Monetary Models Evaluation of Exchange Rate Determination in the Non-WAEMU Anglophone West Africa and Guinea

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by

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Abstract

This paper assessed exchange rate determination and the associated macroeconomic fundamentals across the non-West African Economic and Monetary Union (WAEMU) Anglophone countries (The Gambia, Ghana, Liberia, Nigeria and Sierra Leone) and Guinea. These six countries were known the West African Monetary Zone (WAMZ). Further steps were taken to check for similarities in the determination of exchange rates by the fundamentals as well as the uniformity of macroeconomic determinants of exchange rates and their associated explanatory powers towards justifying the appropriateness (or otherwise) of a single fixed exchange rate regime across these WAMZ countries in the event of monetary integration of West Africa which would be characterised by common currency and common central bank. This study applied two variants of the monetary models of exchange rate determination: (i) the flexible-price monetary model (FPMM) and (ii) the real interest differential monetary model (RIDMM). These monetary theories and models of exchange rates determination are very useful tools in explaining the behaviour of exchange rates in any given economy. Annual, quarterly and monthly data, averagely spanning between 1980 and 2015 were employed. Cross-rate conversions were estimated by the author in order to generate bilateral exchange rates among the WAMZ countries. The monetary models constructed incorporated the extent of informal economies within these WAMZ countries. The two monetary models were estimated with the Canonical Cointegrating Regression (CCR), Dynamic Ordinary Least Square (DOLS) regression and Markov Switching Dynamic (MSD) regression approaches for country estimations while Random Effect (Generalised Least Square) estimation of panel data of the six WAMZ countries was applied in the evaluation of homogeneity of exchange rate behaviours. Furthermore, the relationships in the FPMM and RIDMM were examined with three residual-based cointegration tests on the residuals of the estimates of Fully Modified Ordinary Least Square (FMOLS) cointegrating regressions (Phillips-Oualiaris, Engle-Granger and Park's Added Variable). The US *dollar* based exchange rates estimated yielded evidence towards the conclusion that The Gambian *dalasi*, the Nigerian *naira* and the Sierra Leonean *leone* are the three WAMZ currencies well-suited for a single exchange rate regime. Estimations of the Nigerian *naira*-based exchange rates revealed that Sierra Leonean *leone*, the Guinea *franc* and the Ghanaian *cedi* are also suitable for the single foreign exchange market. What is significant here is that Nigeria (the lead economy in West Africa) is evidently suited for the single exchange rate regime. Evidently, Liberia was not reported as being suitable in any of the estimations.

1. Introduction

There are various theories and models of exchange rate determination applicable to the estimation of the rate of exchange of currencies. These theories and models are very useful tools in explaining the behaviour of exchange rates in any given economy. This empirical study analysed exchange rate behaviours in the WAMZ in the context of monetary theory and models of exchange rates determination. The monetary theory of exchange rate determination is fundamentals-based approach to the modelling of exchange rates which is generally built on the construct of the purchasing power parity (PPP). Monetary models of exchange rate determination formed out of this approach are also referred to as 'structural models' of exchange rate because of their derivation from a system of equation which depict the market equilibrium relationships between nominal exchange rate and macroeconomic fundamental variables. These models centres on the assessment of the explanatory powers of these macroeconomic fundamentals in the forecast of the nominal rate of exchange. What is common to all monetary models of exchange rate determination is that they all emphasise the crucial role of relative money supplies in offering explanations about exchange rate. At their initial points is the simple view of exchange rate as the price of one currency in terms of another. This is further to the argument that movements of exchange rates can be explained by the demand for and supply of national stocks of money. Out of the various models offered by monetarists in explaining exchange rate behaviour, this study limited itself to two variants of the exchange rate monetary models of exchange rate determination (the flexible-price monetary model - FPMM and the real interest differential monetary model- RIDMM) in the assessment of exchange rates determination and behaviours in the non-West African Economic and Monetary Union (WAEMU) Anglophone countries (The Gambia, Ghana, Liberia, Nigeria and Sierra Leone) and Guinea. These six countries are hereinafter referred to as the West African Monetary Zone (WAMZ). In this study, exchange rates determination and behaviour in the WAMZ are therefore modelled in accordance with the dictates of the theories behind these two models (FPMM and RIDMM). Consequently, this paper assessed exchange rate determination and the associated macroeconomic fundamentals in the cases of the six WAMZ countries and checked if there are similarities in exchange rate determination by the fundamentals across the WAMZ as well as examining the uniformity of macroeconomic determinants of exchange rates in the WAMZ and their associated explanatory powers towards justifying the appropriateness

(or otherwise) of a single fixed exchange rate regime across these WAMZ countries in the event of monetary integration of West Africa, expected to be characterised by common currency and common central bank.

2. Underlying Theories and Models

The analyses and assessments of the international parity conditions are essential precursor to the monetary approach to the modelling of exchange rate determination. Although, the PPP is of great relevance, a major defect of the PPP theory is that it does not hold for all types of goods and that it is just about goods arbitrage and says nothing about international capital movements. Nevertheless, despite this, PPP still has a role to play in exchange rate determination.

In the asset models of exchange rate determination, the interrelationship between the demand and supply of the specified assets determine exchange rates as the relative price of two currencies. The measurements of these relative prices is in terms of the relative demand for and supply of money. The assets model approach of exchange rate (with perfect capital mobility as basic assumption) can be broken down into two major categories: (i) monetary models approaches (with perfect capital substitutability as core assumption) and (ii) portfolio balance approaches (with imperfect market substitutability as core assumption). The monetary approach to exchange rate determination (which is direct outgrowth of the PPP theory and the quantitative theory of money) suggests that exchange rate is the relative price of two monies. This monetary model of exchange rate determination reflects real interest rate as exogenous in the long run and as a variable which is determined in the world markets due to the perfect capital mobility implicit assumption. These imply that the monetary approach two exchange rate determination hinges on two basic assumptions: (i) perfect capital mobility; and (ii) perfect market substitutability of domestic and foreign assets. Perfect substitutability of domestic and foreign bonds infers that the rate of return must be equalised across currencies. Therefore, the common assumption shared by the asset market models is perfect capital mobility which entails the absence of significant transaction costs, capital control or international capital flows impediments.

