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Demand for Money and Inflation in Ethiopia

Solomon Senbeto Godana

Monetary and Financial Analysis Directorate, National Bank of Ethiopia, P.O.Box 5550, Addis Ababa, Ethiopia

ABSTRACT

One of the vital components of the macroeconomic model that helps policymaking is the demand for money function. Having reliable predictions on the money demand function helps in determining the optimum growth of money supply which is vital in controlling the inflation rate in the economy and also preventing monetary disturbances from affecting real output. In order to formulate and estimate the money demand function in Ethiopia, this study used quarterly data from 2000Q3 to 2021Q2 and employed the Ordinary Least Square method and Engle-Granger two-stage procedure for empirical analysis. The empirical result from the models indicates that, in the long run, all variables (real GDP, CPI inflation, real effective exchange rate, real interest rate and lagged real money balance) are significantly affecting the demand for money in Ethiopia. Whereas, the estimated coefficients of the short-run variable show that the real effective exchange rate, CPI inflation, and lagged real money balance are the main determinants of demand for money while the real GDP and real interest rate are insignificant. Another important finding is that absolute value of the coefficient of the error correction term implies that about 54.2% of the disequilibrium in real money demand is counter-balanced by short-run adjustment in each quarter. The study suggests that in conducting monetary policy, policymakers should consider not only the behavior of income and price but also the movement of exchange rates. The study also calls for appropriate formulation and estimation of the all-encompassing demand for money function that is capable of bringing stability to the growth of money coupled with sustainable economic growth.

Keywords: Demand for money; Consumer price index (CPI); Gross domestic product (GDP)

1. Introduction

The balanced money demand function holds a crucial role in the development and execution of monetary policy. Simply put, the demand for money represents the quantity of financial assets that indi-

viduals desire to possess in the form of cash. Economists have identified three fundamental rationales for holding money. Firstly, it serves as a medium of exchange, enabling individuals to purchase goods and services. Secondly, it can be utilized as a store of value for precautionary measures, providing a buffer against unforeseen contingencies. Lastly, money is also used to capitalize on attractive investment opportunities requiring cash expenditure, as its value is relatively stable compared to other assets such as stocks, bonds, or real estate.

According to Halicioglu and Ugur [1], having a reliable money demand function is crucial for the effectiveness and success of the monetary policy program. The demand for money is a vital factor in determining economic variables like interest rates, inflation, exchange rates, national income, and investment in the economy. The absence of a stable money demand function can adversely impact economic stability, leading to fluctuations in real output. Therefore, it is essential to ensure that the money demand function is stable and can adjust to changes in money supply to maintain stability in the economy.

In light of the current economic conditions, it is imperative that the monetary authority adopts and executes effective monetary policies. However, this can only be achieved if the country has a stable money demand function and appropriately estimated money demand equations. A well-founded money demand function is considered to be fundamental in conducting monetary policy, as it allows the use of monetary aggregates in a way that has a predictable influence over economic variables and facilitates the establishment of economic policies [2]. When there is a reliable consistency between the variation in money and the movements in income, prices, and interest rates, monetary targeting policy becomes a valuable tool for controlling inflation.

The sound money demand function also links money to the real economy, allowing the monetary authority to anticipate policy effects on inflation, real income, and interest rates [3,4]. Therefore, it is decisive for central banks as it enables them to select effective monetary policy instruments. Additionally, it ensures correct predictions of the effects caused by money-supply shocks on the aggregate income and offers valuable information into the relationship between money and inflation. When there is a well-founded money demand form, central banks can pursue their policy objectives with more confidence about the effect of policy action on economic performance.

The demand for money function has been widely studied due to its crucial role in analyzing an economy's performance, particularly in the formulation and transmission of monetary policies. However, most of the research has been conducted in developed countries, primarily in Western countries. In contrast, there have been fewer studies on the formulation of the demand for money function in developing countries, although there have been positive developments in recent years.

The literature on the money demand function in Ethiopia and its relationship with inflation and other macroeconomic variables is quite limited. As a result, there exists a dire need for a comprehensive study to model the demand for money and its impact on inflation, real income, and interest rates. This study aims to bridge this gap and provide valuable insights into the monetary landscape of Ethiopia.

The main objective of this study is to formulate and assess the demand for money function in Ethiopia and particularly examine its relationship with the CPI inflation. In accordance with the above objective, the study determines the effect of real GDP, exchange rate, lagged value of money demand, and real interest rate on demand for real money balance in Ethiopia, and also shows the trend and change of money supply and CPI Inflation.

The remainder of the paper is structured as follows: The next chapter summarizes the historical development of money balance and inflation in Ethiopia. Chapter three is devoted to a brief review of theoretical issues and empirical evidence relating money demand and its relation with main inflation. The data, methodology and empirical result will be presented in the fourth chapter. The final chapter comes out with conclusions and some policy impli-

cations.

