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RESEARCH PAPER

Money Demand Function: A Re-assessment in Sub-Saharan Africa

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Abstract
The paper re-examines the money demand function in sub-regions of Sub-Saharan Africa and its sub-regions with annual time series spanning between 1980 and 2017. Panel homogeneous Autoregressive Distributed Lag, panel co-integration tests, and Dumitrescu and Hurlin panel causality test were employed for analysis. The empirical results showed a co-integrating relation between money demand and its determinants in SSA and its sub-regions. The results also indicated divergence in terms of short-run determinants, long-run determinants, and error correction due to shocks across the sub-regions. The causality test revealed a bi-causal relationship between money demand and its determinants in SSA economies. However, there was divergence in the causality results across the sub-regions. We conclude that price level is the major driver of money demand in Sub-Saharan Africa. The paper, therefore, recommends that governments in SSA economies should employ policies that can enhance price stabilization, which will consequently lead to money demand stability in the whole region.
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JEL Classification*:* C22, C33, E41, E52, F41.

Introduction

Formulation of appropriate monetary policy is one of the critical functions of money demand structure (Samreth, 2008; Ozcalik, 2014). The need to have effective control over monetary aggregate has given rise to various monetary authorities to understand the basic information (causes and consequences) derived from the money demand structure (Anwar and Asghar, 2012). According to Ozcalik (2014), the instability of money demand function and liquidity preference unhinged change resulted in the overall national economy variables such as interest rates, exchange rate, inflation, and output. Moreover, policy switching in the late 1980s directed at bank rates by the central banks in developing economies resulted in institutional and structural (Kumer et al., 2013).

However, the changes altered the relationship among key macroeconomic variables and thereby contributing to the instability in the money demand function (Ozcalik, 2014; and Imimole and Uniamikogbo, 2014). In the same vein, Samreth (2015) argued that currency substitution was a cause of instability in money demand function. Based on the assertions above, it can be summarized that appropriate conduct of monetary policy by the monetary authorities plays a portentous role in any economic system as it affects key macroeconomic variables toward stabilization of money demand function. The strategic choice (monetary targeting or inflation targeting) regarding monetary policy by the central banks remains a key issue in the debate on the role of stable money demand. Gottschalk (1999) and Narayan et al. (2008) claimed that effective monetary targeting is a precondition to a stable money demand whereby the prediction of future growth in money supply is made possible. Conversely, Fetai

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(2008) believed that with high dollarization, monetary targeting resulted in unstable money demand. Dai (2009) and Al Rasasi and Banafea (2018) posited that inflation targeting as a policy option against the failure of monetary targeting reduced the unstable relationship between monetary aggregates and inflation which in turn mitigated inflationary pressure. Further, with the adjustment made to monetary aggregates, the possibility of appropriately controlling inflation by any monetary authority depends on the close relation of money demand to the macroeconomic variables (Hamori, 2008; Simawu et al., 2014).

Studies on estimating the functions of a stable money demand in sub-Saharan Africa are categorized into three groups. The first group of estimated demand function on country basis (see Drama and Yao, 2010; Aiyedogbon et al., 2013; Simawu et al., 2014; Onakoya and Yakubu, 2016; Kumar et al., 2013; and Kapingura, 2014) with mixed results on stability. Of all these studies, some findings report the instability of money demand (see, for instance, Kapingura, 2014; Drama and Yao, 2010). The second group estimated money demand function on the recent SSA sub-regional monetary union (see, Saka et al., 2015; Wang et al., 2007; Dubrun and Masson, 2013; Zehirun et al., 2015; Ekpoh and Udoh, 2013; Asongu et al., 2018; 2019). The third group of studies estimated extensively the money demand function of sub-Saharan Africa (SSA) economies as a whole (see, Hamori, 2008; Salisu et al., 2013).

The global macroeconomic modelling on the subject (money demand) has received far-reaching attention as its empirical building block helps predict the quantity of money demanded in a given economy. However, modelling money demand varies given the divergence in economies, the difference in proxy indicators and differences in adopted methodologies. For instance, Narayan et al. (2008) estimated the money demand (M2) function using a yearly panel data of five countries in South Asia (India, Bangladesh, Sri Lanka, Pakistan, and Nepal) over the period 1974-2002. It employed Westerland co-integration technique, fully modified ordinary least square (FMOLS) and Granger causality test, co-integrating relationship between real broad money, real exchange rate, real income; short-run domestic interest rates; short-run foreign interest rates respectively. The results revealed that real income, foreign interest rate, and real exchange rate were positive and significant except for India (negative foreign interest rate) while Bangladesh and India's domestic interest rates were negative and significant. The result also suggested that all the variables had short-run causality to money demand except for foreign interest rate.

Similarly, Arize and Nam (2012) examined the money demand (M2) function in 7 Asian countries[1] with attention on their exchange rate for the period of 1973Q1-2009Q4. The study used the fully modified ordinary least squares (FMOLS), dynamic ordinary least squares (DOLS) and discovered that an increase in exchange rate resulted in an increase in money demand. The results also indicated that a positive and significant income influenced money demand across the 7 countries respectively. In another study, Carrera (2016) examined the money demand function using a panel data approach in Latin American countries. The study employed the Pedroni co-integration technique and FMOLS for the 15 countries.[2] The results revealed the existence of a long-run relation concerning money demand in Latin America. The paper discovered a positive and significant income for all countries except Uruguay and Argentina (negative and insignificant) respectively while the interest rate was negative and significant for all countries except Brazil which was positive and insignificant. Further, the author posited a low variability in the money demand resulting from changes in interest rate across the countries.

On a country basis, Ozcalik (2014) investigated the dynamic of money demand (M2) in

1. The countries included in the estimation are India, Thailand, Malaysia, Sri Lanka, Philippine, Pakistan, and Korea.
2. The countries include Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Honduras, Mexico, Paraguay, Peru, Uruguay, and Venezuela.

the long-run and short-run with an effective exchange rate in Turkey for the period of 1995Q4-2013Q3. The author discovered that co-integration existed between money demand and its determinants with the use of the Autoregressive Distributed Lag (ARDL) approach. The results also showed that income and interest rate were positively and significantly related to money demand. Further, investigation in the stability of money demand using CUSUM (stable) and CUSUM-Q (not stable) tests revealed some stability problems for money demand in Turkey. However, Samreth (2015) explored money demand function (M1) in cognizance with currency substitution in Cambodia for the period spanning 2002Q1 and 2007Q4. The study employed ARDL and discovered the presence of a long-run relationship among the variables. Based on the results, income and inflation were significant but positively and negatively related to money demand respectively. Moreover, the negative and insignificant exchange rate indicated that their effects on money demand based on the coexistence of wealth and currency substitution in Cambodia; is neutralized by exchange rate fluctuation respectively. The results supported the stability of money demand function with both CUSUM and CUSUM-Q tests respectively overtime. Further, Al Rasasi and Banafea (2018) used the ARDL approach to empirically analyze the stability of quarterly data of money demand (M2) 2000:1 and 2016:4 in Saudi Arabia. The results indicated that given that money demand and its determinant exhibit a stable long-run and short-run relationship, the domestic currency is preferred less to foreign currency in Saudi Arabia.

