



Macroeconomic Drivers of Inflation in Ethiopia: Evidence from ARDL Modeling

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Abstract

Despite ongoing macroeconomic reform and liberalization measures, inflation remains a critical and persistent problem in Ethiopia. Persistent inflation poses a grave threat to the country's status and economic stability. Thus, this study aimed to investigate the macroeconomic factors driving inflation in Ethiopia employing the ARDL model using annual data for the period 2012–2023. The NBE, EEA, IMF, and WB provided the macroeconomic variable data. The unit root test was employed to determine the variables' order of integration and ADF and PP tests revealed that all series are non-stationary while stationary at the first difference. The study's findings indicated that money supply growth, import value to GDP ratio, budget deficit, and public expenditure all have a positive and statistically significant impact on inflation in both the long and short run. Lending interest rates, which are inflationary in the short run, have a deflationary effect in the long run. On the other hand, the external debt to GDP ratio, official exchange rate, and growth rate of real GDP are found to have significant negative effects on inflation in the long run. In the short run, the external debt-to-GDP ratio has a negative but insignificant impact on the determinates of inflation. Meanwhile, the real domestic product's growth rate significantly lowers inflation in the short run. The study recommends that a broad money supply is to be controlled and gross national saving is to be encouraged to reduce inflation in the country.

Keywords: Inflation, Macroeconomic Determinates, Bound Test, ARDL model, Ethiopia

Introduction

In monetary terms, *inflation* is defined as a sustained rise in the overall price level. The inflation rate is defined as the yearly percentage increase of a comprehensive index of monetary prices (Akinsola & Odhiambo, 2017). According to Neoclassical economics, inflation is a rapid and widespread increase in prices caused by an excessive expansion of the money supply (Totonchi, 2011). According to Keynesians, an increase in the money supply beyond the full employment threshold is observed (Palley, 2019). The preservation of price stability is a primary objective of monetary policy for the majority of governments globally (Bonga & Nyoni, 2017). In recent years, inflation rates have emerged as a huge global problem for many economies, necessitating much attention. It has a significant impact on business ventures, resulting in a domino effect on people's lives. Inflation is gradually becoming a significant risk to development, particularly in many

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developing countries. Says this matter is highly sensitive and reminds that one must define an efficient monetary, fiscal, and any other relevant policy with regard to future inflation rate fluctuations (Munyeka, 2014; Nyenyia et al., 2017; Yismaw, 2019).

In developing nations, the impacts of inflation are exacerbated by their fragile economies, which are highly vulnerable to diverse pressures (Adaramola & Dada, 2020). This vulnerability can lead to rapid occurrences such as surges in import prices, failure to meet the projected revenue/expenditure framework, and adverse climatic conditions impacting food production, all of which predispose these economies to severe inflationary spirals (Yemba et al., 2020). The ramifications of inflation are particularly concerning in sub-Saharan nations, especially considering that the majority of the world's impoverished population resides in these areas. Consequently, addressing inflation has become increasingly imperative, as a deteriorating inflationary environment significantly undermines the purchasing power of the impoverished, exacerbates their already low living standards, and contributes to economic instability in countries globally (Musah et al., 2019). Therefore, reducing inflationary rates is a top priority in any developing country's economic policy agenda.

African nations have, on average, been among the most affected by the situation, as they saw their inflation rates increasing constantly and unpredictably. Several cross-sectional empirical studies have been conducted in different years to analyze the factors impacting inflation at the macroeconomic level in these countries. In Africa, inflation is the major problem faced by countries like Tanzania, Zimbabwe, Nigeria, and, most importantly, Ghana. In the Zimbabwean economy, Gelos and Ustyugova (2012), Duma (2008), and Ritzberger Grünwald (2013). Most of these studies applied vector autoregressive (VAR) models and the Johansen-Juselius cointegration technique that included variables such as nominal monetary growth, money supply, the wage rate, economic growth, commodity prices, real income and exchange rates, oil prices, unit labor cost weather, oil prices, and political events, which shows a significant inflationary effect in Zimbabwe.

Empirically, number of studies such as (Kirimi, 2014; Ochieng et al., 2016) analyzed the determinants of inflation in Kenya's economy. The study concludes that real GDP growth, price fluctuations (changes in oil prices), and the previous period's inflation rate (lagging inflation rate) are the best drivers of inflation. (Musa & Yousif, 2018) model the determinants of inflation in Sudan using the GMM method for the period 2000–2017 in order to contribute to the formulation of an effective policy to reduce the rate of inflation. Their work demonstrates that an increase in the money supply and a reduction in the exchange rate lead to an increase in inflation. However, the increase in gross domestic product, unemployment rate, and government spending is causing the inflation rate to fall in Sudan.

Like other sub-Saharan nations, Ethiopia has been facing the challenge of a persistent inflation rate. Unbridled inflation has remained a critical issue in the country since 2014, despite economic reforms and structural liberalization policies (Anagaw, 2023; Yismaw, 2019). After 2017/18, inflationary pressures remained unabated despite PM Abiy Ahmed liberalizing the market, privatizing state enterprises, and encouraging foreign direct investment. During this period, there were changes in less conservative monetary and fiscal policies, which affected the previous macroeconomic structure (Sisay et al., 2022). Before this period, sources of inflation were mostly

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structural constraints, especially in the area of production bottlenecks such as in agriculture and other sectors, while after 2017/18, sources of inflation have more and more reflected money-related phenomena.

Several studies have attempted to address, the underlying macroeconomic determinates of inflations in Africa, particularly in Ethiopia. Such as Research carried out by (Abate, 2020; Kahssay, 2017), among others, analyzed the dynamics and determinants of inflation in Ethiopia by investigating the importance of the different sources of inflation over the past thirty years and recently double-digit inflation. They also pointed out that the major causes were the weaker foreign exchange earnings, rising the demands of imports, high fuel and food price shocks, and depleted national and international reserves. The highest price increase was observed in fuel, housing, food, and transport services, making the urban poor the most vulnerable to the impacts of inflation.

