

# Effects of Monetary Policy on Inflation in Ethiopia: Using ARDL Co-Integration Approach

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**Abstract:** Although many studies on linkage between monetary policy and inflation have been done in both developing and advanced countries, Notably Ethiopia has not featured in the cross-country studies that have included some of the Sub-Saharan African countries. Similar studies in Ethiopia haven't been conducted by including all necessary variables. Therefore, the study is to empirically investigate the effects of monetary policy on inflation in the case of Ethiopia. The study covers the annual data from 1988 to 2021 using time series ARDL co-integration regression analysis. The consumer price index is used as a proxy of inflation. The empirical results suggest that money supply, the openness of trade and the real effective exchange rate exerts a positive and statistically significant effect on inflation, in the long run, and real gross domestic product and real lending rate have a negative and statistically significant effect on inflation in the long run. The estimate of the speed of adjustment coefficient found in this study indicates that about 21.4 per cent of the variation in the inflation from its equilibrium level is corrected within a year. Based on the findings of the empirical analysis, the study recommends that the money supply to the economy should not exceed the country's production of goods and services. Government should implement major changes to ensure that more of the money in circulation is in the productive sector.

**Keywords:** Monetary Policy, Inflation, ARDL Co-Integration, Bound Test, Ethiopia

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## 1. Introduction

Inflation is defined as a sustained increase in the general price level of goods and services. Inflation is defined as an increase in the price of a particular commodity over a specific time period. In order for inflation to occur, the general price of goods and services must continue to rise. Inflation is critical to the smooth operation of a country's economic performance. It is widely acknowledged that an unpredictable fluctuation in the rate of inflation is a major indicator of a country's economic insecurity [31].

Ethiopia has historically not suffered high inflation. From 1980/81 to 2003/04, the annual average was only 5.2 percent, with major inflationary episodes occurring only during times of conflict and drought. Annual average inflation reached a record of 18 percent in 1984/85 due to drought, 21 percent in 1991/92 at the height of the war with Eritrea, and 16 percent again in 2003 due to drought [17].

Also stated that inflation in Ethiopia was not generally regarded as a problem prior to 2002/03, when the

government implemented strict fiscal and monetary policies inherited from previous government regimes. However, after 2002/03, inflation became a major issue as a result of the government's shift toward less conservative monetary and fiscal policy, as well as state activism as a developmental state in the economy, breaking the institutional legacy of fiscal and monetary policy conservatism [23].

The highest inflation rate in Ethiopia was recorded during the fiscal year 2007/2008, when it reached 64.20% in July 2008, while food inflation was 49% in August 2008. Ethiopia had the highest month-on-month food inflation rate in the developing world in 2008, at 3.5% per month. The majority of this inflation is being driven by higher staple food prices like maize, wheat, and teff [27].

There are various hypotheses regarding the cause of inflation. Inflation, according to structuralists, is caused by the structure of developing countries' economies. Monetarists believe that inflation is caused by an expansion of the money supply that exceeds the growth of real output. Inflation can also be caused by an increase in aggregate demand or a

decrease in aggregate supply; both of these factors influence an economy's price level. Demand-pull inflation is defined as inflation caused by an increase in aggregate demand. Demand-pull inflation is caused by a variety of factors such as money supply, government expenditures, exports or GDP, and so on. Cost-push inflation is defined as an increase in the general price level caused by an increase in production costs. Cost-push inflation can be caused by a decrease in aggregate supply as a result of production costs, rising wages, higher imports, rising taxes, a budget deficit, or a fiscal deficit [41].

Argue for targeting the growth rate of monetary aggregates in the post-crisis environment. The existence of a long-run money and inflation link, on the other hand, is critical for a rule-based monetary policy that prioritizes money. Inflation is caused by an increase in the money supply that influences output above the natural rate of unemployment [11].

Defines monetary policy as a policy designed to affect inflation in an economy, through supply of money, cost of money and availability of credit [6].

When inflation becomes persistent, the stock of goods and services and the amount of money in circulation become the primary targets of policies [24].

Although many studies on linkage between monetary policy and inflation have been done in both developing and advanced countries, Notably Ethiopia has not featured in the cross-country studies that have included some of the Sub-Saharan African countries. Similar studies in Ethiopia haven't been conducted by including all necessary variables.

Therefore, the study is to empirically investigate the effects of monetary policy on inflation in the case of Ethiopia. The study covers the annual data from 1988 to 2021 using time series ARDL co-integration regression analysis. The consumer price index is used as a proxy of inflation.

The significance of this study gives insight especially to policymakers on whether monetary policy is an appropriate policy instrument to promote sustainable economic growth and reduction of inflation. Therefore, this study will contribute to the existing literatures by analyzing the effects of monetary policy on inflation in Ethiopia and looking its impact by incorporating other relevant macroeconomic variables using the recent data.