Hamori (2008) used panel FMOLS to empirically analyze the money demand (M1 and M2) functions in 35 SSA countries[1] for a non-stationary yearly time series data between 1980 and 2005. The author found the existence of a co-integration relation concerning M1 and M2. Given the intermediate-target perspective; money supply (M1 or M2) was regarded as a reliable policy variable in Sub-Saharan African countries. In the same vein, using panel FMOLS (homogeneous case) and mean-group estimator (heterogeneous case) for a period between 1980 and 2010. Salisu et al. (2013) extended the work of Hamori (2008) by modelling money demand in 24 sub-Saharan countries[2] and the sub-regions[3] therein. The empirical results showed that regardless of whether SSA or its sub-regions were used, money demand, income, price level, interest rate, and exchange rate respectively exhibited a co-integrating relationship. It found that even with an increase in income, the income elasticity of money demand responded to a less proportional increase in SSA while the negative relationship of exchange rate and interest rate to money demand led the individuals to either substitute foreign currency for domestic currency or to purchase other financial assets (bond, stocks, and real estate properties) in SSA.

Asongu et al. (2018) investigated the stability of long-run money demand in West Africa using ARDL and annual data spanning between 1981 and 2015. The study used 13 out of the 15 ECOWAS countries[4] and found a deviation vis-à-vis the money demand stability among member states. The results showed that half of the sampled countries[5] exhibited a co-integrating relationship. It also revealed that money demand instability existed only in Liberia, Mali, and Togo respectively. Similarly, Asongu et al. (2019) examined the stability

1. The countries include Benin, Botswana, Mauritius, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, Togo, Uganda, Zambia, Zimbabwe, Congo, Republic, Cote d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, and Chad.
2. The countries include Burkina Faso, Cameroon, Botswana, Kenya, Cote d'Ivoire, Central African Republic, Lesotho, Seychelles, Gambia, Chad, Malawi, Uganda, Ghana, Congo DR., Mauritius, Mali, Gabon, South Africa, Mauritania, Swaziland, Niger, Zambia, Nigeria, Senegal, and Togo.
3. The regions include Central, Southern, West, and East.
4. The economic community of West African States (ECOWAS) includes Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo.
5. Countries with long-run relationship include Cape Verde, the Gambia, Ghana, Liberia, Mali, Nigeria and Senegal

of a long-run money demand in Southern Africa using the ARDL approach and yearly data spanning between 1981 and 2015. The study used 10 SADC countries[1] and found a deviation vis-à-vis the money demand stability among member states. The results revealed the existence of a co-integrating relationship among 6 countries[2] while 6 out of the 10 countries[3] exhibited a stable demand for money function.

Kumar et al. (2013) advanced money demand (M1) stability, using yearly data of Nigeria from 1960 to 2008 with an error correction model and Gregory and Hansen's co-integration test. The result revealed a stable money demand through the assistance of the liberalization of the financial sector. The results displayed a one-to-one income elasticity and a negative and significant interest rate. However, Aiyedogbon et al. (2013) provided empirical evidence with the use of a vector error correction model (VECM) and DOLS to ascertain the money demand function (M2) in Nigeria. The study found that only the inflation rate significantly (and negative) influenced money demand in Nigeria over the period of 1986-2010. The study confirmed the evidence of stable real money demand in Nigeria given the CUSUM and the CUSUMSQ plots within the critical boundaries.

Further, Onakoya and Yakubu (2016) with the use of multiple regression and stability tests scrutinized the money demand function (M2) stability in Nigeria. The study employed yearly time series data spanning between 1992 and 2014 and found a co-integrating relationship between broad money, income, inflation rate, and interest rate. Also, the results showed that the CUSUM test provided evidence of stability while the CUSUMSQ test presented evidence of instability between the period 2000 and 2005. The authors concluded that a stable money demand existed in Nigeria during the period of study.

Drama and Yao (2010) evaluated the demand for money for the period 1980- 2007 in n Cote d' Ivoire. Employing Johansen maximum likelihood, the results revealed that the influence on money demand was a result of the positive and significant effects of income and the negative and insignificant role of the interest rate. The study concluded that money demand in Cote d' Ivoire was not stable within the study period. Similarly, using a Johansen co-integration and VECM for quarterly time-series data of 1994:1 and 2012:4. However, Simawu et al. (2014) used co-integration analysis, vector auto-regression model (VAR) with variance decomposition and impulse response to investigate broad money demand (M3) for the period between 1990 and 2009 in South Africa. The results showed that income and interest rate exhibited a positive and a negative (both significant) influence respectively on money demand. The results also revealed a stable money demand.

As the debate continues, this study reexamines the demand function in sub-Saharan Africa with relatively updated data. More prominently, given the importance of money demand for policy purposes, our study focuses on small open economies in SSA countries, which is, therefore, an extension of the studies in the third group, whose findings exhibited evidence of a stable demand for money. The contribution of this paper is threefold: it extends the study of Salisu et al. (2013) by increasing the sample size to 2017, increases the small and open economies to 34 countries, and investigates the demand function causal relationship between the 34 small and open economies in SSA as a whole and its sub-regions respectively.

The study is structured into five sections. Following the introduction, section 2 reviews relevant literature while Section 3 sheds light on the data and methodology vis-à-vis the money demand function. Section 4 discusses empirical results and Section 5 concludes the study.