To the best of researcher's knowledge, only some scholars have conducted studies on the factors determining inflation in Ethiopia. For example, (Bedada et al., 2020) investigated determinants of inflationary experience in Ethiopia using time series data from the period 1974/75 to 2014/15. This study used the Johansen Cointegration methodology and the Vector Error Correction approach. His empirical findings indicated that in the long run, real GDP, growth money supply, public expenditure, and overall budget deficit have a positive and statistically significant impact on inflation. In the short run, the budget deficit in the preceding year is the only variable dedicated to explaining the current year consumer price index.

Furthermore, a few of recent studies, such as (Bane, 2018; Bekana, 2022; Fufa & Legese, 2020), among others, have devoted themselves to identifying the possible macroeconomic sources of inflationary experience in Ethiopia using the ordinary least squares method. They have used the time series data from 1975 to 2014 in their study. The results from their work reveals that broad money supply, real GDP, national saving, nominal exchange rate, and the spreading overall budget deficit and ways of financing this deficit, and import of goods and services have a strong and statistically significant determinates of Inflation.

This study, using the ARDL approach, examines the determinants of inflation experience in Ethiopia from 2012 to 2023. This study distinguishes itself from earlier research by primarily focusing on periods prior to 1017/2018. Secondly, earlier studies do not employ the ARDL model; this research offers a more robust analysis of both short- and long-run relationships between inflation and its determinants. This model provides deeper insights into the current inflation dynamics and contributes valuable findings to support more effective economic policies. Thirdly, earlier studies do not account for the significant economic reforms and trade liberalization initiatives launched by the Ethiopian government in 2018, which have influenced the country's inflationary trends. By focussing on this post-reform period, the study captures the volatile inflationary experience in Ethiopia, particularly the fluctuations observed since 2018, when periods of double-digit inflation have become worrisome and were followed by deflation. As a result, this scenario motivated the researcher to conduct a study on the determinants of inflation in Ethiopia.

2. Literature Review

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2.1. Theoretical Considerations and Empirical Evidence on Inflation

A significant and growing body of literature has investigated the determinants of inflation, whether in developed countries or developing countries. One of the best-known theories is the structuralist theory of inflation. This theory emphasizes that inflation in developing countries is caused by structural factors rather than excess monetary aggregates (Taylor, 1982). This view stresses that structural factors on the supply side including agriculture backwardness, market imperfection, social unrest, inadequate infrastructure, and import dependence, continue exerting inflationary pressures (Cardoso, 1989). Thus, structural factors as for example, rigidities in the labour market and market segmentation escalate cost push inflation through enhancement of inefficient resource allocation. In addition, persistent demand supply gaps resulting from high population growth, and low productive capacity, inflationary expectations, and backward indexation practices sustain inflationary spirals. The situation where through use if price control, subsidies and fiscal deficits there is an increase in the price of every commodity makes markets even more distorted and leads to higher inflation rates in the long run (Canavese, 1982). Moreover, restrictive measures of foreign exchange and balance of payment, such as the devaluation of a currency, is also another because that contributes more to inflation because of the increased cost of imports.

Another widely accepted theory is the monetarist theory of inflation, in which monetarists opine that inflation is always and everywhere a monetary phenomenon that arises from a rapid increase in the quantity of money more than total output (Johnson, 2013). They believe that too much money is chasing too few goods (Danlami et al., 2020), which means that inflation is a function of money supply and real output. To explain the sources of inflation, monetarism adopted the quantity theory of money. Monetarists, best known for the thoughts of economist Milton Friedman, believe inflation to be at its core a monetary issue, which is to say when too much money prints up somewhere without any production increase following along, it will lead directly to prices going all the way up, just like. According to this view, in the long run, inflation is caused by the rate at which the money supply increases. They defined m , v , y , and π as the percentage change in money supply, velocity of money in circulation, output, and prices, respectively. Their works can be briefly illustrated as follows:

This theory is based on the so-called Quantity Theory of Money, which is defined by the $MV = PQ$, with M being the money supply, V being the velocity of money, P standing for price level, and Q being the quantity of goods and services produced. Monetarists posited that over time, growth in the money supply would accelerate interest rates as more money are in circulation, ultimately leading to inflation.

According to Keynesian, on the other hand, states that demand-driven factors are more important than other reasons, especially in cases when a nation's aggregate demand exceeds the supply. This economic theory, which is based on Lord John Maynard Keynes' ideas, claims that inflation will begin to rise when an economy is at or near its full employment status, hence the term demand-pull inflation. In this scenario, an increase in aggregate demand due to government spending, imports, or private investment leads to a rise in prices as the economy struggles to maintain the availability of goods and services. Economic growth theories not only recognize this type of inflation; other types, such as cost-push inflation, are also observed, which is inflation triggered

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by increases in costs of production of goods such as wages or raw materials, which get transferred to the consumer in the form of higher prices.

The Keynesian theory of inflation asserts that the major source of inflation is cost-push inflation. The rising price levels begin to affect the production costs of other commodities, such as wages, energy, or raw material prices. In particular, wage inflation is most important, as the higher the salary, the higher the expenses for the company, which then adds those expenses to the prices that are charged to the customers. Also, this type of inflation may spread because of some initial supply shocks, where, for example, the price of oil increases sharply due to some reasons or due to some disruptions in certain industries that are crucial to the economy.

2.2. Review of Empirical Studies:

In the absence of a significant analysis of inflation in Ethiopia, it is worthwhile to look at some of the inflation deterrents in Africa in general and sub-Saharan Africa in particular. A study by (Ali et al.) examined Algeria cases with an ARDL model during the period 1980–2012. The study used the Algerian dinar's public expenditure, oil price, money stock, import price, and effective nominal exchange rates as explanatory variables. His empirical findings indicate that, in the long run, the nominal exchange rate, oil price, import prices, and public expenditure have all impacted Algeria's inflation. Similarly, (Ouafâa, 2018) used a vector error correction model to empirically analyze the determinants of inflation in Algeria from 1990 to 2015. The empirical results showed that inflation in Algeria is determined by public expenditure, real GDP, import price, and the level of gross domestic product, which are the main determinants of inflation in Algeria. At the same time, A negative relationship was found between inflation and the price of oil.