The paper is organized as follows. After this introduction, the following section reviews the relevant literature, both theoretical and empirical. After this review, the methodological framework is presented. A series of test are shown to assess the sensibility of the model. The discussion of the results is presented. Finally, some concluding remarks are shown.

## 2. Literature Review

The purpose of this chapter is to review the related literature on the area of the effects of monetary policy on inflation. This establishes a framework that guides the study. Theoretical and empirical literature haven't been addressed the key sections of the section. The first part deals with theoretical literature, and empirical study is reviewed in the

second part.

### 2.1. Theoretical Review

For decades, every country in the world has aspired to achieve a geometric acceleration of long-term sustainable economic growth and development, particularly through an increase in export as one of the primary macroeconomic objectives. Without a doubt, achieving this aim will not be easy. It does, however, necessitate policy guidance, which necessitates the manipulation of policy instruments [1].

Mutually monetary and fiscal policies are examples of macroeconomic policies that could be employed to achieve the above goal. Apart from instruments and implementing authorities, these policies are inextricably linked. Due to the frequency with which it applies and changes policy tools, the relative simplicity with which it makes decisions, and the sheer nature of the sector that propagates its effect to the real economy, monetary policy looks to be more effective in addressing short-term macroeconomic maladjustments. As a result, economists view monetary policy as a critical tool that every country may use to ensure correct pricing and exchange rate stability, as well as a necessary condition for achieving long-term economic growth and development [13].

According to the quantity theory of money, if the money stock rises without a corresponding increase in output, the extra money supply will simply bid up prices. If the money stock rises without a corresponding increase in output, the additional money supply will simply bid up prices based on the quantity theory of money. As the price level rises, the exchange rate depreciates based on the purchasing power parity theory [16].

As the money supply rises, so do the prices of goods and services, particularly if output growth approaches its maximum capacity, as demonstrated by [12].

The rise in money stock will result in minimum wage adjustments and government budget deficit financing through the Central Bank of Nigeria. In contrast to the previous, if output is inelastic, it could be due to a foreign exchange constraint, technological backwardness, or low productivity, all of which have the potential to reveal inflationary pressures [14].

#### 2.1.1. The Keynesian View

According to Keynesian analysis, the most important element that raises the price level is demand pull inflation, which is defined as an increase in the quantity of money without a commensurate increase in output.

The resultant negative production gap is caused by excessive aggregate demand, which is expansionary and puts upward pressure on prices [15].

There's also the Supply or Cost-push inflation theory, which claims that inflation is driven by supply-side factors like import or raw material prices, unit labor costs, and other costs of production [40].

The money supply and the amount levels do not have a direct relationship, according to Keynesians. They scrap the

idea that the economy is always at or near its usual level of real production, with the goal of making  $y$  static in the exchange equation and the velocity of money in circulation constant. They believe that an expansionary monetary policy increases the amount of money available for lending through the banking sector. This resulted in lower interest rates. With lower interest rates, growth accelerates, resulting in increased real production. As a result, monetary policy has an indirect impact on real output.

### **2.1.2. Classical Theory of Monetary Policy**

Classical economists' views on monetary policy are based on the amount of money. According to this paradigm, a rise in the money supply causes a proportionate increase in the price, and vice versa. The goods market is always clear, and comparative prices adjust flexibly to ensure that an equilibrium point is attained. Money is a unit of exchange for conveying prices and values. Money makes it feasible for people to exchange commodities and services. Money is impersonal; it has no bearing on the setting of relative good prices, real interest rates, or aggregate real income. The quantity theory of money is discussed in terms of exchange equations [18].

### **2.1.3. The Monetary Theory**

Monetarist is explicitly apprehensive by means of the impending misuse of pecuniary dogma and weakening of the amount level. They rely on the persistent expansionary or contractionary monetarist policies bring about constant instabilities which are purely monetary phenomenon. However, their argument is in favor of a fixed money supply rule as a way of fighting obstinate times of price increases or deflation. Their belief is that the central bank ought to conduct pecuniary plan to keep up with the progression of the economy over time. They therefore believe that pecuniary strategy should serve to cater for escalations in real production without leading to either price increases or decrease [21].

Assuming price increases is faultlessly projected; labor conventions would reflect it such that normal wages intensifies by the anticipated rate of price increases. Similarly, unexpected rate of price rises would cause unconventionalities in the ordinary rate by decreasing the real cost of labor and other contributions. Thus, the anticipated outcome of inflation is regularly used to quantify the cost of holding money.

