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The Determinants of International Reserves in West African States

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The Determinants of International Reserves in West African States

Philip Olomola Ifeoluwa [α] & Tolulope Ajayi [σ]

Abstract- This study examined the relationship between international reserve and its determinants in west African States for the period of 2005 to 2014. The study was based on buffer stock model and was estimated using Panel ARDL approach. In the short run, All the variables except imports and NEER have a positive impact on international reserve. In the long-run, (IMP), export (EXA) and nominal effective exchange (NEER) does not have a statistical relationship with international reserves accumulation.

I. Introduction

International reserve accumulation is considered to be a form of self-protection against financial crisis; they enable the central banks to intervene in the foreign exchange market and help to cushion the economy from external shocks Andreas (2014). International Monetary Fund (IMF) sees international reserves as a means of crisis prevention and proposed new measures to evaluate their adequacy IMF (2000). Feldstein (1999) advised emerging markets to rely on large foreign exchange reserves as a form of self- protection and to count less on assistance by the IMF. Countries have sought to self-insure against future crises, either because of a perceived increase in the cost of crises or because of the perceived conditionality costs of using IMF credit Bird & Mandilaras (2011). A country needs to maintain international reserve for various purposes, such as to finance import, to maintain exchange rate at a certain range of levels, or to maintain a certain level of reserve.

Countries accumulate reserves to fight against future financial crises IMF (2000). Reserve accumulation has been said to be a means by which a country insure itself against external shocks and also escape the conditions of getting loans from IMF (feldstein, bird and mandilaras (2011)). ECOWAS has 15 countries, all of which are developing countries, they are characterized by poor economic performance, political instability, unemployment/ underemployment, low level of technology, poor social infrastructures etc. Nevertheless, member states still accumulate reserves despite the fact that they are seen as Less Developed Countries, the recent fluctuations in the level of international reserve accumulation has gained renewed interest from both academicians and researchers to investigate the major determinants of international reserves especially in ECOWAS States. Hence, this study. This study would also be useful to foreign investors, as it would give insights to the structure of reserves in ECOWAS before trading with them as maintenance of adequate reserves boost investors' confidence and enhance investment and growth.

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II. Literature Review

David and Baba (2013) examined the determinant of foreign reserve accumulation. They estimated buffer stock model with ARDL. For the determinants of foreign reserves in Nigeria, they focused on income, monetary policy rate, imports and exchange rate. The result provided a strong evidence for the long run relationship among the determinants of reserves in Nigeria and provides strong evidence in support of income as a major determinant of reserves management in Nigeria.

Bentum-Ennin (2014) studied the relationship between international reserve accumulation and economic growth in WAMI zone and confirmed that international reserves accumulation promotes economic growth in the zone, a result which is consistent with the findings of Polterovich & Popov (2003) and Fukuda & Kon (2010).

Frenkel and Jovanovic (1981) states that most of the rules for a country's demand for foreign exchange reserves consider real variables, such as imports, exports, foreign debt, severity of possible trade shocks and monetary policy considerations. Similarly, Shcher-bakov (2002) states that, there are some indicators that are used to determine the extent of external vulnerability of a country and the capability of foreign reserves to minimize this vulnerability.

Disyatat & Mathieson (2001) adopted Frenkel and Jovanovic (Buffer stock) model for fifteen countries in Asia and Latin America and submitted that the volatility of the exchange rate is an important determinant of reserves accumulation and that the financial crisis of the late 1990s produced no structural breaks. Adam and Ndikumana (2009) investigated sources, motivations, and effects reserves accumulation in African countries. According to the study, African countries have reserves in recent years from exports and aid flows. African countries are urged to hold reserves to allow monetary authorities to intervene in markets to control the exchange rate and inflation. The study used panel data from 21 African countries to

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examine the sources, motivation and economic implications of reserve accumulation with a focus on the impact on the exchange rate, inflation, and public and private investment. While the level of reserves remains adequate on average, some countries have accumulated excessive reserves especially in recent years. The empirical analysis in this paper shows that the recent reserve accumulation cannot be justified by portfolio choice motives (in terms of returns to assets) or stabilisation objectives. At the same time, it has resulted in exchange rate appreciation, while it has yielded little benefits in terms of public and private investment. The evidence suggests that African countries, especially those endowed with natural resources need to adopt a more pro-growth approach to reserve management.

