EVALUATING STRUCTURAL RELATIONS BETWEEN MONEY DEMAND AND ITS DETERMINANTS

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Abstract

The relationship between money demand and specific macroeconomic predictors has been explained by a number of money demand theories. Panel structural vector autoregressive (SVAR) and generalized autoregressive conditional heteroskedasticity (GARCH) techniques were deployed to analyze the data on money demand with lag adjustment in relation to inflation uncertainty, interest rate variations, household consumption, and exchange rate depreciation in Africa. The study which covers 30 African nations discovered a two-way relationship between money demand and price level variation. While higher prices would increase demand for money, the same demand also influences changes in a nation's price level, such that in the long run, inflation would result from more money held by economic units. With a standard deviation of 5.51, Guinea had the most erratic money demand, followed by Sierra Leone at 5.29. A variance of inflation uncertainty ranged from 9.45 percent to an extremely high proportion for Congo. Exchange rate devaluation is found to be considerably impactful in determining money demand. Results show that as more of the units of the local currency is used to exchange a unit of foreign currency such as the dollar, local economic units are discouraged to increase demand for money in local money and thus hold fewer local currencies while investing in foreign exchange investments.

Keywords: Money Demand, Inflation Uncertainty, Interest Rate Variation, Exchange Rate Devaluation, Emerging African Countries, SVAR

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1. INTRODUCTION

African nations have placed a special emphasis on efficient macroeconomic management in order to enhance the financial system and foster long-term, inclusive economic growth. The relationship between money demand and specific macroeconomic predictors has been explained by a number of recent empirical studies on the money demand function (Nkalu, 2020; Adeyemi et al., 2020; Nel et al., 2020). Demand for money is a stabilization strategy, driven by the capacity of monetary authorities to adjust the supply function of money to meet its demand (Hensch, 2019; Sanya, 2019; Nduka & Chukwu, 2013). A monetary strategy that aims to keep money supply and demand in balance makes macroeconomic management easier and works to maintain price stability in the market. Unfortunately, the quantity of money may not be closely correlated with total payments as it is in contemporary quantity theory if the function is unstable and experiences significant unforeseen shifts following the report of Keynes (Mishkin, 2007).

Demand for money refers to "real cash balances in the hands of economic agents", or "the sum of demand deposits and currency in circulation" (Odularu & Okunrinboye, 2009, p. 40). Alternatively, the demand for money is the preferred holding of financial assets in the form of money which could be cash balances or bank deposits rather than investments. Such preferred holding could be the narrow money demand for fulfilling direct spendable denoted most often by M1 or the broader money demand denoted as M2 or M3. Therefore, the demand for M1 is a result of this trade-off regarding the form in which individuals' funds to be spent should be held. In effect, M1 provides liquidity for purpose of offsetting transactions.

The demand for money is affected by several variables, including, inflation, interest rates, income level, uncertainty about the future, etc. Theories have explained the extent to which the aforementioned variables influence money demand in terms of the three motives for demanding money, namely, transactions, precautionary, and speculative motives (Akinlo, 2006; Albulescu & Pépin, 2018; Anoruo, 2002). The amount of money that people want to keep depends on the value of the transactions that needed to be managed. Hence, the quantity of money sought increases with the volume of transactions. Accordingly, the balance of money held for transaction motive is determined mainly by two factors, which include, overall economic condition, and the propensity of individuals in the economy to spend. For example, transaction spending with regards to financing purchases of goods and services rises whenever there are improvements in salaries with low unemployment, as well as higher nominal gross domestic product (GDP) growth. As time progresses and income level rises, the total number of transactions made in an economy rises as well. Hence, as income reflected in the nominal level of GDP rises, the transaction demand for money also rises. Whereas, as a precaution against an uncertain future together with some unpredicted overheads, the need to have money available rises.

Similarly, the major determinant of speculative money demand is interest rates, inflation, as well as the conditions in other markets, namely, the bond market and the expectations of returns in the bond market. Money holdings provide no rate of return and frequently devalue owing to inflation. The opportunity cost of keeping cash balances is the interest rate earnable by investing or lending cash balances. Investors' decision to hold cash balances rather than hold financial instruments, such as bonds, is manifested in foregone return earnable for holding the financial instruments. Hence, the speculative demand for money rises once potential returns in other assets drop or when the observed risk of investments increases. On the other hand, money demanded speculative motive falls whenever potential returns in other assets rise or when the observed risk of investments regresses. This has informed: 1) a direct correlation between speculative money balances and returns in other financial assets, 2) an inverse correlation between speculative money balances and risks in other financial assets. Going forward, if interest rates are expected to rise, the speculative motive for holding cash balances declines. Similarly, expectations of higher inflation are an indication of a huge devaluation in the purchasing power of money and reduce speculative motivation for money demand.

This study examines the structural link between money demand with a lag adjustment, and inflation uncertainty, interest rate variations, household consumption, and exchange rate depreciation in African countries. Numerous gaps have been identified in previous research regarding determinants of money demand. For example, our inclusion of non-traditional variables of money demand based on theories, namely, household consumption and inflation uncertainty in our model of money demand is of considerable contribution to the study of present-day demand for cash holdings. This is so especially when most of the individual African countries considered in our sample have been exposed to high inflation and uncertainties in future income. Also, the scope as regards the period of data coverage adopted in previous works was short, and most results seem contradictory. All these points to the population gap, theoretical gap, and empirical gap. In this study, we attempted to fill these gaps in the literature by expanding the period of data analysis for a large sample of 30 developing countries, and also, included household consumption spending variable with lag adjustment considering the prevailing circumstance, current realities, and the peculiarity of the countries covered in the study even when most previous studies failed to include the same variable in money demand function.

A study of the relation between money demand and its causal variables is of policy essence considering the growing inflation in African countries. A solid grasp of stability and factors influencing demand for real balances serves as the foundation for monetary policy execution since it allows for changes that are motivated by the policy. Hence, the policy finding of a significant inflation uncertainty could be pointing to a significant unfathomable unpredictability of demand for cash balances. Moreover, it is a pointer to the fact that fluctuations caused by international economic developments

such as rigidities in international trade, global exchange rate risk, COVID-19 pandemic, explosive commodity prices, Russo-Ukrainian War, structural and other fiscal reforms within the affected economies all unfavorably influence the demand for cash balances in emerging economies of Africa.

Moreover, the study deployed the generalized autoregressive conditional heteroskedasticity (GARCH) estimation technique to calculate variations in price levels and interest rates before utilizing the structural vector autoregressive (SVAR) estimation method to evaluate structural relations between money demand with lag adjustment and its causal variables. This indeed contributes to the robustness of our empirical findings on factors responsible for holding money in Africa. Further, prior research seems to have concentrated on the effect of devaluation on national output growth in advanced countries and neglected majorly how currency devaluation impacted demand for cash balances most especially in developing African economies. This present research is motivated by this population gap to empirically investigate the effects of currency devaluation on the demand for money in the sample of 30 developing nations. The focus of Section 2 is a review of past studies. The theoretical framework, study design data source, model construction, and analytic processes are all parts of the technique covered in Section 3. Section 4 includes data analyses and policy implications. Section 5 discusses the findings. In Section 6, the study's conclusions and recommendations are outlined.

2. LITERATURE REVIEW

A number of money demand theories, like Keynes liquidity preference, the classical theory of money, Friedman's quantity theory, and Baumol-Tobin's money theories, have been able to explain the relationship between money demand and certain macroeconomic factors. The money demand relationship is a paramount channel to describe the economic relationship between people and the macro-economy. Effective monetary policy, then, is the best way to describe how people interact with monetary authorities. For example, Tobin's theory of money demand demonstrates how the desire for money is favorably linked with income level and adversely associated with interest rate. People are said to hold money as their primary form of the asset when making purchases. This model is a development of the interest rate-based on the Keynesian theory of money demand. By stressing the function of money as a medium of exchange, it is typically categorized as a transaction theory. According to proponents of the transaction theory, money is a dominant asset that people use to make procurements.

The fee and gains of retaining money were described by the proponents as poor rates of return and ease of transactions, respectively. The advocates cited low rates of return and simplicity of transactions as the disadvantage and advantages of keeping money. The volume of assets a person acquires is a function of interest payment on cash held, that is, forgone as well as the brokerage charge, which is the cost incurred to purchase bonds and convert them into cash. The maximum number of assets a person can own relies on the interest on cash held in the hand that is forgone, as well as the brokerage fee the price paid to buy bonds and turn them into cash. The Baumol-Tobin money function is therefore written as:

$$M^d \sqrt{\frac{Y}{2_i}} = (i, Y, F) \quad (1)$$

where M^d, i, F, and Y represent money demand, interest rate, fixed brokerage fee, and income.

The theory posits that interest rates have a negative correlation with the demand for money in transactions; income has a positive correlation with the need for money in transactions, but because of economies of scale in money holdings, money demand does not rise as quickly as income. Hence, a decrease in brokerage fees brought on by technological developments will lessen money demand because there is no illusion of money in want for money. So, if the price level increases, so do Y and F. Because monetary authorities frequently implement monetary policy by changing reserve requirements, interest rates are used as a surrogate for monetary authorities in this analysis (International Monetary Fund [IMF], 2017). Through the interest rate, monetary authorities have control over the availability of money. Changes in interest rate variation and price variability have a direct influence on money demand, while changes in exchange rates have an indirect impact. It is anticipated that economic entities will opt to invest in overseas markets as a result of a country's exchange rate devaluation.

Interest rate fluctuation is regarded as a key proxy for monetary policy since it provides monetary authorities with information on consumer perception and its effectiveness in maintaining price stability. The opportunity cost of retaining money takes into account the predicted rate of return as well as the rate of return on assets other than cash. All monetary aggregates are anticipated to have a negative relationship with interest rates (Sichei & Kamau, 2012). Price variation, which results from changes in the underlying market pricing, is the difference between the price the trader anticipated and the price at which they were filled. When negative or positive consequences occur, it is frequently referred to as "slippage" or "price improvement", respectively. While slippage (execution at a worse-than-anticipated price) is frequently the focus when employing market orders, we should anticipate seeing both slippage and improvement. It's possible that limit order traders were trained to anticipate neither. Because many traders do not even think about gauging price improvement, they presume that limit orders cannot slip.

On the empirical side, Hasanov et al. (2022) found a limited role of monetary policy in the money demand function under a fixed exchange rate. The desire for real money balances in Africa was investigated by Nkalu (2020) using panel time-series data from Ghana and Nigeria between 1970 and 2014. The study found inflation, real interest rates, and official exchange rates, as significant determinants of money balances and this is in line with the liquidity preference theory. Adeyemi et al. (2020) reported that the trend and

pattern of currency depreciation and money demand showed a procyclical movement in relation to the government's policies for controlling its currency exchange rate based on autoregressive distributed lag (ARDL) model.

Abuhabel and Olanrewaju (2020) obtained a long-term correlation between money demand (M2) and financial development variables *credit to the private sector (CPS)* and *currency in circulation (CIC)* with the conclusion that the money demand function is stable over the long term and has positively confirmed the importance of the financial development variables (*CPS* and *CIC*). According to Albulescu et al. (2019), the opportunity cost of holding the money was significant in explaining the demand for cash holding in Central and Eastern European (CEE) countries. Nakorji and Asuzu (2019) reported that real money demand was positively impacted in the short run by the exchange rate, financial innovation, and real GDP growth rate, but the Treasury Bill Rate and real GDP growth rate lags had a negative effect on it. Furthermore, the estimations only revealed evidence of a significant long-term relationship between money demand and financial innovation variables. The short-term impacts of exchange rate depreciation on perceived wealth were noted due to the inverse relationship between exchange rate and real money balances.

Nel et al. (2020) analyzed the stability of Hungary's money demand function using quarterly data. The results demonstrate a consistent money demand in Hungary as well as a long-standing relationship between money demand and its determinants. Asiedu et al. (2021) evaluated the dynamics of the exchange rate and trade imports, the nature and strength of the relationship between the exchange rate and the trade balance, and the effect of the exchange rate on trade export. The study established a significant relationship between the exchange rate and the trade balance. Sanya (2019) examined how the desire for money, financial innovation, and currency depreciation are related. The findings indicate the significance of the exchange rate with evidence of currency substitution.

Hensch (2019) using a co-integrated VAR framework, demonstrated that the traditional money-demand relation, which is based on a transaction effect and the opportunity cost of holding money is no longer able to explain the recent expansion of monetary aggregates in Denmark. Sidik et al. (2018) reported that financial inclusion decreases (increases) demand for reserve money in developing (developed) countries. Sidik et al. (2018) used a Dynamic Panel Approach on a sample of 36 countries to investigate how financial inclusion influences demand for money. The results demonstrated that financial inclusion in many industrialized nations encourages a rise in reserve currency demand. The development of financial inclusion, however, may cause a decline in the need for money in emerging economies. Khatat (2018) found a steady long-run link between M2 and its variables, including *GDP*, *stock prices, foreign interest rates,* and *real exchange rates.*

Ibrahim (2001) used data collected after 1986 and reported the importance of real income and stock prices in influencing the behavior of money demand in Malaysia. Samreth (2008) used ARDL approach to empirically estimate the money demand function in Cambodia. His estimation period covered from 1994M12 to 2006M12. The findings suggested a combination of wealth impacts and currency substitution over the long run. Bathalomew and Kargbo (2009), who also used the ARDL modeling method, looked at how changes in foreign exchange rates affected Sierra Leone's demand for real broad money (RM2) balances from 1983Q1 to 2008Q4. The data also show that Sierra Leone's strategy for targeting monetary aggregates should consider M2 stability as an appropriate intermediate aim. Howard (2002) examines the impact of exchange rate depreciation on demand for real money balances during the hyperinflation in Jamaica between 1968 and 1997. The model was examined using modeling for error correction and co-integration. The results showed that the severe depreciation in Jamaica's currency after 1990 had a real balance effect on the demand for narrow money. Bitrus (2011) examined Nigeria's insatiable desire for money in 2011. The 26-year yearly data series on the stock market, income, interest rate, and other financial indicators were used in the study. The study employed regression analysis with a number of factors. The study found income as the main factor influencing money demand in Nigeria.

