support of local industries will minimize demand for imported products, besides pulling down the vulnerability to inflation fueled by high import prices in Ethiopia.

To effectively address inflation through the synchronization of fiscal and monetary policies, the demand-driven inflation focus needs to be addressed by policymakers in Ethiopia. A balanced approach is required for sustainable inflation control in managing exchange rates, fiscal deficits, and money supply within the macroeconomic framework. Economic stability is encouraged and long-term development is supported by implementing these policies.

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