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1. Southern African development communities (SADC) include Botswana, Congo DR., Lesotho, Madagascar, Malawi, Mauritius, Seychelles, South Africa, Swaziland, and Zambia.
2. Botswana, Congo DR., Madagascar, Malawi, Seychelles, and Zambia
3. Botswana, Congo DR., Lesotho, Malawi, South Africa, and Swaziland

Methods and Materials

Model

The explanation of the factors involved in the determination of money demand has been explained by several theories. However, the theoretical underpinning of this work as adapted from Hamori (2008) is based on the theories of Kimbrough (1986a; 1986b) and Fraig (1988) as they assumed transaction cost in explaining the factors that influenced money demand. The paper employs panel data analysis by drawing insight from Hamori (2008) and Salisu et al. (2013) which explained the relationship between money demand and its determinants. To analyze the link, the model is specified in a functional form as:

$$\frac{M}{P}_t = L\left(\frac{Y}{P_t} R_{t,} E_{\ t}\right) \quad (1)$$

Where: M is the broad money, Y represents the gross domestic product in nominal term otherwise known as income, R is the domestic interest rate expressed as nominal interest rate, P indicates price index level, and E is the official exchange rate expressed in term of the nominal exchange rate. As a panel data study, equation (1) can be written in a panel framework as:

$$\ln(M_{it}) = \propto_0 + \propto_1 \ln(GDP_{it}) + \propto_2 \ln(R_{it}) + \propto_3 \ln(P_{it}) + \propto_4 \ln(E_{it}) + U_{it} \quad (2)$$
$$\propto_1, \propto_3 > 0 \quad \propto_2, \propto_4 < 0$$

Equation 2 essentially states that income and price level, positively determine the money demand while money demand is negatively related to interest rate and exchange rate respectively. Moreover, the paper employs the ARDL-ECM to capture the coefficient of determination derived from equation (2).

$$\Delta \ln(M_{it}) = \theta_i \left[\ln(M_{it}) - \partial_i \ln(GDP_{it}) - \partial_r \ln(R_{it}) - \partial_v \ln(P_{it}) - \partial_c \ln(E_{it})\right] + \sum_{j-1}^{p-1} \Psi_{ij} \Delta \ln(M_{it-j}) + \sum_{j-0}^{q-1} \Upsilon_{ij} \Delta \ln(GDP_{it-j}) + \sum_{j-1}^{q-1} \beta_{ij} \Delta \ln(R_{it-j}) + \sum_{j-1}^{q-1} \lambda_{ij} \Delta \ln(P_{it-j}) + \sum_{j-1}^{q-1} \xi_{ij} \Delta \ln(E_{it-j}) + \varphi_i + e_{it} \quad (3)$$

Where:

θ is the group's speed of adjustment coefficient (expected that $\theta_i < 0$)

$\partial_i, \partial_r, \partial_v$ *and* ∂_c represents the vector of long-run relationship.

$[\ln(M_{it}) - \partial_i \ln(GDP_{it}) - \partial_r \ln(R_{it}) - \partial_v \ln(P_{it}) - \partial_c \ln(E_{it})]$ is the error correction term (ECT).

Estimation Techniques

In analyzing the money demand function for Sub Saharan countries, we employed the tests of four unit-roots analyses (Levin, Lin and Chu, 2002; Hadri, 2000; Im, Pesaran and Shin, 2003; Maddala and Wu, 1999) to examine the order of integration of the variables in the model. The choice is because the shapes of most economic variables are triggered by variation in time shift, which in turn exhibits random walk. Having understood the integration order, we ascertained the long-run relationship among the variables as a result of the co-integration tests; the Johansen panel co-integration test (Maddala and Wu, 1999) and the residual-based panel co-integration test (Kao, 1999). Given the co-integrating equation, we estimated equation (2) using the Pesaran et al. (1999) panel autoregressive disturbed lag (ARDL) model (the pooled mean group case) to obtain the long-run and short-run coefficients. Lastly, we employed a panel causality test (Dumitrescu and Hurlin, 2012) for the causality among the variables in SSA and its sub-regions respectively.

Data

Data employed were sourced from the World Development Indicator between 1980 and 2017 (an extension of the period used by Salisu et al., 2013) for 34 SSA countries. The paper also divided the SSA into four sub-region for analysis (see Table 1).

Results and Discussions

Unit Root Test

Before testing the stationarity of the panel variables, it is advisable to show the graphical plot of the variables of the study between 1980 and 2017. Figure 1 depicts the average money demand of the sub-regions in Sub-Saharan Africa. It can be seen that on average, East Africa has the highest money demand while Southern Africa has the lowest money demand in SSA. This implies that East Africa prefers to hold cash balance compared to other sub-regions. Figure 2 contains the average income of the SSA sub-regions. As seen in Figure 2, Central Africa on average exhibits the highest income while East Africa exhibits the lowest income in SSA. Interestingly, Figure 3 shows that Central Africa on average has the highest interest rate on sub-regional basis, trailed by Southern Africa and East Africa while West Africa has the lowest interest rate in SSA. This implies that Central Africa and West Africa exhibit the “from head to foot” opportunity cost of holding money. Figure 4 shows the price level in SSA sub-regions. As seen, we can conclude that West Africa has the highest price level while Central Africa exhibits the lowest price level in SSA. Further, it can be seen that East Africa currencies depreciate faster than other SSA sub-region currencies while South Africa currencies depreciate less compared to other SSA sub-region currencies as seen in Figure 5

Tables 2 and 3 show panel unit root test results for all the SSA countries and the sub-regions (Central Africa, Southern Africa, East Africa, and West Africa) conducted at their levels and first difference respectively. Generally, according to the Levin, Lin and Chu, Pesaran and Shin, ADF Fisher Chi-square, and Hadri LM unit root tests conclude that all the variables (money demand, income, interest rate, price level, and exchange rate) for SSA countries and its sub-regions are stationary at first difference except for Southern Africa and Eastern Africa whose interest rates are stationary at levels.

Co-integration Test

Based on the different orders of integration, we use the Johansen panel co-integration test and the residual panel co-integration test (otherwise known as the Kao test) to analyze the existence of long-run relationship among the variables in the model. As evident from Table 4, we rejected the null hypothesis of no co-integration among the series and accepted the alternative hypothesis of at least one co-integrating vector for SSA countries and the sub-regions therein at 5% and 10 % levels of significance respectively. The co-integration result showcase the existence of co-integration among the series. These findings of Hamori (2008) and Salisu et al. (2013) support the findings of this study vis-à-vis the existence of money demand function stability in SSA. Having established the panel co-integration, we further estimated the elasticity coefficients of the demand function using the autoregressive distributed lag (ARDL) method.