In the reviewed empirical literature, it has been established by some studies that interest rates influence the money demand negatively (Nkalu, 2020; Nel et al., 2020; Hensch, 2019; Albulescu & Pépin, 2018), while the income level was found to impact money demand positively (Nakorji & Asuzu, 2019; Khatat, 2018). In contrast, other studies found significant adverse relation between exchange rate devaluation and the desire to hold cash balances in a short-term period (Iyke & Ho, 2021a; Adeyemi et al., 2020; Nakorji & Asuzu, 2019; Asiedu et al., 2021; Sanya, 2019; Bathalomew & Kargbo, 2009) and also that financial innovation played a positive role in the demand for cash balances (Sidik, et al., 2018; Tule & Oduh, 2017; Misati et al., 2010; Odularu & Okunrinboye, 2009; Mannah-Blankson & Belnye, 2004). The crux of the reviewed literature is that there is a multifaceted relation between money demand and all its structural determinants ranging from real income growth, nominal interest rates, policy uncertainty, inflation uncertainty, etc. Such a stable multifaceted link between money demand and its causal factors stimulates the causal relationship between the inflation rate and the growth of money in circulation notwithstanding the regime of the exchange rate in practice.

3. RESEARCH METHODOLOGY

There are several methods of estimating the money demand function. These include the linear and nonlinear methods, smooth transition regression method, parametric non-linear method of estimation, vector error and error corrections estimation methods, threshold regression method, pooled mean group (PMG), dynamic ordinary least squares model (DOLS), fully-modified OLS (FMOLS) estimator, dynamic fixed effect (DFE) model estimation, generalized method of moments (GMM) estimation techniques, etc. The paper explores a SVAR model to measure the structural relationship between interest rate variability, inflation

uncertainty, and exchange rate devaluation together with the relative impact of each variable on money demand impact. The use of SVAR method was necessitated going on the objective of the study which is to evaluate the structural relation between money demand and its causal variables. Sims (1980) asserts that using impulse responses and decomposition analysis of VAR-error-adjusted shocks from macroeconomic variables, the SVAR model provides an analytical depiction of business cycle fluctuations.

$$MD_t = b_{10} + b_{12}EXD_t + b_{13}IRV_t + b_{14}IU_t + b_{15}HC_t + \gamma_{11}MD_{t-1} + \gamma_{12}EXD_{t-1} + \gamma_{13}IRV_{t-1} + \gamma_{14}IU_{t-1} + \gamma_{15}HC_{t-1} + \varepsilon_{MDt} \quad (2)$$

$$EXD_t = b_{20} + b_{21}MD_t + b_{23}IRV_t + b_{24}IU_t + b_{25}HC_t + \gamma_{21}MD_{t-1} + \gamma_{22}EXD_{t-1} + \gamma_{23}IRV_{t-1} + \gamma_{24}IU_{t-1} + \gamma_{25}HC_{t-1} + \varepsilon_{EXDt} \quad (3)$$

$$IRV_t = b_{30} + b_{31}MD_t + b_{32}EXD_t + b_{34}IU_t + b_{35}HC_t + \gamma_{31}MD_{t-1} + \gamma_{32}EXD_{t-1} + \gamma_{33}IRV_{t-1} + \gamma_{34}IU_{t-1} + \gamma_{35}HC_{t-1} + \varepsilon_{IRVt} \quad (4)$$

$$IU_t = b_{40} + b_{41}MD_t + b_{42}EXD_t + b_{43}IRV_t + \gamma_{45}HC_t + \gamma_{41}MD_{t-1} + \gamma_{42}EXD_{t-1} + \gamma_{43}IRV_{t-1} + \gamma_{44}IU_{t-1}\gamma_{15} + \gamma_{45}HC_{t-1} + \varepsilon_{IUt} \quad (5)$$

$$HC_t = b_{50} + b_{51}MD_t + b_{52}EXD_t + b_{53}IRV_t + \gamma_{15}IU_t + \gamma_{51}MD_{t-1} + \gamma_{52}EXD_{t-1} + \gamma_{53}IRV_{t-1} + \gamma_{54}IU_{t-1} + \gamma_{56}HC_{t-1} + \varepsilon_{HCt} \quad (6)$$

where, money demand (*MD*), exchange rate devaluation (*EXD*), interest rate variation (*IRV*), household consumption spending (*HC*), and inflation uncertainty (*IU*) are endogenous; $\varepsilon_{MDt}, \varepsilon_{EXDt}, \varepsilon_{IRVt}, \varepsilon_{IUt}$ and ε_{HCt} — structural shocks; and these error terms are uncorrelated white noise innovations with standard deviations $\sigma_{MD}, \sigma_{EXD}, \sigma_{IRV}, \sigma_{IU}$ and σ_{HCt}.

The volatility series were generated through the estimation of the conditional variance GARCH (3, 3) specified as:

$$\rho_t^2 = \tau + \sum_{i=1}^{3} \mu_i \rho_{t-i}^2 + \sum_{i=1}^{3} \emptyset_i \epsilon_{t-i}^2 \quad (7)$$

where, ρ_t^2 represents current volatility, τ is constant of the volatility function, μ_i are the coefficients of volatility in the previous period, and $\emptyset_i$ are the coefficient of past error. These coefficients are expected to exceed zero to guarantee positive volatility.

This study uses data from thirty countries that formed the cross-sections of the panel. The thirty countries were Burkina Faso, Nigeria, Namibia, Kenya, Zambia, Ghana, Egypt, South Africa, Uganda, Tanzania, Malawi, Eswatini, Mali, Niger Republic, Madagascar, Liberia, Libya, Togo, Benin, Guinea, Côte d'Ivoire, the Gambia, Senegal, Burundi, Sierra Leone, Rwanda, Mauritania, Democratic Republic of Congo (DRC), Algeria and Mozambique. Our *MD* measure is M2 which was calculated as the sum total of savings deposits, short-term government bonds, and demand deposits. By these calculations, our measure of M2 incorporated both wealth (interest-bearing assets) and transactions (demand deposits) components. Different measures of inflation uncertainty have been applied by different studies, namely, Iyke and Ho (2021b), Mandeya and Ho (2022), Batabyal and Killins (2021), Istiak (2022), Haque and Magnusson (2021). In the present study, inflation uncertainty captured as price variation was measured by the standard deviation of the change in the logarithm of inflation. Interest rate variations were calculated from GARCH (1, 1) model. Accordingly, using the lag values and squared lag values of disturbances, the conditional variance was calculated (Atoi, 2014). Exchange rate devaluation was calculated using the percentage change method while household consumption expenditure was measured as the sum of resident and non-resident households' final consumption spending at constant prices. In other words, seasonal components of the household consumption series were deseasonalized.

4. RESEARCH RESULTS

4.1. Descriptive analysis

Table 1 provides descriptive data on the countries' respective money demand (in log values). The financial amounts served as the appropriate baseline for comparison. The country with the biggest demand for money at the time was Tanzania, followed by Nigeria (maximum values). According to the standard deviation of 5.51, Guinea has the most erratic money demand, followed by Sierra Leone at 5.29.

Table 1. Money demand (Part 1)

Countries	*Mean*	*Minimum*	*Maximum*	*Std. dev.*	*Kurtosis*
Burkina Faso	9.639819851	638	1063638	1.821624	2.6255
Côte d'Ivoire	10.17895524	789	1105727	1.90423	2.93017
Ghana	7.653273041	618	8596318	1.479082	2.89858
The Gambia	7.054640836	406	8431406	2.376397	0.193069
Guinea	5.975856727	105	7109205	5.513498	-2.09712
Mali	9.633231508	109	615249	1.813771	0.08822
Niger	9.253531187	965	1012965	1.751168	1.43994
Nigeria	10.07026584	141	1124841	2.708529	2.25043
Senegal	9.870705403	124	1075644	1.856957	0.19517
Sierra Leone	5.046020606	104	1064724	5.299296	-2.13479

Table 1. Money demand (Part 2)

Countries	*Mean*	*Minimum*	*Maximum*	*Std. dev.*	*Kurtosis*
Egypt	9.58730609	108	1021038	1.788576	0.29814
Kenya	9.730727267	338	1034338	1.813069	0.46601
Burundi	9.367883431	575	1014575	1.752531	2.92659
Madagascar	10.23700157	143	1086143	1.906348	3.54019
Rwanda	9.019417332	197	1018097	2.425008	2.12736
Malawi	7.549220734	9.497205	9497205	3.378281	1.79959
Namibia	5.302681005	8.887639	8587639	4.286489	-1.88689
Mauritania	4.399104441	8.78504	2578504	1.33264	-2.13276
Eswatini	7.276856887	8.058448	8058448	1.950006	1.47823
Uganda	9.678127921	11.24539	11324539	3.237802	0.47369
South Africa	9.794109665	10.39981	10239981	1.832938	2.87712
Tanzania	10.42190026	11.18907	11918907	1.960478	0.20466
Zambia	7.627741764	8.625894	8625894	2.051033	1.26764
Algeria	10.326126	11.05857	13405857	1.944778	2.10501
Liberia	5.710228983	6.729541	6729541	1.919256	1.24091
Mozambique	5.032969263	9.488307	9488307	4.645747	-1.0094
Benin	9.301728981	10.38247	1038247	2.496077	2.39233
Togo	9.411117411	10.24177	1024177	1.767667	1.4034
DRC	7.050464847	10.59395	1059395	4.597534	-1.14239
Libya	8.056591671	8.726433	8726433	1.528296	0.13733

Source: Researchers' estimations.

Table 2 shows that inflation uncertainty in studied countries ranged from 9.45 percent to Congo's extreme percentage. In this study, the DRC is taken as an outlier and thus, the values for the early years (1991 to 2001) are recomputed to take the mean values of other years for further analysis.

Table 2. Inflation uncertainty

Countries	*Mean*	*Minimum*	*Maximum*	*Std. dev.*	*Kurtosis*
Burkina Faso	2.873785301	-3.23339	25.17788	5.068076	12.40267
Côte d'Ivoire	3.531364311	-1.10686	26.08157	4.972428	14.86596
Ghana	18.82023931	4.865398	59.46155	12.82489	2.616749
The Gambia	5.913019042	0.84497	17.03287	3.479596	2.987255
Guinea	14.90556717	4.684389	34.69527	8.419092	0.937755
Mali	2.62433311	-6.24251	23.17679	5.405995	6.377034
Niger	2.84530372	-7.79664	36.04106	7.284908	14.63431
Nigeria	18.6339107	5.388008	72.8355	17.06491	3.759449
Senegal	2.606989359	-2.24802	32.29367	6.050914	21.32907
Sierra Leone	10.00065869	4.645462	18.21981	4.183889	-0.79904
Egypt	9.793036857	2.269757	29.50661	5.937759	2.893229
Kenya	11.22121223	1.554328	45.97888	9.442934	5.424639
Burundi	10.47023016	-2.8147	31.11159	8.227231	0.355207
Madagascar	11.48389548	-1.704	49.08021	9.943382	8.014856
Rwanda	6.928980918	-2.40593	19.63717	5.196221	-0.12175
Malawi	20.46102283	7.411591	83.32577	15.49641	8.670054
Namibia	5.330127744	2.209382	9.451727	1.997031	-0.04022
Mauritania	5.302237285	1.486007	12.12565	2.667043	0.319506
Eswatini	7.544185167	2.598016	13.76932	2.978117	-0.43978
Uganda	6.210118175	-0.28751	15.12515	3.896424	-0.06132
South Africa	6.398084528	-0.69203	15.3348	3.194219	1.828863
Tanzania	11.28248543	3.290291	34.08336	8.62442	0.622373
Zambia	31.03418643	6.429397	183.312	43.17779	7.526513
Algeria	8.298349346	0.339163	31.66966	9.209455	1.454624
Liberia	10.55401238	6.831787	23.56351	4.40968	4.018913
Mozambique	7.83658691	2.559749	17.41804	5.283865	-1.36914
Benin	4.138437643	-0.79405	38.53087	7.470837	17.63292
Togo	3.894506583	-1.00688	39.16277	7.547809	17.25835
DRC	1331.616326	0.744199	23773.13	4672.267	23.68982
Libya	5.241323841	-9.79765	25.9	7.986653	1.53834

Source: Researchers' estimations.

As shown in Table 3, the negative signs of average values for the thirty panels reveal that exchange rate devaluation is obtainable in African states with the DRC having the worst scenario of devaluation of its currency and Burkina Faso being the least hit.

Table 3. Exchange rate devaluation (Part 1)

Countries	*Mean*	*Minimum*	*Maximum*	*Std. dev.*	*Kurtosis*
Burkina Faso	-0.974097069	-1.10768	-0.03509	0.175305	30.21192
Côte d'Ivoire	-1.001996734	-1.00376	-1.00136	0.000575	4.529752
Ghana	-2.208164154	-13.3027	-1.15048	2.25474	20.84557
The Gambia	-1.050607438	-1.10313	-1.01904	0.030568	-1.2782
Guinea	-1.000456805	-1.00132	-1.0001	0.000384	-0.76618
Mali	-1.001995857	-1.00376	-1.00136	0.000575	4.556405
Niger	-1.001995858	-1.00376	-1.00136	0.000575	4.556404

Table 3. Exchange rate devaluation (Part 2)

Countries	*Mean*	*Minimum*	*Maximum*	*Std. dev.*	*Kurtosis*
Nigeria	-1.017778047	-1.08977	-1.00247	0.021244	2.985507
Senegal	-1.001995872	-1.00376	-1.00136	0.000575	4.556422
Sierra Leone	-1.000626677	-1.00336	-1.0001	0.000725	6.048757
Egypt	-1.160489149	-1.25219	-1.05147	0.064463	-1.00359
Kenya	-1.014168218	-1.03492	-1.00904	0.005604	7.098799
Burundi	-1.001610039	-1.00548	-1.00051	0.001445	0.854102
Madagascar	-1.00081456	-1.00272	-1.00026	0.000691	3.174715
Rwanda	-1.002627831	-1.0079	-1.00101	0.00197	2.210987
Malawi	-1.090864373	-1.30471	-1.00273	0.098362	-1.15961
Namibia	-1.1317812	-1.27522	-1.05705	0.06218	0.198791
Mauritania	-1.012164462	-1.03315	-1.00336	0.010945	-1.02682
Eswatini	-1.131510066	-1.27759	-1.05703	0.061526	0.128662
Uganda	-1.000581926	-1.00136	-1.00027	0.000276	0.573665
South Africa	-1.131461835	-1.27801	-1.05707	0.061417	0.121568
Tanzania	-1.001114784	-1.00454	-1.00027	0.000953	5.083188
Zambia	-1.373125095	-4.99107	-1.04754	0.701336	25.55924
Algeria	-1.016345419	-1.04892	-1.00735	0.010235	4.464541
Liberia	-1.147669883	-1.66585	-1.00519	0.252895	0.014504
Mozambique	-1.066998382	-1.33685	-1.01417	0.077553	6.245925
Benin	-1.001995752	-1.00376	-1.00136	0.000575	4.5522
Togo	-1.001995746	-1.00376	-1.00136	0.000575	4.55221
DRC	-14335.90073	-444303	-1.0005	79798.53	3.9896
Libya	-1.703725432	-2.98818	-1.1664	0.373421	3.350147

Source: Researchers' estimations.

