International Journal of Economics & Management Sciences

Opoku, Int J Econ Manag Sci 2017, 6:6
DOI: 10.4172/2162-6359.1000477

Research Article Open Access

Determinants of Money Demand in Ghana

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Abstract

This paper examines the factors that influence money demand in Ghana using the ARDL approach as the baseline estimator. We find strong evidence of existence of long-run equilibrium relationship between money demand and its determinants. The results also indicate that expected inflation and real exchange rate are the key determinants of money demand both in the short-run and long-run. The role of real interest rate is only recognized in the long-run whereas the impact of financial innovation resulting from the on-going financial sector reforms only affect the transitional dynamics of the money market conditions. There is also an ample evidence of instability in the money demand relationship as a result of inflation and exchange rate volatility. Moreover, given that the wealth effect phenomena holds in Ghana, the paper concludes by suggesting that policies directed towards regulating and maintaining stable exchange rates and low and steady inflation would be necessary to maintain stable money demand and thus enhance the effectiveness of monetary policy in Ghana.

Keywords: Money demand; Financial sector reforms; Financial innovation; Ghana

JEL classification: C22; C32; E41

Introduction

Knowledge about the parameters in the money demand function plays an important role in the formulation of monetary policy rule, more so under monetary and inflation targeting regimes. The objective of this paper is to estimate the parameters in the money demand function for Ghana using time series econometric methods. We acknowledge that this is not the first paper that empirically estimates the money demand function for Ghana. There have been quite a number of studies on the determinants of money demand function in Ghana [1-4]. Conclusion emanating from these studies is that in Ghana money demand depends on macroeconomic forces such as changes in inflation, real income, net foreign assets, and exchange rate volatility. Moreover, evidence from previous studies show that the determinants of money demand in Ghana is many and evolving. In the existing literature on Ghana, findings reported in one study usually differs from the one reported elsewhere on Ghana possibly due to differences in specifications, time period covered and frequency of the data series used [5]. While specification and data structures can be responsible for the mixed evidence in the existing studies thereby casting some doubt on the reliability of the results reported therein, instability in the relationship between money demand and its drivers may be the hidden factor for the inconclusiveness of the evidence reported so far. The instability in the money demand relationship may be the combined effects of structural reforms and financial innovations [6]. The doubts about the stability of money demand is one of the main reasons for Ghana's departure from monetary aggregate targeting to inflation targeting framework in 2002. This is due to the fact that inflation targeting does not solely rely on the stability of money demand, but instead uses a broad range of financial and real sector information to assess monetary policy stance. Nevertheless, a stable money demand is somewhat required as a transparent transmission mechanism for smooth operation of inflation-targeting program, given that the use of monetary policy is used as intermediate instrument in the implementation of its inflation-targeting (IT) framework. Consequently, given that stability of money demand depends on its determinants, it is important to establish a fitting demand function; especially taking into account the impact of the emerging financial innovations as a result of the on-going financial and structural reforms while excluding foreign interest rate in the money demand function. Most people in developing country including Ghana live near subsistence level and are not able to save over long periods. As such, they tend to be inactive in terms of patronage in foreign interest-bearing financial assets; hence the role of foreign interest rate in the money demand function is ignored. Nevertheless, the role financial innovation in terms the development of money substitutes like ATM cards and VISA cards in the financial sector, which enhance the medium of exchange role of money and facilitate transactions, is becoming prevalent in Ghana.

Identifying the relevant determinants and stabilizing them provides vital information for the conduct of monetary policy under IT regime. This paper there contributes to the debate on what factors determine money demand in Ghana by controlling for financial innovations and investigating the stability or otherwise of the estimated relationship.

We employ the ARDL approach to co-integration to estimate both the long and short run multipliers of the key drivers of money demand in Ghana using an annual time series data spanning the period 1970 -2012. As a robustness check, we also estimate the long-run elasticities of the money demand using the dynamic ordinary least squares (DOLS) estimator. The paper covers the periods of economy decay in the 1970s through the early 1980s, the Economic Recovery Program and Structural Adjustment Program of mid 1980s through early 1990s and transition to democratic governance since 1992. By examining impact of real income, inflation, domestic interest rate, exchange rate and financial innovation measures on money demand concurrently, this paper provides more robust evidence on the determinants of money demand in Ghana than reported elsewhere in the literature.

Foreshadowing the main results, we found that inflation rate and exchange rate play a dominant role in money demand stability in

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Received October 29, 2017; **Accepted** November 27, 2017; **Published** November 29, 2017

Citation: Opoku E (2017) Determinants of Money Demand in Ghana. Int J Econ Manag Sci 6: 477. doi: 10.4172/2162-6359.1000477

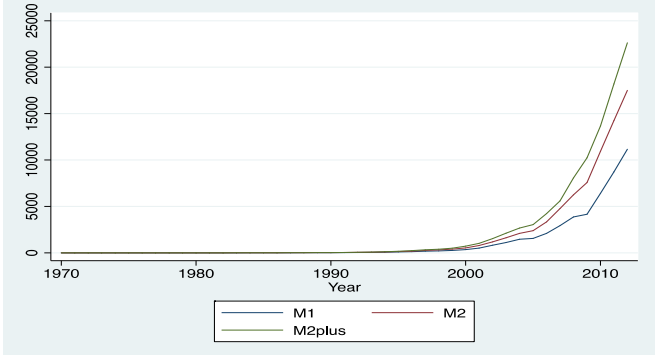
Ghana, both in the short-run and long-run. The impact of financial innovation fairly realized only in the short-run, whiles interest rate affects money demand, but only in the long-run. Also, we found that there is wealth effect on money demand in Ghana. The paper concludes that, anchoring inflation expectations and stabilizing the exchange rates while ensuring a stable real income growth will help in stabilizing money demand, a good prerequisite for effective monetary and inflation targeting polices.

Stylized facts about money demand in Ghana

Ghana's is currently on inflation targeting policy regime, where several indicators are considered in taking monetary policy decisions rather than only monetary aggregates. The rational behind the shift from monetary targeting to inflation targeting is due to the unstable behavior of demand for money function following the period of steady structural reforms and financial sector deregulation. Looking at the trend of the monetary aggregate (M1, M2, M2+) since the 1980s, there have been consistent fluctuations (especially in the mid-1980s) even though there seem to steady growth in the monetary aggregates in absolute terms. Figure 1 shows the trend of M1, M2, M2+ in Ghana Cedis (GHS) currency.