Long Run Result

Having established the presence of a co-integrating relationship among the series, we apply the homogenous panel ARDL estimation method based on the Hausman (1978) test[1] to obtain the long-run elasticity of money demand. According to the long-run equation in Table 5, the output coefficients for SSA countries meet the prior expectations (except for the positive influence of interest rate and exchange rate respectively). All the independent variables were all statistically significant. That is, according to the estimation result, Income (Y), Interest rate (R), Exchange rate (E), and Price levels (P) were all significant factors affecting the long-run money demand. The positive income elasticity coefficient of approximately 1.57 indicates that a rise in income leads to a more than one rise in money demand in the long-run. This is in line with Simawu et al. (2014), Samreth (2015) and Al Rasasi and Banafea (2018) given that SSA countries are filled with underdeveloped financial sectors.

Also, a positive interest rate elasticity coefficient of approximately 0.49 indicates that a rise in interest rate leads to a less than one rise in money demand in the long-run. This may be underscored by the fact that monetary authorities in SSA countries place more emphasis on controlling monetary aggregates. This implies that a rise in the opportunity cost of holding money will lead to a rise in money demand in SSA (see Ozcalik, 2014; and Narayan et al., 2008). However, the rise in money demand as a result of rise in exchange rate supports the currency substitution argument (exchange rate depreciation) indicating that individual member states in SSA countries demand more foreign currency than their local currencies such as US Dollar and UK Pounds Sterling (see Narayan et al., 2008; Arize and Nam, 2012; and Simawu et al., 2014). An explanation for this is that there is a rise in foreign securities owned by member states in sub-Saharan Africa.

Additionally, Table 5 also reveals a long-run elasticity in sub-regions in SSA, indicating that all regressors for the cases of both East Africa and West Africa significantly influenced the money demand function while for the cases of both Central Africa and Southern Africa, only interest rate and price level have no significant influence on money demand function respectively. The results also indicate that income for all sub-regions influenced money demand positively except for West Africa (which is negative). In addition, the results show that interest rate for all the sub-regions influences money demand positively (except for Central Africa that is negative and insignificant). As evident from Table 5, the difference in the results across these sub-regions may be as a result of the differences in the macroeconomic indicators (see Salisu et al., 2013).

Short Run Result

Table 5 reveals the short-run estimate (second part). The short-run differs from the long run in that it provides both the speed of adjustment and the short-run elasticity coefficient of the money demand function in the ARDL-ECM model (see equation 3). The results, using the full sample, indicate that in the short run, a rise in both income and price level will lead to a rise in money demand. Thus, a 1 % rise in both income and price levels results in about 0.25 % and 0.28 % rise in money demand respectively. However, there exists a positive interest rate elasticity coefficient (wrong sign and insignificant) of about 0.14. This is an indication that the short-run interest rate in SSA countries did not contribute significantly to money demand. The estimate of the error correction term (correct sign and significant) for SSA countries using the homogeneous panel estimation is negative, the coefficient is about -0.079 which implies that a 7.9% disequilibrium in money demand of the previous year's shock

1. The validity, efficiency, and consistency of Pooled mean group (PMG) estimation than mean group (MG) estimation indicates that the null hypothesis of slope homogeneity for money demand holds in SSA.

adjusts back to the long-run equilibrium in the current year. Therefore, it will take the money demand approximate of 12.7 years to adjust fully to equilibrium and be steady-state once again in SSA.

Further, Table 5 reveals the short-run elasticity of sub-regions in SSA, indicating that the regressors in the case of SSA sub-regions insignificantly influence the money demand function. Also, income is significant for Southern Africa, interest rate and price level are significant for Central Africa, the price level is significant for East Africa and interest rate is statistically significant for West Africa. The estimates of the error correction term for SSA sub-regions meet the conventional conditions (/< 1/, negative, and statistically significant) except for the estimate of West Africa which is insignificant and negative. The coefficients of the error correction term indicate that about 10.8 percent, 15.3 percent and 10 percent of disequilibrium in money demand were corrected within one year in Central Africa, Southern Africa, and East Africa respectively. The implication is that it will take money demand about 9.3 years, 6.5years and 9.9 years to adjust fully to transitory shock and be steady-state once again in Central Africa, Southern Africa, and East Africa respectively. The absolute value of the coefficient of adjustment for Southern Africa indicates a faster adjustment process than other sub-regions. This is similar to the results of previous literature (see Kumar and Rao, 2012; Salisu et al., 2013). Nevertheless, the implication of a statistically insignificant coefficient of the error term for West Africa is that the resulting speed of adjustment from shock to long-run equilibrium does not restore equilibrium. This may be due to the unexpected change in the monetary transaction concerning income (negative change in income) and high insecurities within the West Africa region.

Dumitrescu Hurlin Panel Causality Test

Table 6 shows the Dumitrescu Hurlin Panel Causality Test results for money demand, income, interest rate, price level, and exchange rates in SSA countries and its sub-regions. The results reveal money demand and its determinants exhibit a bi-directional causal relationship in SSA economies. This implies that in SSA countries, money demand drives income, exchange rate, price level and interest rate with a feedback causal effect from each of these determinants. Conversely, the causality results differ among the sub-regions in SSA. While Central Africa and East Africa exhibit bi-directional causation between income and money demand, Southern Africa and West Africa exhibit uni-directional causation running from money demand to income in SSA respectively. This implies that money demand and income drive each other in Central Africa and East Africa while money demand drives income in Southern Africa and West Africa respectively.

Southern Africa and West Africa exhibit bi-directional causation between the interest rate and money demand, while Central Africa and East Africa have uni-directional causation running from money demand to the interest rate in SSA respectively. This implies that money demand and interest rate drives each other in Southern Africa and West Africa while money demand drives interest rate in Central Africa and East Africa. Further, all the sub-regions exhibit bi-directional causation between both price level and money demand, and exchange rate and money demand except West Africa whose causality is uni-directional running from money demand to price level and absence of causality between exchange rate and money demand. Thus, money demand drives price level and exchange rate with a feedback causal effect from both price level and exchange rate in all sub-regions except for West Africa with no feedback effect from price level. Based on the results, it is obvious that price level indicates a greater feedback causal effect to money demand both in SSA as a whole and its sub-regions.