Table 4 shows that about 67 percent of sampled countries had rising interest rates in terms of average values. Congo had the most volatile rates with a standard deviation of 8.34.

Table 4. Interest rate variation

Countries	*Mean*	*Minimum*	*Maximum*	*Std. dev.*	*Kurtosis*
Burkina Faso	3.5476	0.4659	6.8683	2.1587	1.7065
Côte d'Ivoire	0.0251	0.3281	7.0467	1.2718	3.6128
Ghana	0.7536	0.2054	23.1238	4.2693	3.9144
The Gambia	0.0035	0.3036	13.2246	0.0828	2.3112
Guinea	0.0139	0.4149	12.8511	0.2144	1.8734
Mali	0.0127	0.4542	10.5293	0.1459	1.4882
Niger	0.0162	0.5612	10.0481	0.1062	3.7716
Nigeria	0.0129	0.3528	18.2375	0.1325	1.2337
Senegal	0.0707	0.4121	11.9639	0.2756	2.8149
Sierra Leone	0.0326	0.4590	9.2594	0.1261	3.1109
Egypt	0.0135	0.2947	10.6397	0.1043	4.6573
Kenya	0.0061	0.2439	9.4348	0.1485	1.8208
Burundi	0.4275	1.0000	15.7684	2.7073	0.6726
Madagascar	0.0163	0.1455	10.4308	0.1751	3.3673
Rwanda	0.5119	0.0844	18.2583	3.2799	3.1647
Malawi	0.1982	0.5045	19.5282	0.2319	0.8968
Namibia	0.7041	0.2253	21.3333	4.2076	3.9143
Mauritania	0.0267	1.0000	14.5853	0.2213	1.8799
Eswatini	0.0895	0.2331	10.1964	0.1127	-0.4793
Uganda	0.6546	0.2451	20.8595	0.1431	1.4236
South Africa	-0.0135	0.3773	11.0512	0.3688	0.2367
Tanzania	0.8209	0.2266	27.6087	4.9813	0.7616
Zambia	0.1582	1.0000	21.0512	0.3387	1.5526
Algeria	0.5269	0.2679	10.4667	3.3121	3.9767
Liberia	0.7195	1.0000	14.2525	3.5768	1.5611
Mozambique	0.9598	0.1939	9.9667	5.5346	2.9198
Benin	0.2144	0.4528	8.0167	1.4468	2.9645
Togo	0.2170	0.4590	18.7533	1.5815	3.3136
DRC	1.569	0.3498	16.1583	8.3434	3.9932
Libya	0.9268	1.0000	7.7823	1.2947	2.5692

Source: Researchers' estimations.

Table 5 shows that South Africa had the highest household consumption spending with a value of 9512.0 while Nigeria was the second highest country with household spending of 9375.0. Following these two countries were Uganda, and Burkina Faso with household consumption expenditures of 8795.0, and 8333.0 respectively. Congo had the least 1083.0 household spending followed by Madagascar with an expenditure value of 1728.0.

Table 5. Household consumption (Part 1)

Countries	*Mean*	*Minimum*	*Maximum*	*Std. dev.*	*Kurtosis*
Burkina Faso	56.065	11.59	8333.0	0.763	1.765
Côte d'Ivoire	38.628	3.81	2167.0	0.109	4.128
Ghana	56.984	40.54	7538.0	6.269	2.044
The Gambia	36.112	23.6	3746.0	8.082	1.912

Table 5. Household consumption (Part 2)

Countries	*Mean*	*Minimum*	*Maximum*	*Std. dev.*	*Kurtosis*
Guinea	88.234	14.9	3511.0	0.214	1.234
Mali	18.472	53.42	2083.0	4.147	1.182
Niger	26.706	26.12	4281.0	0.102	1.106
Nigeria	11.337	50.28	9375.0	0.135	1.337
Senegal	92.849	12.7	4639.0	0.276	1.149
Sierra Leone	78.109	59.0	2594.0	2.161	0.109
Egypt	40.873	90.47	6397.0	0.143	0.873
Kenya	41.878	40.39	2348.0	0.185	2.208
Burundi	39.626	20.0	2565.4	5.773	0.616
Madagascar	69.673	45.5	1728.0	0.051	1.673
Rwanda	38.647	89.44	2583.0	1.099	3.147
Malawi	60.468	15.45	6882.0	0.589	0.968
Namibia	39.963	20.53	6333.0	0.176	0.143
Mauritania	46.890	27.00	4633.0	0.223	1.129
Eswatini	72.793	30.31	6784.0	0.529	-0.493
Uganda	16.236	40.51	8795.0	0.191	0.236
South Africa	60.267	72.73	9512.0	0.283	0.367
Tanzania	34.616	26.6	6087.0	0.912	0.916
Zambia	58.026	30.0	2512.0	0.385	1.026
Algeria	36.967	65.79	2667.0	1.100	1.967
Liberia	52.561	43.00	4525.0	0.582	1.611
Mozambique	39.998	90.39	4667.0	1.236	0.998
Benin	24.0645	528	2267.0	0.468	2.645
Togo	39.326	590	1833.0	1.215	1.336
DRC	39.932	598	1083.0	0.634	1.932
Libya	28.540	000	5967.0	1.347	3.592

Source: Researchers' estimations.

The panel series were tested for stationarity using panel unit root tests (see Table 6) that assume an absence of cross-section dependence (CSD) and those that assume the presence of CSD exists among cross-sections. Only price variation was found stationary at level. Other variables were *I*(1). Stationarity at first differencing implies that the data were fit for SVAR analysis.

Table 6. Unit root test results

Variables	*LLC*		*Breitung test*		*IPS*		*ADF-Fisher*		*PP-Fish*	
	I(0)	*I(1)*	*I(0)*	*I(1)*	*I(0)*	*I(1)*	*I(0)*	*I(1)*	*I(0)*	*I(1)*
MD	21.2	5.62308*	19.50	20.1025*	8.32	-4.01*	31.75	232.6*	32.88	245.9*
EXD	-156.9*	-469.5	0.8659	-4.193	-107.1*	-141.719	922.364*	1142.5*	994.79*	1777.9*
IRV	-108.4*	-103.0*	3.974	2.326	-36.4*	-52.09*	567.2*	1154.8*	588.9*	3914.7*
IU	-9.38*	-	-7.42*	-	-8.47*	-	188.9*	-	229.4*	-
HC	-123.1*	-179*	1.124	1.426	-29.1*	-32.02*	134.2*	170.2*	125.1*	109.1*

*Note: LLC = Levin, Lin, and Chu t-values, IPS = Im, Pesaran, and Shin W-stat, ADF-Fisher = Augmented Dickey–Fuller Fisher test, PP-Fish = Fisher chi-square; * significance at 0.05.*
Source: Researchers' estimations.

The co-integration test results of Table 7 revealed an absence of long-term relations. The ADF statistic alone of seven tests showed co-integration. Accordingly, the study assumes the absence of co-integration.

Table 7. Co-integration results

Tests	*Statistic*	*W-stat*
Panel tests		
rho-statistic	-0.828566	2.594454
PP-statistic	-0.128017	0.462802
ADF-statistic	-0.193728	-4.130622*
Group tests		
rho-statistic	0.761519	
PP-statistic	-1.195942	
ADF-statistic	-0.416787	

Note: rho-statistic = Pedroni test statistic.
Source: Researchers' estimations.

4.2. GARCH analysis

The inflation uncertainty and interest rate variation were respectively tested for the presence of ARCH effects to satisfy the condition for GARCH analysis in measuring volatility. The results of Table 8 revealed that the variables for most countries could not be subjected to GARCH. Interest rate variations for Nigeria, Kenya, and Liberia were the only interest rate variations that could be estimated with GARCH. Price variability for Nigeria, Madagascar, and Zambia also had their volatilities estimated with GARCH.

Table 8. Heteroscedasticity — ARCH effects (Part 1)

Country	*Interest rate variation*	*Inflation uncertainty (price variation)*	*Exchange rate devaluation*
Burkina Faso	0.973091	0.083785	0.020551 (0.8860)
Côte d'Ivoire	0.867138	0.020108	0.075482 (0.7835)
Ghana	0.677085	0.017562	0.033985(0.8537)
The Gambia	0.629213	0.156796	7.059103(0.0079)*
Guinea	0.009540	1.377292	0.167894(0.6820)
Mali	0.137703	0.026310	0.075482(0.7835)
Niger	0.246821	0.041227	0.075485(0.7835)
Nigeria	11.24319*	10.86735*	0.730232(0.3928)
Senegal	0.259939	0.031889	0.075482 (0.7835)
Sierra Leone	0.010408	0.060213	0.075482(0.7835)
Egypt	0.549399	0.000682	0.000198(0.9888)
Kenya	5.601904*	0.060153	1.333121(0.2483)
Burundi	0.008220	0.009068	5.817494(0.0159)*
Madagascar	0.227035	5.873247*	4.425301(0.0354)*
Rwanda	3.324018	2.185679	0.801331(0.3707)
Malawi	0.556023	0.068441	0.003146(0.9553)
Namibia	0.020587	0.379342	1.038704(0.3081)

Table 8. Heteroscedasticity — ARCH effects (Part 2)

Country	*Interest rate variation*	*Inflation uncertainty (price variation)*	*Exchange rate devaluation*
Mauritania	0.390475	1.342016	0.042120(0.8374)
Eswatini	0.029707	0.000005	1.097282(0.2949)
Uganda	0.154980	0.415093	0.186657(0.6657)
South Africa	0.590268	0.000924	1.158473(0.2818)
Tanzania	1.483586	0.993832	7.891082(0.0050)*
Zambia	0.571774	5.493594*	1.666137(0.1968)
Algeria	0.302011	2.999011	6.085164(0.0136)*
Liberia	4.929078*	0.005732	0.020445(0.8863
Mozambique	0.494388	0.408201	24.20706(0.0000)*
Benin	3.675254	0.121388	0.075156(0.7840)
Togo	1.612842	0.010423	0.075127(0.7840)
DRC	0.187797	0.038343	28.99632(0.0000)*
Libya	0.097895	0.181601	1.343705 (0.2464)

*Note: * significance at 0.05.*
Source: Researchers' estimations.

Table 9 shows GARCH estimates reveal volatility persistence in the inflation uncertainty of the three countries (persistence < 1). For interest-rate variability, however, only Kenya's showed persistence with the sum of ARCH and GARCH terms yielding less than, but close to 1 (0.8815). Thus, future interest rate variability in Kenya can be predicted from past values. For Liberia, ARCH and GARCH terms were found to be significant in the model revealing volatility in the interest rate variation series. The volatility is however without persistence, implying that it would be difficult to draw a trend through past values that would aid future forecasting. Nigeria in variations of its interest rates had weak persistence with a persistence value of 1.0486. Volatility terms, the ARCH and GARCH terms were also not found to be significant in the model.

For inflation uncertainty, Nigeria had high volatility has confirmed by the significance of the values in the model (1.0528 and -0.182362). Persistence was also found at 0.891 (< 1). This implies that the unpredictable rate of inflation in Nigeria is prevalent in high measures. Madagascar like Nigeria, had its price levels exhibit large volatility with significant ARCH and GARCH terms of -0.1276 and 1.0528. Persistence was also found at a value less than 1. This reveals that Madagascar's price levels can be predicted from initial values. The last country fit for GARCH estimation for price level volatility was Zambia. The inflation uncertainty of Zambia showed weak volatility compared to other countries. Persistence, though less than 1, is not close to 1 and thus does not fall under a highly persistent statistic. All models had autocorrelation absent justifying the robustness of the GARCH models.

Table 9. GARCH estimates

Method	*Interest rate variations*			*Inflation uncertainty*		
	Nigeria	*Kenya*	*Liberia*	*Nigeria*	*Madagascar*	*Zambia*
ARCH	1.477278	-0.085997	1.147637*	-0.182362*	-0.1276*	0.4799
GARCH	-0.068663	0.967579*	0.317653*	1.073365*	1.0528*	0.0635
Persistence	1.408615	0.881582	1.46529	0.891003	0.9252	0.5434
Log-Likelihood	-56.55581	-62.5255	-35.00536	-83.51439	-81.8128	-95.7565
Akaike information criterion (AIC)	4.103721	4.5017	3.0810	6.322456	5.9870	6.948725
Autocorrelation	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05

*Note: * significance at 0.05.*
Source: Researchers' estimations.

Table 10 reveals the Gambia had a significant ARCH effect in the model, however, GARCH was not found to be significant. Volatility persistence depicted by the sum of ARCH and GARCH term was not close to 1 and reveals that there is no volatility persistence in the devaluation rates of the Gambia. Burundi has an insignificant ARCH term but a significant GARCH term revealing volatility in the declines of its local currencies *vis-à-vis* the US dollar. Instability is also found to be persistent at 0.811608 which is less than and close to 1. The persistence of volatility in Burundi's devaluation rates shows that one can predict future falls in its local currencies from historical values. For Madagascar, GARCH term is significant in the model revealing volatility in the devaluation rate series. Furthermore, volatility persistence is 0.752, revealing the ability of past values of exchange rate devaluations to proffer future rates. Mozambique shows weak persistence of devaluation rate at 1.833 implying that it would be difficult to draw a trend through past values that would aid future forecasting. Algeria, Tanzania, and the DRC are found to have insignificant model estimates and weak persistence revealing a weak level of accuracy in predicting future devaluation occurrences from past devaluation measures.