Another study by (Kirimi, 2014), investigated the determinants of inflation in Kenya for the period 1970–2013. The OLS method is used to estimate the relationship between corruption, political instability, oil price, food price, money supply, wages, the central bank rate and exchange rate, and inflation in Kenya. The study showed that real GDP growth, corruption, and food had a negative impact on Kenyan inflation, whereas money supply and the exchange rate had a positive effect. Wage and political instability were found to be insignificant in affecting inflation in Kenya.

Determinates of inflation in Nigeria for the period 1981 to 2010 were analyzed by (Charles et al., 2022), using the ARDL model. The short-run results of both models revealed that the real output gap, money supply, public expenditure, total import, and employment rate were significant determinants of inflation in Nigeria, whereas the long-run results indicated that public expenditure, total import, and employment rate were significant determinants of inflation in Nigeria. The impact of the real output gap, broad money supply, public expenditure, and total import was positive in both long and short runs, whereas the real output gap, total import, and employment rate impacted negatively on inflation in both periods.

One seminal study by (Eftekhari-Mahabadi & Kiaee, 2015) study the factors influencing inflation for a panel of countries available in the World Bank database for 2008-2012. For this purpose, logistic logarithmic models with random effects and ordinal logistic are used for the analysis. The results of the two models show that monetary growth, GDP, oil prices, and income levels in available countries are important determinants of expected inflation. (Ochieng et al., 2016) analyze

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the determinants of inflation in Kenya's economy. The study concludes that real GDP growth, price fluctuations (changes in oil prices), and the previous period's inflation rate (lagging inflation rate) are the best drivers of inflation in Kenya. A similar approach was used by (Alexander et al., 2015) to study the main determinants of inflation in Nigeria for the period 1986-2011. VAR modeling was used. The overall findings of the study reveal that fiscal deficits, the exchange rate, imports of goods and services, money supply, and agricultural production all have a long-term influence on Nigeria's inflation rate. In the short and long term, only the loan rate influences inflation. Also, the results showed that the major determinants of inflation in Nigeria are obviously influenced by fiscal and monetary policy.

In a related study, (Musa & Yousif, 2018) investigated the determinants of inflation in Sudan using the Generalised Method of Moments (GMM) technique and annual time series data on real GDP, public expenditure, exchange rate, money supply, and unemployment as determinants of inflation. His findings revealed that real GDP, public expenditure, and an exchange rate had a significant and positive effect on inflation, whereas unemployment and the broad money supply had a significant and negative impact.

Regarding the Ethiopian economy, several studies have attempted to address the underlying causes of the global price rise. One of the earliest works has been done by (Tafere, 2008), examined determinants of recent inflation in Ethiopia using quarterly data from 19 to 2008. The empirical findings show that a broad money supply had a positive and significant effect on inflation and domestic output (negatively). Though expected to have a significant effect, budget deficits, oil prices, and fluctuations in the official exchange rate were found to have an insignificant impact on the inflation rate. A similar study done by (Hagos, 2014) found that food inflation, in the long run, is explained by broad money supply, narrow money supply, food consumption price index, non-food consumption price index, interest rate, real GDP, and nominal GDP, whereas non-food inflation is determined by broad money supply, narrow money supply, food consumption price index, non-food consumption price index, interest rate, real GDP, and nominal GDP variables.

Moreover, recent studies on the Ethiopian economy have highlighted two significant works. One of these studies was conducted by (Kahssay, 2017) investigated the determinate factors of inflation in Ethiopia using OLS and found that GDP, money supply, and national savings significantly and positively contributed to the inflation rate both in the short and long run. Similarly, (Melaku, 2020), investigated inflation determinants in Ethiopia using the ARDL model to cointegrate, which has been used to find out the short-run and long-run determinants of inflation. The results indicated that in the long run, public expenditure, broad money supply, and oil prices have a positive impact on inflation. However, real GDP and external debt have a negative long-term impact on inflation. However, the real exchange rate is found to be insignificant in the long run. In the short run, the real exchange rate and government expenditure affect inflation positively. Meanwhile, real GDP has a negative effect on inflation in the short run. However, oil prices, money supply, and external debt are found to have insignificant effects on inflation in the short run.

The most recent paper by (Abate, 2020), examine macroeconomic determinants of inflation in Ethiopia using OLS by annual data spanning from 1985 to 2018. In light of his empirical results, he concluded that real exchange rate and real interest rate are significant in determining inflation

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both in the long and short run. The broad money supply determines inflation only in the long run, and gross domestic saving does not determine the rate of inflation both in the long run and short run. The monetary base of the country, which is a broad money supply, has some dispersion or different impact in determining inflation. It has a significant impact in the long run but became statistically insignificant in the short run since monetary policy has a higher outside lag and needs a longer time to affect inflation after increasing the money supply.

In conclusion, the empirical analysis of macroeconomic variables for explaining inflation in Ethiopia is scarce, but the existing studies utilize money supply, budget deficits, and real GDP as indicators of macroeconomic factors. However, the above-mentioned empirical evidence supports that there is no consensus on why Ethiopia is experiencing such a rampant inflation rate. This, they said, is due to variance in number and joint use of the explanatory variables by the two models under consideration. This makes it hard to conclude what causes inflation due to its volatility even in the quarterly analysis, hence emerging policy differences. Given this background, understanding the recent macroeconomic factors that may be influencing inflation in Ethiopia is essential for policy decision-making.

3. Research Methods

3.1. Sources and Methods of Data Collection

The researcher used secondary data sources to fulfill the primary aim of the study, acquiring essential information from various secondary data repositories, primarily the NBE, MoFED, ADB, EEA, IMF, WB, and CSA. We employed both descriptive and econometric regression analysis techniques to analyze the data. The descriptive method evaluates inflation patterns from 2012 to 2023, while the time series econometric technique estimates the long-run and short-run relationships among the determinants of inflation in Ethiopia.