Conclusion and Recommendations

The modelling of the money demand function has received wide attention globally since it helps predict the quantity of money demanded in a given economy. By employing panel co-integration tests, homogeneous ARDL, and Dumitrescu and Hurlin panel causality test for the period 1980-2017, the study in the same vein extends the knowledge further by reassessing money demand functions in some sub-regions in SSA and 34 SSA economies as a whole. The empirical results suggest the existence of a co-integrating relation of money demand and its determinants (income, interest rate, price level, and exchange rate). Accordingly, the finding that greater than one income elasticity of money demand in SSA indicates that with a rise in income, the income elasticity of money demand responds more proportionally. In accordance, with a rise in the opportunity cost of holding money (interest rate), interest elasticity of money demand in SSA responds less proportionally. Also, the estimate of the error correction term for SSA countries reveals that in the event of a shock to the money demand, only about 7.9 percent of such shock adjust back to the long-run equilibrium in the current year and it takes approximately 12.7 years for long-run equilibrium to be restored and be steady-state once again.

Besides, among these sub-regions, Southern Africa indicates a faster adjustment process than other sub-regions with approximately 6.5 years to restore to long-run equilibrium. However, money demand in West Africa does not restore equilibrium following the unexpected change in the monetary transaction concerning income (negative change in income) and high insecurities within the West Africa region. The causality test reveals that money demand and its determinants in SSA countries exhibit two-way causation. Given the difference in the causality (bi-directional causality, uni-directional causality, and no causality) results among the sub-regions, we conclude that price level is the major driver of money demand in Sub Saharan Africa.

Based on the findings, the governments within the SSA economies should make policies that are essential to stabilize the price level and achieve money demand function stability.

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Appendix

Table 1. SSA Sub-Regions

Central Africa	East Africa	SOUTHERN Africa	West Africa
Angola	Madagascar	Lesotho	Burkina Faso
Cameroon	Seychelle	Mauritius	Cote d' Ivoire
Central Africa Republic	Comoros	Malawi	Mali
Chad	Rwanda	Congo DR	Mauritania
Gabon	Kenya	Swaziland	Nigeria
Equatorial Guinea	Uganda	South Africa	Senegal
Zambia	Tanzania	Namibia	Gambia
	Togo	Botsowana	Ghana
	Burundi		Cape Vade
			Benin

Source: Research finding.

Table 2. SSA Unit Root Test

Regions	@ Levels				
		HLM	IPS	LLC	ADF
SSA countries	lnM	79.5575[abc]	3.4290	-0.0873	36.4887
	lnGDP	72.5613[abc]	1.5156	-1.9517[bc]	55.2429
	lnR	53.1862[abc]	0.7309	-0.9560	92.1496[bc]
	lnP	75.2740[abc]	0.9695	-1.8615[bc]	75.5599
	lnE	85.6583[abc]	0.3322	-2.0615[bc]	54.6066
Central Africa	lnM	40.5708[abc]	1.2124	-0.0178	7.8330
	lnGDP	27.4137[abc]	1.0936	0.4557	6.2536
	lnR	25.0127[abc]	-0.1260	-2.6649[abc]	11.0211
	lnP	33.7407[abc]	-2.5822[abc]	-0.2285	38.4002[abc]
	lnE	37.0456[abc]	0.2897	-0.0426	9.7915
Southern Africa	lnM	36.7126[abc]	1.2670	-0.4036	11.2289
	lnGDP	32.6138[abc]	0.2136	-2.2553[BC]	14.9852
	lnR	30.1089[abc]	-1.7801[bc]	-2.5219[abc]	39.5158[abc]
	lnP	43.6202[abc]	4.0229	0.2248	3.5056
	lnE	44.4118[abc]	-1.1047	-1.8120[bc]	21.6945
East Africa	lnM	49.7031[abc]	1.7352	-0.4107	9.6282
	lnGDP	43.6189[abc]	0.9134	-1.5123[c]	13.8498
	lnR	20.5971[abc]	-1.5241[c]	-1.9012[bc]	27.4595[c]
	lnP	49.0844[abc]	1.0681	-2.1080[bc]	8.8076
	lnE	48.6274[abc]	1.2315	-1.3263[c]	9.0157
West Africa	lnM	45.5398[abc]	2.5290	1.0117	7.7986
	lnGDP	48.8056[abc]	0.8221	-1.3102[C]	20.1543
	lnR	30.1288[abc]	4.4912	4.9891	14.1532
	lnP	44.5690[abc]	-0.6633	-3.5056[bc]	3.5056
	lnE	35.7926[abc]	0.1899	-1.2157	14.1049

Source: Research finding.

Note: [a], [b] and [c] denote significance at 1 %, 5 %and 10 % respectively. HLM, IPS, LLC, and ADF represent Hadri LM Test, Im, Pesaran and Shin Test, Levin, Lin and Chu Test and ADF Fisher Chi Square Test respectively.

Table 3. SSA Unit Root Test

Regions	@ 1st difference					
		HLM	**IPS**	**LLC**	**ADF**	**Decision**
SSA countries	lnM	7.0388[abc]	-12.4842[abc]	-9.7196[abc]	339.5871[abc]	I(1)
	lnGDP	12.3527[bc]	-12.4685[abc]	-9.2547[abc]	347.5349[abc]	I(1)
	lnR	-0.5495	-15.7104[abc]	-14.3423[abc]	472.8997[abc]	I(1)
	lnP	14.3091[abc]	-12.5610[abc]	-10.8036[abc]	357.9653[abc]	I(1)
	lnE	32.6215[abc]	-13.1171[abc]	-10.9672[abc]	357.7917[abc]	I(1)
Central Africa	lnM	4.7216[abc]	-4.7892[abc]	-4.1847[abc]	55.6884[abc]	I(1)
	lnGDP	13.3177[abc]	-3.4829[abc]	-2.6294[abc]	42.9291[abc]	I(1)
	lnR	-0.6945	-6.5733[abc]	-5.9901[abc]	78.5846[abc]	I(1)
	lnP	6.4181[abc]	-7.7897[abc]	-4.8977[abc]	115.6570[abc]	I(1)
	lnE	17.3513[abc]	-4.7348[abc]	-3.7560[abc]	57.8660[abc]	I(1)
Southern Africa	lnM	4.7216[abc]	-6.0565[abc]	-4.5153[abc]	79.0569[abc]	I(1)
	lnGDP	1.2388	-5.2574[abc]	-3.9481[abc]	65.1496[abc]	I(1)
	lnR	-0.0334	-10.0306[abc]	-9.3838[abc]	149.7010[abc]	I(0)
	lnP	13.7134[abc]	-4.0632[abc]	-4.0632[abc]	53.9130[abc]	I(1)
	lnE	14.5506[abc]	-7.9298[abc]	-7.0558[abc]	112.1911[abc]	I(1)
East Africa	lnM	5.4484[abc]	-5.3095[abc]	-3.9382[abc]	72.5620[abc]	I(1)
	lnGDP	0.3976[abc]	-6.3226[abc]	-5.5173[abc]	88.9990[abc]	I(1)
	lnR	0.1313	-10.1360[abc]	-9.1624[abc]	157.4904[abc]	I(0)
	lnP	1.9032[bc]	-5.7297[abc]	-4.9050[abc]	77.9292[abc]	I(1)
	lnE	11.6789[abc]	-5.8997[abc]	-4.7353[abc]	81.4915[abc]	I(1)
West Africa	lnM	-1.1823	-8.5587[abc]	-6.9062[abc]	132.2797[abc]	I(1)
	lnGDP	3.2682[abc]	-9.3762[abc]	-6.9406[abc]	150.4571[abc]	I(1)
	lnR	-1.3831	-4.8815[abc]	-4.2893[abc]	87.1238[abc]	I(1)
	lnP	4.1846[abc]	-7.5741[abc]	-8.0186[abc]	110.4661[abc]	I(1)
	lnE	-0.3153[abc]	-7.5358[abc]	-6.8926[abc]	106.2431[abc]	I(1)