Table 10. GARCH estimates

Methods	*Exchange rate devaluation*						
	The Gambia	*Burundi*	*Algeria*	*Mozambique*	*Madagascar*	*DRC*	*Tanzania*
ARCH	2.5892*	0.1981	0.9445	-0.166	0.123508	-0.0717	1.0142
GARCH	0.009751	0.613547*	-0.246880	1.99*	0.628*	0.466	0.2579
Persistence	2.5990	0.8116	0.697	1.832	0.752418	0.39441	1.2722
Log-Likelihood	136.175	246.8224	160.6465	114.3489	243.635	-361.37	214.78
AIC	-8.7450	-16.1215	-10.3764	-7.289	-15.909	24.4249	-14.467
Autocorrelation	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05

*Note: * significance at 0.05.*
Source: Researchers' estimations.

The devaluation of currencies in the seven countries is largely volatile. However, Burundi, Algeria, and the DRC show volatility persistence. For these three countries, there would be a level of accuracy in predicting future devaluation occurrences from past devaluation measures.

Figure 1. Volatility graph of Nigeria *IRV*

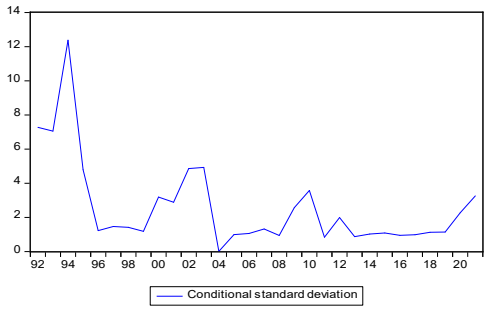


Figure 2. Volatility graph of Nigeria *IU*

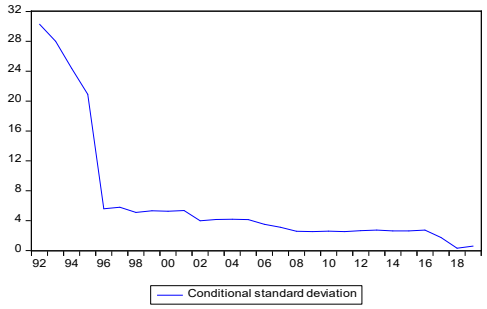


Figure 3. Volatility graph of Kenya *IRV*

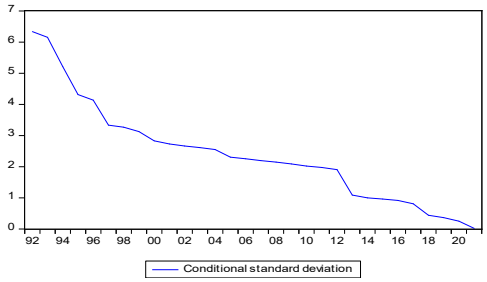


Figure 4. Volatility graph of Madagascar *IU*

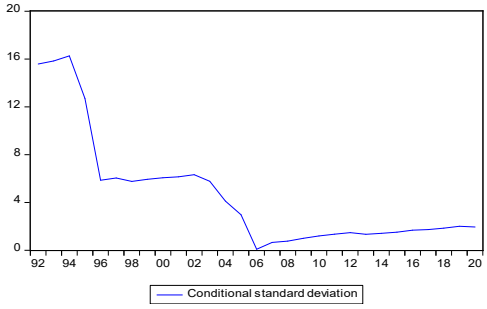


Figure 5. Volatility graph of Zambia *IU*

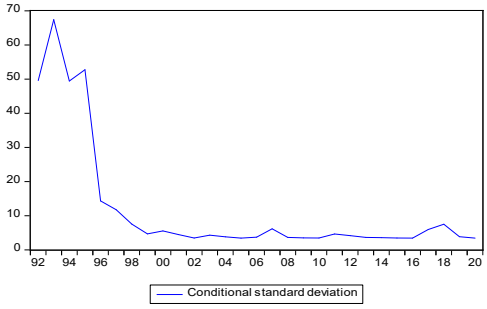
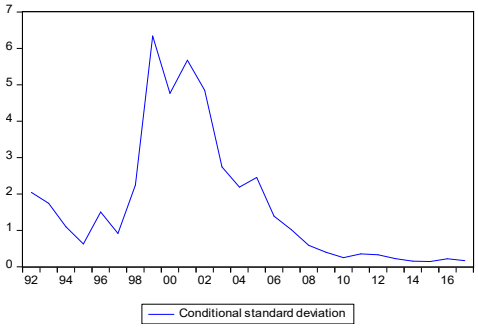


Figure 6. Volatility graph of Liberia *IRV*



The graphs of interest rate volatility for Nigeria and Liberia do not have small (large) volatilities. There is therefore no evidence of volatility persistence, thus, future values of these rates cannot be predicted from their past values.

Figure 7. Volatility graph of Burundi *EXD*

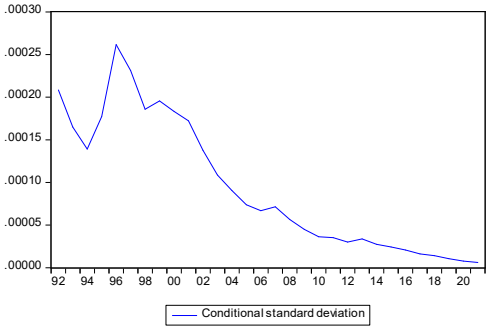


Figure 8. Volatility graph of Tanzania *EXD*

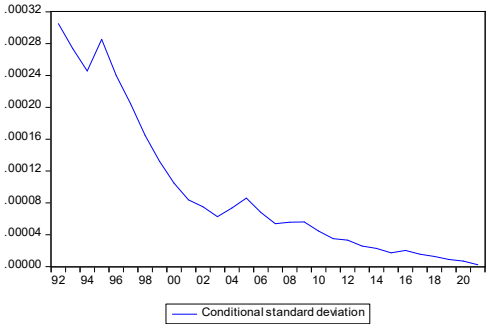


Figure 9. Volatility graph of Madagascar *EXD*

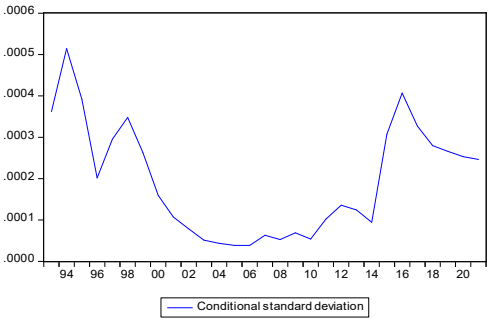


Figure 10. Volatility graph of Algeria *EXD*

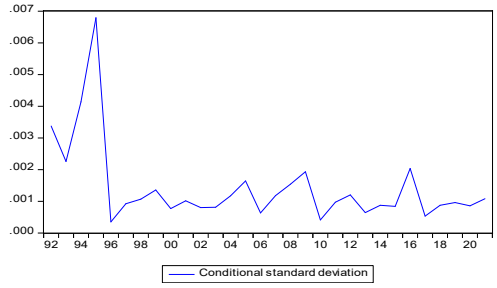


Figure 11. Volatility graph of Mozambique *EXD*

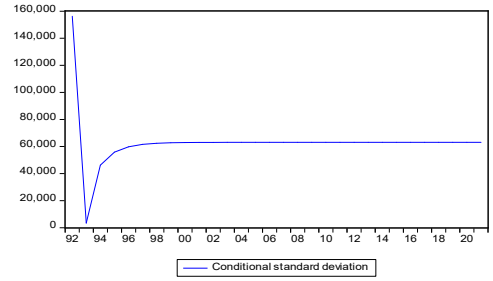


Figure 12. Volatility graph of DRC *EXD*

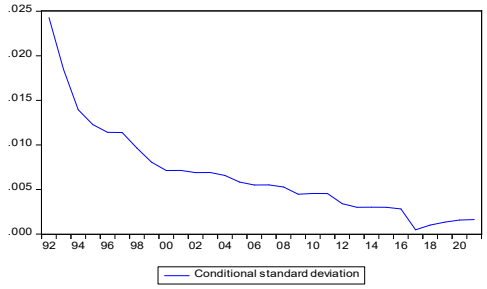


Figure 13. Volatility graph of Gambia *EXD*

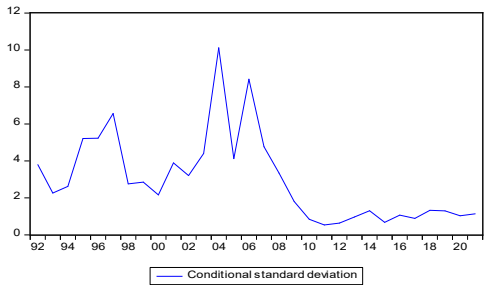
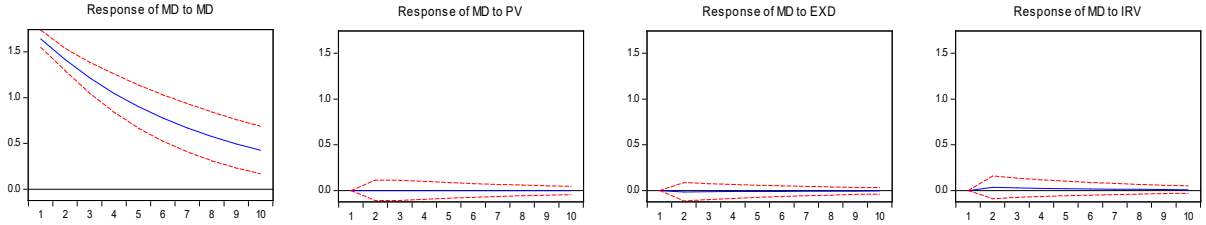


Table 11. Optimal lag selection

Lag	*LogL*	*LR*	*FPE*	*AIC*	*SIC*	*HQ*
0	-6244.851	NA	2555.978	19.19770	19.22522	19.20837
1	-5584.115	1311.322	352.6361	17.21694	17.35453	17.27031
2	-5055.422	1042.768	72.99192	15.64185	15.88951	15.73790
3	-4625.231	843.2003	20.44805	14.36937	14.72710	14.50812
4	-4455.208	331.1677*	12.7396*	13.8961*	14.3639*	14.07762*

*Note: LR = Linear regression, FPE = Final prediction error, AIC = Akaike information criterion, SIC = Schwarz information criterion, HQ = Hannan-Quinn information criterion; * significance at 0.05.*
Source: Researchers' estimations.

Figure 13. Money demand with 1-year lag adjustment



Source: Researchers' elaborations.

As shown in Figure 13 above, it was discovered that money demand with a year lag adjustment reacts adversely to shocks from changes within itself. To put it another way, if money demand grows in one period, it will decline in the next, causing alternating movements within periods. The money demand curve is observed to remain within equilibrium regions despite shocks from the variables, indicating that other factors in the model, such as inflation uncertainty, interest rate variation, and exchange rate devaluation, did not cause a meaningful response from the money demand for a while.

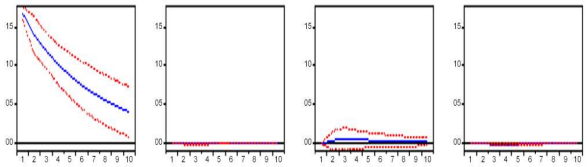
Table 12. Forecast error variance decomposition (1-lag)

Period	*Variance decomposition of M2*					*HC*
	S.E.	*M2*	*IU*	*EXD*	*IRV*	
1	1.642844	100.0000	0.00000	0.00000	0.00000	0.00000
		(0.00000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
2	2.168915	99.96990	3.33E-06	0.00547	0.02554	0.02368
		(0.18383)	(0.0970)	(0.11351)	(0.13440)	(0.1470)
7	3.026087	99.95119	6.24E-05	0.007212	0.041536	0.02386
		(0.32403)	(0.1986)	(0.18984)	(0.2138)	(0.49845)
8	3.080382	99.95050	6.49E-05	0.007313	0.042126	0.04289
		(0.32908)	(0.2053)	(0.19261)	(0.2446)	(0.24810)
10	3.149027	99.94967	6.79E-05	0.007432	0.042829	0.093648
		(0.33496)	(0.2016)	(0.1586)	(0.2807)	(0.192940)

Source: Researchers' estimations.

The forecast error variance decomposition (FEVD) of Table 12 also shows that in period 1, money demand is its sole predicting factor in the model. As the number of periods progresses, other study variables have a combined influence of less than 1 percent in explaining variations in money demand. Thus, money demand with a 1-lag adjustment is highly exogenous. Interest rate variation in this model is found to be the highest predictive variable aside from money demand with a 0.02 percent to 0.04 percent portion of money demand variance explanation compares with lower values of price value and exchange rate devaluation. In Figure 14 below, money demand within itself reacted poorly to recent shocks. The annual need for money would result in a consistent reduction in subsequent periods. The confidence intervals' edges and the zero line are where the money demand response curve is located. Hence, when the demand for money is delayed by two periods, it would not appreciably react to an exchange rate devaluation. The same is true for interest rate fluctuation, but money demand will react to these shocks more strongly than it will to a decline in the value of the country's currency relative to the dollar. Price differences will also have little impact on the demand for money among African countries' economic units.

Figure 14. Money demand with 2-year lag adjustment



Source: Researchers' elaborations.

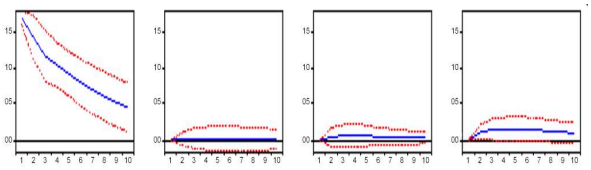
As shown in Table 13 below, FEVD confirms that money demand is the greatest predictor of itself compared to the other variables with 99% forecast power even in the 10th period. Inflation uncertainty is pointed out because its self-explanatory power stands at more than 10 percent of the total decomposition. The table above reveals that money demand has a 20.75% predictive value on price variation implying prices rise when people hold more money. Exchange rate devaluation is also found to respond to shocks from money demand with the latter influencing devaluation to a 10% degree.