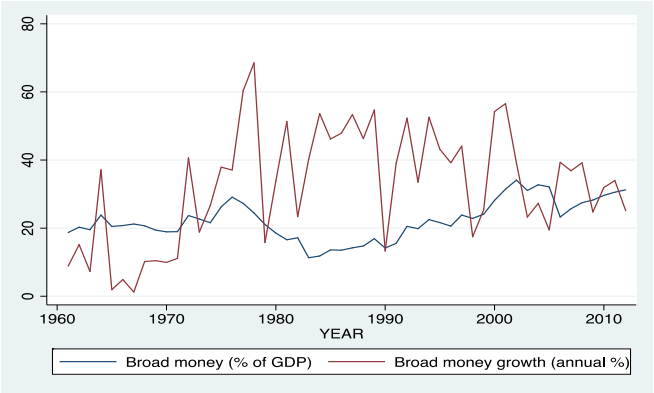
Figure 1 shows that the growth trend in narrow and broad money (M1, M2 and M2+) has generally been increasing between 2000 and 2010. According to the World Bank, narrow money refers the currency in circulation outside banks plus demand deposit; and broad and quasi money comprise the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. This definition of money supply used in Ghana is frequently called M2+. The M1, M2, M2+ are also used as proxies for money demand based on the assumption that money supply equals money demand in equilibrium [7].

The growth rates of the monetary aggregates are mainly due to the higher rates of GDP within that period. For instance, average GDP growth rate between 2000 and 2012 is over 6% as compared to lower rate of about 3.14% between 1985 and 1999. Increase in broad money supply was also substantially driven by growth in reserve money. For instance, growth in reserve money was 36% in 2012 that translated into growth in currency deposits (M2+) by 24.3% in 2012. Also, the high money demand by the public is partly due high rates of the population within this period. For instance average population between 2000 and 2012 records over 22.1 million people as against around 17 million between 1985 and 1999. This buttresses Friedman's argument about



Source: Bank of Ghana.

Figure 1: Time trend of M1, M2, M2+ (in GHS).



Source: Bank of Ghana.

Figure 2: Growth rates of broad money.

large size of the population influencing economic activity and thus increasing the demand for money. However, the trends of monetary growth rates (in percentage change) tend to fluctuate. Figure 2 depicts changes in the growth rate of broad money (annually) and growth rate of broad money as percentage of GDP.

From Figure 2, it is seen that, monetary growth records its highest rates around 1978 and 1983. In 1978, high money supply lead to high growth rates but in 1983, there was a decline in output despite the increase in money supply. This was due to the unstable nature of the economy as a result of the structural reforms from the Economic Recovery Programme and Structural Adjustment Programme. There are also lower rates in the mid-1960s and 1990. The slowdown in the monetary growth was attributed to the negative growth rate recorded in the Net Foreign Assets (NFA). The Net Domestic Assets of the banking system grew by 49.9% whilst the Net Foreign Assets fell by 10.2%.

Monetary growth doubled between 1991 and 1992 from 26% to 52%. Broad money growth fell to 34.65% in 1993 but increased again to remain around 41% by 1997. This contributed to increase in inflation, from 10.26% to 70.82% between 1991 and 1995. At the same time, the exchange rate (Ghs/$) depreciated by 11.27% in 1991 and further by 22.5% in 1995. By 1998, monetary growth was reduced to 17.6%. Thereafter, inflation was also reduced to 20.83% by 1997 and further to 15.7% by 1998. While the results are mixed, one can argue that the increased broad money growth after 1991 resulted in the high inflation of 70.82% by 1995. On the other hand, the slower broad money growth by 1998 is also the likely cause of the lower inflation levels by 1998. This shows that money supply growth in Ghana exhibits seasonal patterns that translated into price increases and depreciation of the cedi. GDP ratio and the currency-to-money supply ratio did not record any significant changes from 2011. Broad money supply as a percentage of GDP increased by 0.10% from 0.65% in 2011 to 0.75% in 2012, while the ratio of private sector credit to GDP increased marginally by 0.07%, from 0.31% in 2011 to 0.38% in 2012.

Review of the Related Literature

This section of the paper reviews the plethora of theoretical and empirical studies on money demand and money demand functions. As is typical in many macroeconomic relationships, there is some controversy in money demand analysis with regards to the nature of the money demand function. Traditionally, money demand function originated from a variant the classical quantity theory (Fisher approach

versus Cambridge approach) of money [8]. According to Fisher, money demand is determined by nominal income, whiles the Cambridge posits that money demand is influenced by interest rate and nominal income. Building on the Cambridge argument, Keynes [9] maintained that money demand depends negatively on interest rate but positively on income.

Since the Keynesian theory of money demand, the question of what factors influences the demand for money to hold (liquidity preference) has received a great deal of attention from academics and policy makers. However, there is no agreed list of factors that determine money demand in the empirical literature. For instance, Friedman [10] included permanent income, expected return on money, expected return on bonds, expected return on equities, expected inflation in his money demand function. According to Friedman, income elasticity of money demand is about unit. However, Baumol [11] and Tobin [12], (in their inventory theoretic approach to money demand model), reported that the income elasticity of money demand is less than one, which contracts with Friedman finding. McCallum [13]; Arrau et al. [14], also justify the inclusion of factors that account for technological improvement in financial sector (financial innovation) in the money demand function. Also see Mannah-Blankson and Belnye for similar specification of the money demand function.

Mundell [15] was the first to include exchange rate as opportunity cost variable aside interest rate and expected inflation. However, the sign of exchange rate in the money demand function can be ambiguous. Exchange rate will have a negative sign in the money demand function when people hold more foreign currencies as domestic currency depreciates (currency substitution); but exchange rate will have a positive sign when more of domestic currencies are rather demanded when the domestic currency loses its value, for those who wish to maintain a fixed share of their wealth invested in domestic assets (wealth effects). Bahmani-Oskooee et al. confirms wealth effect from Hong Kong 1985Q1-1999Q4 using ARDL; Abbas Valadkhani [16] for six Asian countries 1975-2002; Dagher and Kovanen [17] for Ghana. On the other hand, Bahmani- Oskooee and Rhee found the existence of wealth effects in Canada and US, using data from 1973: Q1-1987: Q4. They also found that real money, real GDP, and real exchange rate are significant determinants of money demand in these countries.

With regards to the existing empirical literature on Ghana, there have been a number of diverse findings of the money demand function. For instance, Bawumia and Abradu-Otoo, using monthly data for the period 1983-1999, employed Vector Error Correction (VECM) in estimating the money demand function, which included inflation, domestic interest and exchange rate. They concluded that there is stable long-run relationship between expected inflation and broad money in Ghana. Also, Mannah-Blankson and Belnye, employing co-integration and error correction modeling of data from 1992: Q1 to 2000: Q4. They included financial innovation aside real GDP, exchange rate, inflation arrive even though still arrived at the conclusion that money demand in Ghana is still stable despite the structural reforms and the deregulation of the financial sector. Dagher and Kovanen also found a stable money demand function after applying Autoregressive Distributed Lagged (ARDL) modeling to data from 1990:Q1 to 2009:Q4, and including real GDP as scale variable; domestic deposit interest rate, the cedi Treasury bill interest rate, the U.S. Treasury bill interest rate, and the U.S. dollar Libor interest rate as opportunity cost variables. Most of the studies conclude on stable money demand function in Ghana. Nevertheless, there has been other few studies that support the view that money demand in unstable. For instance, Amoah and Mumuni, using quarterly data from 1980:Q1 through 2007:Q1, arrive at the conclusion that structural reforms and the deregulation of the financial sector have resulted in parameter instability in the demand for broad money. Asuamah et al. also found an unstable money demand relation, after employing ARDL to analyze data (1970-2011), which include inflation, exchange rate, GDP.