Gerti (2012) analyses the change in international reserve pooling and their determinants, and evaluates their optimal level from a cost opportunity perspective. The buffer stock model was analyzed with ARDL approach. Results indicate a negative relationship of reserve pooling with opportunity cost, volatility and deviation of exchange rate from the trend and positive relationship with imports. The approach estimation suggests that the level of optimal reserve holdings is more sensitive to precautionary rather than mercantilist motives. Ramachandran (2004) applied the buffer stock model for India covering the period 1993 - 2003, which was characterized by flexible exchange rate, and high level of capital flows.

From the empirical literature surveyed above the links between international reserves and many variables such as Gross Domestic product (GDP), exchange rate, imports, exports among others have been tested in various economic regions of the world but it has not been studied critically in ECOWAS. Furthermore, there have been variations in the results on the analysis of international reserve pooling. This variation in the result is with regard to the choice of sample period (monthly, quarterly, yearly etc.), estimation techniques and regions considered (Latin America, ASEAN, OECD etc.)

III. Methodology

a) *Theoretical Framework*

Reserve holdings are important macroeconomic indicators. They are necessary as a guarantee to balance external sector shocks. The higher the reserve stock level, the more protected the economy is. On the other hand, reserve holdings have a financial and economic cost expressed as forgone earnings from investment and in the growth of the external government debt. Thus, it is necessary to evaluate the optimal level of reserve that satisfies both outlined criteria. Estimating the optimal level is a task faced by the monetary authority of a country. The most widely used of these models in the literature is the 'buffer stock model'.

The model implies that the authorities demand reserves as a buffer to curb fluctuations in external payment imbalances. This is to avoid macroeconomic adjustment cost arising from imbalances in the external payments. The advantage of the model over others is its adaptability to both fixed and floating exchange regimes. The model is as relevant in a modern floating exchange regime as it was during the Bretton Woods regime. Frenkel & Jovanovic (1981) developed Buffer Stock model of the demand for reserve. This model describes reserves as a continuous exogenous Wiener process of the following form:

$$dIR(t) = -\mu dt + \sigma dw(t) \quad (1)$$

$I(t)$: reserves held in time t

W(t): standard Weiner process based on a simple random walk, with mean μ and variance

σ

μ: deterministic part of the instantaneous change in reserves

σ : standard deviation of the Weiner increment in reserves At each point in time the distribution of reserves holdings R (t) is characterized by

$$IR(t) = IR^* - \mu t + \sigma IRW(t) \quad (2)$$

Where:

*IR**is the optimal stock of reserves, which is obtained by minimizing two types of costs:

i. The cost of adjustment, which is incurred once reserves reach an undesirable lower bound;
ii. Foregone earnings on reserve holdings. The optimal stock of reserves is obtained by minimizing these two costs and it yields an expression:

$$R^* = \left[\sqrt{\frac{2c\sigma^2}{(2r\sigma^2)0.5}}\right] \quad (3)$$

Where:

c: fixed cost of adjustment

r: opportunity cost of holding reserves

σ: standard deviation of change in reserves

In this model, reserves are a stochastic process governing the inflows of payments and receipts in the balance of payments. Thus, changes in reserves are a normal variety process with mean $-\mu\Delta t$ and variance. The actual stock of reserves, in time t, is a random $\sigma\Delta W(t)$The actual stock of reserves, $IR\ (t)$ in time *t,* is a random variable characterized by:

$$IR(t) = IR_0 - \mu t + \sigma W(t) \quad (4)$$

$$\text{And } IR(t) \sim N(IR_0 - \mu t; + \sigma 2(t) \quad (5)$$

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In the above case, according to Frenkel & Jovanovic (1981),IR_o is the initial stock of reserve (assumed to be the optimal level). If we also assume that overall reserves are at their optimum level, in other words on average each year stocks are close to the optimal level, the displacement constant μ is zero and thus the product μ is zero. So the stochastic process that governs changes in reserves is without a drift. For developing economies, μ is a conditional 0 IR variable, which requires further discussion. It is, however, worth noting that many authors, who have been basing on this model, have adjusted this assumption as described below.