Table 13. FEVD (2-lag)

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5
Variance decomposition of lnM2						
1	1.674430	100.0000	0.000000	0.000000	0.000000	0.09113
2	2.174867	99.96517	1.73E-05	0.034790	2.30E-05	0.05127
5	2.821662	99.87083	5.27E-05	0.126658	0.002461	0.00235
10	3.107745	99.84877	6.06E-05	0.148055	0.003117	0.01025
Variance decomposition of EXD						
1	0.282951	0.002092	99.99791	0.000000	0.000000	0.04782
2	0.283828	0.600939	99.38096	0.018100	5.08E-07	0.07672
5	0.294225	7.488075	92.48158	0.026671	0.003673	0.00273
10	0.299525	10.72460	89.23716	0.034476	0.003759	0.07621
Variance decomposition of IRV						
1	2.0082	0.3349	0.0491	99.61729	0.000000	0.00000
2	2.2112	0.3555	0.0421	99.59620	3.34E-07	0.00001
5	2.2138	0.3558	0.0011	99.59622	1.75E-06	0.00231
10	2.2491	0.3511	0.0281	99.59621	1.75E-06	0.00015
Variance decomposition of IU						
1	26.6834	2.66301	0.017309	0.028313	97.2360	0.0902
2	26.7353	2.96750	0.017290	0.056671	96.9541	0.000212
5	28.6210	15.2650	0.015207	0.080735	84.6011	0.020021
10	29.591	20.2147	0.014225	0.091625	79.1428	0.07629
Variance decomposition of HC						
1	83.143	2.30234	0.0192	0.0213	7.2913	0.00013
2	35.238	3.7189	0.0101	0.4065	6.9527	0.01897
5	21.307	2.2781	0.0107	0.0812	4.6102	0.13971
10	98.531	3.2570	0.0152	0.0924	9.1814	0.092021

Source: Researchers' estimations.

Figure 15. Money demand with 3-year lag adjustment



Source: Researchers' elaborations.

Figure 15 shows that a 3-year lag in money demand retains the negative reaction of money demand to shocks from within itself. However, the magnitude of the reaction is less than the 2-year lag as depicted by the less-steep slope. Money demand also responds to the external shocks from inflation uncertainty with increased prices leading to higher demand for money in the first three periods, then maintaining that level till the seventh period before it the response gradually weans off converging to 0. Exchange rate devaluation is first unaffected by movements in money demand till year 2 after the initial 3-year lag (five years from origin) when it is sharply affected in a direct relationship. In other words, higher money demand will increase devaluation and vice versa. Price variation will also be affected by shocks in money demand negatively but this would begin to converge to 0 at the end of the 6th period. Table 14 shows

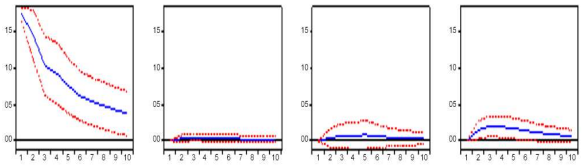
money demand still shows high endogeneity with over 98% explanatory power even in the 10th period. Inflation uncertainty still has its response to shocks from money demand at 18%, large enough to predict money demand.

Table 14. FEVD (3-lag)

Period	*S.E.*	*Shock1*	*Shock2*	*Shock3*	*Shock4*	*Shock5*
Variance decomposition of lnM2						
1	1.690024	100.0000	0.000000	0.000000	0.000000	0.00000
2	2.211350	99.72591	0.008086	0.034313	0.231691	0.05120
5	2.871423	98.83103	0.025288	0.163794	0.979888	0.08105
10	3.208997	98.23168	0.029523	0.203645	1.535154	0.00025
Variance decomposition of EXD						
1	0.194322	0.008771	99.99123	0.000000	0.000000	0.00000
2	0.238868	0.013706	99.92480	0.006011	0.055485	0.05236
5	0.277814	3.024234	96.74489	0.009890	0.220990	0.04316
10	0.286619	5.435732	94.32604	0.015114	0.223115	0.47800
Variance decomposition of IRV						
1	2.304969	0.305722	0.005243	99.68904	0.000000	0.00000
2	2.306121	0.354699	0.022815	99.59743	0.025056	0.02468
5	2.306860	0.370966	0.041654	99.54986	0.037520	0.04287
10	2.306922	0.371551	0.045146	99.54455	0.038754	0.00905
Variance decomposition of IU						
1	19.54031	1.453996	0.934888	0.006804	97.60431	0.00000
2	23.08628	1.232156	0.741904	0.006965	98.01897	0.04905
5	25.89494	8.166226	0.647201	0.034128	91.15244	0.02931
10	27.59712	18.65565	0.678865	0.072816	80.59267	0.32461
Variance decomposition of HC						
1	19.54031	1.453996	0.934888	0.006804	97.60431	0.00000
2	23.08628	1.232156	0.741904	0.006965	98.01897	0.09010
5	25.89494	8.166226	0.647201	0.034128	91.15244	0.20005
10	27.59712	18.65565	0.678865	0.072816	80.59267	0.06587

Source: Researchers' estimations.

Figure 16. Money demand with 4-year lag adjustment



Source: Researchers' elaborations.

Money demand lagged by 4 periods revealing a similar reaction of money demand to a standard deviation shock within itself. Figure 16 above also confirms the visible response of inflation uncertainty to shocks from changes in money demand. Table 15 reveals money demand lagged by 4 periods reveal a similar reaction of money demand to a standard deviation shock within itself. Inflation uncertainty is also found to cause changes in money demand. The graph above also confirms the visible response of inflation uncertainty to shocks from changes in money demand.

Table 15. FEVD (4-lag)

Period	*S.E.*	*Shock1*	*Shock2*	*Shock3*	*Shock4*	*Shock5*
Variance decomposition of lnM2						
1	1.727377	100.0000	0.000000	0.000000	0.000000	0.00000
2	2.256536	99.50243	0.025828	0.036204	0.435535	0.07894
5	2.772408	97.95881	0.107658	0.234162	1.699369	0.02379
10	2.995266	97.47792	0.129792	0.324815	2.067470	1.02784
Variance decomposition of EXD						
1	0.048332	0.002157	99.99784	0.000000	0.000000	0.00000
2	0.050901	0.355066	97.73534	0.144222	1.765371	0.02349
5	0.063923	0.488854	96.23942	0.422495	2.849229	0.00123
10	0.068197	0.510027	95.57978	0.553888	3.356305	0.02479
Variance decomposition of IRV						
1	2.364252	0.305697	0.156372	99.53793	0.000000	0.00000
2	2.365218	0.337622	0.157494	99.46493	0.039953	0.02389
5	2.365799	0.342260	0.157937	99.44969	0.050116	0.02038
10	2.365866	0.346486	0.159069	99.44408	0.050365	0.23860
Variance decomposition of IU						
1	17.91331	1.072862	6.562858	0.019426	92.34485	0.00000
2	23.88221	1.326518	6.181121	0.010929	92.48143	0.01270
5	32.88082	37.84191	3.795002	0.091568	58.27152	0.06230
10	33.45000	39.42130	3.724005	0.210014	56.64468	0.23630
Variance decomposition of HC						
1	17.91331	1.072862	6.562858	0.019426	92.34485	0.00000
2	23.88221	1.326518	6.181121	0.010929	92.48143	0.02081
5	32.88082	37.84191	3.795002	0.091568	58.27152	0.03205
10	33.45000	39.42130	3.724005	0.210014	56.64468	0.32100

Source: Researchers' estimations.

Inflation uncertainty is using over half of its explanatory power in the fifth period following a five-year lagged money demand when it comes to shocks from its internal dynamics. By the fifth cycle, money demand starts to significantly predict price level. Future price levels will still be influenced by money demand, albeit at a slower rate. Overall, results indicate that baseline results of the SVAR model are robust as responses are similar for different lags. All values within the stability Table 16 are less than 1 and depict no root lies outside the unit circle, hence, our SVAR model is stable. By implication, monetary authorities in Africa can conveniently forecast how much money will circulate in their economies. In sum, money demand amidst inflation uncertainty, interest rate, and exchange rate devaluation is vital for better financial policy formulation and implementation.

Table 16. Stability of the VAR model

Root	*Modulus*
0.860692	0.860692
0.732229	0.732229
0.649465	0.649465
-0.015332 - 0.240731i	0.241219
-0.015332 + 0.240731i	0.241219
-0.031435 - 0.143447i	0.146851
-0.031435 + 0.143447i	0.146851
-0.107795	0.107795
0.071154 - 0.016447i	0.073030
0.071154 + 0.016447i	0.073030
-0.004815 - 0.023665i	0.024150
-0.004815 + 0.023665i	0.024150
VAR satisfies the stability condition	

Source: Researchers' estimations.

5. DISCUSSION OF THE RESULTS

Individual money demand curves with lag 1 and lag 2 adjustments were derived from ARDL analyses to aid the conduct of the cumulative sum (CUSUM) and CUSUM-squared graphs (contained in Table A.1). Burkina Faso and South Africa's demand for money are similar to the SVAR estimation with increases followed by reductions in periods in both lag 1 and lag 2 adjustments. Guinea also had alternating movements in money demand but with less intensity. However, the money demand dwindles for two periods in 2020 and 2021. Côte d'Ivoire also has alternating money demand in earlier periods but begins with a continuous decline after the year 2015. Ghana also has similar results with SVAR prediction with rises accompanied by falls but the intensity reduced in later years. The money demand in the Gambia reverses the effects of Ghana with more intensity recorded in later years. Mali and Niger have similar money demand curves with a one-time low demand between 2004 to 2006 before the fall in 2020 and 2021. Nigeria, Senegal, Egypt, Madagascar, Uganda, Eswatini, Tanzania, Togo, Benin, Mozambique, and Liberia have money demand in their respective jurisdictions constantly rising as shown with a downward sloping curve from right to left. The DRC looks to have a stable money demand after a steep decline and rise between 1996 and 1998. Zambia using the lag 1 demand model had a fairly stable money demand through the periods. However, by adjusting to lag 2, the money demand is found to follow alternating movements though on an ascending scale. Overall, the study finds heterogeneity of money demand functions in African countries.

To further test the structural stability of estimated coefficients in the money demand model, the CUSUM-test of recursive residuals was used. Structural stability is achieved when the CUSUM line lies within the boundaries of significance. CUSUM identifies systemic changes in parameters while square detects sudden changes from the constancy of the parameters. When the line lies outside the critical bounds, the model is found to be unstable. The ARDL analyses were conducted with fixed lags of 1 to 4 for each country to derive the parameter stability tests. Nigeria and Tanzania had parameters from lag 1 to lag 4 to be stable as lines fell within critical bounds in the CUSUM and CUSUM-squared charts. Liberia was also stable in the 2 lags that were computed. Thus, parameters are structurally stable in these countries. For Senegal and Mauritania, CUSUM graphs showed the structural stability of parameters. However only lag 2 and 3 for CUSUM of squared charts showed structural stability in parameters. Egypt had similar stability results, except that lag 1 and 2 for the CUSUM-squared test had sudden changes weakening the structural stability of parameters. Zambia had structural instability in parameters as shown by the CUSUM-test for lag 3; Uganda and Madagascar had a similar result for lag 4. For Rwanda, only estimations of lag 4 were stable while Togo and Malawi had lag 2 stables for model estimation. Other countries had no stability as the CUSUM-squared graph depicts.

Only Kenya's interest rate variability was volatile and persistent, suggesting that they are more heavily impacted by state monetary authorities' discretionary decisions than by historical values. Taking short and long terms together, money demand is an indirect predictor of itself. Due to favorable and unfavorable economic variables, the more money held off investments in a given period, the less will be available to retain in succeeding ones. Exchange rate devaluation is found to be very weak in determining the demand for local money. Results show that as more of the units of the local currency is used to exchange a unit of foreign currency such as the dollar, local economic units are discouraged to increase demand for money in local money and thus hold fewer local currencies while investing in foreign exchange investments.

Inflation uncertainty was found to be a direct and significant predictor of money demand. Increased price levels, which signify inflationary trends would cause economic units to want to hold more money for consumption and leave fewer resources for investment and in turn, economic growth. Interest rates also had a positive effect on the demand for money. Implying that rising interest rates would motivate economic units to withdraw financial resources from investments and hold money. This relationship negates the normal money demand curve in which money demand rises with decreasing interest rates. Apparently, rising price levels cause interest rates to rise because surplus units would require higher interest rates to cushion the falling value of currencies. The direct relationship in money demand from rising price levels is typically in a trio-relationship with interest rates. Governments of these countries will not be

able to use interest rates to regulate consumer spending, rather inflation-targeting policies will be implemented. The study also finds a bi-directional relationship between inflation uncertainty and money demand. While increased prices would cause the demand for money to rise, the demand for money also influences the changes in inflation of a particular country such that in the long run, more money held by economic units would cause inflation (increased price levels). In relation to lag adjustments, similar results are found in study relationships. However, this study upholds 3-year lag results as the most practical. This stems from the noticeable reactions of money demand to shocks external to itself that were absent in the 2-year lag result. The 3-year lag FEVD also reveals that the explanatory power of variables from assigned lagged values is significant. There were also lower standard errors in some of the lines than there were in other lags examined, revealing the 3-year lag as a more reliable prediction of future values.

We found a significant positive variation between household expenditure and demand for cash balances in all countries in our sample. This finding validates those obtained by Mahanty et al. (2022) where a positive effect of household consumption spending on money demand was reported for ten emerging Asian economies, namely Cambodia, Vietnam, Malaysia, Philippines, India, Indonesia, Bangladesh, Pakistan, Sri Lanka, Thailand both in the long run and short run. Our finding is also in support of the findings of Albulescu et al. (2019). These authors found that household consumption accounted for significant variations in the long-run demand for money equation in CEE countries.

In terms of policy findings and implications of results, the negative coefficient of interest rate differentials can be interpreted to suggest that an increase in the nominal interest rate stimulated an increase in time deposits while demand deposits fall. This same result was obtained by Carpenter and Demiralp (2008) for the Turkish economy. The variations in official interest rates of the central monetary authorities affect directly money-market interest rates and, indirectly, lending and deposit rates, which are set by banks to their customers. Hence, whenever there are expectations of future official interest-rate variations, it affects medium and long-term interest rates. In these countries, the speculative motive for demanding money would rise whenever there are speculations of a crash of the stock market because those expecting the market to crash would sell-off their stocks and hold the proceeds as cash or money balances.