2. Historical development of money and inflation in Ethiopia

Over the past two decades, the economic landscape of Ethiopia has undergone significant changes. The implementation of the structural adjustment plan has led to an increase in government spending through external financing and a loosening of fiscal policy. In order to spur economic growth and development, successive strategic plans have been also implemented to reform the country's economy. To achieve these reforms, the government has had to increase its level of investment, which has in turn stimulated additional demand and bolstered economic growth. These growths have in turn led to increasing government spending and generating additional economic demand from various actors.

According to the research conducted by different scholars, it is widely believed that an increase in the money supply, within a reasonable limit, can result in a significant boost to both investment and economic growth in the short run; in the long, however, it just causes inflation. The broad and reserve money supply in Ethiopia, as shown in **Figure 1** below, has been growing steadily since 2000. From 2000 to 2007, monetary aggregates grew at a moderate pace. However, both broad money and reserve money have started to increase steadily and have continued to do so since 2007, although reserve money increment has not been as large as broad money. Between 2000 and 2007, the aggregate amount of money in circulation (broad money) increased by about 12 billion Birr. However, over the course of just four years following this period, it experienced a remarkable surge, rising by 33 billion Birr. In the period from 2010 to 2021, the overall money supply grew by a modest 1.2 trillion Birr, culminating in a total of 1.41 trillion Birr by the close of Q2 2021/2022. On the other hand, the country's reserve money saw an increase of 14 billion Birr from 2000 to 2007. However, from 2007 to 2021, the stock of money in the country grew by an additional 314 billion Birr, ultimately reaching a total of 341 billion Birr by the end of Q2 of the fiscal year 2021/2022.
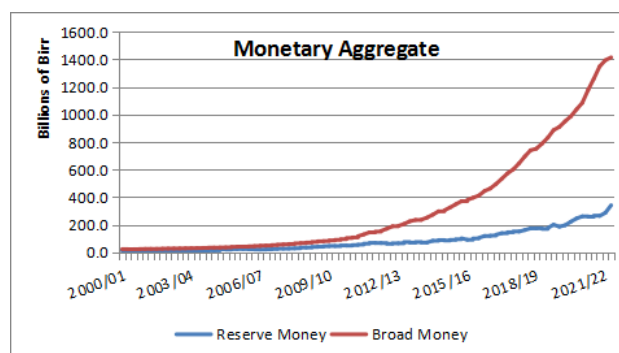

Figure 1. Trend in broad and reserve money.

Source: National Bank of Ethiopia.

Based on the data presented in **Figure 1**, it is evident that the reserve money statistics for Ethiopia demonstrate an average reserve money value of 117.5 billion Birr from the period of 2000/2001 to 2021/2022. The minimum value was recorded at 8.787 billion Birr in 2000/2001, while the maximum value was observed at 341,947 billion Birr in the second quarter of 2021/2022. These figures represent a significant increase in base money supply and consequently broad money.

The graphical representation in **Figure 2** shows the correlation between money supply growth and inflation in Ethiopia. Over the period of study, there has been a fluctuating but overall minor increase in money supply growth on both a quarterly and yearly basis. In many underdeveloped countries, inflation tends to be unstable in the economy. Similarly, inflation in Ethiopia has been characterized by continuous fluctuations, with an overall upward trend. Since 2002, the rate of inflation has increased at a faster pace, which coincided with improvements in the economy. Inflation occurs when the quantity of money in circulation grows at a faster rate than the economy's ability to produce new goods and services. This results in a situation where the supply of money outstrips the supply of goods and services, thereby causing an increase in prices. The underlying cause is that the excess money available chases a relatively limited quantity of goods, thus making them more costly to acquire.
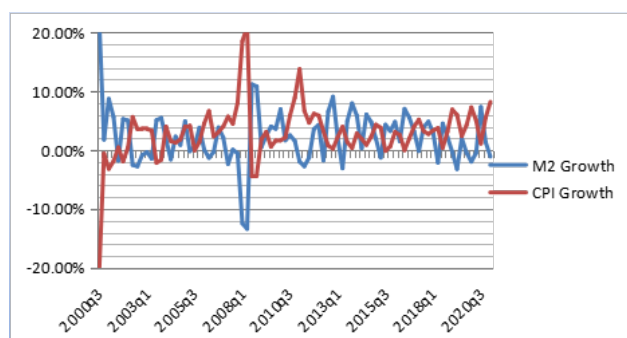
Figure 2. Trend in broad money growth and consumer price index growth as a proxy for inflation.

Source: National Bank of Ethiopia and CSA.