Methodology

In estimating our money demand function, we first test for unit root using the Philips–Perron (PP) and Zivot-Andrews (ZA) unit root tests, which were considered to be appropriate for the study. Philips–Perron (PP) unit root test is preferred to the traditional Augmented Dickey–Fuller (ADF) because it is valid even in the presence of serial correlation and heteroscedastic errors. Perron [18] however shows that the presence of structural breaks in the time series can bias unit root test estimates. We therefore complement the PP test by employing the Zivot–Andrew (ZA) unit root test developed by Zivot and Andrews [19]. ZA allows for unknown breaks in the deterministic terms of the time series. The procedure provides three different models for testing three possible types of structural breaks in the trend functions of a data series: structural break in the intercept, the slope, and both the intercept and slope. The null hypothesis here is that the series has a unit root without a structural break, against the alternative of trend stationary process with a structural break in the trend function at an unknown time.

On the basis of preceded discussions and theoretical as well as methodological literature, we consider Real Gross Domestic Product (RGDP) at 2005 constant prices as our scale variable; 90-days Treasury bill Real Domestic Interest Rate (RDIR), Real Exchange Rate (RER), and Expected Inflation Rate (EIR)[1] as opportunity cost variables; and Financial innovation (FI) to represent the impact of financial sector development on money demand. All data are annual time series covering the period 1970 to 2012, which were obtained from a single source of World Bank database (World Development Indicators) for consistency. Financial innovation is measured in various forms depending on how one wants to define it. In our study, we focus on the development of money substitutes like ATM cards and VISA cards in the financial sector, which enhance the medium of exchange role of money and facilitate transactions, because it is the most prevalent form of financial innovation in Ghana. We use the ratio of M2 to M1 (M2/M1) to proxy financial innovation following Mannah-Blankson and Belnye. M1 consists of currency and traveler's checks balances that are used as medium of exchange whereas M2 which include M1 plus saving assets which reflects greater array of money substitutes (store of value). Therefore, the ratio between the two (M2/M1) provides some information about the rate at which cash are converted into money substitutes like credit cards, which reflects financial innovation. We also excluded foreign interest rate; given that Ghana is a small open economy in terms of inactive patronage in foreign interest-bearing financial assets, we normalize it to unit without loss of generality, and assume that the effect of foreign interest rate on money demand is similarly captured by the effect on domestic real interest rate. Real narrow and broad money (RM1, RM2, RM2+) are the dependent variables for money demand functions, which implies that we examine

[1]We use the US dollar to cedi exchange rates (US$/GHS) since US dollar is our major trading currency. $RER = \frac{Pf}{Pd} \times nominal\ exchange\ rate$ where Pf is foreign price (consumer price index of US) and Pd is domestic price (consumer price index of Ghana). We assume that expected inflation is the same as actual inflation holding the assumption that economic agents follow rational expectation.

the money demand in three (3) different models. Functionally, the money function is expressed as;

$$RM=f\,(RGDP,\ RDIR,\ RER,\ EIR,\ FI) \quad (1)$$

where all variables are previously defined. From eqn. (1), we specifically express the long-run model for money demand in Ghana in log-linear form as;

$$\ln RM_t = \beta_1+\beta_2 lnRGDP_t+\beta 3 lnRDIP_t+\beta_4 lnRER_t+\beta 5 lnEIR_t+\beta 6 lnFI_t+\varepsilon_t \quad (2)$$

where ε_t is the error term, which explains other factors that affect money demand, which are not considered in the model. It is assumed to be white noise. The variables are in real units to reduce the degree of likelihood of multi-collinearity. The function is also expressed in log-linear to convert all variables into a common scale and interpret the coefficients to be estimated as elasticities.

We employ three real monetary aggregates (RM1, RM2, RM2+) to capture money demand from both narrow and broad perspectives. The RM1, RM2, RM2+ are all set of equilibrium values of which money demand equals money supply. Narrow and broad money were also chosen based on their close empirical relationship with income, interest rate and other economic variables. Even though most Ghanaians prefer to hold in currencies or cash (narrow money) for transactions, broad money (which includes money substitutes like credit cards) is also increasingly becoming used as medium of exchange. In this vein, considering all three monetary aggregates (RM1, RM2, RM2+) gives us a good evaluation of the nature of money demand in Ghana.

A priori, demand for money increases in real income, hence β_2 expected to be positive. Thus, people are expected to hold more money when income increases. The coefficients on interest rate and expected inflation, β_3 and, β_5 are expected to be negative. Thus, both domestic interest rate and expected inflation rates are expected to have a negative relationship with money demand a priori, because there is higher opportunity cost of holding money as interest rate and expected inflation rise, holding other things constant. The coefficients on real exchange rate and financial innovations cannot be signed apriori. Thus, coefficient of the real exchange rate could be negative or positive depending on the perception of Ghanaians. When there is a positive coefficient, it is supportive of the wealth effect theory; negative coefficient supports the currency substitution effects. When there is an increase in the exchange rate (depreciation), currency substitution argument suggests that more of the domestic currency (cedi) is supplied in exchange of less foreign currencies (dollars). This means foreign assets and foreign goods would be relatively more valuable. Ghanaians would prefer to hold more foreign currency in order to patronize in the foreign assets and hold less domestic currencies. Nevertheless, the wealth effect argument suggests that some Ghanaian investors would still prefer to hold fixed portfolio of their wealth, by repatriating part of their foreign assets to domestic assets, including domestic currency, causing the demand for domestic currency to rise. Financial innovation is also expected to be ambiguous. This is because the increase in the use of cash cards, which is captured by higher M2 relative to M1, would represent high velocity of money to facilitate transactions and enhance business activities, and hence increasing in the transaction demand for real money balances. On the other hand, the increasing use of cash cards (or higher M2 relative to M1) could lead to a reduction in the holding of cash balances by economic agents.

Estimation strategy

The paper employs the Autoregressive Distributed Lagged (ARDL) Bounds Testing procedure developed by Pesaran and Shin [20] to test for co-integration. There are several other models that can be used to test for co-integration in the money demand function. Some of these econometric models include; Engle-Granger [21] co-integration technique; Johansen and Juselius [22] co-integration technique; Vector Error Correction Model (VECM). The study uses ARDL model because it does not require that all variables to be necessarily of the same order of integration as required by the Johansen's procedure. It provides a single equation alternative to the often-used Johansen's procedure for estimating long-run demand for money.