There six aggregate markets in the open market macroeconomics. These are: (i) good markets; (ii) money markets; (iii) labour markets; (iv) foreign exchange markets; (v)

domestic bonds (no-money assets) markets; and (vi) foreign bonds markets. The concentration of the monetary model is directly on only one of these markets, which is money markets. The assumption of perfect market substitutability of domestic and foreign assets essentially converts the domestic and foreign bonds markets to a single market. This accordingly brings the number of aggregate markets to five markets out of which three markets are cleared when perfect market flexibility of prices and wages would equilibrate supply and demand in the goods market as well as labour market, while exchange rates freely adjust in order to equilibrate supply and demand in the foreign exchange market. Given these, the equilibrium of the full system in monetary market is determined by equilibrium conditions for the money market (Walras Law).

The three relationships in a standard monetary model are: (i) money market equilibrium; (ii) purchasing power parity (PPP) and (iii) the uncovered interest rate parity (UIP). The element of an open market is derived from the relationships of the PPP and the UIP. The postulations of the PPP is that an exchange rate is subject to transaction costs such that prices of homogeneous goods in both the domestic and foreign markets are equalised when they are expressed in a common currency. For the UIP, interest rate differential is equated to the expected depreciation of the domestic currency over the term of deposits/bonds to which the interest rates apply. UIP hypothesises that there will be appreciation of currency if domestic interest rate is lower than the foreign interest rate, this implies negative differential while currency appreciation occurs if this differential is positive (that is when domestic interest rates are higher than foreign interest rates). PPP is driven by trade in good and it mainly propels currency transaction in developing economies and accounts for small proportions of developed markets' currency trading. Perfect substitutability of domestic and foreign bonds suggests UIP (as an assets market arbitrage relationship) where domestic interest rate must differ from foreign interest rate by a value exactly equal to the expected rate of currency depreciation.

Generally, developing economies are characterised by 'embryonic' economic terrains and financial markets which are however integrated within international financial markets. In these developing economies, currency demands are hugely driven by trade in goods and services as opposed to developed and emerging economies and financial markets where demands are propelled by large volumes of trade in currencies which can be explained only by currency speculations and hedging activities of market participants.

These are micro-structure effects that cause simple monetary models to be unable to fully explain exchange rate swings in developing economies (Lyons, 2001). Hence, for developing economies (like the WAMZ), in which high price impact of trade may cause the magnitude of exchange rate to be large, there are infrequent currency movements when compared with developed economies. Macroeconomic fundamentals are therefore very likely to play more important role in exchange rate determination in the WAMZ if emphasis is not placed on interest rate parity (IRP) condition. Aron and Ayogu (1997) got evidence to suggest that in developing economies (like those of the WAMZ), IRP is not theoretically realistic assumption and not also an empirical fact. Domestic and foreign assets are never near perfect substitutability while currency and fixed income markets are characterised by high degree of illiquidity. Generally (and specifically for the WAMZ), financial markets are at the rudimentary levels. Theoretical motivations for the arbitrage-based IRP is not applicable in developing economies characterised by nascent or less-developed financial markets. Thus, for the WAMZ, in consideration of the monetary model of exchange rate determination as proposed by Frankel (1976), Mussa (1976) and Frankel and Rose (1995), only money market equilibrium. Consequent upon the foregoing discussions, the monetary models of exchange rate employed in this study do not assume the UIP. Because of the developing nature of the WAMZ economies and the under development of their financial markets, PPP is otherwise considered as the international parity condition. Further evaluation is placed on PPP here in order to explore currency relationships for the monetary zone and assess similarities in the characteristics of exchange rates underlying fundamentals among the WAMZ countries towards the adoption of a future common currency.

The flexible-price monetary model (FPMM) assumes that goods prices are perfectly flexible, implying that the PPP holds instantaneously at all times. This model was first developed by Frenkel (1976), Mussa (1976) and Bilson (1978). According to Bilson, the approach reflects the quantity theory of money and strict PPP.[1] The FPMM incorporates the effect of inflationary expectation and its major argument is that within an economy, all prices (wages, exchange rates, prices *etc*.) are in both the long run and short run

[1] In the Quantity Theory of Money, monetary equilibrium between nominal money supply and real money demand determines fully flexible prices.

flexible (upwards and downwards). Therefore, the reduced form exchange rate equation for the FPMM could be derived from the major assumptions that: (a) prices, nominal interest rates and nominal exchange rates adjust instantaneously to clear goods, money and foreign exchange markets; (b) there are stability in monetary conditions (meaning that the Quantity Theory of Money holds at all times); (c) money demand function is stable; and (d) PPP holds continuously. These assumptions can be expressed thus:

$$p = m^s - m^d \quad 1$$

$$p^* = m^{s^*} - m^{d^*} \quad 2$$

$$m^d = \alpha y - \beta i \quad 3$$

$$m^{d^*} = \alpha y^* - \beta i^* \quad 4$$

$$p = s + p^* \quad 5$$

where p is the price level, m is the money supply, y is the real income and i is the nominal interest rate, s is the exchange rate while superscript d is the demand variable and superscript s is the supply variable while superscript $*$ indicate the corresponding foreign variable. Equation (1) represents the proposition of a stable monetary condition while Equation (2) stands for the proposition of stability in the foreign monetary condition. Equations (1) and (2) indicate the implication of instantaneous adjustment in the price levels towards bringing equality between demand for money and supply of money as well as further implication of the essence of QTM where, given the real demand for money, the nominal money supply determines the price levels. Equation (3) indicates that the demand for nominal money balance is a stable function of real income and nominal interest rate in the domestic country as well as in the foreign country as shown in Equation (4). Parameter α measures income elasticity of demand while parameter β measures the interest rate semi elasticity of demand for money. Equation (5) shows the PPP condition in which: (a) there is one-to-one movement in the domestic price level and the exchange rate adjusted foreign price level; and (b) the adjustment of the exchange rate to offset the inflation differential. Under a flexible exchange rate regime, money supply is exogenous; and through equations (1) and (2), price is determined. Equations (3) to (5) determine the nominal interest rate and exchange rate. On the other hand, under a fixed exchange rate system, money supply is exogenous, where the domestic

price level is determined by Equation (5), while Equations (1) to (4) determines the real money balance in the domestic and foreign countries. What these indicate is that without alterations to the underlying structure of a model of exchange rate, the underlying regime of exchange rate specifies the set of independent variables.