According to data presented in **Figure 3**, it is evident that the real GDP growth in Ethiopia on average has remained consistently high between the years 2000Q3 and 2021Q2, while the growth of money supply has experienced fluctuations. Despite variations in the early 2010s, the period after 2005 witnessed stable and rapid growth, largely attributable to the government's adoption of its Growth and Transformation Programs (GTPs). The government's substantial investments in health and education services, as well as in the development of transportation and industrial infrastructure, including hydroelectric power plants and transmission lines, have all contributed significantly to the country's rapid and consistent economic growth over the past two decades, as noted by the World Bank (2020).
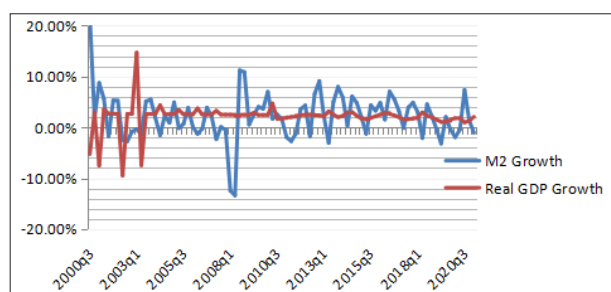

Figure 3. Trend in broad money growth and real GDP growth.

Source: National Bank of Ethiopia and CSA.

3. Literature review

3.1 Theoretical framework of money demand

Theoretical explanation of money demand has been a subject of controversy among the different money demand theories, and these theories have evolved over time. This section briefly defines the developments of the money demand beginning from the classical theory of aggregate demand to Milton Friedman's modern quantity theory of money.

Classical theory

Classicalist's quantity theory of money demonstrates that people use money merely for payment purposes. That means people hold money for current transaction purposes—for personal and business exchange of goods and services.

According to Fisher's Quantity Theory of Money, the main factor that affects the level of inflation in an economy is the quantity of money circulating in the economy. They advocate that there will be a proportionate change in the price level as change in the quantity of money supplied, other things remain constant.

The transaction approach of Fisher's Equation of Quantity theory of Money formally is stated as follows:

$$MV = PY \tag{1}$$

where, M = total quantity of money in circulation in the economy, V = velocity of circulation, P = average price level (GDP Deflator), T = real GDP demand.

Equation (1) above demonstrates that the total money paid to purchase goods and services which is MV (velocity multiplied by stock of money) is equal to their value PT (price of goods and services multiplied by the number of real transaction). Nominal stock money circulating in an economy is purely controlled by the monetary authority that it canned as an exogenous variable. On the other side, the real people's demand for goods and services in any given period of time is a function of real income that there will be a higher demand for goods and services as increase in national income.

Fisher's equation measures only the volume of business transaction. And thus, it failed to measure the purchasing power of money and also neglected the role of the interest rate as one of the causal factors between money and price. The relationship between the rate of price and money in a fisher's quantity theory of money equation is independent of

the rate of interest.

Keynes' theory of money and prices

Keynes in his General Theory (1936) criticized the classical quantity theory of money and argued that the quantity of money and its value of prices have no direct, proportional and predictable relationship between them and also postulated that the changes in money supply may be transferred to real GDP and employment through interest rates and investment. His theory provided us with the causative mechanism by which the change in the level quantity of money brings to the change in the level of price.

Keynes's theory of demand for money is termed as 'Liquidity Preference' for demand for money. According to Keynes, the desire for liquidity arises because of three motives; the transactions motive, the precautionary motive, and the speculative motive. Keynes advocates that households, businesses, governments, and central banks hold cash relates for the sake to satisfy the current need for cash transactions for personal and business exchange. The lack of systematic harmonization between the receipt from the economy and expenditure leads to a rise in the demand for money holding.

$$M^t = f(Y) \tag{2}$$

where, M^t = money demand for transactions, Y = revenue, $\dfrac{dM^t}{dY} > 0$.

People also desire to hold money to cover unforeseen and unpredictable contingencies since entities are sometimes insecure as to when they will have the required cash balance in day-to-day life (precautionary motive).

$$M^p = f(Y)$$

where, M^p = money demand in precaution, Y = revenue.

Whereas, the store value of money function is emphasized by the speculative motive of the demand for money as investors and traders employ strategies to keep money in liquid form to take advantage of future market uncertainty resulting in a change in the interest rate. Economic entity's desire to buy the bonds depends on the interest rate as the potential buyers would willing to purchase and make profit at least the current interest rate on their bond portion of their portfolio.

$$M^S = f(I) \tag{3}$$

where, M^s = money demand for speculative, I = interest rate.

The demand for money of transaction, precaution and speculative purpose are written in the form of:

$$M^t + M^p + M^S = f(Y, I) \tag{4}$$

Another theory Keynes modeled regarding money demand is liquidity trap concept. A liquidity trap is described as the period where the economy have experienced very low level of interest rate and high level of savings. In other, word economic entities are holding cash rather than asset which yields close to 0% of interest rate. It is caused when entities hold cash balance for unexpected incidents for instance instabilities, lack of income in the hands of the consumers, lack of investment by the private or government entities or due to falling net exports, or deflation. Economists called it a liquidity trap as growth in money supply gets trapped in sphere influence and thus could not stimulate the level of investment and interest rate. Keynes argues that in the period of the existence of liquidity monetary policy would be ineffective to stimulate aggregate demand.