Again, co-integration among the variables would justify our assumption of equilibrium in the money market. Short-term divergence between demand and supply in the money market is catered for by the error correction model. It is also known to perform better by other money demand literatures as it addresses residual serial correlation and potential endogeneity problem in the demand for money equation. This estimator also has good small sample properties, which makes it appropriate for our sample. We then select optimal lag length of variables to carry out the ADF and PP tests based on the Schwarz Information Criterion (SBIC) and Akaike information Criterion (AIC). SBIC is considered because it is a consistent estimator.

With respect to eqn. (3), the ARDL framework for the money demand model is specified as;

$$\begin{aligned}\Delta \ln RM_t &= \alpha_0+\sum_{i=1}^{p}\alpha_{1i}\ln RM_{t-i}+\sum_{i=1}^{q}\alpha_{2i}\Delta\ln RGDP_{t-i}+\sum_{i=1}^{r}\alpha_{3i}\Delta\ln RDIR_{t-i}+\sum_{i=1}^{s}\alpha_{4i}\Delta\ln RER_{t-i}\\ &+\sum_{i=1}^{t}\alpha_{5i}\Delta\ln EIR_{t-i}+\sum_{i=1}^{u}\delta_{6i}\Delta\ln FI_{t-i}+\gamma_1\ln RM_{t-i}+\gamma_2\ln RGDP_{t-i}+\gamma_3\ln RDIR_{t-i}\\ &+\gamma_4\ln RER_{t-i}+\gamma_5\ln EIR_{t-i}+\gamma_6\ln FI_{t-i}+\varepsilon_t\end{aligned} \quad (3)$$

where Δ is the difference operator and ε_t is the disturbance error term assumed to be white noise. The parameters α_i; i = 1,….,6 are the short-run coefficients (elasticities) and γ_i; i=1,…6 are the long-run coefficients of the underlying ARDL model. To test the long-run relationship among the variables, the Wald test (F-statistic) is conducted by imposing restrictions on the estimated long-run coefficients. The null and alternative hypotheses are stated as follows:

H0: $\gamma_1=\gamma_2=\gamma_3=\gamma_4=\gamma_5=\gamma_6=0$

H1: $\gamma_1\neq\gamma_2\neq\gamma_3\neq\gamma_4\neq\gamma_5\neq\gamma_6\neq0$.

Then, the computed F-statistic is compared with the critical value tabulated in Pesaran et al. The lower bound values assumed that the explanatory variables are integrated of order zero, or I(0), while the upper bound values assumed that the explanatory variables are integrated of order one, or I(1). Therefore, if computed F-statistic falls below the lower bound value, I(0), we accept Ho, it means there is no co-integration or long-run relationship. But if the computed F-statistic exceeds the upper bound value, I(1) it is concluded that money demand and its determinants are co-integrated and approach a long-run equilibrium. However, if the F- statistic lies between these two bounds, the result is inconclusive.

Having tested for co-integration, we estimate the long-run and short-run error correction models (ECM) following the order of ARDL specification. The ECM of the money demand function above is presented as;

$$\begin{aligned}\ln RM_t &= \alpha_0+\sum_{i=1}^{p}\delta_{1i}\ln RM_{t-i}+\sum_{i=1}^{q}\delta_{2i}\ln RGDP_{t-i}+\sum_{i=1}^{r}\delta_{3i}\ln RDIR_{t-i}+\sum_{i=1}^{s}\delta_{4i}\ln RER_{t-i}\\ &+\sum_{i=1}^{t}\delta_{5i}\ln EIR_{t-i}+\sum_{i=1}^{u}\delta_{6i}\ln FI_{t-i}+\varepsilon_t\end{aligned} \quad (4)$$

$$\Delta \ln RM_t = \alpha_0 + \sum_{i=1}^{p} \delta_{1i} \Delta \ln RM_{t-i} + \sum_{i=1}^{q} \delta_{2i} \Delta \ln RGDP_{t-i} + \sum_{i=1}^{r} \delta_{3i} \Delta \ln RDIR_{t-i} + \sum_{i=1}^{s} \delta_{4i} \Delta \ln RER_{t-i} + \sum_{i=1}^{t} \delta_{5i} \Delta \ln EIR_{t-i} + \sum_{i=1}^{u} \delta_{6i} \Delta \ln FI_{t-i} + \theta ECT_{t-1} + \varepsilon_t \quad (5)$$

$$(\bar{R})^2$$

where all variables are previously defined. The signs of short-run coefficients are expected to be the same as long-run from economic theory. θ is the coefficient of ECT_{t-1} (which is the lagged error correction term, that is, the fitted residuals from the co-integrating equation), which measures the rate at which short-run adjust to the long-run each year; It is expected to have a negative sign even though we analyze from its absolute value.

After Autoregressive Distributed Lag estimations, we also conduct robustness checks using Dynamic Ordinary Least Square (DOLS) model. Thus, we estimate the long-run coefficients by semi-parametric Dynamic Ordinary Least Square (DOLS) model; by Stock and Watson [23], and then compare the results of DOLS estimates to that of the ARDL to examine the similarities and deviations.

Last but not least; we test whether money demand (RM1, RM2, RM2+) in Ghana has been stable under the period of review. To determine the stability, we employ the Chow test, and compare with the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) tests developed by Brown et al. following Bahmani-Oskooee and Shin. A breakpoint (1984) was chosen for the Chow test. The reason for choosing this point is that the reforms in the financial sector were intensified in 1985 when the Economic Recovery Programme (ERP) and Structural Adjustment Programme (SAP) was embarked upon, with its prongs of liberalization, privatization and deregulation, on a scale previously unknown in Ghana [24-26]. Ghana also experienced the lowest rate of broad money to GDP in history during this time (Figure 2). To correct the shortcoming of assumed breakpoint of the Chow test, the second test (CUSUM and CUSUMSQ tests) is also used, which assumes knowledge of the exact breakpoint. The CUSUM and CUSUMSQ test statistics are updated recursively and plotted against break points in the data. For stability of the real broad money to be achieved, the CUSUM and CUSUMSQ statistics have to stay within the 5% critical bound [27]. We also analyze the stability of the money demand by accounting for the existence of breaks by introducing a shift dummy for money demand, using the information from the Zivot and Andrews test for unit root.

Empirical Results and Discussions

Before estimating the money demand, we perform the Zivot and Andrews test for unit roots to determine whether the underlying series are stationary with either trend or mean break or both or they are purely unit root processes. We complement this with the Phillips-Peron (PP) unit root test. The results of these exercises are reported in Table 1. The results in the table indicate that all the variables are stationary at first difference (integrated of order one) with the exception of real domestic interest rate (RDIR) and expected inflation rate (EIR) that were stationary at their levels [28-30]. The ZA test results indicates that the null hypothesis of unit root without structural breaks could not be rejected for almost all series except real money demand (RM1 and RM2) and real gross domestic product (RGDP).