Monetarists tend to put much consideration on money and monetary policy. However, there is a lot of uncertainty that velocity is persistent to make pecuniary steering necessary. Furthermore, the many alternatives resulting from financial improvements make it challenging for monetary authorities to have defined description of money. The instability between monetary base and the targeted variables are therefore as a result of financial markets developments [19].

## **2.2. Empirical Review**

In this section, the article looks at the empirical literature

to see what different academics have found about the monetarist determinants of inflation approach's applicability. According to the empirical literature, the subject has gotten a lot of attention from economists all across the world, just like many other macroeconomic theories.

The impact of monetary policy on inflation and economic growth. A vector autoregressive (VAR) framework with two lags was used to examine the influence of money supply growth, exchange rate changes, and interest rate changes on inflation and economic growth. The study used quarterly, seasonally adjusted data on variables like interest rate, money supply, inflation, and real GDP in Sri Lanka from 1978 to 2005. According to the findings, inflation in Sri Lanka does not reduce as a result of contractionary monetary policy. Furthermore, following a contractionary reserve shock, inflation fell as the exchange rate appreciated, and the rate of interest rose as well [2].

The impact of monetary policy on price stability. He looked at monetary policy shocks and their effects on inflation, market interest rates, and the currency rate. As a surrogate for monetary policy indicators, the monetary policy rate was utilized. From December 2006 to February 2012 in Nigeria, secondary data was collected. The year 2006 was chosen because it was the first year that the monetary policy rate was implemented. The model was estimated using a structural VAR framework. The study found that in Nigeria, market interest rates and currency rates were more susceptible to monetary policy rate shocks than inflation [3].

Found no association between money and inflation in countries with high inflation rates, contradicting this assumption. Turkey has been experiencing high and rising inflation rates for more than 30 years. The higher rates, according to the author's empirical results, are mostly due to the depreciation of the country's currency and rises in public-sector costs [45].

Several studies on money supply and inflation have been conducted in Tanzania. Employed a GARCH model to investigate the money supply and inflation relationship in the country, using  $M_2$  and  $M_3$  monetary aggregates as proxies for money supply. The research was conducted using monthly data from 1994 to 2006. According to the findings of the study, any changes in the money supply in Tanzania take seven months to have an impact on inflation rates [4].

Examined the role of money in explaining inflation trends in Tanzania using an Autoregressive Distributed Lag (ARDL) and Error Correction Model (ECM) using quarterly data from 1967 to 2005. The model failed to find any association between money and inflation when  $M_0$ ,  $M_1$ , and  $M_2$  were used as money aggregates. He concluded by downplaying the role of money in determining inflation in Tanzania [34].

When the Central Bank uses its tools to stimulate the economy, this is known as expansionary monetary policy. To expand the money supply, this usually entails decreasing the prime rate. Mortgage rates will fall, consumers will borrow, and businesses will expand, resulting in the hiring of more

workers who will consume even more [5].

Furthermore, an attempt to utilize monetary policy to enhance or deflate aggregate demand, output, and jobs is characterized as an expansionary monetary policy (also known as a relaxation of monetary policy). Typically, this entails a reduction in the central bank's official policy interest rate. In some nations, it may also imply a loosening of credit rules. A fall in the exchange rate (depreciation) is also an expansionary monetary policy [30].

Estimates the link between prices, money, and the exchange rate for quarterly data in Madagascar from 1982 to 2004 using a two-sector model. The findings reveal that the money supply has a major impact on inflation [35].

Using the error correction model, evaluate the impact of money demand on inflation for monthly data in Russia from April 1996 to January 2004. The findings show that an excess supply of effective wide money is inflationary, whereas other forms of excess money are not, and that effective broad money expansion has the most powerful and long-lasting effect on short-run inflation [37].

Puts forward the hypothesis that the responsiveness of prices to exchange rate fluctuations depends positively on inflation [44].

The significant link between inflation and the growth rate of the money supply supports the quantity-theoretic thesis that an increase in the money supply leads to an equal increase in the price level [47].

Supply shocks account for 45 percent of inflation swings in Non-CFA Sub-Saharan countries (including Nigeria), whereas demand pull shocks account for 55 percent [33].

The variations in money supply are the predominant factors of changes in inflation, as the coefficient of change in money supply is highest at 41%, which was unswerving in regard to the monetarists theory that the effect of an expansionary pecuniary policy on an economy operating at optimum is inflationary in nature [32].

### 3. Methodology and Data Sources

#### 3.1. Data Source and Variable Definitions

This studies will use secondary annual times series data which spans from 1988 to 2021. The data will be collected from National Bank of Ethiopia (NBE). The variables used in this study are Consumer price index (Inflation Rate) as dependent variable and money supply, real effective exchange rate, real lending rate, real gross domestic product and openness of trade as explanatory variables.