With the assumption that money supply could be exogenously determined by the monetary authorities in the domestic and foreign countries (that is $m^s = m$ and $m^{s^*} = m^*$), if Equations (1) to (4) are combined, we will have:

$$p - p^* = (m - m^*) - \alpha(y - y^*) + (i - i^*) \quad 6$$

The information in Equation (6) is that in consideration of the real domestic and foreign demand for money, price level in the domestic country will be lower (higher) than the price level in the foreign country by the extent to which the money supply in the domestic country is lower (higher) than money supply in the foreign country. If Equation (5) is substituted into Equation (8), we will obtain:

$$s = (m - m^*) - \alpha(y - y^*) + (i - i^*) \quad 7$$

This is the Flexible-price monetary model of exchange rate determination which leads to an exchange rate equation depicting the nominal exchange rate as the relative price of two national monies (dependent variable) being determined by the independent variables which are the relative money supply, relative income and relative interest rate differential. This is a model which introduces the role of money supplies, inflationary expectations and economic growth as exchange rate changes determinants but based upon the premise that all prices within an economy are fully flexible. The model simply posits that what matter for exchange rate determination is money demand in relation to money supply and that this causes countries with high monetary growth to develop high inflationary expectations leading to reduction in demand to hold real money balances, increased expenditure on goods, increase in domestic price level and depreciation in currency so as to maintain the PPP (Pilbeam, 2010).

The assumption taken by Dornbusch (1976) is that prices are not perfectly flexible continuously. His argument is that in the short run, prices are very likely to be sticky thereby causing nominal interest rate changes to reflect in the contractionary monetary policy. Further assumption is that the PPP does not hold in the short run, but in the long

run.[2] This means that the PPP condition is temporarily violated when the short run price stickiness sets in, and consequently, the exchange rate has to reflect the monetary policy's short term liquidity effect. Recalling the Fisher effect as indicating that the nominal interest rate is made up of real interest rate and expected inflation, if the differential of the spot exchange rate and the long run equilibrium rate as well as the differential of expected long run inflation between the domestic and foreign countries positively explain expected depreciation of the exchange rate, the following relationship evolves:

$$E(s) = -\lambda + (s_t - \bar{s}_t) + \pi_t^e - \pi_t^{e^*} \quad 8$$

where is λ the speed of adjustment to equilibrium while the bar over the variable denotes long run equilibrium. If the Fisher equation ($i = r_t + \pi^e$) and its foreign version are combined, they yield:

$$s_t - \bar{s}_t = \frac{1}{\lambda}\{(i_t - \pi_t^e) - (i_t^* - \pi_t^{e^*})\} \quad 9$$

The simple explanation of Equation 6.9 is that the gap between spot rate and its long run equilibrium level is proportionate to the real interest rate differentials between two countries. As already stated, a stiff monetary policy is therefore required so as to raise interest rate differentials. The short run interest rate captures the liquidity effect. If PPP holds in the long run, this is represented as:

$$\bar{s}_t = \bar{p}_t - \bar{p}_t^* \quad 10$$

It is further assumed that the differentials of interest rate and expected inflation must be equal thus:

$$\bar{r}_t - \bar{r}_t^* = \pi_t^e - \pi_t^{e^*} \quad 11$$

We can consequently re-state equation (11) as:

$$\bar{s}_t - \bar{s}_t = \frac{1}{\lambda}\{(\bar{\imath}_t - i_t) - (\bar{\imath}_t^* - i_t^*)\} \quad 12$$

[2] This follows Dornbusch (1976) and Frankel (1979).

The implication of equation (12) is that whenever nominal interest rate increases over and above its equilibrium level, exchange rates overshoots its long run rate. If equations (7), (11) and (12) are combined, they produce:

$$s_t = (m_t^* - m_t) - \beta_y(y_t^* - y_t) + \beta_\pi(\pi_t^{e^*} - \pi_t^e) \quad 13$$

By substituting equation (13) into (12) we obtain the sticky price monetary model (SPMM) thus:

$$s_t = (m_t - m_t^*) - (y - y^*) - (i_t - i^*) + (\pi_t^e - \pi_t^{e^*}) \quad 14$$

The major innovation of the SPMM is that it emphasises capital-market arbitrage as major short-run determinant of exchange rates (rather than goods-market arbitrage which is viewed as medium to long run determinant). The model offers good explanations on why movements in international prices and changes in international money stocks account for exchange rate changes while clarifying that such movements are due to rationale foreign exchange market that yields exchange rates which exhibit deviations from PPP based on the realities of economic fundamentals and not in isolation from these fundamentals. This model also assists in explaining the reason why exchange rates experience volatility more than supposed determinants like money supply.

Frankel (1979) developed the real interest differential monetary model (RIDMM) which accommodates here (FPMM and SPMM), with the introduction of interest rate differentials as additional explanatory variable that allows for the role of differences in secular inflation rates. The argument here is that changes in long term nominal interest rates serves as measure of changes in inflation expectations. His view is that it is only short term interest rate differential that moves independently of inflation. Long term interest rate differential is introduced into exchange rate models either because long term interest rate serves as the measure of the cost of holding money or rather because long term interest rate proxies for interest rate differential. From any of the two points of views, whenever domestic long term interest rate differential rises, there would be reduction in real money demand and consequently, higher prices and depreciation of currency. Drawing from the SPMM, the RIDMM assumes that the PPP is valid in the long run even if it fails to hold in the short run. The mechanism of the postulation of the RIDMM points to the determination of the expected change in the exchange rate as: (a) the gap

between the current spot rate and the long run equilibrium rate; and (b) the expected long run inflation differential. These could therefore be expressed in two-fold. Firstly as:

$$E(\Delta s) = i - i^* \qquad 15$$

which indicate that in the absence of uncertainty, but in situation of perfect capital mobility and neutrality of market participants, expected rate of domestic currency depreciation equals interest rate differential. Secondly as:

$$E(\Delta s) = \theta(\bar{s} - s) + (\Delta p^e - \Delta p^{*^e}). \qquad 16$$

which states that exchange rate is expected to return to its long run equilibrium value $\bar{s}$ at a proportional rate of the current gap. The long run implication of $\bar{s} = s$ is that the expected change to exchange rate is at a rate equal to the long run inflation differential $(\Delta p^e - \Delta p^{*^e})$, and this equals the expected long run relative monetary growth rate. If equation (15) and (16) are combined in solving for s, we obtain:

$$\bar{s} = s\frac{1}{\theta}[(i - \Delta p^e) - (i^* - \Delta p^{*^e})] \qquad 17$$

Equation 17 specifies that when prices of goods are sticky in the short run, exchange rate overshoots its long run value only to converge on this long value when prices of goods adjust in the long run. What this equation is saying is that as tight monetary policy would lead to the rise in nominal interest differential above its long run level, capital inflow prompt rise in domestic currency above its equilibrium value in proportion to the expected real interest rate differential.