Friedman's restatement of the quantity theory of money

Milton Friedman's Quantity Theory Money (Monetarist) advocates his theory in supporting the classical theory with minor adjustment and reinforce Keynes's speculative motive within the system of asset price theory. Milton advocates that the people's money demands are determined not only by interest rate and permanent income but also wealth, the opportunity cost of holding money, and inflation. He considered the stability of the demand for money as just real world facts demonstrated by empirical studies and the impact of money supply movement on GDP spending and income is predictable [5]. Monetarists advocate that when there is an unexpected change in money supply there will be immediate adjustment as this change in the long run will only affect nominal variables.

3.2 Empirical literature

There are a number of studies that have been studied by many scholars to assess the demand for real money balance function and its relation to inflation in the case of both a cross country and single country analysis. In the case of Ethiopia, however, there has generally been lacking in the empirical literature. This section will discuss the available empirical literature of different countries' demand for money and its relation to other macroeconomic variables.

For instance, for the period of 1971/1972 to 2008/2009 and employing the error correction model (ECM) in Ethiopia, Mamo [6] investigated the determinants money demand function and estimated its function. He found that the real GDP positively impacts peoples' demand for real money balance whereas inflation expectation and money demand are negatively related. He also found that depending on the degree of local currency appreciation or depreciation the impact of real effective exchange rate would be positive or negative.

In the same way, Abate Yesigat et al. [7] examined the determinants of demand for money and its stability in Ethiopia by employing the ARDL bounds testing approach. Their finding shows that the real money balance and its determinants of real GDP, interest rate, exchange rate, and inflation have a long-run correlation. The money demand function was stable over the period of their consideration and they suggest that monetary aggregating monetary policy targets would be effective to achieve the monetary policy objective in Ethiopia.

Haile [8] carried out the performance of the demand for money function in Ethiopia for the period 1970/1971 to 2002/2003 by employing Engle-Granger two-stage procedures and estimating broad and narrow money. Alike Abate Yesigat et al.'s finding, he found that in the long run income, exchange rate, and interest rate are significant determinants of demand for money. Findings also identify that in the short-run broad money definition is well defined by interest rate and exchange rate than the narrow money definition.

The researcher aimed to discuss the long-run monetary policy condition in Ethiopia from 1970 to 2000. The Ethiopian economy had experienced a huge political ideology shift, an economic downturn, and two consecutive periods of drought in those decades. The study found that political and economic changes in those periods country experienced higher inflation and demand for money due to a shortage of production. Although political ideology shifts in a country and production drops had long-run monetary policy consequences, narrow money demand was stable [9].

For the period of 1990Q1 to 2016Q3 in Ghana, Bernard and Sin-Yu Ho [10] tested Friedman's hypothesis that the change in monetary uncertainty caused an increase in money demand and a fall in the velocity of money by emphasizing the effect of monetary uncertainty on the demand for money. Contrary to Friedman's hypothesis, they found that in both the short-run and long-run monetary uncertainty has a negative and significant impact on the demand for money. Ruling out monetary policy as a source of uncertainty, they believe that there is a stable demand for money as a smooth growth rate of monetary aggregate. Because of a stable demand for money function, they suggest that demand for money changes could be anticipated and monetary policy objective can achieve its objective.

Two studies that carried out the empirical analysis of the factors that affect the demand for money in Pakistan for the period 1975-2009 and 1960-1999, respectively, found that income, inflation, and exchange rate significantly determine the demand for money. The study also reveals that the rates of interest, market rate, and bond yield are important causes for the long-run money demand behavior [11,12].

Similarly, Djambak, Syaipan, et al. [13] analyze the impact of interest rates, inflation rate, and GDP growth variables on demand for money in Indonesia for the period 2005 to 2018. The study found that money demand is positively affected by inflation but statistically insignificant, whereas the effect of interest rate and economic growth is negative and statistically significant in Indonesia.

By using monthly data for the period 2005 to 2012 and employing the Ordinary Least Square method and the Granger Causality test, Rosli, Norhidayu, et al. [14] analyzed factors that affected demand for money in Japan incorporating crises, consumer price index, industrial production index, and bond rate. Their finding shows that there is the existence of a relationship among variables significantly affecting money demand, and also the presence of bidirectional causality between CPI and bond rate to monetary.

John R. Moro [15] estimates modem version of the quantity theory of money growth, real GDP growth, and inflation for 81 countries. In his long run estimation, he found that high long-run inflation is driven by equally high long-term money growth (one-for-one relationship). In the countries with relatively low money growth and inflation, the one-for-one relation breaks down.