#### 3.2. Variable Definitions and Expectations of Sign

Money Supply ( $M_2$ ): The total amount of cash and other liquid instruments circulating in a country's economy at any given time is known as the money supply ( $M_2$ ). Cash, coins, balances in checking and savings accounts, and other near-money substitutes can all be included in the money supply. Government borrowing is said to diminish the quantity of accessible domestic savings, putting upward pressure on

interest rates, because the sale of Treasury bills and bonds reduces the amount of money in circulation, whilst government expenditure replenishes it. Thus, the money supply has a positive expected inflation rate.

Real Effective Exchange Rate (REER): is the weighted average of a country's currency in relation to an index or basket of other major currencies. The weights are determined by comparing the relative trade balance of a country's currency against each country within the index. If there is depreciation in the exchange rate, it is likely to cause inflation to increase. Depreciation in the exchange rate, on the other hand, will boost exports of products and services. As a result, to obtain more foreign currency and import goods and services more readily. Thus, the real effective exchange rate has a negative /positive expected inflation rate.

Real Lending Rate (RLR): The bank rate typically fits the private sector's short and medium term financing needs. When interest rates decrease, there's an increase in borrowing. This means people have more money to spend on the economy, subsequently causing inflation to rise. Conversely, when inflation is falling and economic growth slowing, central banks may lower interest rates to stimulate the economy. Thus, the real lending rate has a negative expected inflation rate.

Real Gross Domestic Product (RGDP): the standard measure of the value added generated by the production of products and services in a country over time. GDP and inflation rate have an indirect association, which means that as a country's gross domestic product rises, it shows that more investment is being made in the economy, which lowers inflation. As a result, the predicted inflation rate for the gross domestic product is negative.

Trade of Openness (TO): Trade openness is measured as the sum of a country's exports and imports as a share of that country's GDP (in %). The sensitivity of inflation to both the marginal cost and relative international prices is affected by trade openness. Firms' steady-state price elasticity of demand increases as trade integration and the number of types offered in the domestic market expand, lowering their desired mark-ups. Thus, the trade of openness has a positive expected inflation rate.

#### 3.3. Model Specification

In regression analysis if model includes both current and lagged values of independent variables it is called distributed lags model and if model also includes lagged values of dependent variables it is called autoregressive distributed lag model. Autoregressive distributed lag model allows us to express co-integrated behavior of variables which have different order of integration [10].

ARDL is appropriate for the independent variable in the model which is  $I(0)$ ,  $I(1)$  or a mix of  $I(0)$  and  $I(1)$ , but it fails in the presence of  $I(2)$  in any variables [22].

ARDL model is the more appropriate method to determine the co-integration relation in small samples [38].

The log linear form of Equation (EQ1) can be rewrite in ARDL model form as follows:

$$\begin{aligned} \Delta \ln CPI_t = & \alpha_0 + \sum_{j=1}^k \theta_j^1 \Delta \ln CPI_{t-j} + \sum_{j=1}^m \theta_j^2 \Delta \ln M_{2,t-j} + \sum_{j=1}^s \theta_j^3 \Delta \ln REER_{t-j} + \sum_{j=1}^l \theta_j^4 \Delta RLR_{t-j} + \\ & + \sum_{j=1}^q \theta_j^5 \Delta \ln OT_{t-j} + \sum_{j=1}^z \theta_j^6 \Delta \ln RGDP_{t-j} + \theta_0^1 \ln CPI_{t-j} + \theta_0^2 \ln M_{2,t-j} + \theta_0^3 \ln REER_{t-j} \\ & + \theta_0^4 \ln RLR_{t-j} + \theta_0^5 \ln OT_{t-j} + \theta_0^6 \ln RGDP_{t-j} + \varepsilon_t \end{aligned} \quad (1)$$

After finding the long-run association existing between variables, the study uses the error correction model (ECM) to find the short-run dynamics. ECM shows the speed of

adjustment in the long-run equilibrium after a shock in the short run. The ECM general form of Equation (EQ1) is specified in Equation (EQ2):

$$\begin{aligned} \Delta \ln CPI_t = & \alpha_0 + \sum_{j=1}^k \theta_j^1 \Delta \ln CPI_{t-j} + \sum_{j=1}^m \theta_j^2 \Delta \ln M_{2,t-j} + \sum_{j=1}^s \theta_j^3 \Delta \ln REER_{t-j} + \sum_{j=1}^l \theta_j^4 \Delta RLR_{t-j} \\ & + \sum_{j=1}^p \theta_j^5 \Delta \ln OT_{t-j} + \sum_{j=1}^q \theta_j^6 \Delta \ln RGDP_{t-j} + \delta ECM_{t-1} + \varepsilon_t \end{aligned} \quad (2)$$

Where; CPI consumer price index, M<sub>2</sub> Money supply, REER Real effective exchange rate, RLR Real Lending rate and RGDP real growth domestic product, OT openness of trade  $\Delta$  is first difference operator,  $\ln$  stands for natural logarithmic.