Now that we have established that the underling series are a mixture of I(1) and I(0) variables, we proceed with our proposed ARDL approach to cointegration. We choose a lag length of one (1) for our ARDL model as suggested by SBIC.[2] Table 2 presents the boundstest for co-integration. The result indicates that the F-statistics are greater than the upper bound values for the three (models) at 5% significance level. Hence, we reject the null hypothesis of no co-integration [31-33]. This implies that, there is a strong evidence of a long-run steady state relationship between money demand and its covariates; and that real income, inflation, exchange rate, interest rate and financial innovation are long-run forcing determinants of money demand in Ghana. Co-integrating relationship among the variables means we are not wrong by assuming equilibrium holds in the money market.

Variables	ZA levels			PP levels	
	Break in mean	Break in Trend	Break in both	Trend	Without Trend
lnRM1	-2.757 (1979)	-3.312 (1984)	-3.044 (1979)	-0.527	0.645
lnRM2	-2.899 (1977)	-3.949 (1984)	-3.180 (1981)	-0.613	0.523
lnRM2+	-3.196 (1977)	-4.621** (1984)	-3.727 (1981)	-0.662	0.746
lnRER	-3.474 (1984)	-3.406 (1977)	-5.912*** (1984)	-2.13	-1.314
RDIR	-5.128** (1984)	-8163.033	-6.253*** (1984)	-3.707**	-2.73*
lnRGDP	-1.827 (1979)	-2.925 (1983)	-2.969 (1981)	-0.373	3.525
lnEIR	-5.688*** (1976)	-6.063*** (1978)	-6.073*** (1976)	-4.633***	-3.831***
lnFI	-3.795 (1976)	-8709.336	-4.366 (1986)	-3.179	-2.48

Note: ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively.

All values are t-statistics.

Table 1: ZA and PP Unit root test.

k	95%		90%	
	I (0)	I (1)	I (0)	I (1)
5	2.9591	4.302	2.4575	3.6766
Model			Calculate F statistic	
(1)Fm1 (RER,RDIR,RGDP,EIR,FI			11.3101**	
(2) Fm2 (RER,RDIR,RGDP,EIR,FI)			11.8452**	
(3) Fm2+ (RER,RDIR,RGDP,EIR,FI)			15.6837**	

Note: Critical values are extracted from Microfit 5.0 econometric software; k is number of regressors.

** and * denote statistical significance at 5% and 10% levels respectively.

Table 2: Bounds test for co-integration relationship.

Results of the long-run money demand equations are presented in Table 3. As seen, the DOLS provides similar results to the ARDL, demonstrating the robustness of the long-run estimates [34,35].

Observing the coefficients, we see that in the long run, income positively influences the demand for money whereas inflation and interest rate have negative influences, which is in conformity with economic theory. Most of the variables (real exchange rate, domestic interest rate, and expected inflation rates) are significant, indicating that the problem of multi-collinearity is minimized to produce efficient estimations [36].

Inflation is so far the most significant determinant of money demand in the long run followed by real interest rate and real exchange rate. A percentage point increase in expected inflation, ceteris paribus, would reduce money holdings by about 1.7% on the average. This pre-supposes that expected inflation has a lot of impact on the portfolio decisions of people in Ghana aside the rate interest on financial assets;

[2]The Schwarz Bayesian Information Criterion (SBIC) statistic revealed maximum lag length of one for all the three models. However, the Akaike Information Criterion (AIC) statistic revealed a maximum lag length of four (4) for all the three models. But we choose a lag length of one (1) for our ARDL model as suggested by SBIC. SBIC is preferred to the AIC because SBIC provides consistent estimates. AIC tend to mostly over-estimate the maximum lags (Brockwell, 2002).

Variables	Autoregressive Distributed Lag models			Dynamic Ordinary Least Square models		
	lnRM1 (1)	lnRM2 (2)	lnRM2+ (3)	lnRM1 (1)	lnRM2 (2)	lnRM2+ (3)
lnRER	0.67131	0.89198	1.0432	0.372052	0.372052	0.405907
	(2.2018)**	(1.8710)*	(1.6741)	(3.874628)***	(3.874634)***	(3.985653)***
RDIR	-0.035438	-0.041964	-0.031555	-0.037221	-0.037221	-0.033769
	(-2.4414)**	(-2.0862)**	(-1.4132)	(-7.554680)***	(-7.554690)***	(-6.462311)***
lnRGDP	0.31698	0.39683	0.51635	0.536112	0.536112	0.865332
	(0.72597)	(0.67415)	(0.73007)	(2.937225)***	(2.937228)***	(4.470033)***
lnEIR	-1.3637	-1.8446	-1.8633	-0.466197	-0.466197	-0.359592
	(-2.6858)**	(-2.1646)**	(-1.7735)*	(-5.948883)***	(-5.948888)***	(-4.326348)***
lnFI	2.4588	1.4319	1.3216	2.954894	3.954895	3.864281
	(1.2120)	(0.59277)	(0.48443)	(3.449991)***	(4.617547)***	(4.253936)***
Constant	3.2763	5.0578	4.5028	-2.371118	-2.371119	-5.506288
	(0.66157)	(0.66519)	(0.46650)	(-1.613820)	(-1.613822)	(-3.533516)***

Note: Dependent variables are lnRM1, lnRM2, lnRM2+ for model (1), model (2), and model (3) respectively. ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively. Values in parenthesis are t-statistics. ARDL (1,0,0,1,0,1) selected for model (1); ARDL (1,0,1,0,0,1) selected for model (1); ARDL (1,0,1,0,0,0) for model (2) and for model (3) based on the Schwarz Bayesian Criterion.

Table 3: The estimated long run money demand models.