Under the above assumption, Frenkel and Jovanovic (1981) assume that the optimal level is the stock of reserves that minimises the cost of adjustment (which itself means a cost that can be derived by adjusting the current level of reserves to the optimal level and the opportunity cost of holding reserves). In the case of the first cost, it can be considered as the level of money that should be withdrawn from the economy so as to yield the desired balance of payments surplus that is necessary to accumulate reserves. Thus, this cost measures the cost of pursuing reserves in the case when it is below the optimal level (in other words the cost of real adjustment necessary to enable a positive balance of the foreign payments). The second cost represents the opportunity cost (forgone earnings) of reserve holdings. So, it is the amount of forgone earnings from not investing the reserves, or the amount of forgone earnings lost in the form of interest in case of borrowing. It measures the cost for the society whenever the level of reserves is above the optimal level and should be adjusted down. The optimal stock serves to simultaneously minimise both costs, so that it minimises the loss function.

Using a second order approximation of Taylor series and then the log linearization of the obtained expression; the optimal stock of reserves can be expressed by:

$$\text{Log } IR(t) = b_0 + b_1 \log(\sigma t) + b_2 \log(rt) + \mu t \quad (6)$$

Where, r is the opportunity cost of reserve holdings.

Frenkel & Jovanovic (1981) evaluated equation (6) in order to calculate the corresponding value of the coefficients, which later can be used to estimate the optimal level of reserve holdings.

The priorities of the Buffer Stock model relate to the appearance as a time continuous approach and to the possibility to evaluate easily generated variables. To evaluate the same equation, in order to find the approximate values of the respective coefficients, variables included in equation (6) are expressed in nominal value.

b) Model Specifications

This study adopted the model specification of Aizenman & Marion (2003) in determining the optimal level of reserve.

$$IR = f(POP, GPC, EXA, IMY, NEER) \quad (7)$$

Where IR is actual holdings of reserves minus gold, POP is the total population of the country; GPC is real GDP per capita; EXA is the volatility of real export receipts; IMY is the share of imports of goods and services in GDP; and NEER is the volatility of the nominal effective exchange rate.

Transforming equation (7) to its explicit form, it becomes:

$$IR_{it} = \beta_0 + \beta_1 POP_{it} + \beta_2 GPC_{it} + \beta_3 EXA_{it} + \beta_4 IMY_{it} + \beta_5 NEER_{it} \quad (8)$$

Therefore, taking log of equation (8) and putting the model into an econometric form, we have:

$$Log\ IR_t = \beta_0 + \beta_1 \log POP_{it} + \beta_2 \log GPC_{it} + \beta_3 \log EXA_{it} + \beta_4 \log IMY_{it} + \beta_5 NEER_{it} + e_t \quad (9)$$

According to Aizenman & Marion (2003), there should be a positive relationship between IR and POP, IR and EXA, IR and GPC. IR should be negatively correlated with NEER, IMY.

From equation (9) above, the volatility of real export and nominal effect exchange rate is generated using GARCH model.