We can broadly summarize that there are studies available on the relationship between demand for money and inflation from the review of empirical as well as theoretical literature, but most of them are advanced and emerging economies level. A comprehensive study focusing on the estimation and formulation of different macroeconomic policies incorporating money demand function is lacking in Ethiopia. The proposed study intends to fill the gap by analyzing the relationship between money supply and variables that affect the level demand for money.

4. Methodology, data and estimation result

4.1 Model specification

Conventional demand for money theory advocates that the behavior of money demand function is determined by scale and opportunity cost variables. Gujarati in 1968, as cited in Ghatak estimated demand for money function through the conventional standard equation approach for least developed countries by undertaking scale and opportunity cost variables as determining factors. The scale variable in the money demand function is used as a measure of economic performance related to economic activities. The theory argues that variables such as income, expenditure, and wealth are dominant variables considered as scale variables. Economic performance measurements such as income, expenditure, and wealth are considered as scale variables whereas, interest rate (domestic and foreign), general price level, and expected exchange as well as inflation rate are opportunity cost variables.

The functional relationship of the money demand function is generally presented in Equation (5) below.

$$M/P = f(SV, OCV) \qquad (5)$$

where, M = monetary aggregates in nominal terms, P = price, SV = scale variables, OCV = opportunity cost variables.

Money market is a market in which economic entities interact with each other through central bank supply of money to the economy and its demand from individuals, firms and other institutions. This study assumed that the quantity of money supplied to the economy and demanded by the economic entities is equal-which means the money market is at an equilibrium level. Having assumed that the money market long run would be at equilibrium, an approach of nominal money supply in a country is going to be used as a demand for money [7]. This paper follows similar fashion and real demand for money will represented by the real money supply (nominal money supply divided by inflation rate).

Accordingly, the Ethiopian long-run real money demand function can be well modeled in the following forms:

$$MD = f(RGDP, CPI, REER, RIR, MD1) \qquad (6)$$

where, MD = the stock of money, $M2P$ = real money demand, $RGDP$ = real GDP, CPI = consumer price index, REER = real effective exchange rate, RIR = real interest rate, $MD1$ = the previous year real tock of money.

After specifying the long-run demand for the real money balance model, the study reformed the function in logarithmic in the following form:

$$lM2P = \beta0 + \beta1lRGDP + \beta2lCPI + RIR \\ + \beta3lREER + \beta4l(M2P1) + \varepsilon \qquad (7)$$

where, *lM2P* = Log (Real Money Balance), *lRGDP* = Log (Real Gross Domestic Product), *lPE* = Log (Consumer Price Index), *RIR*= (Real Interest Rate), *lREER* = Log (Real Effective Exchange Rate), *l(M2P1)* = Log (Lagged Real Money Balance), ε= error term.

Variable explanation

(i) Real money balance

The model of real demand for money is closely connected to the real money supply. In this study, the real money demand is implicitly represented as the amount of the money supplied to the economy that will be deflated by the general price level (MD/P).

(ii) Real GDP

Real GDP is regarded as the most important scale variable for measuring demand for money, and it has been used for most empirical research in developing economies. Real GDP is a macro-economic variable that is measured as the current value of goods and services produced by a country in a particular period, after adjusting for inflation. Other things being equal, GDP is considered a good measure of the total economy's income, and as GDP increases, so does the income of people, and as income increases, so does demand for money. At the same time, people's demand for money would increase at higher GDP and income levels.

(iii) Real interest rate

In most of the research papers, interest rate is one of the most important opportunity cost variables in the estimation of money demand function [16]. Interest rates play a crucial role in shaping investment opportunities within a well-functioning financial market. However, this is not the case in many underdeveloped financial market countries, Ethiopia included, where national policies dictate the rate rather than market forces. In Ethiopia, the official rate is the bank's savings rate, which is infrequently adjusted and has minimal effect on lending rates, resulting in stagnation within the financial sector. Thus, this study used real interest rate as one of opportunity cost variables. Real interest rates are calculated by adjusting the nominal lending interest rate by the inflation rate in the economy.

(iv) Real effective exchange rate

Due to the fact that the domestic currency depreciates or appreciates in nominal terms, we were unable to measure the competitiveness of one currency in relation to the index of partner country's currencies. Hence, in this study, we used real effective exchange rate (REER) to measure the performance of domestic currency in relation to an index (or basket) of other partner country's currencies. For example, in the case of Ethiopia, due to higher foreign exchange intervention by the monetary authority and information asymmetries and risks in the parallel market, the official exchange rate would be below the market clearing rate.