whereby an increase in the rate of inflation instantly encourages agents to diversify their portfolios by acquiring real assets like equity holdings (shares), investment in land, building (real estate) amongst other things [37]. This is consistent with earlier findings of Bawumia and Abradu-Otoo; Bahmani-Oskooee and Gelan; Dagher and Kovanen on Ghana. Moreover, inflation seems to have greater effect on broad money (M2 and M2+) than narrow money (M1). The average income elasticity is about 0.6, which is also in conformity with Adam's assumption that the elasticity of developing economies should lie between 0.5 and 1.0. This means that income is inelastic, such that 1% point increase in real income leads increase in money demand by 0.6% on the average. This supports Baumol's and Tobin's inventory theory of holding money, which means Ghanaians prefer to increase their money holding by proportionately less of the incremental change of income. This result is not so much different from previous results from Mannah-Blankson and Belnye and Dagher and Kovanen, even though they used only recent data that exclude earlier years of economic recovery programs and structural adjustment programs in the 1980s. This implies that the emergence of the ongoing financial reforms since the 1990s have not had much influence on the elasticity of money demand to income. However, income elasticity is statistically insignificant in the long run, which contradicts earlier findings that suggest that income is a major determinant of money demand in Ghana. This means that, income is not a key determinant of money demand when we take into account the period of economic recovery and structural programs which exhibit high volatility as suggest by Dagher and Kovanen. Real domestic interest rate, as an opportunity cost variable, has a significant negative effect on money demand, which is consistent with Keynes' liquidity preference theory. This means that the role of interest rate in influencing the speculation decisions of agents is key [38]. However, the impact of interest rate is relatively small as compared to the other determinants in the long run. This means that Ghanaians are less influenced by the rate of interest on assets in their money demand decisions in the long-run. This result probably indicates the underdeveloped nature of Ghana's money market, which is deficient in depth and flexibility. This supports Ericsson's [24] argument about the trivial contribution of interest rate in money demand function of developing countries. Baumol and Tobin also predicted that, interest rate elasticity is inelastic like income elasticity following the same economies of scale hypothesis; which is confirmed by our results. Real exchange is a good determinant of money demand in Ghana, especially when money demand is viewed narrowly. However, exchange rate is has a positive sign in the long run, which contradicts most of the previous studies in Ghana. The average coefficient of real exchange rate is around 0.86% implying that there is an increase in money demand holdings when the Ghana Cedi (GHS) depreciates. This means that Ghanaians evaluate their asset portfolio in terms of their domestic currency such that, an increase in the value of their foreign assets held as a result of depreciation, makes them rather repatriate part of their foreign assets to domestic assets since they wish to maintain a fixed share of their wealth invested in domestic assets. This suggests that Ghanaians are also xenophobic in terms of investing in foreign financial assets; they rather prefer domestic ones. Since they add up to their domestic assets with domestic currency rather than foreign currency, there is therefore increase in domestic money demand as result of the depreciation. Hence, we conclude that Ghana experiences wealth effects of exchange rate rather than currency substitution or capital mobility effect as suggested by Dagher and Kovanen, which may be due to the period under review. Again, the wealth effect is justified on the grounds that exchange rate has greater effect on money demand when it is broadly defined than when it is narrowly defined. The proxy for financial innovation was found to also exert a positive influence on the demand for money for both narrow and broad money, even though insignificant in the long run. This implies that technological advancement in the payment system causes the demand for money to increase for more liquid monetary aggregates than for less liquid aggregates, which is consistent with Podolski as cited in Mannah-Blankson and Belnye. This is because the increase in the use of cash cards, credit cards, ATM cards, money transfer cards and the likes, leads to high velocity of money and enhance transactions and business activities, hence increase transaction and speculation demand for money.

The short-run results estimated within the ARDL framework and its associated diagnostic tests are presented in Table 4. In order to ensure the reliability of the estimated parameters in the error correction model, series of diagnostic tests were applied. The lagged dependent variables are added to ensure that the resulting residuals in the models are white noise. The estimated model show congruence with the data and passes all specification tests applied. Our results show the absence of serial correlation, heteroskedastic errors, model misspecification and non-normality of residuals. The coefficient of determination $(\bar{R})^2$, used to measure the goodness-of-fit of the estimated model, is high enough to indicate that the model is reasonably accurate in prediction. It suggests that approximately between 73% and 76% of the variations in money

Variables	ΔlnRM1 (1)	ΔlnRM2 (2)	ΔlnRM2+ (3)
ΔlnRM1 (-1)	0.83913	-	-
	(12.3016)***	-	-
ΔlnRM2 (-1)	-	0.88423	-
	-	(14.4447)***	-
ΔlnRM2+ (-1)	-	-	0.90580
	-	-	(15.3539)***
ΔlnRER	0.10799	0.10326	0.098262
	(2.6992)**	(2.5525)**	(2.6443)**
ΔRDIR	-0.0025329	-0.0018890	0.2271E-3
	(-0.86013)	(-0.63985)	(0.08574)
ΔRDIR (-1)	-0.0031679	0.0029690	-0.031995
	(-2.1116)**	(-1.9589)*	(-2.3173)**
ΔlnRGDP	0.050991	0.045940	0.048638
	(0.61508)	(0.54662)	(0.5634)
ΔlnEIR	-0.21937	-0.21355	-0.17551
	(-4.867)***	(-4.6865)***	(-4.3680)***
ΔlnFI	-0.86914	0.16576	0.1449)
	(-2.8597)***	(0.5398)	(0.43754)
ΔlnFI (-1)	1.2647	-	-
	(4.5948)***	-	-
Constant	0.52705	0.58552	0.42415
	(0.81341)	(0.89236)	(0.60928)
ECT_{t-1}	-0.16087	-0.11577	-0.094196
	(-2.3583)**	(-1.8911)*	(-1.5967)
Diagnostic tests			
R^2	0.8021	0.77583	0.29
$\bar{R}^2$	0.75413	0.72968	0.76159
F-statistic	22.2928***	19.6118***	22.9951***
DW-staistic	1.6938	1.8353	18355
Akaike Information Criterion	36.089	35.9691	39.9080
Schwarz Bayesian Criterion	28.3894	29.0184	32.9573
χ^2 auto (1)	1.0608 [0.03]	0.23695[0.626]	0.2110[0.646]
χ^2reset (1)	0.40519[0.524]	0.17477[0.676]	0.11012[0.74]
χ^2normality (2)	0.37002[0.831]	12075 [0.54]	1.1358 [567
χ^2 white (1)	6.3485 [0.012]	3.7308 [0.053]	2.512 [0.113]

Note: Dependent variables are ΔlnRM1, ΔlnRM2, ΔlnRM2+ for model (1), model (2), and model (3) respectively. ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively. Values in parenthesis are t-statistics. ARDL (1,0,1,0,0,1) selected for model (1); ARDL (1,0,1,0,0,0) for model (2) and for model (3) based on the Schwarz Bayesian Criterion.

Table 4: Error correction representation for the selected ARDL models.

demand are explained by variations in the estimated determinants. The F-statistic shows a very good fit of the model, confirming its predictive ability.

The results indicate substantial money demand inertia, as shown by its positive and significant lagged coefficient in all ARDL Models (0.84, 0.88 and 0.91) for M1, M2 and M2+ respectively. This implies that current period changes in real money demand are affected by lags of real money demand. This confirms that, expectation or inertia is very significant in explaining current and future money demand in Ghana as suggested by earlier studies. Existence of persistence is also seen in short-run changes in interest rate and financial innovation.