3.2. Model Specification and Variables

The model of the current study is constructed in accordance with theoretical review, existing literature, and prior empirical findings. The selected explanatory variables, which are believed to determine customer price index, reflect the different features characterizing the Ethiopian economy; the rate of inflation (INF) represents the dependent variable, while growth of money supply (M2G), the import GDP ratio (IMGDP), the external debt GDP ratio (EDGDP), the lending interest rate (LIR), the GDP growth rate (GDPG), the public expenditure (PEXP), the official exchange rate (OEXR), and budget deficit (BD) represent the selected explanatory variables.

To attain this objective, the autoregressive distributed lag (ARDL) model, as adapted by Nkoro and Uko (2016), was used for co-integration analysis through the 'Bounds Testing Approach.' This model was chosen because it applied to the required type of relationship between the dependent and independent variables and its performance with small or finite sample sizes. This paper presents the monetarist and the structuralist theories as the factors that can justify inflation in Ethiopia following the proposed model. In regression form, the inflation function of equation (1) is expressed as follows:

$$INF = \beta_0 + \beta_1(M2G) + \beta_2(IMGDP) + \beta_3(EDGDP) + \beta_4(LIR) + \beta_5(GDPG) + \beta_6(PEXP) + \beta_7(OEXR) + \beta_8$$

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(BD)+ ε

3.3. Method of Data Analysis

After collecting the required secondary data, the researchers used both descriptive and econometric analyses to determine the macroeconomic determination of inflation in Ethiopia from 2012 to 2023. Descriptive analysis was utilized to examine the time series, while econometric approaches were applied to examine the effects of various explanatory variables on the inflation measure.

4. Results and Discussions

4.1. Descriptive Analysis

The descriptive statistics for Ethiopia's inflation rate from 2012 to 2023, along with related economic variables: Table 4.1 shows descriptive statistics such as mean, standard deviation, minimum, and maximum values for the series under review.

Table 1: Summary of Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Inflation	17.68	9.13	7.4	34.7
Budget Deficit (%)	8	4.7	2.1	16.9
Import to GDP (%)	22.6	9.4	5.6	39.55
Public Expenditure (%)	50.2	18.1	20.5	95.3
External Debt to GDP (%)	44.6	21.9	11.2	90.8
Lending Interest Rate (%)	10.9	2.5	6.8	15.5
Growth of Real GDP (%)	5.9	5.7	-8.8	13.13
Exchange Rate (%)	9.1	7.4	2.07	28.05
Growth Money Supply (%)	17.7	8.5	4.3	39.2

Sources: computed by the author

Table 4.1 shows the results of the mean inflation rate in Ethiopia from 2012 up to 2023 has been estimated to be 17.68% per annum with showing a highly fluctuating nature if measured by standard deviation, which was estimated to be 9.13%. The rates of inflation were; the peak at 34.7% and the lowest inflation rate of 7.4%. The budget deficit as a percentage of GDP was averaged 8.00%, it was max 16.9 and min 2.1 for the duration of, which proves that it is a continuous fiscal issue. The share of imports in the GDP showed that the average import level was 22.60% of the GDP with a minimum of 5.6 % and a maximum of 39.55 % which shows that the country's imports are very high. The average of public expenditure which is about 50.20 % with the percent varying from 20.5% to 95.3% indicate large measures of government interferences in the economy.

Moreover, the above table shows that the average figure of 44.60% and a maximum of 90.8% that the concept of external debt to GDP has been expanding with increasing financial obligations. Interest charged on loans was ten percent ninety, seven percent, which is crucial to investment and expenditure. Looking at the increase in real GDP the average increase was at 5.90 percent but this was defined by a negative value of -8.8 percent thus pointing towards volatility. Also, the exchange

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rate growth made 9.10% on average and reached 28.05%, which influenced the trade relations. The average improvement of the money supply also keeps at approximately 17.70%, which shows the threat level of inflation. These statistics illustrate the volatility and trends in Ethiopia's economic indicators during the specified period. The following statistical figures represent the fluctuation and direction of the economic indicators of Ethiopia for the particular period under consideration.