Regarding inflation uncertainty, the finding upholds that whenever inflation uncertainty rises, demand for cash holding rises as well. This indeed suggests that an increase in unpredictability of the inflation rate results in an escalation of the motivation to hold cash balances for transaction spend. In effect, uncertainty varies the portfolio composition of economic agents to favor cash balance as against investment in stock markets and holding other financial assets. This empirical finding corroborates the works of Hossain (2019) and Taylor (2019). Specifically, a monetary policy implemented by African countries has not properly guided expectations of economic agents of future inflation and this has adversely swayed price movements. What it implied is that in Africa, central banks lack a high degree of credibility and so lack the capacity to confidently drive expectations of price stability. In this case, economic agents increase domestic prices for fear of greater inflation.

The impact on financing conditions in the economy via money demand and on market expectations triggered by price movements induces adjustments in stock market prices and exchange rates. Given that money as a speculative instrument is situated on conjectures of changes in currency rates, when there are expectations of a depreciation of the local currency against a foreign currency, economic agents including investors prefer to hedge against exchange rate risk, by purchasing the foreign currency and store same only to sell off whenever such currency appreciates against the domestic currency. This practice is prevalent in all emerging African countries (in our sample) as they are characterized by volatile currency and high inflation, whereby economic agents operate in such a manner to store money in pounds, euros, or US dollars. The reason is that these foreign currencies are relatively stable.

Future expectations of exchange rates are strongly related to those of future money prices for a country's goods, which in turn depend on shifts in the money supply and demand. Changes or in particular, devaluation in the exchange rates unswervingly generate inflation especially when imports are made by economic agents for consumption. Our finding for the coefficient of exchange rate devaluation validated the findings of Bahmani-Oskooee et al. (2016) that exchange rate movements have a significant asymmetric impact on demand for cash balance in China. Calvo and Reinthart (2002) whereby devaluation in the official exchange rate of local currencies of emerging African countries results in an escalation of the domestic inflation rate. This comes about through importation. In effect, the devaluation of the local currency had escalated demand for cash balances for transactions in Africa. For example, the pace of depreciation of the Congolese franc against the US dollar accelerated to an average of 14.9% year on year in June–August, as against an average weakening of 3.4% in January–May 2022 (Fitch Solutions Country Risk & Industry Research, 2021). This has informed monetary tightening in the country. Besides, insufficient foreign exchange reserves have also militated against the effectiveness of the Central Bank of the Congo (BCC)'s interventions in the foreign exchange market. The dollarization of the Congolese economy could be responsible for the devalued franc and this has resulted in amplified inflationary pressures in Congo. For example, year-to-date inflation stood at 10.6% in January–July, as against BCC's projection of 7%. According to Fitch Solutions Country Risk & Industry Research (2021), the failure of mining companies to repatriate US dollar export earnings back to the DRC remains the major cause of the rapid currency depreciation. As it were, reserves are exhausted without any provision for replenishment.

6. CONCLUSION

In this study, the money demand was evaluated with lag adjustment in the context of inflation uncertainty, interest rate fluctuations, household consumption expenditure, and currency devaluations in Africa. The study focused on 30 African countries and runs from 1990 through 2022. The study focused on 30 African nations, including Burkina Faso, Nigeria, Namibia, Kenya, Zambia, Ghana, Egypt, South Africa, Uganda, Tanzania, Malawi, Eswatini, Mali, Niger, Madagascar, Liberia, Libya, Togo, Benin, Guinea, Côte d'Ivoire, The Gambia, Senegal, Burundi, Sierra Leone, Rwanda, Mauritania, DRC, Algeria, and Mozambique. Panel SVAR and GARCH methods are some of the econometrics tools used in the research work to analyze the data. *Money demand* was used as the dependent variable, while *household consumption spending, interest rate variations, inflation uncertainty*, and *exchange rate devaluation* were used as independent variables.

The country with the largest demand for money at the time was Tanzania, followed by Nigeria (maximum values). According to the standard deviation of 5.51, Guinea has the most erratic money demand, followed by Sierra Leone at 5.29. Price variance in the investigated nations ranged from 9.45% to an extremely high proportion for Congo. The DRC is treated as an anomaly in this study, thus the values for the early years (1991 to 2001) are recalculated to include mean values from other years for additional analysis. The negative average values for the thirty panels show that exchange rate depreciation is possible in African countries, with Burkina Faso suffering the least from it and the DRC experiencing the worst case.

In terms of average values, rising interest rates were present in about 67% of the sampled nations. The country with the highest rate of volatility was Congo, where it was 8.34. The GARCH calculations show that the inflation uncertainty in the three nations has persistent volatility. However, only Kenya's interest rate shows consistency. Thus, previous values can be used to estimate future inflation for these nations and interest rates in Kenya. In addition to the importance of the auto-regressed variable, the results showed that changes in price levels and interest rates have a direct impact on money demand. In other words, as prices rise, there will be a greater need for people to hang onto their money to pay for more expensive goods.

Only Kenya's interest rates were significantly volatile and persistent, suggesting that they are more heavily impacted by state monetary authorities' discretionary decisions than by historical values. In both the short and long terms, money demand is an indirect predictor of itself. Due to both favorable and unfavorable economic conditions, the more money held off investments in a given period, the less will be available to hold in succeeding ones. Devaluation of the exchange rate was weak in determining a demand for local money compared to the demand for foreign money such as US dollars. Results demonstrate that local economic units are discouraged from increasing demand for money and holding more money when engaging in foreign exchange investments as more local currency units are used to exchange a unit of foreign currency, such as the dollar.

Besides, it was discovered that price level was a direct and powerful predictor of money demand. Economic units would want to store more cash for consumption as a result of rising prices, which indicates inflationary trends, leaving less for investment and, consequently, economic growth. The demand for money was positively impacted by interest rates as well. Suggesting that economic agents would become more inclined to retain cash and remove resources from investments as interest rates rise. This relationship contradicts the conventional money demand curve, which states that demand for money increases as interest rates decrease. It appears that rising price levels lead to rising interest rates since surplus units would require higher interest rates to offset the depreciating worth of currencies. Money demand, which frequently has a trio-relationship with interest rates, is strongly impacted by rising uncertainty in the inflation rate. Governments in these countries will be unable to regulate consumer spending through variations in domestic interest rates; instead, inflation-targeting policies will be implemented. The study also identifies a two-way relationship between changes in inflation uncertainty and money demand. While increasing inflation uncertainty raises the demand for money, the same desire also drives changes in a country's unpredictability of the domestic inflation rate, such that over time, inflation would come from more people wanting to spend their money.

Our inability to include a variety of economic policy regimes in our model of money demand especially when most of the African countries considered in our sample have been exposed to policy shocks is a limitation of the study. We, therefore, suggest the need for future researchers to engage a Markov Switching methodology to estimate an expanded money demand function that makes provision for seasonal and structural dummies under different policy regimes. Different models of money demand for different exchange rate regimes (fixed and floating) with the inclusion of country-specific dynamics together with policy uncertainty variables should be estimated.

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APPENDIX

Figure A.1. GARCH variable plots

Source: Researchers' elaborations.

Table A.1. CUSUM and CUSUM-squared stability graphs for respective money demand curves (Part 1)

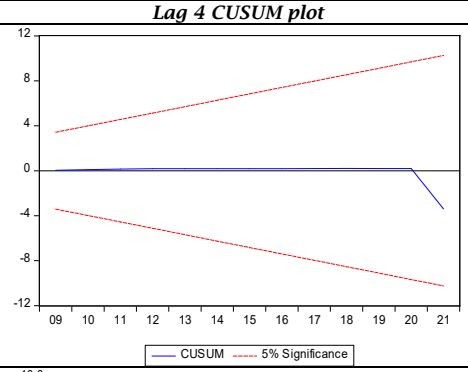
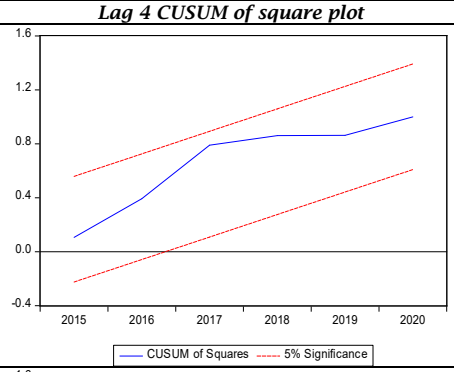
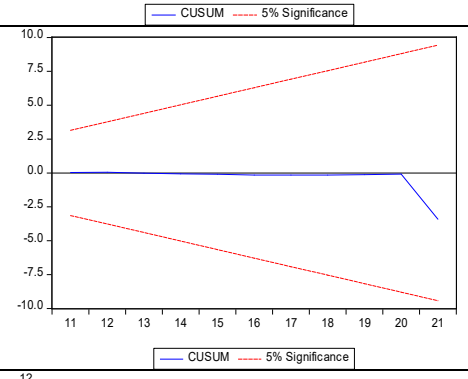
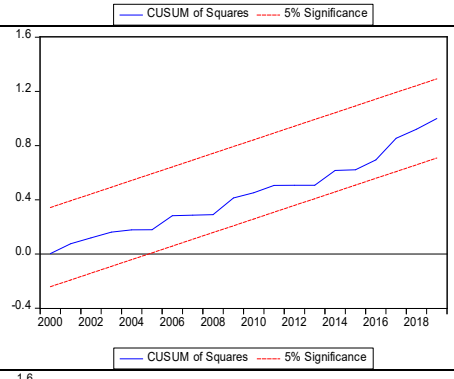
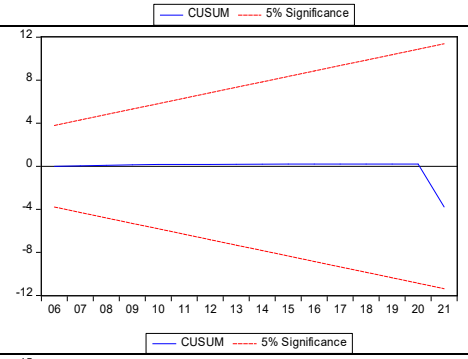
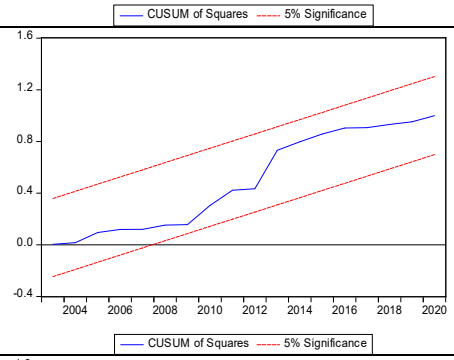
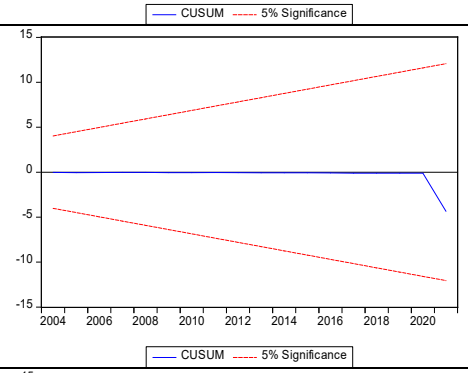
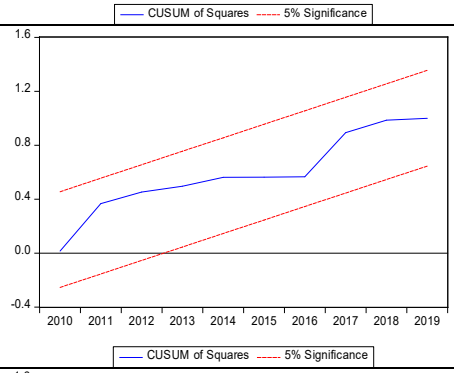
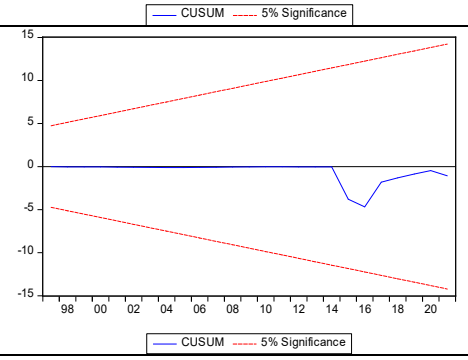
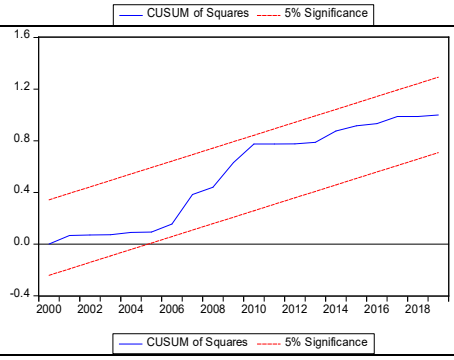
No	*Country*	*Lag 4 CUSUM plot*	*Lag 4 CUSUM of square plot*
1	Burkina Faso		
2	Guinea		
3	Côte d'Ivoire		
4	Ghana		
5	The Gambia		

Table A.1. CUSUM and CUSUM-squared stability graphs for respective money demand curves (Part 2)