### 3.4. Estimation Method

#### 3.4.1. Stationarity Test

Data analysis requires testing the time series data stationarity. There are numerous methods for determining whether or not a unit root problem exists. Dickey-Fuller (DF), Phillips Perron test (PPT), and Augmented Dickey-Fuller are three of them (ADF). The ADF test will be used in this investigation, which will contain lagged differences to make the residuals a white noise process.

#### 3.4.2. ARDL Bound Test for Co-Integration

Before determining the long-run and short-run relationships between variables, the ARDL bound test should be used to confirm co-integration [38].

For a particular significance level, two sets of critical values can be derived. The first level is derived assuming that all variables in the model are integrated of I (0), while the second level is calculated assuming that the variables are integrated of I (1). For both I (1) and I (0) data sets, these two sets provide important value bonds for co-integration.

#### 3.4.3. Model Stability Check and Residual Diagnostic Test

Several diagnostic tests are used to verify the model's standard properties. The model stability condition check and

residual diagnostic tests, which comprise serial correlation, normality, and heteroscedasticity tests, will be performed in this study.

Serial Correlation Test: The chosen model in time series analysis should satisfy the assumption of no serial correlation. To check for the presence of serial auto-correction, the Durbin Wastson test will be used.

Heteroskedasticity Test: This is used to test for the homoscedasticity of residuals in the model.

Normality Test: The residuals of the selected model should be normally distributed.

Model Stability Check: The study uses the cumulative sum (CUSUM) and cumulative sum of square (CUSUMSQ) tests to verify the model's stability after confirming that long-run relationships exist between variables.

## 4. Estimated Results and Interpretation

### 4.1. Descriptive Analysis

The study provides a brief explanation of statistical analysis before proceeding to present a thorough econometric analysis. Descriptive statistics demonstrate the fundamental feature of the data. They represent quantitative descriptions in a comprehensible format and provide basic data summaries. It is distinct from inferential statistics. Descriptive statistics describe what the data is or what it indicates, but inferential statistics is used to derive conclusions that go beyond the immediate facts.

Table 1. Descriptive Statistics.

	lnCPI	lnM <sub>2</sub>	lnOT	lnREER	lnRGDP	RLR
Mean	3.41	10.94	-2.65	4.96	13.26	0.37
Median	2.93	10.53	-2.65	4.94	13.05	1.6
Maximum	5.39	14.11	-1.12	5.84	14.56	24.1
Minimum	2.03	8.56	-4.73	4.54	12.38	-43.7
Std. Dev.	0.97	1.67	1.15	0.30	0.74	14.23
Observations	34	34	34	34	34	34

Source: Authors own computation using E-views

The mean and median in the table above were computed to find the central tendency of each variable for 34 observations. The standard deviation indicates the sample's dispersion (spread) level of the variables. According to the above table, the average inflation rate is 3.41% which means the consumer price index during the period under study is approximately 3.41%, while money supply ( $M_2$ ), openness of trade (OT), real effective exchange rate (REER), real gross domestic product (RGDP) and Real lending rate (RLR) recorded an average of 10.94%, -2.65%, 4.96%, 13.26% and 0.37%.

#### 4.2. Unit Root Test

The first step in time series econometric analysis is to carry out a unit root test on the variables of interest. The test examines whether the data series is stationary or not. To conduct the test, the conventional Augmented Dickey-Fuller (ADF) test was employed with and without a trend. The results of the test for the variables at a level and first difference are presented in Table 2. As reported in Table 2

one variable with intercept and with Intercept and trend at the level is stationary at a 5% level of significance and five variables with intercept and with intercept and trend at first differences are stationary at 5% level of significance.

#### 4.3. The Lag Selection Criteria

Lags are very useful in time series analysis because of a phenomenon called autocorrelation, which is a tendency for the values within a time series to be correlated with previous copies of itself. The Akaike information criterion was used in this study. The Akaike information criteria used for determination of optimal lag length requires that, the lag length with the smallest critical value. The results of these tests showed 2, 2, 2, 3, 3, and 2 as optimal lag lengths are selected for dependent variable of money supply, openness of trade, real effective exchange rate, real growth domestic product and real lending rate respectively. With information on the lag length, it is now possible to verify if the variables are co integrated using the bound test technique.

Table 2. Unit Root Tests of the Variables at Level and First Difference.