RIDMM as a general model combining the traits of the FPMM and SPMM, can be derived from Equation (17) through the identification of the long run equilibrium exchange rate determinants (the equilibrium relative price ($\bar{p} = \bar{p}^*$) which have the domestic and foreign equilibrium monetary conditions as the principal determinant). With the assumption of money market equilibrium (where $\bar{\imath} = \bar{\imath}^* = \Delta p^e - \Delta p^{*^e}$ indicating that nominal interest rate differential is equal to inflation differential), we can express the expected equilibrium relative prices as a function of the relative money supply, relative income and the long run expected inflation differential, yielding:

$$(\bar{p} - \bar{p}^*) = (\bar{m} - \bar{m}^*) - (\bar{y} - \bar{y}^*) + \beta(\Delta p - \Delta p^*) \qquad 18$$

with the assumption that the equilibrium relative money supply and income are given by the current actual levels, if equation (17) is substituted into equation (18), we will have an equation representing the RIDMM thus:

$$s = (m - m^*) - \alpha(y - y^*) + \frac{1}{\theta}(i - i^*) + \left(\frac{1}{\theta} + \beta\right) - (\Delta p^e - \Delta p^{*e}) \qquad 19$$

If some right hand terms of equation (19) are rearranged, it can lead to a specification that reveals the RIDMM having a resemblance of FPMM, only for the inclusion of the real interest rate differential on the right hand side of the FPMM thus:

$$s = (m - m^*) - \alpha(y - y^*) + \beta\left(\Delta p^e - \Delta p^{*e}\right)\frac{1}{\theta}\left[(i - \Delta p^e) - \left(i^* - \Delta p^{*e}\right)\right]. \qquad 20$$

If Equation 6.19 is rewritten, we obtain the reduced form of RIDMM as:

$$s = (m - m^*) - \alpha(y - y^*) + \gamma(i - i^*) + \delta\left(\Delta p^e - \Delta p^{*e}\right). \qquad 21$$

This equation shows that the RIDMM includes both the FPMM and SPMM. The clarifications made by the Frankel's RIDMM is that if the set of real interest rate is at a disequilibrium, exchange rate will then deviate from its long run-run equilibrium value; and if the real domestic interest rate falls below the real foreign interest rate, the exchange rate of the domestic currency will then be undervalued in relation to its long run equilibrium value in order to cause compensation in the form of an expected appreciation of the real exchange rate of the domestic currency.

Nevertheless, the unrealistic assumption that financial assets (domestic and foreign) are perfect substitutes is a major shortcoming of the monetary models of exchange rate determination. As well, the theoretical literature give recognition to the influence of hedging, speculation and international trade and payments. Nevertheless, because of the peculiar nature and environment (economic, political and legal) of the developing countries, some distinct factors should be recognised in the modelling of exchange rate determination and behaviour in this class of countries. It is important to stress here again that the WAMZ economies under investigation operate sizeable proportion of informal economic activities which impact exchange rate behaviour. Therefore, it is appropriate to consider the effects of the informal economy in the modelling of exchange determination and behaviour in these countries. When the augmentations of informal economic activities and primary commodity price were introduced into the two monetary models

of exchange rate determination for the WAMZ countries, the flexible price monetary model turned out as:

$$s_t = md_t - yd_t + id_t + yd_t + CP_t^n \quad 22$$

while the real interest differential monetary model resulted in:

$$s_t = md_t - yd_t + id_t + \pi d_t^e + syd_t + CP_t^n \quad 23$$

Where $md_t, yd_t, id_t, syd_t, CP_t^n$ and π_{dt}^e are of money stock differentials, real income differential, interest rate differentials, informal (shadow) economy's real income differential, commodity price and long run inflation differential respectively. What the flexible price monetary model of exchange rate determination in Equation 22 predicts here is that exchange rates are affected by relative money supplies, relative levels of national income (formal and informal) and relative interest rate while these were controlled for by price of primary commodities. This is a novel step taken in exchange rate behaviour empirical literature. The augmentation of the theoretical structural models with the effects of informal economic activities and commodity prices as supplementary factors in explaining the dynamics of nominal exchange rates contributes to the resolution of extant empirical exchange rate disconnect puzzles in these developing nations.

Failure of Monetary Models: Series of research methodologies involving econometric and statistical techniques have been applied to investigate currency parities in many researches on monetary models of exchange rate determination. Generally, in these past studies, these monetary models performed poorly as a very large number of empirical findings failed yield evidences in support of relationships between macroeconomic fundamentals and exchange rates under the floating exchange rate regimes. Most of these empirical works rejected the absolute PPP assumption which is the monetary models' bedrock.[3] Consequently, it can be suffice to state that the failure of these monetary models could be strongly ascribed to deviations of PPP as Smith and Wickens (1994) established that the rejection of the monetary models often emanated from the breakdown of the PPP assumptions. In spite of the devotion of attention of academic empirical researches to

[3] Husted and MacDonald (1998), Groen (2000), Rapach and Wohar (2004), Sosvilla-Rivero and Garcia (2006), Uz and Kentenci (2008) Cerra and Saxena (2010).

PPP deviations, Afat et al (2015) in a study of flexible exchange rate determination in OECD countries asserted that the failure of monetary models is due to the insufficiency of the Keynesian Money Demand Function which disregards intercountry money demand, particularly for currency parities comprising 'reserve currencies' (US dollar, euro, pound sterling, Japanese yen) commonly traded with internationally and which are only demanded for and kept in reserve by many monetary authorities, being reserve currencies for the purpose of maintaining financial stability and for intervention in the foreign exchange market as and when necessary. These global demand for these reserve currencies (particularly the euro and US dollar) for international trade and direct investment and for assets and currency swaps are huge but the implied assumption of the monetary model of exchange rate is that currency are not demanded as reserve currencies internationally. This narrow perception overlooks the various reasons for foreign currencies demand. This is a major drawback of these monetary models. Further highlights by Afat et al (2015) was that currency substitution (relating to demand for reserve currencies which are parallel (or as alternatives) to domestic currencies) is a crucial in negatively impacting the mechanism of these monetary models. An instance is a situation in which foreign currency is a reserve currency while the domestic currency is not and in this case, there should appropriately be appreciation of nominal exchange rate whenever there is increase in the home country's real income, however in real sense, because it is impossible to separate the demand for domestic currency from the demand for foreign (reserve) currency, there may not be appreciation of domestic currency as expected. Another shortcoming of the monetary models identified is the restriction imposed on econometric model (which requires one-to-one relationship between money supply and price levels) by the decomposition of real money balances and the use of money supply and price level individually as entrenched in the underlying PPP theory. Also, while these monetary models assume stable income elasticity and interest rate semi-elasticity, it is very possible that these may not be achievable due to financial crises, developments in the financial systems and changes in banking sector regulations (like the use of bank cards taking prominence over the use of physical cash). These are some of the fundamental flaws of monetary models of exchange rate determination.