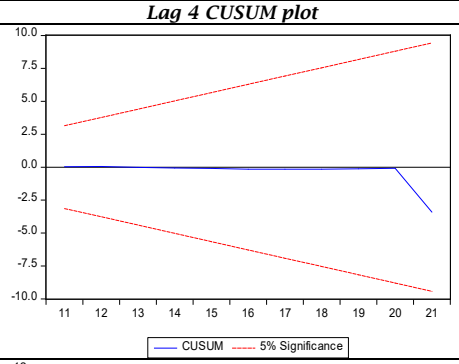
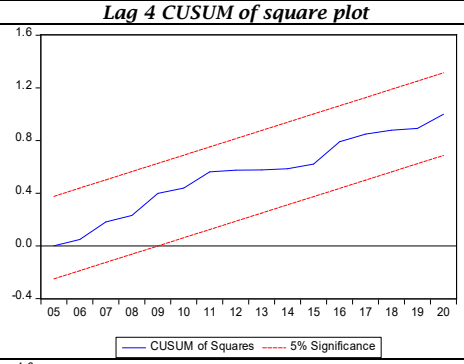
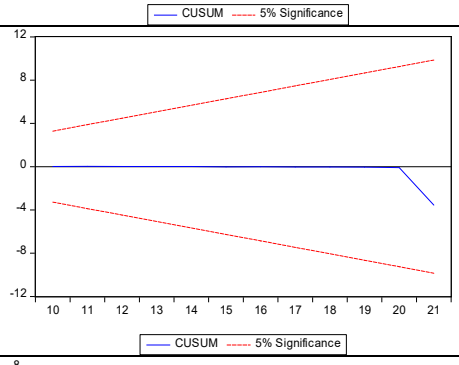
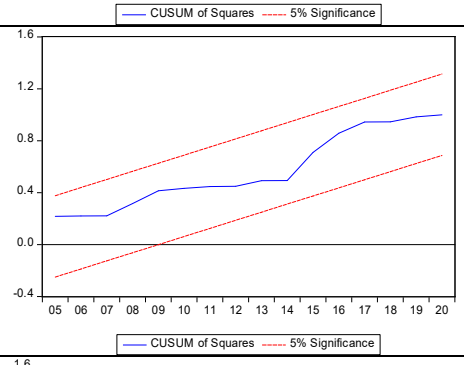
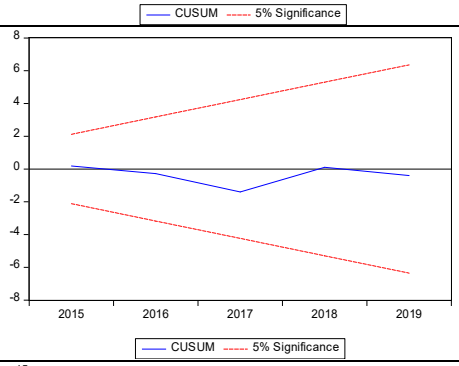
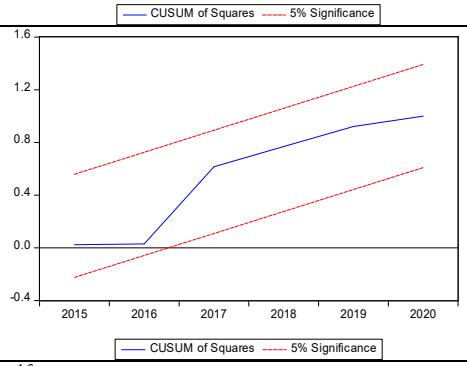
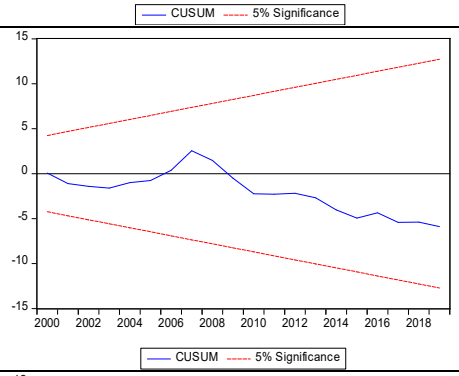
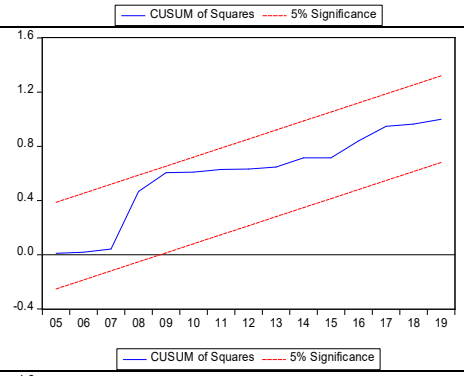
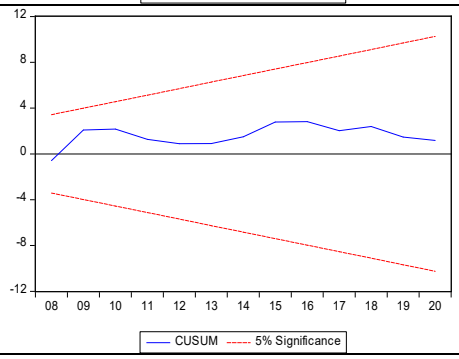
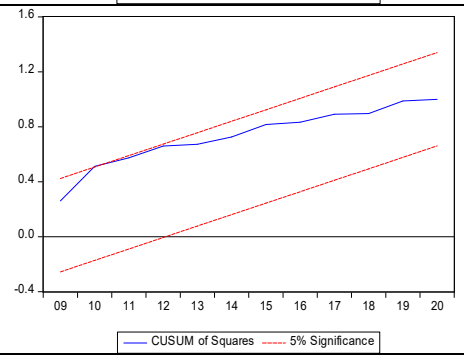
No	*Country*	*Lag 4 CUSUM plot*	*Lag 4 CUSUM of square plot*
6	Guinea		
7	Mali		
8	Niger		
9	Nigeria		
10	Senegal		

Table A.1. CUSUM and CUSUM-squared stability graphs for respective money demand curves (Part 3)

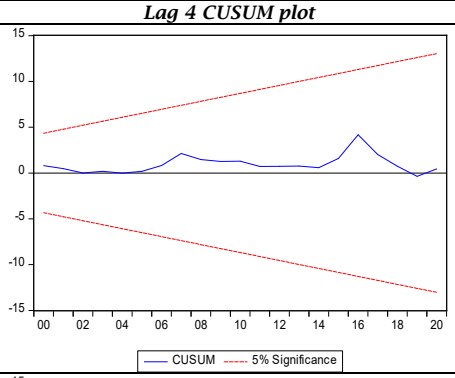
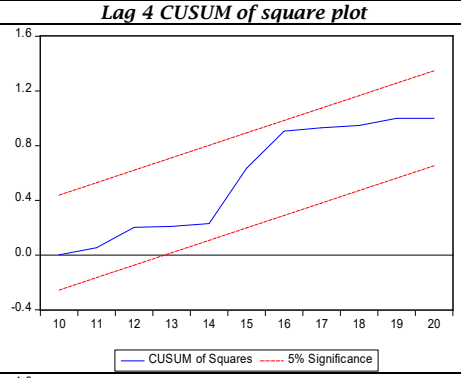
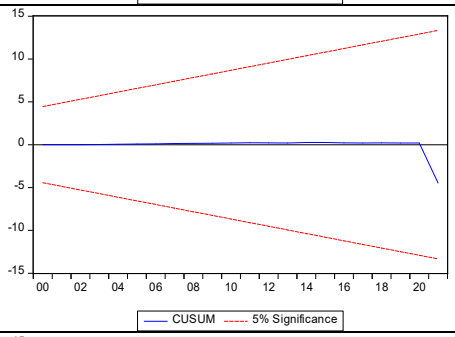
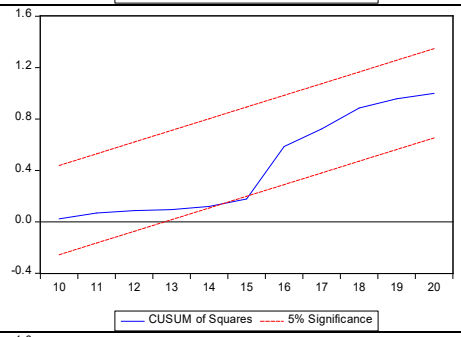
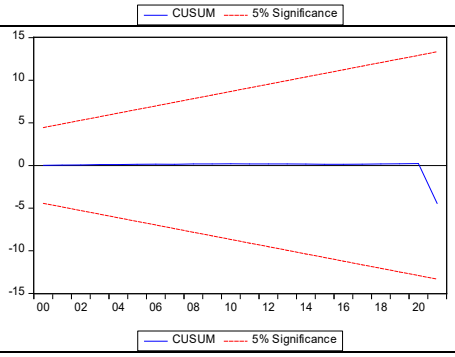
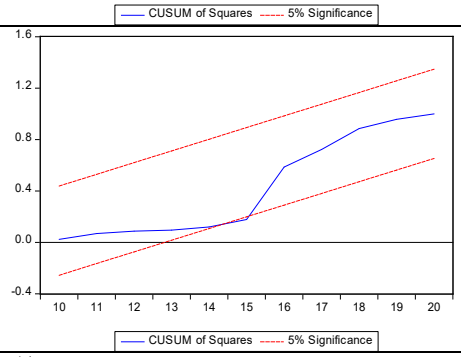
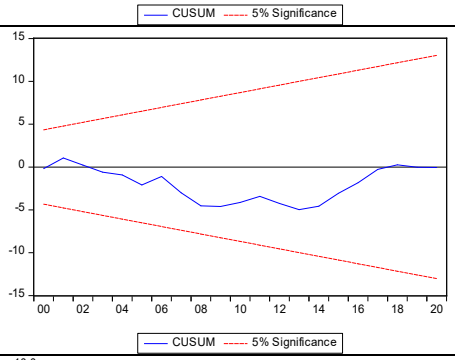
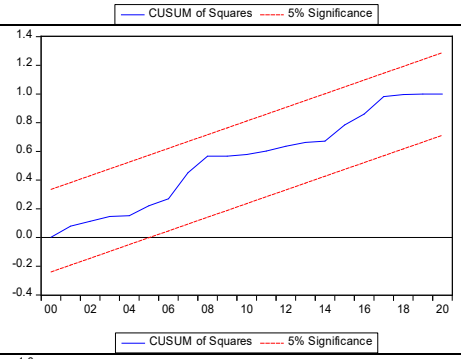
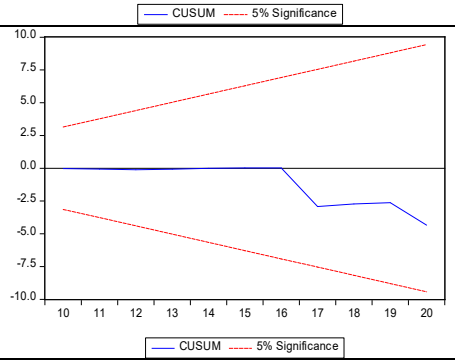
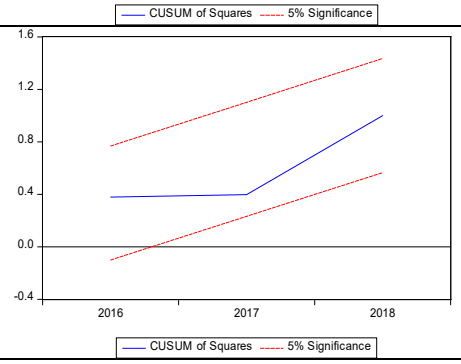
No	*Country*	*Lag 4 CUSUM plot*	*Lag 4 CUSUM of square plot*
11	Egypt		
12	Kenya		
13	Burundi		
14	Madagascar		
15	Rwanda		

Table A.1. CUSUM and CUSUM-squared stability graphs for respective money demand curves (Part 4)

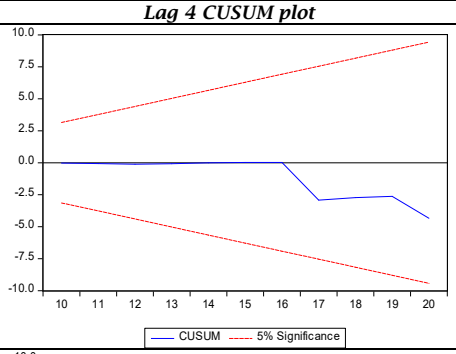
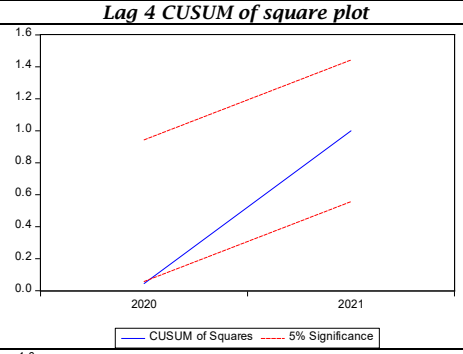
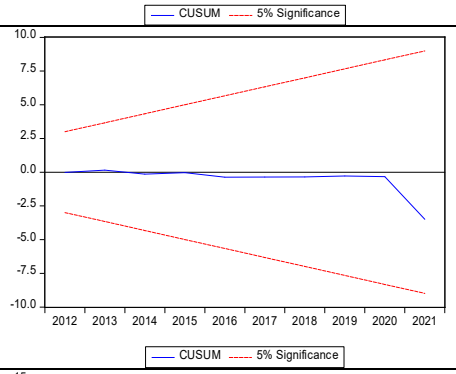
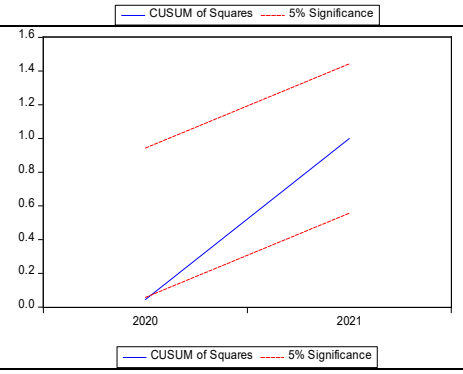
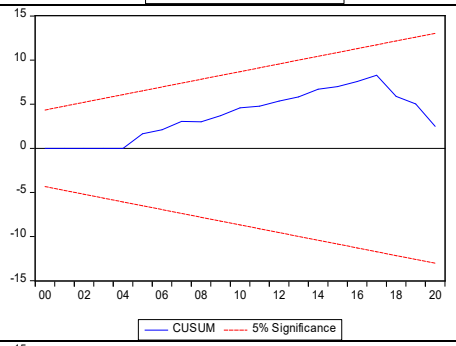
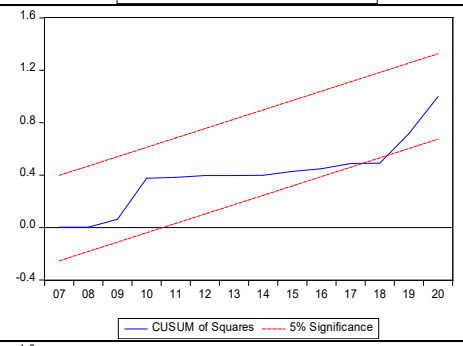
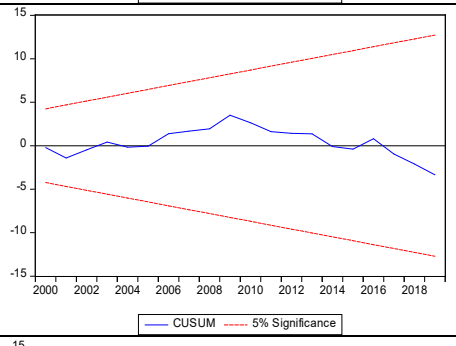
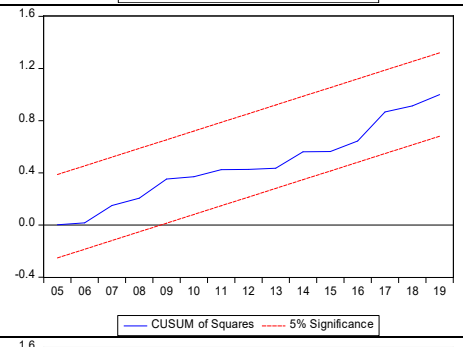
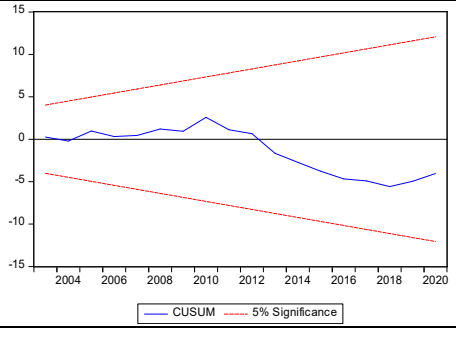
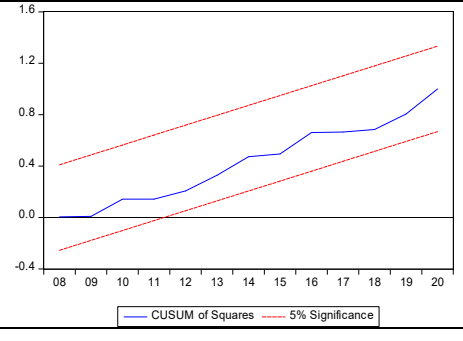
No	*Country*	*Lag 4 CUSUM plot*	*Lag 4 CUSUM of square plot*
16	Malawi		
17	Namibia		
18	Mauritania		
19	Eswatini		
20	Uganda		