Variables	Augmented Dickey Fuller (ADF)							
	With Intercept				With Intercept and trend			
	Level (I(0))		1's difference (I(1))		Level (I(0))		1's difference (I(1))	
	t-stat	P-value	t-stat	P-value	t-stat	P-value	t-stat	P-value
lnCPI	1.317	0.9982	-4.805	0.0005*	-0.635	0.9699	-5.131	0.0012*
lnM <sub>2</sub>	2.089	0.9998	-2.577	0.108	0.002	0.9946	-3.542	0.0517
lnOT	-0.686	0.837	-5.027	0.0003*	-1.812	0.6758	-4.990	0.0017*
lnREER	-1.796	0.376	-5.927	0.000*	-1.673	0.7405	-6.003	0.0001*
lnRGDP	1.510	0.999	-3.886	0.0056*	-2.406	0.3699	-4.572	0.0049*
RLR	-4.778	0.0005*	-7.655	0.000*	-4.820	0.0025*	-7.548	0.000*

#### 4.4. Testing for Bounds Test or Co-Integration

In order to check for the existence of long run relationship, co integration, in the model bound co integration test was

used to check whether have a long run relation among the variable's or not. The results of the ARDL bounds testing approach are also shown in Table 3.

Table 3. ARDL Bounds Test for Co-integration.

Test Statistic	Value	k
F-statistic	11.08886	5
Critical Value Bounds		
	Lower Bound (I <sub>0</sub> )	Upper Bound (I <sub>1</sub> )
10% significance level	2.75	3.79
5% significance level	3.12	4.25
1% significance level	3.93	5.23

Source: Computed by authors using E-views 10 software

From Table 3, the calculated F statistics (11.08886) is higher than the upper bound critical values at a 1%, 5% and 10% level of significance [38].

This implies that the null hypothesis of no long-run relationship is rejected; rather accept the alternative hypothesis (there is a long-run relationship) based on the critical values at a 1%, 5% and 10% level of significance [38].

Therefore, there is a co-integration relationship among the variables in long run.

#### 4.5. Long Run Model and Optimal Lag Length

The ARDL (2, 2, 2, 3, 3, and 2) maximum lag lengths are selected for dependent variable of money supply, openness of trade, real effective exchange rate, real growth domestic

product and real lending rate respectively.

**Table 4.** Long-Run Estimation of Parameters.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnM <sub>2</sub>	1.470076	0.24589	5.978602	0.0001*
lnOT	0.643214	0.11167	5.759949	0.0002*
lnREER	0.572335	0.219405	2.608577	0.0261*
lnRGDP	-1.867236	0.695706	-2.683944	0.0229*
RLR	-0.060869	0.0154	-3.952601	0.0027*
Durbin-Watson stat	2.208624	F-statistic	22644.06	
Adjusted R-squared	0.999934	Prob (F-statistic)	0.0000	

Source: Own Computation by Eviews 10.

\*\*\*and \*\* indicates significant at 1%, 5% and 10% level of significance

The above Table 4 had shown the empirical results of the long run relationship between inflation and explanatory variables. Money supply has a positive and significant effect on inflation at 5% level of significance. This implies that an increase in money supply in Ethiopia can significantly raise inflation. The estimated results imply that a 1 percent rise in money supply can increase inflation by 1.47 percent in the long run. Money supply shows a positive relationship with inflation in Nigeria [28]. Money supply shows a positive relationship with inflation in Bangladesh [26]. Money supply shows a positive relationship with inflation in GCC countries [48]. Money supply shows a positive relationship with inflation in 160 countries [25]. Money supply shows a positive relationship with inflation in Nigeria [46]. Money supply shows a positive relationship with inflation in Pakistan [42].

Openness of trade has a positive and significant effect on inflation at 5% level of significance. This implies that an increase in openness of trade in Ethiopia can significantly raise inflation. The estimated results imply that a 1 percent rise in openness of trade can increase inflation by 0.64 percent in the long run. The openness of trade shows a positive relationship with inflation in Nigeria [7]. The openness of trade shows a positive relationship with inflation in Pakistan [49]. The openness has a favorable effect on inflation [20]. The possibility of importing inflation from the rest of the globe via the pricing of manufactured imports or raw material imports drives this beneficial effect of openness on inflation. The the impact of the degree of trade openness on inflation for a total of eight Caribbean countries between 1980 and 2009. The empirical results suggested a positive relationship between openness and inflation [43]. Effect of trade openness on shows a positive relationship with inflation [30].

Real effective exchange rate has a positive and significant effect on inflation at 5% level of significance. This implies that an increase in real effective exchange rate in Ethiopia can significantly raise inflation. The estimated results imply that a 1 percent rise in real effective exchange rate can increase inflation by 0.64 percent in the long run. The real effective exchange rate shows positive relationships with inflation in Ethiopia [36]. The real effective exchange rate shows positive relationships with inflation [29]. Increased exchange rate directly affects the prices of imported commodities and increase the price of imported goods and services contributes directly to increase in inflation [39].