4.2. Trends of Ethiopia Inflation Rate

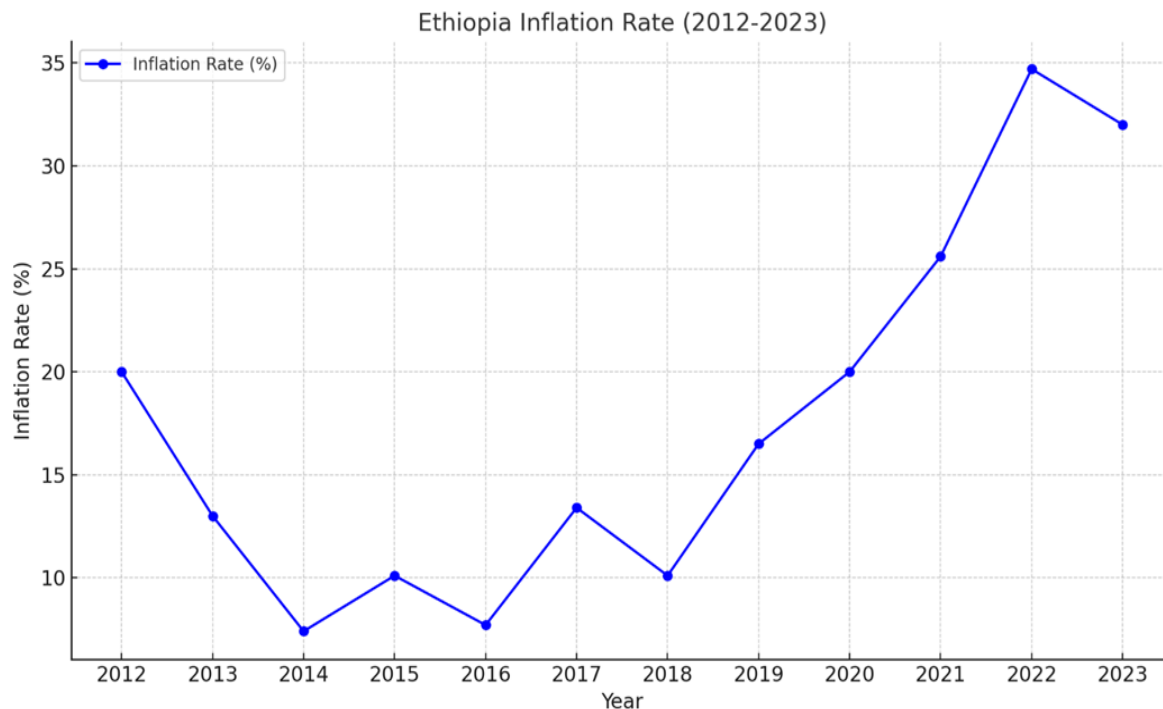


Figure 1 Ethiopia inflation rate from 2012 to 2023

Sources: own computation from NBE data, 2024

Figure 1. revealed that the due to various economic challenges, the inflation rate in Ethiopia has fluctuated significantly from 2012 to 2023. Starting at around 20% in 2012, inflation remained relatively high throughout the decade. In 2021, inflation surged past 25%, and in 2022, it reached 34.7%, primarily driven by factors such as the budget deficit, imports to GDP, public expenditure, external debt to GDP, lending interest rate, growth of real GDP, exchange rate, and growth of money supply. The government has faced persistent inflationary pressure despite efforts at economic reform and liberalization.

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4.3. Unit Root Test

Since the problems of non-stationarity are encountered in the analysis of macroeconomic data, carrying out a unit root test is a standard initial procedure. Before estimating an econometric model, it is critically important to check the stationarity of all the variables in the model to check for stationarity and ensure stability in mean, variance, and covariance. This was important because regressing one non-stationary variable against another non-stationary variable may result in erroneous regression, which tends to produce inadequate estimators and test statistics. As a result, a unit root test is performed using the ADF test to ascertain the stationarity of the variables in the model.

Table 2: ADF Test for Unit Root

Variable	ADF Test				Order of integration
	Level Intercept	Intercept & Trend	1st difference Intercept	Intercept & Trend	
General inflation	-3.75***	-4.11***	-8.41***	-8.31***	I(0)
Growth of money Supply	-1.81	-3.23	-6.32***	-6.79	I(1)
Import to GDP ratio.	-2.11	-1.62	-6.56***	-6.49***	I(1)
External debt to GDP ratio	-2.31	-2.56	-4.98	-4.91	I(1)
Lending interest Rate	-2.13	-2.51	-6.87***	-6.47***	I(1)
GDP growth rate	-1.83	-5.73***	-10.11***	-9.97***	I(0)
Public expenditure	1.81	-0.52	-3.45*	-3.7*	I(1)
Official exchange Rate	1.91	-0.41	-3.31*	-3.9*	I(1)
Budget deficit	-1.94	-2.11	-6.96	-4.96	I(1)

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

The results in Table 4.3 indicate that the null hypothesis is accepted for the first differences of the indices given those pp values. The unit root test results indicated that in both augmented Dickey-Fuller and Phillip and Perron tests, general inflation is stationary at level, integrated of order zero (I(0)), whereas broad money supply, public expenditure, lending interest rate, external debt to GDP ratio, import to GDP ratio, GDP growth rate, and official exchange rate are not stationary at level but stationary at the first difference, integrated of order one (I (1)). This implies the series are of mixed order of I (1) and I (0), and therefore, for the given time series, the ARDL methodology is

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quite appropriate to be adopted. This gives the stepping stone for the next co-integration analysis and error correction estimation that may proceed to the existence of co-integration.

Result of Bound Test for Co-Integration

Co-integration, on the other hand, provides formal stochastic evidence of long-term co-movement among variables. The next step of the bounds test approach is to estimate the specified ARDL model, and here, the choice of the lag length is carried out appropriately. As mentioned by Pesaran and Shine (1999), as cited in Narayan (2004), an ideal lag length is two when data is annual, but only one lag is appropriate for small samples in order to maintain the long-run relation. In this study, a co-integrated (long-run) relationship between general inflation and the selected determinants is demonstrated as follows:

Table 3: Bound test for co-integration

Table: Bounds Co-integration Testing Result

Null Hypothesis: No long run relationship exist (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

Source: Author's own computation by eviews10: 2023

At the 1 percent level of significance, the F-statistics from Table 4.3 above show that the F-value (5.87) is higher than both (Narayan & Narayan, 2013; Pesaran et al., 2001) upper bound critical values. As such, this implies that the alternative hypothesis that postulates the existence of a long-run relationship is accepted; instead, the null hypothesis hypothesizing that there is no long-run relationship is rejected at the 1% level of critical test values. As a result, evidence exists to suggest that the variables under consideration are co-integrated or have a long-run relationship. Therefore, according to the preliminary bound test analysis, the evidence in the series indicates co-integration. In other words, there is a systematic relationship that functionalizes the variables to form a linear stationary process that moves shocks/deviations from the short run into the long run.

4.4. Diagnostics Testing Result

However, before any statistical regression analysis, several diagnostic tests must be performed in order to check whether the model assumptions are met. This investigation uses several diagnostic tests, including the Breusch-Godfrey LM test to detect serial correlation, Ramsey's RESET to test functional form, the Jarque-Bera test to test for normality, and the heteroscedasticity test. On this basis, the possibility to accept or reject the null hypothesis depends on the p-value of probable test statistics; the null hypothesis should be rejected when the p-value is below the standard

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significance level of 5%.

Table 4: Diagnosing testing results for ARDL Model

Test Type	H ₀ Hypothesis	H ₁ Hypothesis	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 ₀
Homoskedasticity	Homoskedastic	Heteroskedastic	Breusch-Pagan Test	1.32 (0.27)	Accept H ₀
Omitted Variable	No omitted variable	Omitted variable	Ramsey RESET Test	1.75 (0.25)	Accept H ₀
Normality of Residuals	Normally distributed residuals	Not normally distributed	Jarque-Bera Test for the Distribution of Disturbance	1.15 (0.61)	Accept H ₀

Source: Author's own computation by eviews10: 2023

As demonstrated in Table 4.4, all the diagnostic tests conducted on the model estimated in this study suggest that the model passes most of them. The necessary diagnostic tests of the ARDL model in the above table indicate that all are passed. The serial correlation test shows no serial correlation present, as the p-value of.83 is much greater than 05. Independent variable heteroscedasticity has no problem according to the Breusch-Pagan-Godfrey heteroscedasticity test, having a p-value of 0.27. In the regression model, Ramsey's reset test for functional form equals 0.25, which indicates that this model has no omitted variable bias. Finally, the Jarque-Bera test shows that the residuals are normally distributed because the p-value, equal to 0.61, is greater than the significance mentioned above level of 0.05. In general, the model was proven to be sound, and all significant tests were held.