Note: [a], [b] and [c] denote significance at 1 %, 5 %and 10 % respectively. HLM, IPS, LLC, and ADF represent Hadri LM Test, Im, Pesaran and Shin Test, Levin, Lin and Chu Test and ADF Fisher Chi Square Test respectively.
Source: Research finding.

Table 4. SSA Cointegration Tests

Countries	Kao Residual Cointegration Test	Johansen Fisher Cointegration Test	
	Test Statistics	**Trace Test**	**Maximum Eigenvalue**
SSA Countries	-4.919136[abc]	214.6[abc]	140.5[abc]
Central Africa	-1.727824[bc]	37.46[bc]	26.07[bc]
Southern Africa	-6.119036[abc]	84.04[abc]	49.38[abc]
East Africa	-4.560227[abc]	65.60[abc]	46.6[abc]
West Africa	-1.352732[c]	71.75[abc]	69.69[abc]

Source: Research finding.
Note: [a], [b] and [c] denote significance at 1 %, 5 %and 10 % respectively. At least 1 cointegrating relationship among the variables is used for all regions.

Table 5. Homogenous Panel ARDL Long-Run and Short-run Coefficients

Dependent Variable: $ln(M)$

Variables	SSA Countries	Central Africa	Southern Africa	East Africa	West Africa
$\boldsymbol{ln(GDP)}$	1.572429[abc] (15.93)	1.182297[abc] (6.55)	2.01136[abc] (7.96)	1.61756[abc] (10.35)	-2.966463[abc] (-3.35)
$\boldsymbol{ln(R)}$	0.491149[abc] (3.90)	-0.453869 (-1.49)	0.353541[bc] (2.15)	0.6571754[abc] (3.24)	2.248425[abc] (5.85)
$\boldsymbol{ln(P)}$	0.327756[abc] (5.45)	-1.268491[abc] (-2.74)	-0.113186 (-0.68)	0.3599273[abc] (3.66)	3.374292[abc] (-2.15)
$\boldsymbol{ln(E)}$	0.845576[abc] (22.61)	1.516673[abc] (3.32)	0.936092[abc] (19.03)	0.8384736[abc] (8.71)	-0.8754703[abc] (-2.51)
$\Delta\boldsymbol{ln(GDP)}$	0.246607[C] (1.76)	0.061161 (0.24)	0.513875[abc] (2.74)	0.1234698 (0.87)	0.3400078 (1.60)
$\Delta\boldsymbol{ln(R)}$	0.141606 (1.33)	-0.160694[c] (-1.59)	0.074511 (1.19)	-0.0983518 (-1.92)	0.7623149[abc] (4.12)
$\Delta\boldsymbol{ln(P)}$	0.279653[bc] (2.08)	0.271033[bc] (2.27)	-0. 112103 (-0.32)	0.2122566[bc] (2.04)	0.6127499 (1.52)
$\Delta\boldsymbol{ln(E)}$	0.036430 (0.66)	0.059501 (0.39)	0. 0157274 (0.19)	-0.0137573 (-0.22)	0.1041289 (1.27)
$\boldsymbol{ECM(-1)}$	-0.079095[abc] (-4.20)	-0.1082341[bc] (-2.10)	-0.1536083[bc] (-2.08)	-0.1006972[abc] (-3.78)	-0.0784175 (-1.33)
Hausman Test (MG or PMG)					
chi2(4)	7.76				
Prob>chi2	0.1008				

Source: Research finding.

Note: [a], [b] and [c] denote significance at 1 %, 5 %and 10 % respectively. PMG and MG represent Pooled Mean Group and Mean Group respectively.

Table 6. Pairwise Dumitrescu Hurlin Panel Causality Test

Countries	Null Hypothesis	W-Stat.	Zbar-Stat.	Prob.	Decision
SSA Countries	lnGDP does not homogeneously cause lnM	4.04176	4.84591	0.0000	Causality exists
	lnM does not homogeneously cause lnGDP	6.43048	10.9260	0.0000	
	lnR does not homogeneously cause lnM	2.78542	1.64809	0.0993	Causality exists
	lnM does not homogeneously cause lnR	7.80131	14.4152	0.0000	
	lnP does not homogeneously cause lnM	3.79757	4.22436	0.0000	Causality exists
	lnM does not homogeneously cause lnP	6.11733	10.1290	0.0000	
	lnE does not homogeneously cause lnM	3.97547	4.67718	0.0000	Causality exists
	lnM does not homogeneously cause lnE	4.35569	5.64495	0.0000	
Central Africa	lnGDP does not homogeneously cause lnM	4.88861	3.17685	0.0015	Causality exists
	lnM does not homogeneously cause lnGDP	7.19769	5.84367	0.0000	
	lnR does not homogeneously cause lnM	2.84281	0.81408	0.4156	Causality exists
	lnM does not homogeneously cause lnR	11.9235	11.3017	0.0000	
	lnP does not homogeneously cause lnM	3.75673	1.86960	0.0615	Causality exists
	lnM does not homogeneously cause lnP	4.20824	2.39106	0.0168	
	lnE does not homogeneously cause lnM	4.10341	2.26999	0.0232	Causality exists
	lnM does not homogeneously cause lnE	5.65380	4.06059	0.0000	
Southern Africa	lnGDP does not homogeneously cause lnM	2.50185	0.44932	0.6532	Causality exists
	lnM does not homogeneously cause lnGDP	5.46352	4.10602	0.0000	
	lnR does not homogeneously cause lnM	4.57467	3.00858	0.0026	Causality exists
	lnM does not homogeneously cause lnR	8.24598	7.54144	0.0000	
	lnP does not homogeneously cause lnM	6.25406	5.08208	0.0000	Causality exists
	lnM does not homogeneously cause lnP	7.59125	6.73307	0.0000	
	lnE does not homogeneously cause lnM	4.84509	3.34246	0.0008	Causality exists
	lnM does not homogeneously cause lnE	5.64722	4.33283	0.0000	