(v) Consumer price index

Inflation denotes the general and continuous increase in the prices of goods and services over a specific period of time. This is a crucial factor utilized in demand for money model specification and is typically measured by the growth of the Consumer Price Index (CPI). The CPI is a metric that measures the average change over time in the price paid by society for a market basket of goods and services.

4.2 The data sources

With the purpose of estimating and formulating the demand for money in Ethiopia, this study used secondary data which were drawn from Central Statistical Agency (CSA), Ethiopian Ministry of Planning and Development and National Bank of Ethiopia (NBE). The study employed quarterly data that covers the period from 2000Q3 to 2021Q2. The data of Consumer Price Index and GDP were collected from CSA and Ethiopian Ministry of Planning and Development, respectively. The data for monetary aggregate, exchange rate, and interest rate were obtained from NBE.

4.3 Estimation result and analysis

Unit root test

It is mandatory to verify the integrating properties of the variables before determining the statistical specification of the model. In order to determine

whether the variables in the money demand function are stationary or not, the study performs the Augmented Dickey-Fuller (ADF) unit root tests. If the calculated test statistic is greater than the ADF critical values in absolute terms, then we will accept the null hypothesis of unit root for the variables which implies that the series under investigation is nonstationary. In contrast, the alternative hypothesis claims that the series is stationary. In this regard, as we can see from **Table 1**, all variables of interest on our money demand function model have unit roots at a level and stationary at first different-integrate order one I (1). There again, real money demand (M2P), real GDP (RGDP), Consumer Price Index (CPI), the real effective exchange rate (REER), real interest rate (RIR), and lagged value of real money demand (M2P1) are integrated of order one.

The long run money demand model

As the summary of result displayed in **Table 2**, in the long run estimation model the coefficients of the all variables considered are consistent and statistically significant implying that the variables included in the model explain significantly real money balance in the long run. Demand for real money balance is determined positively by real income, lagged value of real money whereas, inflation, real effective exchange rate and real interest are explained negatively.

The long run estimation model result reveals that there is a positive and statistically significant relationship between real GDP and demand for real money balance as income elasticity for money demand is statistically significant at the 5% level. The finding is in line with Keynes, the Cambridge school, and Baumo-Tobin's theoretical work on money demand which shows that when real income rises, individual demand for money increases. The study found that a 1 percent increase in real income will lead to 0.34 percent increment in the demand for real money balance. Many studies support an argument of decrease of income elasticity of money demand when there are financial and technology development, macroeconomic stability, accessible money substitutes and liberalization of an economy. This result is in line with the findings [17,18] for Sierra Leone and for Nigeria.

The other important variable that positively af-

fects the real money balance, in the long run, is its lag value. For the period of the study review, the demand for real money balance in Ethiopia has been continuously increasing. Thus, in general, other things remain the same last year's demand for real money balance has a significant and positive effect on the current period demand for real money.

The study found that the inflation rate (measured by CPI growth) has a negative elasticity of –0.14, which is statistically significant at the 5% level. This confirms Friedman's theoretical expectations, suggesting that a general increase in the price of basket goods and services will result in a decrease in the demand for real money balance in Ethiopia. Specifically, the study found that a 1% increase in CPI inflation would lead to a 0.14% decrease in the demand for real money balances in the long run. As the price of consumer goods and services goes up, people tend to turn to alternative forms of investment such as land and real estate, commodities, and equity holding, which leads to a decrease in demand for Birr. As the inflation rate increases, economic entities prefer money holding to asset holding to match the expected rise in nominal expenditure [19].

The real effective exchange rate (REER) coefficient is negative and statistically significant. REER is explained as the value of a domestic currency against a weighted average of several foreign currencies. The negative coefficient of REER indicates that where domestic currency depreciates, the public tendency towards holding foreign currency will increase, and domestic currency appetite will reduce which in turn increases demand for money. This indicates that the public will substitute foreign currency for domestic currency when there is a better investment opportunity.

In addition to real GDP, real effective exchange rate and CPI inflation, there is an interest rate variable that the study estimated in the demand for money function. In the long run, the movement of real interest rate has a negative and statistically significant effect on demand for money. This implies that in the long run, the demand for real money balances in Ethiopia is also affected by the domestic real interest rate.

Table 1. Unit root test Augmented Dickey-Fuller test.

Variable	Level/first difference	ADF test statistics	Critical value		
			1%	5%	10%
LM2P	Level	−0.742	−3.534	−2.904	−2.587
	First diff.	−8.064	−3.535*	−2.904**	−2.587***
LRGDP	Level	0.426	−3.534	−2.904	−2.587
	First diff.	−12.122	−3.535*	−2.904**	−2.587***
LCPI	Level	1.667	−3.534	−2.904	−2.587
	First diff.	−8.137	−3.535*	−2.941**	−2.609***
LREER	Level	−0.975	−3.534	−2.904	−2.587
	First diff.	−5.658	−3.535*	−2.941**	−2.609***
RIR	Level	−2.948	−3.534	−2.954	−2.587***
	First diff.	−7.410	−3.535*	−2.941**	−2.609***
LM2P1	Level	−0.181	−3.534	−2.904	−2.587
	First diff.	−8.450	−3.535*	−2.941**	−2.609***

(***), (**) and (*) denotes 90%, 95% and 99% confidence interval respectively.