4.3.1. Stability of the Model

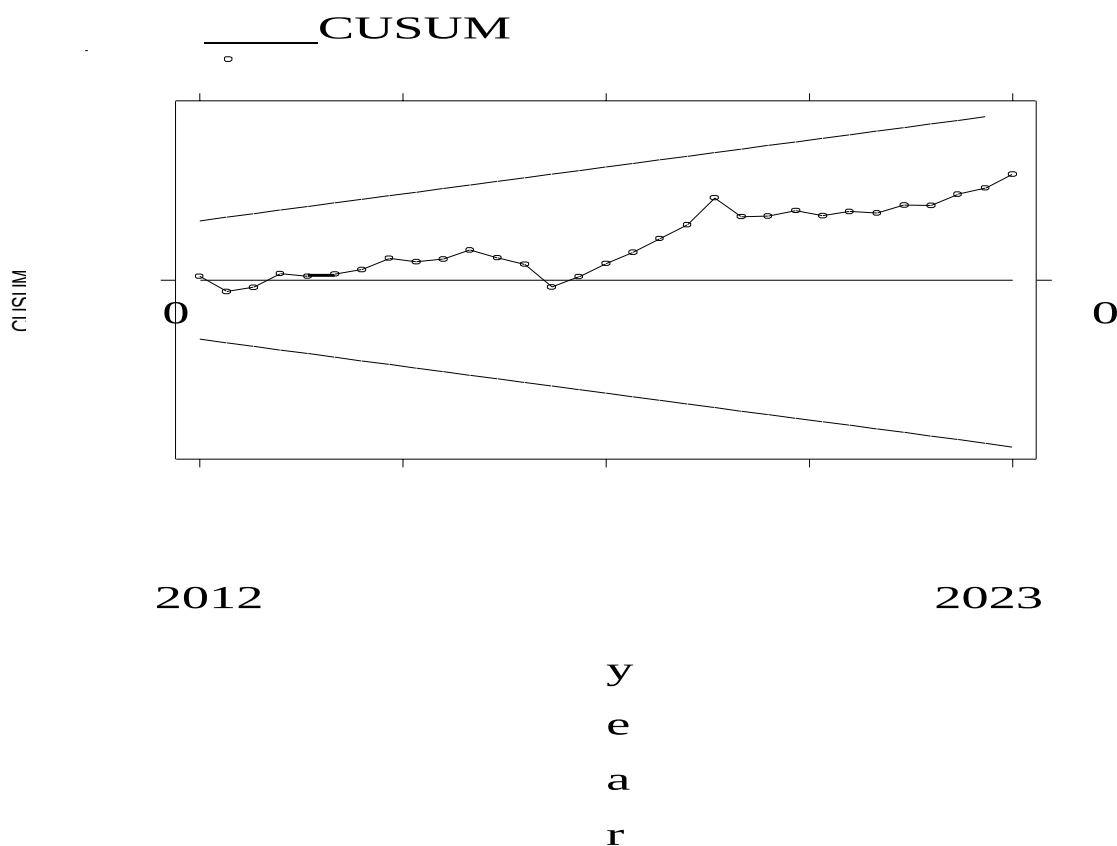
When the whole short-run and long-run estimation is over, model/parameter stability is checked. Usually, the constancy of the long-run and short-run coefficients of recursive

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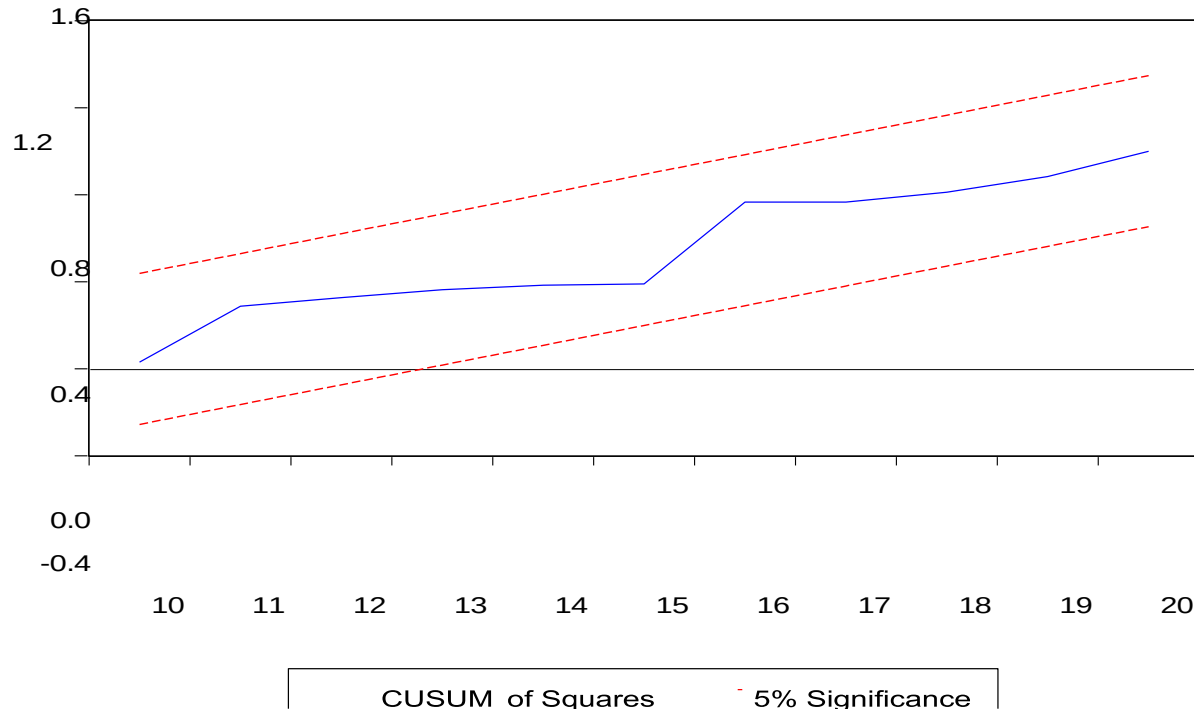
residuals is checked by CUSUM and CUSUMSQ. The recursive residuals tests aid in determining if the coefficients of the parameters are changing systematically, and the cumulative sum of the squared recursive residuals (CUSUMSQ) tests assist as well in helping determine if the coefficients of regression are changing abruptly. Consequently, the null of parameter instability shall be accepted if the blue line crosses the red line, which is the critical line, and should not crossover between the two critical lines again; vice versa, the null and the result that there is parameter stability in the short run and long run must be rejected and accepted, respectively, if the cumulative sum goes within the area (can crossover) between the two critical lines.