Real GDP has a negative and significant effect on inflation at 5% level of significance. This implies that an increase in real GDP in Ethiopia can significantly decrease inflation. The estimated results imply that a 1 percent rise in real GDP can decrease inflation by 1.87 percent. Empirically established a statistically significant negative relationship between economic growth and inflation using CPI and real GDP as proxy variables for Bangladesh [8].

Real lending rate has a negative and significant effect on inflation at 5% level of significance. This implies that an increase in real lending rate in Ethiopia can significantly decrease inflation. The estimated results imply that a 1 percent rise in real lending rate can decrease inflation by 0.061 percent. Using a model of segmented market, showed that “a policy of increasing short term interest rates to reduce inflation can be rationalized with essentially quantity theoretic models of monetary equilibrium”. When the interest rate is high, the supply for money is less, and hence inflation decreases. A contractionary monetary policy increases interest rates in order to slow the growth of the money supply and bring down inflation [9].

**Table 5.** Diagnostic tests of the residual of the ARDL model.

Diagnosis	Test	Null hypothesis	F-stat	Prob.
Autocorrelation	Lagrange-multiplier	No serial correlation	0.206	0.661
Normality	Jarque-Bera test	Residuals are normal	1.55	0.46
Heteroskedasticity	white	Homoscedasticity	0.448	0.939

Tests of autocorrelation, normality and heteroskedasticity of the autoregressive distributed lag (ARDL) models are conducted with the help of Lagrange-multiplier test, Jarque-Bera test, and white test. These tests are used to confirm the

basic assumptions regarding the residual and the validity of the results in this study. From the tests, it was found that the nulls of no serial correlation, normality and homoskedasticity in the residuals could not be rejected in all cases.

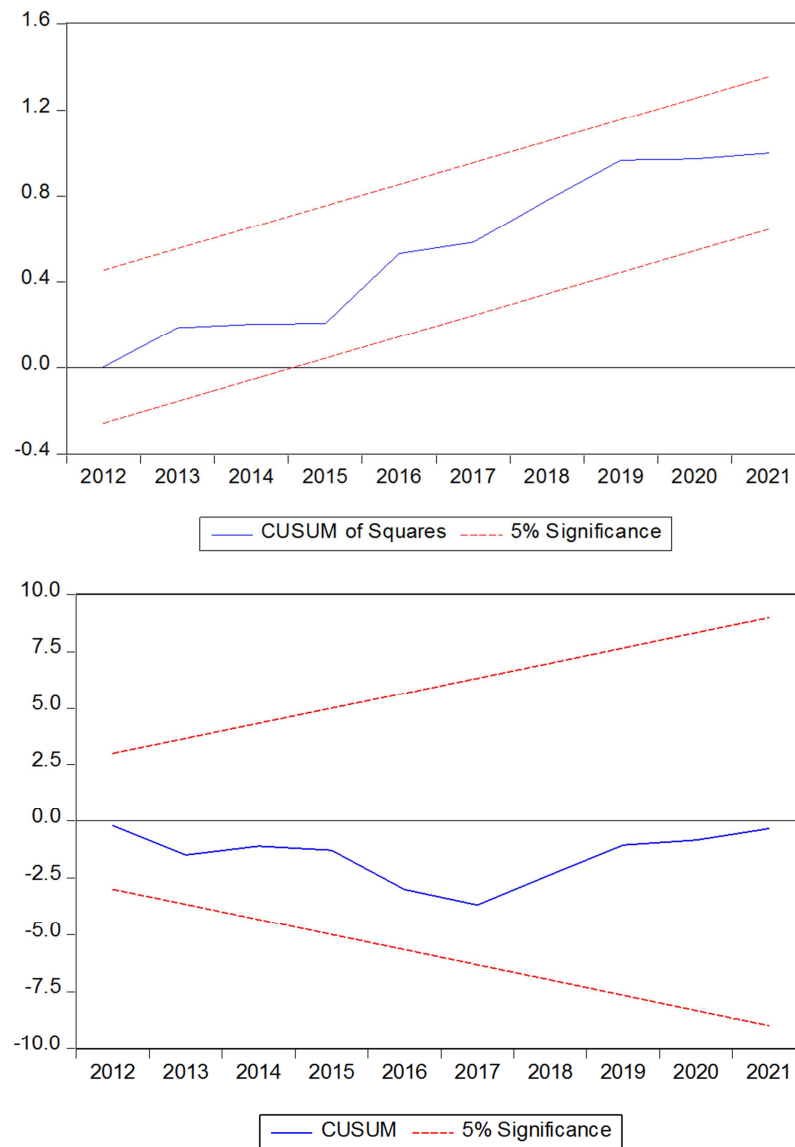


Figure 1. CUSUM and CUSUMSQ test.