3. Data and Methods

Data (annual and quarterly) generally spanning between 1980 and 2015 on US dollar/WAMZ countries' bilateral exchange rates and fundamental data of money supply, nominal interest rates, inflation, real GDP, estimated real GDP of the informal economy, and primary commodity price were employed for the six WAMZ countries for the purpose of exchange rate determination in the WAMZ. Appropriate cross-rate conversions were made to generate bilateral exchange rates among the WAMZ countries.

The monetary model constructed here considered the extent of informal economy in member countries. Estimates of the sizes of informal economy incorporated into the monetary models here were generated with the application of the Multiple Indicators Multiple Causes (MIMIC) modelling.[4]

Table 1: Summary Statistics of MIMIC Estimations of Sizes of Informal Economy (as Percentages of GDP) in the WAMZ (1991-2015)

Year	*Gambia*	*Ghana*	*Guinea*	*Liberia*	*Nigeria*	*S/Leone*	*WAMZ*
1991	50.60	46.07	41.22	42.08	56.95	38.20	45.85
1992	49.38	46.12	41.34	43.89	58.17	41.77	46.77
1993	49.46	47.71	41.16	44.70	58.82	43.77	47.60
1994	53.55	46.18	41.88	45.25	66.61	43.67	49.52
1995	56.73	44.98	41.75	45.55	62.21	44.51	49.29
1996	55.31	46.87	42.03	46.67	61.09	46.36	49.72
1997	54.35	44.65	41.32	45.12	60.69	46.60	48.79
1998	51.61	45.70	39.73	45.95	62.33	45.96	48.55
1999	48.35	44.58	40.14	44.64	59.87	48.49	47.68
2000	45.10	41.90	39.70	43.20	57.90	48.60	46.07
2001	43.36	42.62	39.12	42.23	57.64	50.14	45.85
2002	51.76	42.66	38.09	41.84	59.93	47.76	47.01
2003	42.85	42.60	39.01	43.02	57.19	45.34	45.00
2004	38.90	42.90	28.77	42.31	56.72	43.88	42.25
2005	45.77	43.16	37.54	42.47	55.84	43.45	44.71
2006	48.19	41.68	37.41	39.95	51.95	42.96	43.69
2007	47.90	41.51	38.30	42.71	54.96	40.92	44.38
2008	45.28	41.41	38.94	43.09	53.06	40.87	43.76
2009	39.78	40.61	42.16	43.45	53.98	40.60	43.43
2010	35.17	40.03	43.89	41.57	52.80	39.34	42.13
2011	48.57	40.64	39.60	41.52	51.51	36.12	42.99
2012	42.64	40.99	37.51	42.23	51.56	32.36	41.21
2013	40.95	39.25	38.32	42.37	51.70	25.69	39.71
2014	43.81	38.50	38.18	42.45	50.64	26.47	40.01
2015	43.64	39.37	41.58	43.67	52.49	34.18	42.49
Average	***46.88***	***42.91***	***39.95***	***43.24***	***56.67***	***41.50***	***45.19***

Source: Medina and Schneider (2018).

These secondary data (percentages) of shadow economies as generated statistically by Medina and Schneider (2018) were employed for the estimation of the real GDP of the

[4] MIMIC is a special type of structural equation model (SEM) which is frequently used in literature.

informal economy as percentages of the formal real GDP. Informal real GDP estimated over the period between 2001 and 2015 were in line with the related percentages exhibited in Table 1 above.

Apart from incorporating informal economic activities in the modelling of exchange rate determination here, the monetary models were further augmented with the effects of primary commodity price, given the fact that the WAMZ countries under assessment are primary commodity producing countries. Although, market powers of a country in the world commodity market is a source of endogeneity and there is the possibility that WAMZ commodity exporting countries hold market powers in the world commodity market. It may therefore be inappropriate to augment these monetary models with country-specific commodity price indices due to the potential problem of endogeneity that could bias the estimates. Nevertheless, country-specific weighted commodity price indices in relation to the generalised 'world commodity price indices' estimated for each WAMZ country were applied in these respects in order to avoid (or reduce) potential endogeneity. For individual WAMZ countries, this study applied the specific class of indices into which the top export commodities of each country fall. The percentage of these top primary export commodities in the total exports were applied as weights to these class-index to generate country indices applied in this work.

For estimations based on annual data, the macroeconomic fundamentals in the models were expressed in the annual percentage change difference between those of the five WAMZ countries (The Gambia, Ghana, Guinea, Liberia and Sierra Leone) and that of Nigeria (a possible lead economy). This approach was applied in order to generate more stable results when seasonal effects in the data are removed and when noise are removed from the short term movements in the exchange rate and the explanatory fundamentals. The estimations of the two exchange rate determination models built here were performed in two-fold. In the first instance, the model estimations were carried out from the perspective of the US dollar bilateral exchange rates of the six countries. In the second instance, the Nigerian naira bilateral exchange rate of the five other WAMZ countries were estimated. The reason for the second instance estimation is the big size of the exchange market of Nigeria which may absorb other exchange markets in the event of the monetary union coming into fruition due to the fact that these five other economies sharing less than 20% of the total GDP of the entire proposed monetary zone will be in a

monetary integration in which Nigeria is big enough to dominate with her strong economic forces that can cause the country to solely determine the proposed single official exchange rate for the proposed union. Apart from checking the similarities (or otherwise) in the expected signs of coefficients of the fundamentals, the inclusion of commodity price index further reveals the similarities (or otherwise) in the role of commodity price in determining exchange rate movements in the WAMZ.