Based on Pesaran, Shin, and Smith (1999), using the autoregressive distributed lag ARDL (p, q), the dynamic heterogeneous panel regression equation with the error correction model can be formed as:

$$\Delta \log IR_{i,t} = \alpha_0 + \sum_{j=1}^{p-1} \lambda_j \Delta \log IR_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta \log POP_{i,t-j} + \sum_{j=1}^{p-1} \psi_j \Delta \log GPC_{i,t-j} + \sum_{j=1}^{p-1} \varpi_j \Delta \log EXA_{i,t-j} + \sum_{j=1}^{p-1} \varphi_j \Delta \log IMY_{i,t-j} +$$
$$\sum_{j=1}^{p-1} \sigma_j \Delta \log NEER_{i,t-j} + \phi_i' \left[\log IR_{i,t-1} - \left\{ \beta_0 + \beta_1 \log POP_{i,t-1} + \beta_2 \log GPC_{i,t-1} + \beta_3 \log EXA_{i,t-1} + \beta_4 \log IMY_{i,t-1} + \beta_5 \log NEER_{i,t-1} \right\} \right] + \varepsilon_{it} \quad (10)$$

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IV. Empirical Results

Table 1 reports the descriptive statistics such as means, median, maximum, minimum and standard deviation. For the purpose of achieving the objectives of the study, the variables were logged, which will also enhance the robustness of the estimated model and consistency of the residual.

a) Descriptive Statistics of the Data

Table 1 shows that all the variables displayed moderate level of consistency, as the difference between their mean and median are not really significant; the mean and median values lie within their maximum and minimum values. However LIMY is the least volatile variable with standard deviation of 0.411204 while LEXA is the most volatile variable with 2.073573 of standard deviation. The skewness statistics revealed that both LNEER and LPOP were negatively skewed while every other variable are positively skewed. Also, the low deviation of all variables showed that each variable is not far to its mean. The kurtosis of all the variables in the analysis exceeds 3, meaning that the series are leptokurtic (peaked) relative to normal distribution. Finally,

The Jarque-Bera statistics rejected the null hypothesis of normal distribution at 5% level of significance; all the variables are below 5% level of significance, except POP which is above 5% level of significance.

Table 1: Descriptive Statistics of the Variables

	LEXA	LGPC	LIMY	LIR	LNEER	LPOP
Mean	21.61097	6.247141	3.696664	20.40294	5.615554	15.93656
Median	21.34133	6.101914	3.706968	20.30022	6.172257	16.20088
Maximum	27.31922	7.916361	4.974859	24.70480	8.855680	18.99435
Minimum	18.16663	5.110542	2.560431	15.98210	-0.098408	13.06944
Std. Dev.	2.073573	0.605706	0.411204	1.622055	1.901631	1.324381
Skewness	0.977356	0.945644	0.238002	0.557077	-1.100476	-0.110497
Kurtosis	3.772483	4.107894	4.132991	4.139005	4.835767	3.429366
Jarque-Bera	25.95357	29.82732	8.998556	15.65515	50.65442	1.457461
Probability	0.000002	0.000000	0.011117	0.000399	0.000000	0.482521
Sum	3047.147	930.8241	528.6230	3019.634	831.1020	2390.484
Sum Sq. Dev.	601.9589	54.29822	24.01055	386.7664	531.5814	261.3437
Observations	141	149	143	148	148	150

Source: Author's Computation

Table 2: Panel Unit Root

Variable	LM, Pesaran and Shin W-stat	ADF - Fisher Chi-square	PP - Fisher Chi-square	Remarks
LEXA	-3.7886	71.169	84.1165	I(1)
LGPC	-4.7599	82.584	86.828	I(1)
LIMY	-3.9707	74.832	122.547	I(1)
LIR	-3.4874	69.2598	84.7767	I(1)
LNEER	-1.78596	45.7295	77.0863	I(1)
LPOP	-5.9546*	111.512*	89.8324*	I(0)

Source: Author's Computation

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Table 2 shows that all the variables are I (1) except Population which is I (0), therefore panel ARDL is suitable for estimating the model.

b) Bound Test/Cointegration Test

In investigating the long run relationship among the variables, the null hypothesis of co integration and long run convergence was tested using the bound test obtained after ARDL. The null hypothesis of no co integration was tested against the alternative hypothesis by the means of F-test with an asymptotic non-standard distribution. Table 3 reports the bound test among the variables. The F-statistic of 8.288 is greater than the upper critical bound at all the level of significance, this implies that long run relationship exists among the variables and therefore, they are co-integrated. This informed the decision of the study to estimate both short run and long run relationship of the variables.