Table A.1. CUSUM and CUSUM-squared stability graphs for respective money demand curves (Part 5)

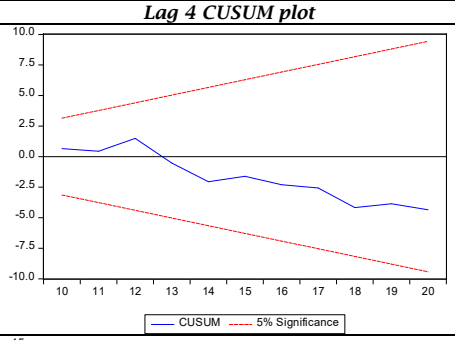
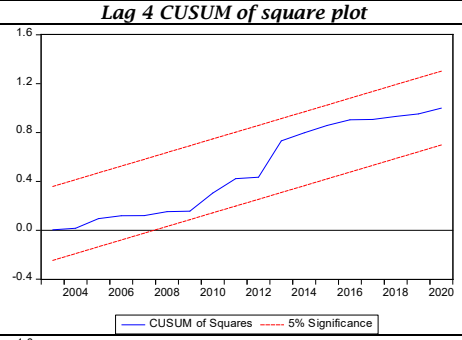
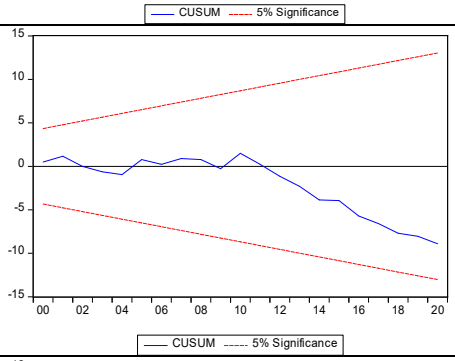
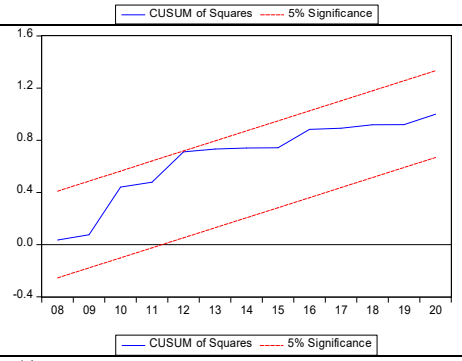
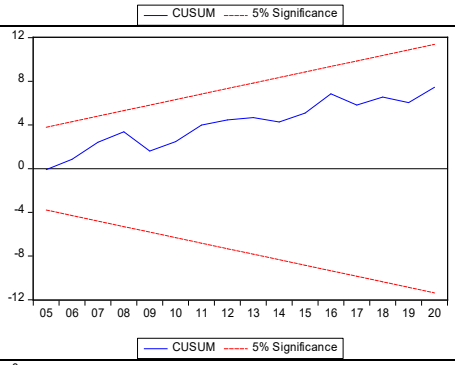
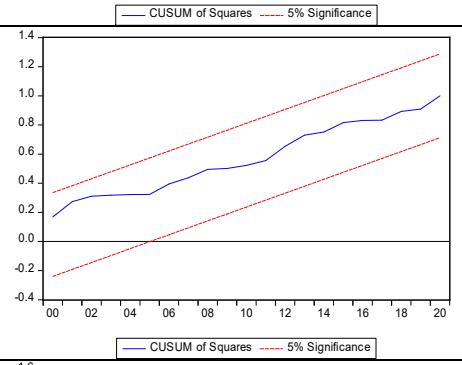
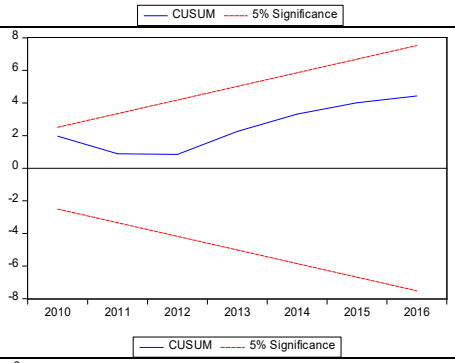
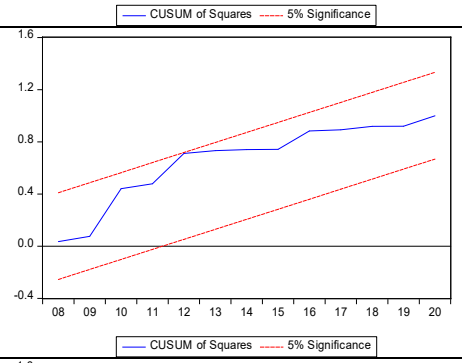
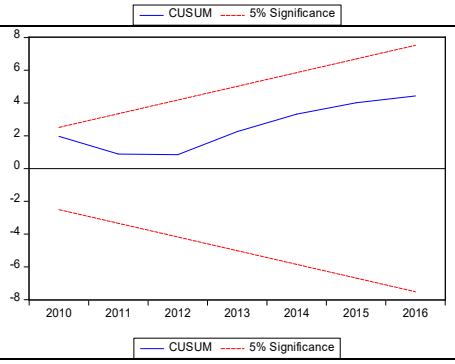
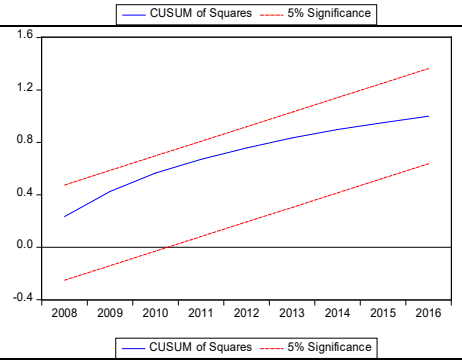
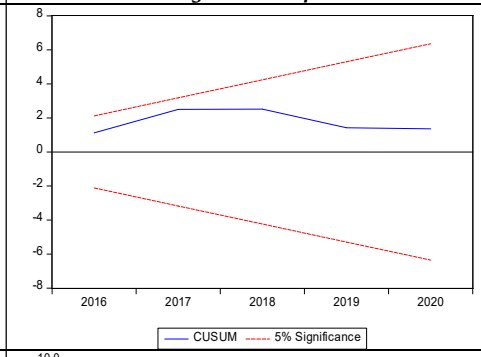
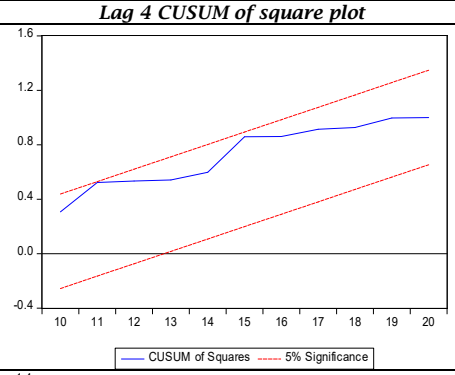
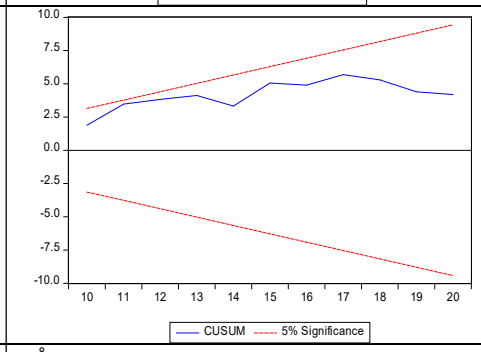
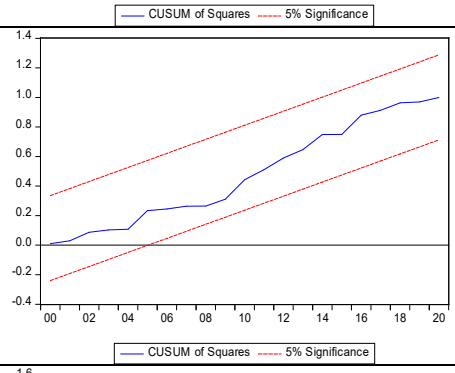
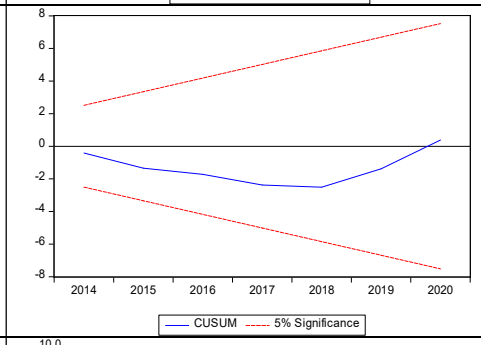
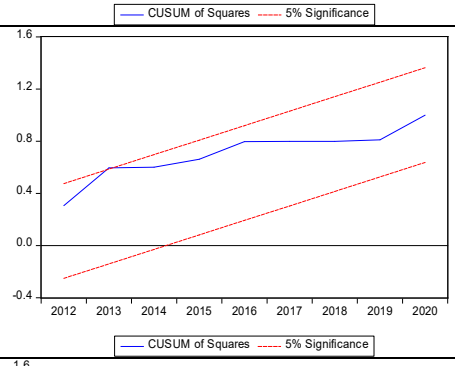
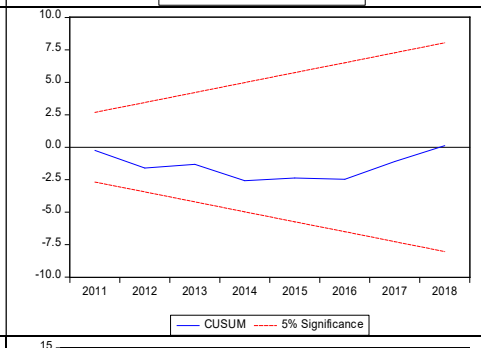
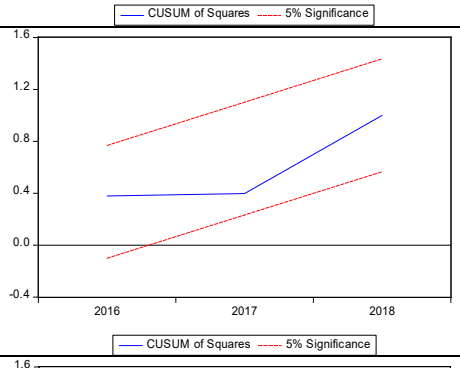
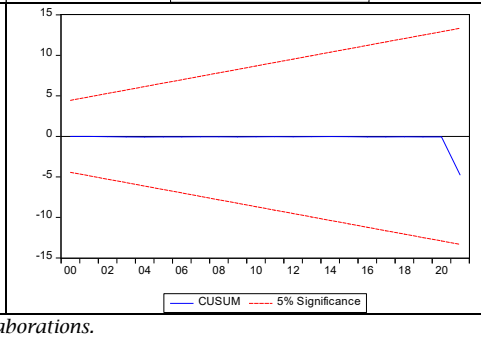
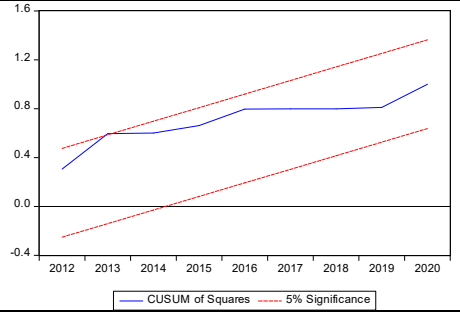
No	*Country*	*Lag 4 CUSUM plot*	*Lag 4 CUSUM of square plot*
21	South Africa		
22	Tanzania		
23	Zambia		
24	Libya		
25	DRC		

Table A.1. CUSUM and CUSUM-squared stability graphs for respective money demand curves (Part 6)

No	*Country*	*Lag 4 CUSUM plot*	*Lag 4 CUSUM of square plot*
26	Togo		
27	Benin		
28	Mozambique		
29	Liberia		
30	Algeria		

Source: Researchers' elaborations.