In the annual data evaluation, the two monetary models of exchange rate determination were estimated with the application of the Canonical Cointegrating Regression (CCR), Dynamic Ordinary Least Square (DOLS) regression and Markov Switching Dynamic (MSD) regression approaches for country estimation and Random Effect (Generalised Least Square) estimation of panel data of the six WAMZ countries in order to answer the pertinent question relating to the homogeneity of exchange rate behaviour in the six WAMZ countries was further performed. The questions to answer by the application of this approach on exchange rates of these countries are about: (i) the linearity of exchange rate behaviour; (ii) the major dynamics characterising exchange rate behaviour; (iii) the key fundamentals that determine regime switches and the uniformity in the forces driving regime switches as a well as the roles played by the fundamentals in this regard. The CCR and DOLS methods were applied to establish if the signs of the fundamentals are comparatively, in line with the theoretical expected signs and to determine homogeneities across the proposed member countries of the WAMZ in this respect. The application of the MSDR was meant to assess the pattern of the time-varying influence of macroeconomic fundamentals on exchange rate movements in these countries. The motivation for the application of a more sophisticated estimation of the models of exchange rate fundamental determination through the MSDR was prompted by the poor explanatory powers of the structural monetary models of exchange rate determination in the ordinary sense.

Exchange rates are one of the many economic and financial time series that undergo periods in which the series behaviour changes quite dramatically when compared to what was exhibited during the previous period. The time series behaviour could be of change over time in terms of volatility, its value or rather the extent to which its current value is related to its past value. The time series may have 'structural break' when its behaviour may change once and for all. In some regards, the series may change for a time

period before reverting back to its original behaviour or rather experience 'regime switch' in which case the series switch to another style of behaviour due to wars, financial panics, government policy changes etc. A possible approach towards solving this apparent problem of time series shifts is to split data around the time of change and estimate separate model for each segment. Such model should be flexible enough to allow different types of behaviour at different point in time. Markov switching regression method belongs to the category of regime switching methods that allow this. Markov switching dynamic (MSD) regression is a useful tool to apply in describing exchange rate behaviour due to regime changes in the real world of economies and finances. It defines two or more states/regimes. Therefore, the approach vividly reveals the dynamic process and behaviour of variables of interest and give researcher a clear idea of how the variable evolved in the past as well as the possible future dynamics. The econometric equations of the FPMM and RIDMM models in Equations 22 and 23 above are expressed below for estimation with CRR, DOLS and MSD regressions:

$$\Delta s_t = \alpha + \beta_m \Delta md_t - \beta_y \Delta yd_t + \beta_i \Delta id_t - \beta_{sy} \Delta syd_t + \beta_{cp} \Delta CP_t^n + \varepsilon_t \quad 24$$

and

$$\Delta s_t = \alpha + \beta_m \Delta md_t - \beta_y \Delta yd_t + \beta_i \Delta id_t + \beta_{p_t^e} \Delta \pi d_t^e - \beta_{sy} \Delta syd_t + \beta_{cp} \Delta CP_t^n + \varepsilon_t \quad 25$$

where Δ indicates one-year percentage change in the respective independent variables and exchange rate. In the MSD regression, the coefficients α and β depends of state variables which may be (1) or (2). Exchange rates and fundamentals in these models are expressed in one-year percentage changes because PPP which is a crucial element of the monetary models holds for differences, rather than holding at levels. For the MSD regressions, this approach yields the possibility of reducing noise in the observations as well as taking care of seasonal effects of the data involved. All coefficients are allowed to switch in between states. These coefficients are dependent on the regime variables. The transition probabilities are of greater interest. The method allows the probabilities transition matrix to vary/change so as to conform to the Markov switching monetary models of exchange rate and the time varying transition probabilities models. Further to the application of annual data to the assessments of the FPMM and the RIDMM, higher frequency quarterly data were equally applied. These data span over the period between 1995Q1 and 2015Q4. These evaluation were necessary to provide further insights into

the investigations of the performance of these monetary models, drawing from the fact that long run relationships are better captured in analyses with high frequency data.

For the econometric estimation of FPMM, relative money supply is expected to be positive and unity, domestic output is hypothesised to be negative while nominal interest rate is expected to be positive. Increase in domestic money stock relative to foreign money supply leads to a rise in exchange rate, implying a fall in domestic currency's value. On the other hand, when domestic output increases, there is domestic currency appreciation. Domestic currency depreciates when there is a rise in interest rate because such increase causes reduction in domestic money demand. When relative domestic real income rises, this prompts excess demand for domestic money, all other things being equal. When economic agents attempt to increase their real money balance, this would cause domestic residents to reduce expenditure, and consequently, price would fall until money market equilibrium is achieved. The fall in domestic prices (when foreign prices are constant) amounts to domestic currency appreciation, according to the PPP theory. On the RIDMM, the argument of Frankel (1979) was that the change in nominal interest rate is a reflection of changes in monetary policy tightness and that the reason for increase in domestic interest rate (relative to foreign interest rate) is the contractions in domestic money supply relative to domestic money demand without a fall in price to match this. Domestic interest rates higher than foreign interest rates attract capital inflows, leading to instant appreciation of domestic currency. Consequently, in RIDMM, there is negative relationship between exchange rates and nominal interest rate differentials. Drawing from an assumptions of FPMM, nominal interest rates are reflections of expected inflation changes. There is a rise in domestic nominal interest rate because of the expectation that domestic price would, through inflation and depreciation, lose its value. Demand for domestic currency (relative to the demand for foreign currency would fall causing the domestic currency to depreciate (increase the exchange rate).

4. Results and Findings

The implications of the outcomes the ADF and PP unit roots tests for the variables employed in the estimation of the monetary models of exchange rate determination for the WAMZ countries are expressed in Table 2 below.