Countries	Null Hypothesis	W-Stat.	Zbar-Stat.	Prob.	Decision
East Africa	lnGDP does not homogeneously cause lnM	6.67800	5.94554	0.0000	Causality exists
	lnM does not homogeneously cause lnGDP	5.78251	4.77283	0.0000	
	lnR does not homogeneously cause lnM	3.27323	1.48675	0.1371	Causality exists
	lnM does not homogeneously cause lnR	7.31212	6.77596	0.0000	
	lnP does not homogeneously cause lnM	3.63400	1.95920	0.0501	Causality exists
	lnM does not homogeneously cause lnP	6.84864	6.16899	0.0000	
	lnE does not homogeneously cause lnM	5.35542	4.21352	0.0000	Causality exists
	lnM does not homogeneously cause lnE	3.62102	1.94220	0.0521	
West Africa	lnGDP does not homogeneously cause lnM	2.30828	0.23515	0.8141	Causality exists
	lnM does not homogeneously cause lnGDP	7.25018	7.05699	0.0000	
	lnR does not homogeneously cause lnM	0.87482	-1.74360	0.0812	Causality exists
	lnM does not homogeneously cause lnR	5.00028	3.95120	0.0000	
	lnP does not homogeneously cause lnM	2.00818	-0.17911	0.8579	Causality exists
	lnM does not homogeneously cause lnP	5.61639	4.80169	0.0000	
	lnE does not homogeneously cause lnM	1.94827	-0.26181	0.7935	Causality absent
	lnM does not homogeneously cause lnE	3.07498	1.29351	0.1958	

Source: Research finding.

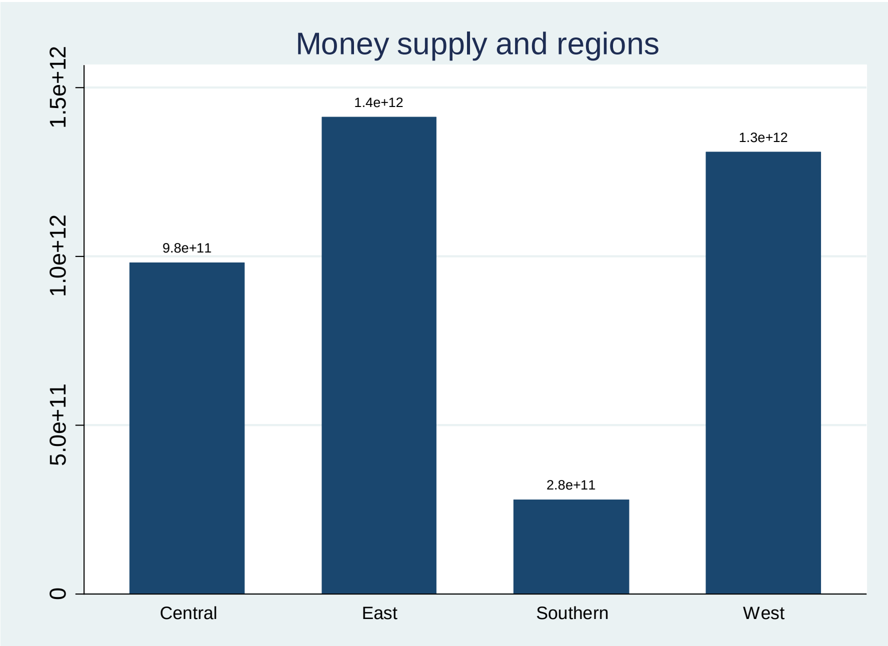

Figure 1. Money Demand in Sub Saharan Africa Sub-regions
Source: World Bank Indicator, 2018.

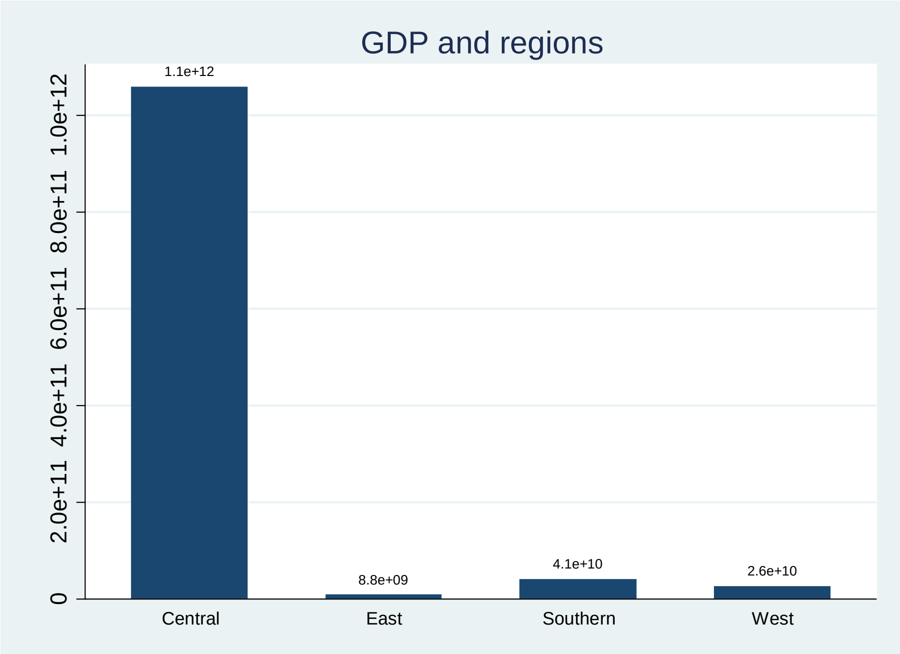

Figure 2. Income in Sub Saharan Africa Sub-regions
Source: World Bank Indicator, 2018.