Figure 2: Model stability testing result.



Source: Model diagnostics test result using *EView 10*, 2023

Figure 3: CUSUM of Squares for model stability test



Source: Model diagnostics test result using *EView 10*, 2023.

The first and second Stata data graphs present the stability test of the model parameters through the cumulative sum of recursive residuals (CUSUM). The evidence in Figure 2 shows that the model is stable because the CUSUM plot never crosses its critical limits. Likewise, the CUSUM of squared residuals (CUSUMSQ) test supports the observation that the plots do not transgress the lower or the upper critical limits. This result indicates that the coefficients from the long-run model are less variable, and there is no sign of a structural break in the concerned model. In addition to ensuring the model's stability, it is also important to evaluate the goodness-of-fit measures to understand the variations in the dependent variable explained by the control/explanatory variables.

Moreover, the results indicated that the independent variables explain 69% of the variation in the dependent variables. The R-square (R^2) value is 0.69, whereas the adjusted-square (R^2) value is 0.57. This indicates that the estimated model is not only consistent but also efficient.

4.4. Long Run ARDL Model Estimation

Since real inflation and its determinates are cointegrated, the long-run parameters of the ARDL model are estimated, and the results are presented in the table below:

Table 4.5: Long Run Coefficients Co Integrating Equation

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Variable	Coefficient	Std. Error	t-Statistic	p-Value
Money Supply	0.80***	0.26	3.08	0.004
Public Expenditure	0.75**	0.30	2.50	0.018
Import/GDP	0.48**	0.19	2.53	0.016
External Debt/GDP	-0.24**	0.09	-2.67	0.012
Budget Deficit	0.62**	0.25	2.48	0.019
Growth of Real GDP	-1.007**	0.43	-2.34	0.024
Lending Interest Rate	0.21	0.69	0.30	0.765
Official Exchange Rate	-0.66*	0.32	-2.06	0.047
C (Constant)	4.35	8.58	0.51	0.613

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

Source: Author's own computation by evIEWS10: 2023

From the estimated result with a long-run coefficient of the ARDL and as presented in Table 4.5, money supply growth is at 0.80, t statistics 3.08, $p = 0.004$, which is significant at the 1% level. Public expenditure also has a positive and statistically significant effect on inflation at the 5% level and with a coefficient of 0.75, at t-statistics 2.50, $p = 0.018$. A similar trend is seen in imports to GDP flaring positively at a significant level of 5% with a coefficient of 0.48, while external debt to GDP is negatively related to inflation, with a coefficient of -0.24, $t = -2.67$, $p\text{-value} = 0.012$. Budget deficits seem to take inflation up as well, and rather significantly at that, with a coefficient of 0.62 and a p-value of 0.019.

On the other hand, according to the results, real GDP growth has coefficients of -1.007 with a 5% significance level, and it has a strong negative influence on inflation. The lending interest rate shows no significant effect, with a t-statistic of 0.30 and a p-value of 0.765. The official exchange rate, with a coefficient of -0.66, is significant at the 10% level, with a p-value of 0.047. The coefficient estimate for C is 4.35, and even though the constant term is regression, which is significant, the p-value of 0.613 shows that it has no statistical significance.

The Short Run ARDL Model Estimation

When we come to the short-run empirical analysis, an error correction model belongs to a category of multiple time series models most commonly used for data where the underlying variables have a long-run stochastic trend. This is called co-integration. The term error-correction refers to the fact that the error, the last-period deviation from long-run equilibrium, influences its short-run dynamics. Thus, ECMs directly estimate the speed at which a dependent variable (general inflation rate) returns to equilibrium after a change in other variables. The ECM estimates the short-run model, and the result is summarised in the table below.

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

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Money Supply	0.79***	0.27	2.93	0.006

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Public Expenditure	0.97**	0.35	2.77	0.010
Import/GDP	0.52**	0.20	2.60	0.014
External Debt/GDP	-0.11	0.12	-0.92	0.364
Budget Deficit	-0.58**	0.27	-2.15	0.039
Growth of Real GDP	2.03**	0.94	2.16	0.038
Lending Interest Rate	0.45**	0.21	2.14	0.041
Official Exchange Rate	-0.65*	0.34	-1.91	0.065
CointEq(-1) (Error Correction Term)	-0.98***	0.16	-6.13	0.000

Note: The dependent variable is $DINFIt$ 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.

Source: Author's computation by eviews10: 2023

The residuals from the error correction model (ECM) in Table 4.6 show that the coefficient for money supply growth is 0.79 with a t statistic of 2.93 and a p-value of 0.006; hence, it is positive and significant at 1% on the inflation level. Similarly, there is a positive and significant effect of lending interest rate and public expenditure with a coefficient of 0.97, which is significant at the 5% level of (p-value 0.010). Likewise, imports are positively related to the GDP and statistically significant with a coefficient estimate of 0.52 ($p < 0.05$). However, there is no significant relationship between external debt and GDP, as the t-statistic (-0.92) and p-value (0.364) depict. From the results, the budget deficits, on the other hand, have a negative and statistically significant impact on inflation at the 5% level of significance, with a coefficient estimate of - 0.58 and a p-value of 0.039.