Source: Author's computation using STATA results, 2022.

Table 2. Long run estimation result.

lm2p	Coef.	Std. Err.	t	P > t
lrgdp	0.335	0.097	3.460	0.001
lcpi	−0.137	0.055	−2.480	0.015
lreer	−0.148	0.051	−2.910	0.005
rir	−0.148	0.071	−2.080	0.041
lm2p1	0.898	0.035	26.000	0.000
cons	−0.759	0.334	−2.270	0.026
R-Squared	0.9923			
Adjusted R-Squared	0.9918			
SSR	0.027			
no. of observations	84			
F(5, 78)	1997.4 (0.000)*			
DW stat	1.712			

Source: Author's computation using STATA results, 2022.

The coefficients in the long run for all variables have the expected sign in line with economic theory. However, the ADF statistics results for stationarity indicate that all the variables are stationary after first difference i.e. I (1). After the study found that variables specified in the money demand model are stationary at the first difference I (1), the next step is determining whether there is a significant long-run relationship among variables.

Test for co-integration

It's important to make sure that variables are stationary and co-integrated to avoid any misleading regression incidents. A study using the ADF unit root test found that all variables in the money demand form were stationary after the first difference. The theory of co-integration suggests that even if variables in a regression have a unit root, their linear long-run combination between variables can still be stationary. Once the co-integration of variables has been tested and the long-run model has been estimated, the next step is to establish a short-run dynamic error correction model.

To determine if there is a co-integration between variables, it is important to check the stationarity of the residual term that generated from the variables being regressed. If the test statistic exceeds the critical values for the MacKinnon test in absolute terms, it means that the null hypothesis of no unit root for the error term holds true, indicating that the residual term is stationary at I (0). However, if the test statistic falls below the MacKinnon critical values, then the null hypothesis will be rejected. **Table 3** shows that the residual term is stationary at the 1%, 5%, and 10% MacKinnon critical values.

Table 3. Co-integration test.

Variable	Test statistics	1% critical value	5% critical value	10% critical value
E	−8.49	−5.563	−4.13	−4.585

Source: Author's computation using STATA results, 2022.

From the above analysis, it has been determined that the variables utilized in our money demand function are co-integrated. This signifies that there are significant relationships between the real money balance and the explanatory variables, indicating that the regression model is not spurious.

Normality test

Based on the study's findings, it can be concluded that the data used in the analysis are normally distributed. The normality test is used to assess whether the data adhered to a normal distribution, which is necessary for measuring the effect of the explanatory variable on the dependent variable. The study employed the Shapiro-Wilk SW test to test the normality of the residual term, and when the null hypothesis was rejected (the SW was less than the relevant critical value), the residual term was considered as normally distributed. **Table 4** shows that the statistical probability of Shapiro-Wilk's test was 0.0505, which is greater than the 5% significance level. Therefore, the study's data can be considered normally distributed.

Autocorrelation

The Breusch-Godfrey serial correlation LM test is a statistical method utilized to assess the existence of correlation among residuals. The null hypothesis of

no autocorrelation will be rejected if the probability of chi-square falls below the 5% significance level. Conversely, if the probability exceeds the 5% significance level, the null hypothesis will be accepted. This test is a crucial tool for data analysts to ensure the reliability and accuracy of the data under analysis.

Table 4. Shapiro-Wilk W tests for normal data.

Variable	obs	W	V	z	prb > z
E	84	0.95995	2.861	2.31	0.0505

Source: Author's computation using STATA results, 2022.

Upon analyzing the data presented in **Table 5**, the study found that there is no autocorrelation problem. This is due to the statistical probability of the chi-square from the Breusch-Godfrey LM test of 31.8% is greater than the 5% significance level. As a result, it can be concluded that the residuals are not correlated, and the data being analyzed is both reliable and accurate.

Table 5. Breusch-Godfrey LM test for autocorrelation.

lag(p)	chi^2	df	Prob > chi^2
1	0.997	1	0.3181
	H0: No serial correlation		

Source: Author's computation using STATA results, 2022.

The short run dynamic error correction model

After the study was tested the variables included in the regression model are being co-integrated and found a significant error correction term, the dynamic error correction model is estimated and presented in **Table 6** below. The study of how individuals, business men and governments behave financially is a topic of great interest in analyzing money demand. The models employed in this field play a crucial role in understanding the dynamics of such behavior. It agreed that the error correction model is a valuable tool for analyzing money demand, as it considers all variables and can even be suitable for analysis in adverse conditions [20]. Additionally, it helps us understand the behavior of economic agents out of equilibrium, which is important as the statistical behavior of the demand for real balances does not provide insight into this behavior in the long run.