Table 2: Results Unit Roots Tests for the Variables of Exchange Rate Determination

Variables	*Gambia*	*Ghana*	*Guinea*	*Liberia*	*Nigeria*	*S/Leone*
Nominal Exchange Rate (US	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Dollar)	I(1)	I(1)	I(1)	I(1)	na	I(1)
Nominal Exchange Rate(NGR	I(1)	I(1)	I(1)	I(1)	I(2)	I(2)
Naira)	I(1)	I(1)	I(1)	I(2)	na	I(1)
Relative Money Supply (US)	I(0)	I(1)	I(1)	I(0)	I(0)	I(0)
Relative Money Supply (NGR)	I(0)	I(0)	I(0)	I(0)	na)	I(0)
Relative Real Interest Rate (US)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)
Relative Real Interest (NGR)	I(1)	I(1)	I(1)	I(1)	na	I(1)
Relative Nominal Interest (US)	I(1)	I(2)	I(2)	I(1)	I(1)	I(1)
Relative Nominal Interest (NGR)	I(2)	I(1)	I(1)	I(2)	na	I(1)
Relative Real Income (US)	I(0)	I(0)	I(2)	I(1)	I(0)	I(1)
Relative Real Income (NGR)	I(0)	I(0)	I(1)	I(0)	na	I(0)
Relative Expected Inflation (US)						
Relative Expected Inflation (NGR)						
Oil Commodity Price: I(1)						
Non-fuel Commodity Price: I(1)						

Source: Author's estimations. Note: ADF and PP unit root tests were carried out at 5% level of significance
'US' indicates variables for the US dollar based models while 'NGR' variables are for the Nigerian naira-based models.

The variables of exchange rate determination for both the US dollar rate and the Nigerian naira rates reported a mix of stationarity, first-order integration and second order integration. All non-stationary variables were made stationary according to the respective orders of integration.

The first task was to examine if the fundamentals yield the expected theoretically hypothesised signs in the two monetary modelling (FPMM and RIDMM), in the two instances of modelling and estimation (US dollar rate and the Nigerian naira rates). Homogeneity in these expected signs among the WAMZ countries were also evaluated, given the necessity for the underlying properties and fundamentals of exchange rate determination in these countries to behave in similar manner if the adoption of the future single exchange would be appropriate for all. Table 3 below exhibits these expected signs and explanatory powers of the fundamental's coefficients of the exchange rates applied.

Table 3: Expected Signs of Coefficients of Fundamentals in Monetary Models of Exchange Rate Determination

Fundamentals/Models	Flexible Price Model	Real Interest Diff. Model
Relative Money Stock	+	+ (>0)
Relative Real Income	-	-(<0)
Relative Nominal Interest Rate	+	-(<0)
Commodity Price Shock	+	+
Relative Real Interest Rate	not applicable	+(>0)

Source: Theoretical Literature

The results of the CCR and DOLS estimations performed are shown in Table 4 below for the US dollar and the Nigerian naira rates. We can remarkably observe that relative money stock coefficients generate the expected positive signs for all the six countries in the CCR and DOLS regressions of the FPMM and the DOLS estimations of the RIDMM. It is interesting to note that all the fundamentals for The Gambia (reported as the most economically stable of all) and Nigeria (the largest economy) generated the expected coefficient in the FPM model in both CCR and DOLS estimations. For the RIDMM, all the fundamentals of The Gambia and Nigeria produced the expected coefficient signs. It is apparent that at least two-third of the WAMZ countries had two of their fundamentals money supply and nominal interest rates (which are two strong monetary policy instruments) yielding the same coefficient signs in the two monetary models of exchange rate determination when the two estimation methods were employed.

Table 4: Cointegrating Equation Estimation Coefficients and Signs of the Fundamentals in the US Dollar/WAMZ Exchange Rates Determination Modelling

Flexible Price Monetary Model: Canonical Cointegrating Regression (CCR)						
Variables	**Gambia**	**Ghana**	**Guinea**	**Liberia**	**Nigeria**	**S/Leone**
Relative Money Stock	+0.570*	+0.961*	+1.780*	+2.374*	+0.803*	+1.116*
Relative Real Income	-1.29**	-1.265**	-1.795***	+0.680	-2.029	-0.816
Relative Nominal Interest Rate	+0.056*	+0.010	+0.005	-0.103*	+0.051*	+0.014*
Commodity Price Shock	+0.001	-0.006	-0.015	-0.087	+0.003	-0.012
Flexible Price Monetary Model: Dynamic Ordinary Least Square (DOLS)						
Variables	**Gambia**	**Ghana**	**Guinea**	**Liberia**	**Nigeria**	**S/Leone**
Relative Money Stock	+0.444*	+0.895*	+1.486*	+2.131*	+0.803*	+1.116*
Relative Real Income	-0.609	+1.161	-16.373	+0.265	-3.636*	-0.0871
Relative Nominal Interest Rate	+0.074*	+0.005	-0.045	-0.051	+0.055*	+0.006
Commodity Price Shock	+0.001	-0.026	+0.000	-0.087	+0.003	-0.012
Real Interest Rate Differential Monetary Model: Canonical Cointegrating Regression (CCR)						
Variables	**Gambia**	**Ghana**	**Guinea**	**Liberia**	**Nigeria**	**S/Leone**
Relative Money Stock	+0.621*	+0.948*	+0.980*	+2.434*	+0.979*	+1.118*
Relative Real Income	-1.391**	-1.435*	-0.206	+0.759*	-1.845***	-1.018*
Relative Nominal Interest Rate	+0.052*	+0.011***	-0.001	-0.098*	+0.056*	+0.011*
Relative Real Interest Rate	-0.004	+0.003	-0.007**	-0.007	-0.002	-0.007*
Commodity Price Shock	+0.001	-0.004	-0.013*	-0.092*	+0.001	-0.009*
Real Interest Differential Monetary Model: Dynamic Ordinary Least Square (DOLS)						
Variables	**Gambia**	**Ghana**	**Guinea**	**Liberia**	**Nigeria**	**S/Leone**
Relative Money Stock	+0.520*	+0.911*	na	+4.298	+0.898*	+1.300*
Relative Real Income	-0.703	+0.438	na	+4.103	-3.529*	-0.459
Relative Nominal Interest Rate	+0.068	+0.002	na	-0.087	+0.039*	+0.002
Relative Real Interest Rate	-0.004	+0.005	na	-0.063	-0.011	-0.018**
Commodity Price Shock	+0.000	-0.018**	na	-0.219	+0.015***	-0.018

Source: Author's Estimation and EViews7 Output

The coefficient of commodity price consistently produced its expected positive signs in The Gambia and Nigeria, all through. The percentage achievements of the expected

coefficient signs (country by country) within the application of the monetary models and the two estimation methods are as shown in Table 5 below.