The short-run results reveal that an increase in real GDP growth is positively related to inflation, with an elasticity of 2.03 at the 5% level of significance ($p > F = 0.038$). The coefficient for the lending interest rate was found positive and significant at 5%, with 0.45 as the value for the coefficient and 0.041 as the p-value. The official exchange rate bears a negative and weakly significant coefficient, equal to -0.65 and with a p-value of 0.065=10%. The error correction term CointEq(-1) is significantly less than zero with a coefficient of -0.98 (p-value of 0.000), and the adjusted coefficient indicates an AT rapid adjustment back to its long-run equilibrium.

Moreover, based on the above table, the model fit assessment yields an R-square of 0.69, which means that the model explains 69% of the inflation change. We get an adjusted R-square of 0.57, an F-statistic of 5.497, and a p-value of 0.000, which indicates the model's overall significance in the current study. As with the prior model, the Durbin-Watson statistic is calculated as 1.87, which indicates no severe autocorrelation of the residuals.

5. Conclusion

5.1. Conclusion

The main objective of this study was to analyze the determinants of inflation in Ethiopia using annual time series data from 2012 to 2023. Considering the effects of structural change in Ethiopia's economy, especially during the eight years of the launch of economic reforms and trade liberalization initiatives, an econometric model was constructed and estimated using the ARDL

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approach.

The empirical analysis relies on time series econometrics. The current investigation reveals that all variables are non-stationary at level but stationary at 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 results reveal, public expenditure, money supply growth, and import-to-GDP ratios display positive and significant coefficients for inflation, the result showing that an increase in any of the variables leads to an increase in the level of inflation. On the other hand, external debt to GDP has a negative relationship, indicating that higher external debt may be effective in fading off inflationary forces. In addition, its negative relationship with inflation indicates that the deficit might have been, over time, a tool for stabilizing fiscal discipline. The percentage of growth of real GDP also lays down the positive effect, thus highlighting the fact that inflation and KY economic growth are the main determinants of inflation.

In the short run, the results reinforce many of the long-run findings: public expenditure and money supply growth again emerge as significant positive influences on inflation. This result contrasts with standard Keynesian teachings that fiscal expansion is inflationary, but it corroborates Jorgensen and Ravn's (2022) findings. Lending interest rates and imports contribute positively to GDP, highlighting trade dynamics and monetary policy's role in inflation fluctuations. Budget deficits have a negative effect, suggesting that managing fiscal imbalances can lead to lower inflation rates in the short term. The significant positive relationship between growth and real GDP highlights the importance of maintaining economic momentum to curb inflation.

By testing the model, the study shows that the inflation variability of 69% is explained by the model as tested by the R-square figure when testing both the long-run and the short-run models. Taken collectively, the results point to how monetary policy, in combination with aspects of fiscal policy, provides the right mix that can be used effectively to combat inflation and promote economic growth.

5.2. Recommendations and Policy Implications

Based on the findings of this study, the following recommendations will be forwarded for policy formulation and upcoming research. That is, to reduce and minimize the severity of inflation in the country.

In both the short- and long-run dynamics, a broad money supply was found to be a dominant source of inflation in Ethiopia, partly in support of the monetarist view. This implies that either reducing the money supply through tight monetary policy or directing the increased money supply into productive development infrastructures can play a role in controlling persistent price growth. Because money supply growth has a direct and material impact on inflation, Ethiopia's central monetary authority should adopt an open and enthusiastic monetary policy. This approach requires close and successful controls on monetary aggregates so as not to allow high inflation rates while at the same time maintaining growth-friendly conditions. In other words, by achieving the right balance between inflation rate control and furthering economic growth, the Central Bank can improve its influence on macroeconomic stability.

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Therefore, for the government to achieve and maintain macroeconomic stability, fiscal discipline has to be strictly practiced. This entails the formulation of policies to contain budgetary deficiency through proper control of public outlay and improvement of incomes. Another way is to focus on the efficient management of resources, and rational spending can cause a price freeze and create the necessary conditions for reasonable economic growth. With reference to the fiscal action plan, it is clear that following a disciplining policy on the fiscals is not only helpful in achieving inflation prevention but also in creating investor confidence and sustaining steady economic growth in the future.

Given these facts about high import dependency, policymakers need to encourage supplier diversification in order to unlock the inflation trap. This paper argues that imposing protective measures and advocating for the growth of local industries will help strengthen Ethiopia's economy by limiting product importation. This change in strategy will not only help to stabilize costs but will also encourage employment, innovation, and growth in the regional economy. In the long run, specificity on import diversification will enhance a more balanced and sustainable economic structure growth.

Because it has been observed that there is a positive relationship between lending interest rates and inflation, the Central Bank of Ethiopia should reconsider its interest rates. This policy measure of interest rate variation contains the inflation element while promoting investment and activity within the economy. In the following manner, thus possessing the function in relation to both consumers and businesses, the Central Bank of Ethiopia can contribute to both price stability and growth. Proper manipulation of interest rates will help the country factor in various economic challenges and achieve sustainable development.

For inflation control purposes, appropriate measures must be taken to manage external borrowings. It is, therefore, necessary that any borrowed external debt be directed to productive sectors in the economy that have a significant positive impact on overall productivity and economic growth. External debt should be well controlled and properly used for projects that yield high economic returns in order to shift pressure from inflation to real economic growth. Therefore, such careful management of external debt will help to improve economic stability and shocks, resulting in an overall improvement in the economy.

Over-reliance on random devaluation of the currency to boost exports may not work as planned; thus, two possible approaches can fix most of the problems arising from the increasing foreign exchange rate. The first of them is the strategy for increasing export performance through increasing the diversification of export products and increasing the productivity of the products exported. The second strategy is concerned with substituting imports by developing new manufacturing industries and diversifying industrial clusters for goods that the economy mainly imports from trade partners. To this end, it is argued that by supporting a stable and optimal exchange rate regime along with these two approaches, the country can afford to import important capital goods, which aid in the formulation of import substitute industries.

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