Based on the analysis of the short-run dynamic error correction model, it has been determined that CPI inflation, real effective exchange rate, lagged real value of money balance, and lagged error term variables serve as essential factors influencing monetary adjustments. Through the analysis, it appears that real GDP and real interest rate have no influence on the demand for real money balance. On the contrary, variables such as CPI inflation, real effective exchange rate, lagged real value of money balance, and lagged error term have been identified as crucial factors in determining money demand balance for the period from 2000Q3 to 2021Q2 in Ethiopia.

Based on the analysis of **Table 6**, we can see that the error correction term (ECM) is –0.542, which is significant at the 5% level. This negative sign is in line with our expectations, and it suggests that the variables are co-integrated. The error correction term

coefficient shows that 54.2% of real money balance disequilibrium is offset by quarterly adjustments. This implies that there is a significant correlation between the different variables. Moreover, it suggests that when the real money balance value is at disequilibrium, households tend to reduce their demand in the subsequent quarters. Therefore, it is crucial to address this disequilibrium over time in order to achieve long-term equilibrium.

The results of the study suggest that the independent variables exert a significant influence on the demand for real money balance. Notably, the coefficient of determination indicates that roughly 75% of the variability in the dependent variable is explained by the independent variables. This finding underscores the importance of addressing disequilibrium in the real money balance over time, as doing so is essential for attaining long-term equilibrium.

Table 6. Short run estimation result.

D.lm2p	Coef.	Std. Err.	t	P > t
D.lrgdp	0.831	0.103	0.810	0.422
D.lcpi	–0.793	0.650	–12.210	0.000
D.lreer	–0.090	0.052	–1.720	0.090
D.rir	–0.066	0.079	–0.830	0.409
D.lm2p1	0.504	0.135	3.720	0.000
ECM_1	–0.542	0.152	–3.570	0.001
Cons	0.014	0.002	7.010	0.000
R-Squared	0.75			
Adjusted R-Squared	0.73			
SSR	0.01			
no. of observations	83			
F(6, 76)	(38.59)**			
DW stat	1.87			

Source: Author's computation using STATA results, 2022.

5. Conclusions

The money demand function has always been an essential component of macroeconomic models and policymaking. Having reliable predictions on the money demand function helps in determining the optimum growth of money supply which is vital in controlling the inflation rate in the economy and also prevents monetary disturbances from affecting real output. Thus, the aim of this paper was to formulate

and estimate the money demand function by using the framework of Ordinary Least Square method and Engle-Granger two-stage procedure for quarterly data covering the period from 2000Q3 to 2021Q2.

The study conducted an analysis of the factors that impact the demand for money in Ethiopia. The study considered variables such as real GDP, CPI inflation, real effective exchange rate, real interest rate, and lagged real money balance for analysis.

Stationarity of variables was assessed afterward and determined that they were all integrated of order one. Additionally, con-integration tests were conducted and discovered a significant long-term relationship between these variables.

Based on the analysis conducted for the period of 2000Q3 to 2021Q2, the demand for real money balance in Ethiopia is affected by all variables that study considered such as real GDP, CPI inflation, real effective exchange rate, real interest rate, and lagged real money balance. It was found that real income and the lagged real value of money balance have a positive effect on the demand for real money balance, while inflation, real effective exchange rate, and real interest rate have a negative effect. These factors play a significant role in estimating the real money balance in the long run, and their impact should be taken into consideration for effective economic planning.

Based on the short-run dynamic error correction model, it appears that CPI inflation, the real effective exchange rate, the lagged real value of money balance, and the lagged error term are the primary determining factors for monetary adjustments. It is of note that real GDP and real interest rate do not seem to have a significant impact on the demand for real value money balance, suggesting that real income and interest rate may have a weaker effect in the short run.

The error correction term appears to play a crucial role in rectifying the disequilibrium in real money balance. According to the study's finding, short-run adjustments counter-balance approximately 54.2 percent of the disequilibrium in each quarter. This suggests that if the value of real money balance exceeds its equilibrium level, the money holder may reduce their demand during the next quarter. This pattern holds true for any given period and highlights the significance of the error correction term in restoring balance to the real money balance.

It is imperative for policymakers to adopt a comprehensive approach when formulating monetary policy. When conducting this policy, it needs not only taking into account the movement income and pricing, but also the fluctuation of exchange rates. Through the creation and evaluation of a comprehensive demand for money function, policymakers can accomplish stable growth in money and facilitate sustainable economic advancement. It is of utmost importance to consider all these factors holistically in order to arrive at informed decisions that benefit the economy at large.

Conflict of Interest

Data Availability Statement

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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