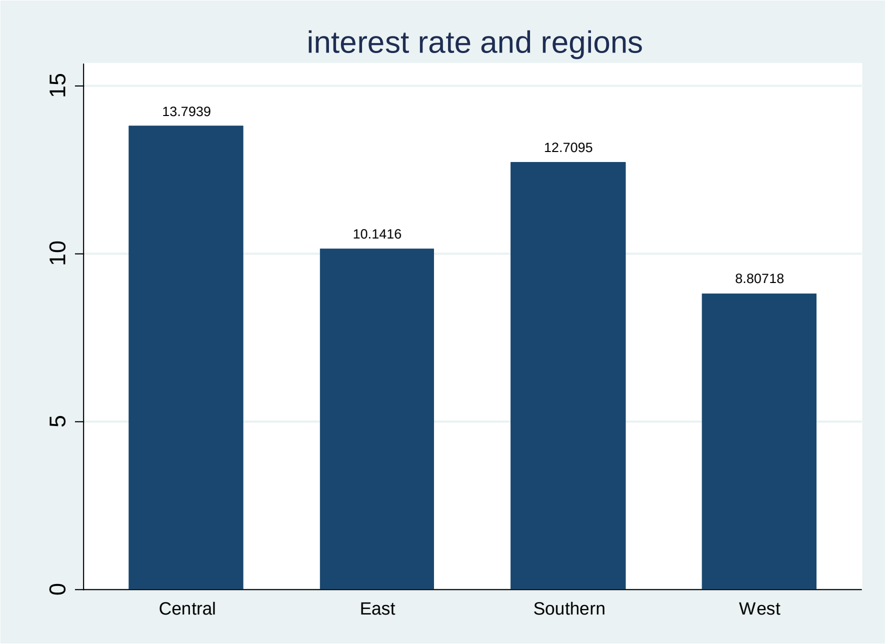

Figure 3. Interest Rate in Sub Saharan Africa Sub-regions
Source: World Bank Indicator, 2018.

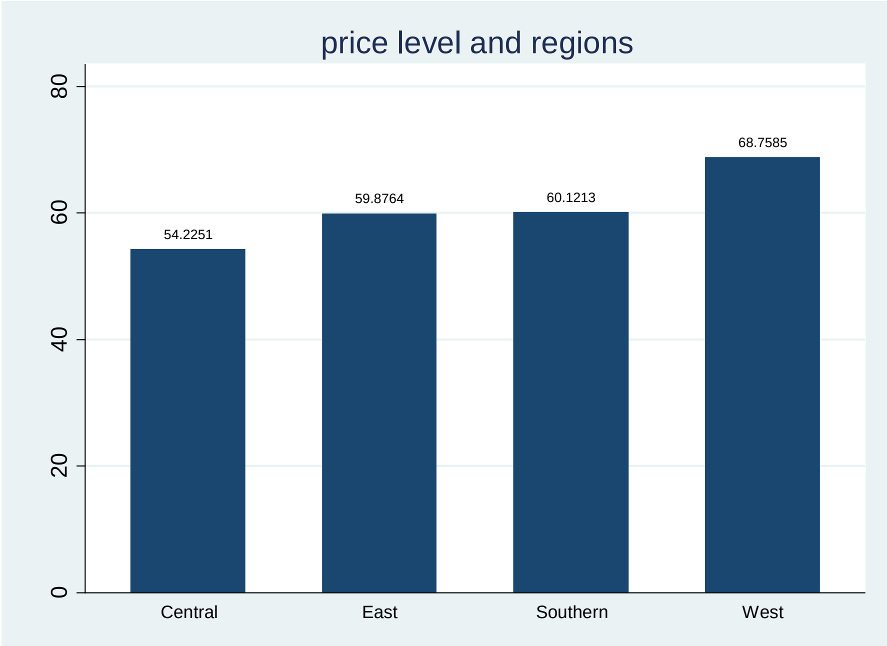

Figure 4. Price Level in Sub Saharan Africa Sub-regions
Source: World Bank Indicator, 2018.

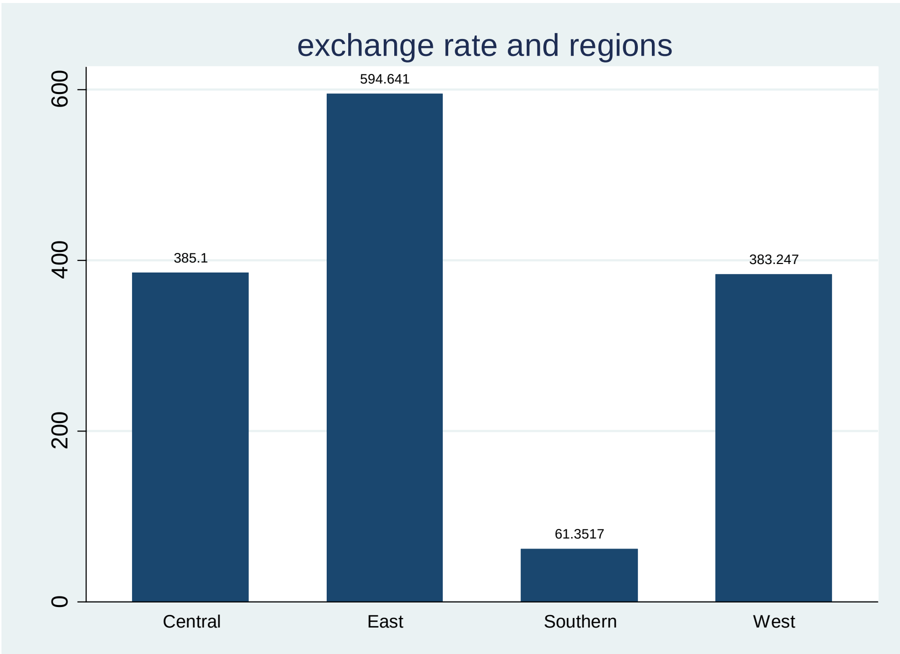

Figure 5. Exchange Rate in Sub Saharan Africa Sub-regions
Source: World Bank Indicator, 2018.