Table 3: Bound Test

Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	k
F -statistic	8.288316	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Source: Author's Computation

Table 3 shows that the calculated F statistics (8.29) is greater than the tabulated upper boundary of the F statistics of the bound test (5.06) then the variables are co-integrated at 1% level of significance.

Table 4: Short Run Coefficient

Variable	Coefficient	t-Statistics	P-value
D(LIMY)	-0.635298	- 3.127117	0.0022
D(LEXA)	0.162989	2.377177	0.0188
D(LNEER)	-0.303724	- 5.523703	0.0000
D(LNEER(-1))	-0.176254	- 3.298717	0.0012
D(LPOP)	0.673941	7.751094	0.0000
D(LGPC)	0.182826	2.820754	0.0740
CointEq(-1)	-0.185774	-3.849175	0.0002
R-squared	0.895354		
Adjusted R-squared	0.887716		
S.E. of regression	0.547001		
Sum squared resid	40.99183		
Log likelihood	-114.9988		
F-statistic	117.2178		
Prob(F-statistic)	0.000000		
Durbin-Watson stat	2.064344		

Source: Author's Computation

After ascertaining that there is a long run relationship between the variables, equation 9 is then estimated. The short run estimate reports the coefficient of the error correction term and other explanatory variables. The coefficient of the error correction term (-0.185774), being negatively signed indicates a significant adjustment process, correcting short-run disequilibrium from long-run positions. This occurs at a speed of 18.57 percent per period till the disequilibrium is corrected and long-run stability is achieved. The coefficient of import is -0.6353 in the short run and statistically significant at 5 percent level of significance,

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which indicates that in the short run rise in import will leads to fall in international reserve of the ECOWAS countries. Studies have established that most ECOWAS countries have preferences for imported goods Rincón (2007), and this reflect in a rapid rate of decay in their international reserves. The mono-cultural nature of these countries' economies affect their export capability and encourage the importation of finished commodities. Countries in this part of the world engage in exportation of primary commodities with low value addition processes. This arguably leads to shallowness in international reserve of most ECOWAS countries.

Also, International reserves adjustment in the short run, responds positively to the volatility of real export in ECOWAS countries. The coefficient of 0.1629 shows that positive movement in export revenue will induce the reserve to be in equilibrium and aid it stability over the horizon. It is a well-known assertion that export grows reserve of any economy, while imports deplete it. The positive effect of export on international reserve revealed the extent to which sustained export promotion in ECOWAS countries could boost their international reserve position and prepare them for future investment and consumption in the event of unfavourable external shocks effect. The strength of currency of countries in ECOWAS depends on export revenue and international reserve position.

Furthermore, corroborating a-priori expectations that the nominal exchange rate critically influences the level of reserve pooling, Disyatat and Mathieson (2001) submitted that the volatility of the exchange rate is an important determinant of reserve accumulation. The short-run estimates revealed that a 1% appreciation in the nominal exchange rate precipitates fall in international reserves by 30% basis points. This implies that depreciation of exchange rate will reduce the depletion of international reserve, as it will discourage importation, increase export earnings and simultaneously enhance the inflow of foreign capital.

In the same vein, the coefficient of the population of ECOWAS member states (POP) shows a significant positive impact on the accumulation of international reserves. This implies that a percentage increase in population, drives an expansion in the reserves position of member countries by a factor of 67 percentage basis points. Thus, the population of a country, the degree of factor mobility and the educational demographic of its workforce, serve as a major determinant of foreign capital investment inflow. This implies that increase in population will arguably leads to rise in investment and thereby bring about increase in the volume of local production. ECOWAS countries can thus exploit the growing demand from rapid population expansion, provided that the social capital of the population is well enhanced through education.