The results of both CUSUM and CUSUMSQ test given below as depicted in the first figure; the plot of CUSUM test did not cross the critical limits. Similarly, the CUSUMSQ test shows that the graphs do not cross the lower and upper critical limits. Therefore, we can conclude that long and short runs estimates are stable and there is no any structural break. Hence, the results of the estimated model are reliable and efficient.

#### 4.6. ARDL Short Run Estimate Output

After estimating long-run coefficients of the model, then

the short-run error correction model (ECM) is estimated. The estimated coefficient of error correction term is negative and statistically significant at 5% level of significance confirms the existence of co-integration between variables. Error correction term shows the speed of adjustment to the long-run equilibrium after short-run shocks. The coefficient of ECM is -0.214, which indicates that 21.4% of any disequilibrium of the current year shock adjusted back to the long-run equilibrium in the next year.

Table 6. Estimated Short Run Coefficients (ECM).

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.767493	0.277793	9.96	0.000
@TREND	-0.016395	0.001712	-9.58	0.000
D(lnCPI(-1))	-0.281781	0.125468	-2.25	0.0485
D(lnM2)	0.099417	0.032711	3.04	0.0125
D(lnM2(-1))	-0.089359	0.030215	-2.96	0.0144
D(lnOT)	0.025982	0.013164	1.97	0.0767
D(lnOT(-1))	-0.047275	0.014547	-3.25	0.0087

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(lnREER)	-0.076001	0.014228	-5.34	0.0003
D(lnREER(-1))	-0.160614	0.026714	-6.01	0.0001
D(lnREER(-2))	-0.068136	0.012618	-5.40	0.0003
D(lnRGDP)	-0.209289	0.038592	-5.42	0.0003
D(lnRGDP(-1))	0.145907	0.038509	3.79	0.0035
D(lnRGDP(-2))	0.091313	0.043114	2.12	0.0602
D(RLR)	-0.00842	0.000142	-59.49	0.000
D(RLR(-1))	0.000775	0.000153	5.06	0.0005
ECM(-1)	-0.214238	0.021445	-9.99	0.000
R-squared	0.9987	Durbin-Watson stat	2.208624	
F-statistic	768.4512	Prob (F-statistic)	0.000	

Source: Own Computation by Eviews 10.

\* \*\*and \*\*\* indicates significant at 1%, 5% and 10% level of significance

## 5. Conclusion and Policy Implications

### 5.1. Conclusion

Inflation influences growth by changing labor supply and demand, reducing aggregate employment in the sector with increasing returns and monetary policy is one of the main economic management tools that governments use to shape of economic performance and that it can help promote stable prices, which are very helpful in ensuring inflation rates.

The main objective of this study was to examine the effects of monetary policy on inflation in Ethiopia. Annual time-series data for the period of 1988-2021 were employed.

This paper employs the co-integrated ARDL model to examine the effects of monetary policy on inflation. Before applying the ARDL model, all the variables are tested for their time series properties (stationarity properties) using the ADF tests. ADF tests results show us, real lending rate with intercept and with Intercept and trend at the level is stationary at a 5% level of significance and consumer price index (inflation), openness of trade, real effective exchange rate, real gross domestic product and real lending rate with intercept and with intercept and trend at first differences are stationary at 5% level of significance.

As we discussed above, this study applied the methodological approach called ARDL model also known as bound test approach. As the result indicted the bound test (F-statistic) value is larger than the upper bound critical value both for [38].

Which indicates there is a long run relationship between inflation and its determinants (money supply, openness of trade, real effective exchange rate, real gross domestic product and real lending rate) in long run during the study period?

The econometric analysis of ARDL long run model shows that money supply, openness of trade and real effective exchange rate has a positive significant effect on inflation while real gross domestic product and real lending rate have negative effects on inflation in Ethiopia.

The coefficient of error correction term (ECM) is -0.214, which suggests that 21.4% of the disequilibrium of the current year shock corrected back to the long-run equilibrium in the next year.

### 5.2. Policy Implications

The findings of the study lead to the following policy recommendations necessary to ensure steady and price stability. Based on the findings of the study the following policy implications are suggested:

- i) Spends the money to the economy should not exceed the country's production of goods and services. Government should implement major changes to ensure that more of the money in circulation is in the productive sector.
- ii) The shortage of foreign exchange rate, the government may resort to an import substitution approach. If the government uses import substitution to produce previously imported commodities domestically, the government will be able to manage inflation.

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