Inflation is inversely related to money demand and also the most significant determinant in the short-run, which is consistent with the long-run results. The coefficients of income elasticity are rightly signed but insignificant in the short-run, which is similar to the long-run results. However, the magnitude of the coefficient in the short-run is lesser than the long-run, which conforms to our expectation based on Samuelson's Le Châtelier principle, that long-run elasticity of money demand with respect to real income is at least as large as its short-run elasticity. Again, the high-income on money demand depends on the level of aggregation used. The result is similar to the findings of Bahmani-Oskooee and Gelan. Real domestic interest rate, in the short-run, has a negative relationship with money demand (RM1 and RM2), which is consistent with the long-run but has a positive relationship with RM2+. Also, all the short-run coefficients are insignificant and relatively smaller than that of the long-run. This shows that Ghanaians are sluggish to interest rate changes in the short-run, which supports Ericsson's argument about the underdeveloped nature of money market system of developing economies as mentioned earlier. The wrong sign of M2+ coupled with the insignificant coefficients insinuates that interest rate loses its function as opportunity cost of holding money in the short-run. In other words, Ghanaians may not consider interest rate fluctuations in their speculative decisions in the short-run but rather in the long-run. Real exchange rate is still statistically significant at 5% for both narrow demand for money (RM1) and broad demand for money (RM2 and RM2+) in the short-run, even though it has relatively smaller magnitude. This implies that real exchange is a potent determinant of money demand in Ghana both in the short-run and long-run. This justifies Mundell's argument about the significance exchange rate in the money demand function. It still has a positive sign in the short-run, which supports the wealth effect hypothesis and depicts the xenophobic nature of Ghanaians to foreign assets investment. Changes in financial innovation enter the short-run narrow money demand (RM1) with a highly significant (1%) negative sign that contradict the insignificant positive impact in the long-run. Nevertheless, RM2 and RM2+ exhibit insignificant positive signs consistent with the long-run estimates. This means that improvement in financial technology especially in terms of producing new modern ways of payment systems such as the use of credit cards and VISA cards; initially tend to make people hold less cash balances for their transaction activities. This presupposes that people in Ghana embrace the use of these modern financial instruments especially when they are newly introduced. In the long-run when it has gained mass acceptance, it enhances business activities and transaction levels, which leads to higher demands for money. The result suggests the relative importance of financial innovation in the determination of money demand. Observed shifts in money holdings over time may be attributable, at least in part, to changes in the transaction technology in the short-run as argued by Mannah-Blankson and Belnye. Significant positive sign of the inertia of financial innovation at 1%, implies that increases in previous year's financial innovation result in a further rise in the current year's financial innovation.

The lagged error correction terms, (ECT_{t-1}) are all correctly signed (negative) and statistically significant at the 5% for RM1, 10% for M2 but insignificant for RM2+. The coefficient of (ECT_{t-1}) measures the adjustment speed of money demand to long-run equilibrium due to changes in the money demand covariates. Following a deviation from the long-run in the previous period, full convergence to its equilibrium level is corrected by about 16%, 12% and 9.4% in the current year in Models (1), (2) and (3) respectively, which are low. The speed of adjustment of RM1 is greater RM2, and RM2 is greater RM2+. The least error correction value of RM2+ justifies its insignificance.

Stability tests using the Chow test[3]; and CUSUM and CUSUMQ

[3]Before applying the Chow test, we test for the homoscedasticity assumption. It was found that the Chow test is valid after accepting H0 of equal variance for M1 and M2 even though M2+ showed. But we still carry on with our chow test since it will be supported by the second test (CUSUM and CUSUMQ).

Variables	Short-run models			Long-run models		
	lnRM1	lnRM2	lnRM2+	lnRM1	lnRM2	lnRM2+
ln RER	01159	0.0680	0.0549	0.8671	0.5181	0.44617
	(2.5045)**	(1.5845)	(1.3720)	(1.0884)	(0.9616)	(0.8281)
RDIR	-0.0026	-0.0023	-0.1583	-0.0452	-0.0177	-0.1284
	(-0.8741)	(-0.7575)	(-0.0056)	(-1.1907)	(-0.7454)	(-0.0056)
lnRGDP	-0.0097	0.0869	0.1336	-0.0726	0.6617	1.0841
	(-0.0511)	(0.4451)	(0.5996)	(-0.0494)	(0.6014)	(1.0195)
lnEIR	-0.2238	-0.2246	-0.1799	-1.6738	-1.7094	-1.4602
	(-4.7247)***	(-4.2957)***	(-3.6388)***	(-1.2913)	(-1.3341)	(-1.1186)
lnFI	-0.8421	0.0701	0.0020	3.2636	0.5327	0.0165
	(-2.6541)**	(0.2293)	(0.0071)	(0.8846)	(0.2307)	(0.0072)
Db	0.0367	0.2121	0.1828	0.2746	-0.1568	-0.3597
	(0.0367)	(1.6617)	(1.4931)	(0.2926)	(-0.1951)	(-0.4827)
Constant	1.0066	0.3143	-0.2131	7.5280	2.3918	-1.7296
	(0.6720)	(0.1985)	(-0.1172)	(0.4604)	(0.1773)	(-0.1278)

Note: ***, ** and *represent statistical significance at 1%, 5% and 10% levels respectively. Values in parenthesis are t-statistics.

Table 5: ARDL model in the presence of structural breaks.

tests of Brown et al. for each of the model generally suggest the presence of structural breaks, even though the CUSUM indicates fair stability as they remain within the bands. We conclude that, money demand is becoming unstable as a result of the on-going structural reforms and financial innovation. Table 5 presents the ARDL short-run and long-run money functions in the presence of structural breaks. The existence of structural breaks are found to be insignificant in both the short-run and long-run; which suggest that the unstable nature of money demand in Ghana does not entirely depend on the existence of structural breaks. In other words, one cannot wholly conglomerate the volatility in the money demand to the sample period used. Nevertheless, empirical studies suggest that money demand is found to be more stable in periods after 1980s rather than before. Other factors that may reconcile the differences in stability of money demand in Ghana are left for future research.

Conclusion

This study examined the determinants of money demand in Ghana. In our empirical analysis, we employed Autoregressive Distributed Lag co-integration procedure to show that there is a long-run relationship between real money demand (RM1, RM2, RM2+), real income, domestic interest rate, inflation rate, real exchange rate, and financial innovation. We also checked for robustness of the long-run inflation equation by estimating comparative model, Dynamic Ordinary Least Square (DOLS). The model provides reasonably accurate in-sample estimates of money demand for the period 1970-2012.

The roles of inflation and exchange rate are very important in explaining money demand in both the long-run and short-run while interest rate is important in explaining the long-run money demand. This presupposes that disinflation effort and exchange rate stabilization are key to the success of maintaining money demand stability in Ghana. Inflation and interest rate, as opportunity cost variables, had expected negative impact on money demand both in the short-run and long-run, while exchange rate had a positive sign. The results also suggest that, money demand decisions in Ghana are less influenced by the opportunity cost variables (inflation and interest rate) in the short-run than the long-run. This is because people in Ghana tend to focus more on transaction demand for money than speculative demand for money in the short-run. But they turn their attention to savings and investments in the long-run as their speculative money demand decisions are more influenced by interest rate and inflation in the long-run. Another key finding is existence of wealth effect in the Ghanaian economy as evidenced by the statistical significance of the positive sign of the real exchange rate in the money demand function. This indicates that Ghanaians rather prefer to invest in domestic assets than foreign assets. Hence, the Ghanaian economy is relatively less vulnerable to external shocks (through capital mobility or flight) than internal shocks. Money demand was also found to be generally unstable in the midst the structural changes that occurred during the period. Financial innovation was found to have a significant negative impact on money demand (RM1) in the short-run, even though it had insignificant positive impact in the long-run. This implies that the instability in money demand is, at least in part, accounted for by financial innovations. However, it does not form a key determinant in Ghana. Income had an expected positive but insignificant sign in both short-run and long-run, which means income is also not a key determinant of money demand.