Besides, the estimates also indicate that upward movements in production volume exerts a positive significant increase in the level of pooled reserves. The reported coefficient of 0.182826 on GDP, implies that reserves will grow by approximately 18% if the National Income of member states appreciates jointly by 100%. The explanatory power of the model shows that 89.53% of the model variation was accounted for by the independent variables, though after adjusting for the loss in degree of freedom, the coefficient of determination fell to 88.77%. The F-statistics of the model reports the joint significance of the variables. It indicates that the variables are jointly statistically different from zero. The Durbin-Watson of 2.064 also revealed a model robust against the problems of serial correlation.

Table 5: Long Run Coefficients

Variable	Coefficient	t-Statistic	Prob.
LIMY	0.156444	0.200563	0.8413
LEXA	0.093847	0.593270	0.5540
LNEER	-0.176037	-1.226982	0.2219
LPOP	0.895799	3.409821	0.0009
LGPC	0.951555	20.63009	0.0000
C	4.518502	0.760349	0.4484

The long run estimate of reserves among the member states was captured using the panel autoregressive distributed lag model owing to the mixed order integration of the variables. Table 5 reports the long run estimates of the model. Imports do not statistically affect the international reserve in the long run. Similarly export of the ECOWAS countries does not have statistical relationship with long run accumulation in international reserve. The same is applicable to nominal effective exchange rate which exhibit no statistical relationship in the long run. Nevertheless, the results suggest that international reserve of members

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states is an increasing function of population growth in the long run, with a coefficient of 0.895799. This is expected because remittance rate will rise due to the high dependence nature of the ECOWAS countries on international remittances.

c) Heteroskedasticity Test

Harvey test for heterokedasticity was used to determine the constant variance and robustness of the overall model. Lack of constant variance could have a devastating effect on the efficiency and consistency of the estimate. The table 6 reports that the model is free from the problem of heteroskedasticity at 5% level of significance with p-value of 0.4798 and f-statistics of 0.9615. Table 7 reports the serial correlation test. The table shows that the presence of serial correlation is rejected and therefore, the model is free from the problem of autocorrelation.

Table 6: Heteroskedasticity Test

Heteroskedasticity Test: Harvey			
F-statistic	0.961548	Prob. F(10,137)	0.4798
Obs*R-squared	9.706279	Prob. Chi-Square(10)	0.4666
Scaled explained SS	12.27136	Prob. Chi-Square(10)	0.2673

Source: Author's Computation

d) Serial Correlation LM Test

The test of serial correlation in Table 7 proved that there is the absence of autocorrelation in the residuals of the model given that the reported F-statistic (0.322850) is insignificant at the 5% level of significance (p-value = 0.7246) permitting the conclusion that there is insufficient information to reject the null hypothesis of no autocorrelation.

Table 7: Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.322850	Prob. F(2,135)	0.7246
Obs*R-squared	0.704508	Prob. Chi-Square(2)	0.7031

Source: Author's Computation

V. Conclusion

This study examined the relationship between international reserve and its determinants in west African States for the period of 2005 to 2014. The study established that export constitute a great factor in ensuring stability of international reserve. The variables used in the study tend to have a high proportional effect on international reserve. The study lends support to the views of scholars like Ramkishen, Reza and Graham (2003) and Jiae (2013) who claim that countries will gains from reserve pooling and it will reduce their risk exposure.

Based on the findings from the study the following recommendations are worthwhile: Export should be encouraged in the ECOWAS countries, especially among the member countries. Since member countries export more of primary products, the products should be repackaged in such a way that it would meet international standard. This will reduce the member countries vulnerability to international shocks. Impediment to trade among member countries should be removed and free flow of goods and services should be embraced. This will go a long way in ensuring stability of the reserve after pooling. Furthermore, countries should focus on the accumulation of reserves for future use and prudently manage the reserve by putting a sound management strategy in place.

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