From our empirical findings, it is seen that the unstable behavior of money demand is vastly due to high volatility in exchange rates, inflation rates and interest rates in the wake of the on-going financial reforms. Hence, structural and institutional reforms should be channeled towards stabilizing exchange rate and interest rate as well as anchoring inflation expectations. This renders the effort of BoG valid for embarking on Inflationary-targeting framework, which seeks to maintain low stable inflationary digits. However, the baffling setback still remains, as a stable money demand is required by BoG in its conduct of Inflationary-targeting (IT) framework.

In the quest to stabilize interest rates and exchanges, deregulation of interest rates and exchange rates as part the on-going financial reforms, should be partially augmented by the BoG, and not left exclusively for market operations. Thus, government involvement and controls of interest rate and exchange rate regulations is key in achieving stable money demand.

Also, policy makers need not take into special account of interest rate volatility when setting the target RM1 growth range because interest rate volatility apparently has not affected RM1 but rather RM2 and RM2+.

References

1. Ghartey EE (1998) Monetary Dynamics in Ghana: Evidence from Cointegration,

Error Correction Modeling, and Exogeneity. Journal of Development Economics 57: 473-486.

2. Bawumia M, Abradu-Otoo P (2003) Monetary Growth, Exchange Rate and Inflation in Ghana: An Error-Correction Analysis. Working Paper, Monetary Policy Analysis and Financial Stability Department, WP/BOG-2003/05, Bank of Ghana.
3. Bahmani-Oskooee M, Gelan A (2009) How stable is the demand for money in African Countries. Journal of Economic Studies 36: 216-235.
4. Bahmani-Oskooee M, Hafez R (2005) Stability of the Money Demand Function in Asian Developing Countries. Applied Economics 37: 773-792.
5. Mannah-Blankson T, Belnye F (2004) Monetary Policy Analysis and Financial Stability. IMF working paper.
6. Benjamin A, Zakari M (2008) Choice of Monetary Policy Regime in Ghana. Working Paper, Monetary Policy Analysis and Financial Stability Department, WP/BOG-2008/07, Bank of Ghana.
7. Fisher I (1911) The Purchasing Power of Money. Macmillian, New York, USA.
8. Laidler, David EW (1993) The Demand for Money: Theories, Evidence and Problems. (4thedn), Harper Collins Publishers, New York, USA (https://www.abebooks.com/book-search/title/demand-money-theories-evidence-problems/author/laidler-david-e-w/).
9. Keynes JM (1936) The General Theory of Employment, Interest and Money, Macmillan publishers, USA.
10. Friedman M (1956) The Quantity Theory of Money - A Restatement. In: Friedman M (ed.) Studies in the Quantity Theory of Money, Chicago: The University of Chicago Press, USA.
11. Baumol W (1952) The Transactions Demand for Cash: An Inventory Theoretic Approach. Journal of Econometrics 66: 545-56.
12. Tobin J (1956) The Interest Elasticity of Transactions Demand for Cash. Review of Economics and Statistics 38: 241-47.
13. McCallum BE (1987) The Case for Rules in the Conduct of Monetary Policy: A Concrete Example. Federal Reserve Bank of Richmond, Economic Review 10-18.
14. Arrau P, De Gregorio J, Reinhart C, Wickham P (1995) The demand for money in developing countries: assessing the role of financial innovation. Journal of Development Economics 46: 317-340.
15. Mundell R (1963) Capital mobility and stabilization policy under fixed and flexible exchange rates, Canadian Journal of Economics and Political Science 29: 475-485.
16. Valadkhani A (2008) Long- and Short-Run Determinants of the demand for money in the Asian-Pacific Countries: An Empirical panel investigation. Annals of Economics and Finance 9: 47-60.
17. Dagher J, Kovanen A (2011) On the Stability of Money Demand in Ghana: A Bounds Testing Approach. IMF Working Papers, (Washington: International Monetary Fund).
18. Perron P (1989) The great crash, the oil price shock and the unit root hypothesis. Econometrica 57: 1361-1401.
19. Zivot E, Andrews D (1992) Further evidence of the great crash, the oil-price shock and the unit-root hypothesis. Journal of Business and Economic Statistics 10: 251-270.
20. Pesaran HM, Shin Y, Smith RP (2001) Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 16: 289-326.
21. Engle RF, Granger WJ (1987) Cointegration and Error Correction: Representation, Estimation, and Testing. Econometrica 55: 251-276.
22. Johansen S, Juselius K (1990) Maximum likelihood estimation and inference on co-integration: with applications to the demand for money. Oxford Bulletin of Economics and Statistics 52: 169-210.
23. Stock JK, Watson M (1993) A simple estimator of cointegrating vectors in higher order integrated systems. Econometrica 61: 783-820.
24. Ericsson NR, Sharma S (1998) Broad Money Demand and Financial Liberalization in Greece. Empirical Economics 417-436.
25. Adu G, Marbuah G (2011) Determinants of inflation in Ghana: Empirical investigation. South African Journal of Economics 79: 251-266.
26. Arrau P, Gregorio JD (1990) Financial Innovation and Money Demand: Application to Chile and Mexico. Review of Economics and Statistics 75: 524-530.
27. Brockwell PJ (2002) Introduction to Time Series and Forecasting. Bartlet Press, New York, USA
28. Friedman BM (1990) Targets and Instruments of Monetary Policy. In: Friedman BM, Hahn FH (eds.) Handbook of Monetary Economics (2ndedn), New York: Elsevier Science Publishers, pp: 1185-1230.
29. Friedman M (1966) Interest rates and the demand for money. Journal of Law and Economics 9: 71-85.
30. Damodar NG (1988) Basic Econometrics, (2ndedn), McGraw-Hill Inc, New York, USA.
31. Johansen S (1988) Statistical analysis of cointegration vectors. Journal of Economics Dynamics and Controls 12: 231-254.
32. Johansen S (1992) Testing weak exogeneity and the order of cointegration in U.K. Money Demand Data. Journal of Policy Modeling 14: 313-334.
33. McCallum BE (1988) Robustness Properties of a Rule for Monetary Policy. Carnegie-Rochester Conference Series on Public Policy 29: 173-204.
34. McCallum BE (1989) Monetary Economics: Theory and Policy. New York: Macmillan Publishing Company.
35. McCallum BE (1993) Discretion versus Policy Rules in Practice: Two Critical Points. Carnegie-Rochester Conference Series on Public Policy 39: 215-220.
36. Nell, Kevin S (2003) The Stability of M3 Money Demand and Monetary Growth Targets. The journal of developmental studies 39: 155-180.
37. Phillips P, Perron P (1988) Testing for unit root in time series regression. Biometrica 75: 335-346.
38. Tobin J (1958) Liquidity Preference as Behavior toward risk. Review of Economic Studies 25: 65-86.