Table 5: Percentage Achievements of the Generation of Expected Fundamentals Coefficient Signs of the US Dollar/WAMZ Exchange Rates Modelling

	FPM Model		*RIDM Model*		*Overall*
	CCR (%)	*DOLS (%)*	*CCR (%)*	*DOLS (%)*	
Gambia	*100*	*100*	*100*	*100*	*100%*
Ghana	*75*	*50*	*60*	*40*	*56%*
Guinea	*75*	*75*	*60*	*na*	*70%*
Liberia	*25*	*25*	*40*	*40*	*33%*
Nigeria	*100*	*100*	*100*	*100*	*100%*
Sierra Leone	*75*	*75*	*80*	*80*	*78%*

Source: Author's Estimation and EViews Output

Liberia scored the least in both models at 25% and 40% respectively for FPM and RIDM models. Ghana also had the least of 40% in the DOLS estimation of the RIDM model. The Gambia and Nigeria both had the overall 100% achievements, followed by Sierra Leone (78%) and Guinea (70%). On the overall, Liberia score the least of 33% achievements; and this indicates that Liberia's exchange rate determination fundamentals were least fit to consider in the determination of an eventual single exchange rate for the future monetary union, whereas, the models for The Gambia, Nigeria and Sierra Leone were able to show 'good fit' in the estimations.

Table 6: Panel Data Estimation Coefficients and Signs of Fundamentals of the Nigerian Naira/WAMZ Exchange Rates

Flexible Price Monetary Model		
Fundamentals	***Fixed Effect***	***Random Effect (GLS)***
Relative Money Stock	-0.814*	+0.580*
Relative Real Income	+0.353*	-1.173*
Relative Interest Rate	-0.009	+0.0100
Commodity Price Shock	+0.005*	+0.000
Corr(μ_i, xb):	-0.723	
F/χ2:	0.00	0.00
Rho:	0.98	0.33
Real Interest Rate Differential Model		
Fundamentals	Fixed Effect	Random Effect (GLS)
Relative Money Stock	+0.832*	+0.566*
Relative Real Income	+0.449*	-1.175*
Relative Nominal Interest Rate	-0.007	+0.006
Relative Real Interest Rate	+0.004**	-0.010***
Commodity Price Shock	+0.003	+0.004
Corr(μ_i, xb):	-0.783	
F/χ2:	0.00	0.00
Rho:	0.58	0.35

Source: Author's Estimation and Stata 14 Output

The results of the unbalanced panel data Fixed Effects (FE) and Random Effects - Generalised Least Square (RE-GLS) estimations of the two augmented models of exchange rate determination for the WAMZ in the context of the Nigerian naira exchange rates of the other five member countries are presented in Table 6 above. The results of the RE-GLS estimations of the two monetary models were considered due to the negative correlation of explanatory variable and the unobserved heterogeneity across clusters at $Corr(\mu_i\ xb) = -0.783$, which caused the rejection of the FE estimations results. The panel data fundamentals employed for the two monetary models generated the theoretically hypothesised signs in the RE (GLS) estimations at joint statistical significance. What these imply for the future currency union is that the fundamental determinants of exchange rates within the zone work well in consonance with theoretical postulations (and as desired) towards exchange rate integration when the largest economy within the zone (Nigeria) was factored into the exchange rate determination.

A common reflection of the explanatory powers of the coefficients of the estimated exchange rate fundamentals as reported in Table 6 above was the low explanatory powers of the relative nominal interest rate, relative real interest rates and the commodity price shocks (which are much more insignificant) in explaining exchange rates movements in the six countries. These have huge implications for these fundamentals in powerfully influencing the proposed single exchange rate. The generated coefficients of relative money supply in all the WAMZ countries which yielded the theoretical postulated signs, are all statistically significant at 1% level of significance, though for The Gambia and Nigeria, they were less than one when they should theoretical be more than one. Surprisingly, relative real income coefficients (expected to be less than one), were greater than one intermittently for the six countries in FPMM and RIDMM estimations as well as the random effect panel data estimations. Although, monetary models of exchange rate determination were attractive, they worked within some assumptions, some of which are the free adjustment towards the equilibrium exchange rate and supply and demand in the foreign exchange market, perfect substitutability of domestic foreign assets etc. Given these and due to the difficulties in the application of the monetary models uniformly to all countries as evident by deviations of the coefficient signs generated from the theory-backed expectations, owing to different economic

situations and dissimilarities in behaviours, Markov switching regime process of changes in exchange rates serves as alternatives.

Markov Switching Dynamic (MSD) Regression methods were applied to the two monetary models of exchange rate determination to estimate the regime switching behaviours of the US dollar and the Nigerian naira exchange rates of the WAMZ countries, in which all the fundamentals were allowed to switch. The comparative results of the MSD regressions of the FPMM and RIDMM of the US dollar exchange rates are exhibited in Tables 7 and 8 below respectively. For the PFMM, the levels of persistence range from 0.64 to 0.97. The Gambia and Nigeria each record the highest probability of 0.97 of remaining in the first state, translating into expected duration of 38.5 years and 31.59 years respectively, while Liberia and Guinea has the lowest of 0.88 years and 0.81 years respectively. In regime two, Nigeria has the lowest probability of 0.64 and the lowest expected duration of 2.8 years.

The Gambia's highest transition probability under this regime translates into 16.57 years of expected duration. Relatively, The Gambia had the most stable expected duration time of all the six WAMZ countries, followed by Nigeria and Ghana. Guinea reported to be the least volatile in the entire process. In spite of these implications, the best fitted FPM model was that of Liberia with the lowest AIC, HQIC and SBIC values, while the log likelihood results infer Guinea (with the highest log likelihood value) as having the maximum likelihood maximisation procedure that gives the best result at -20.161. For the MSD regression of the RIDMM of the US dollar exchange rates, The Gambia, Ghana, Sierra Leone had the highest probability of remaining in the first regime and high expected duration of 39.42, 29.04 and 39.70 years respectively. In the second regime. The Gambia and Sierra Leone keep the highest levels of persistence, both of 0.94 transition probabilities and highest expectation durations of 18.14 and 17.35 years respectively.

Table 7: Comparative Statistics and Fundamental Coefficients of Markov Switching Dynamic Regressions (US Dollar/WAMZ Currencies)

Annual Flexible Price Monetary Model						
Fundamentals	***Gambia***	***Ghana***	***Guinea***	***Liberia***	***Nigeria***	***S/Leone***
ΔRelative Money Supply:						
State 1:	-1.855	0.552*	0.637*	0.019	0.033	0.535
State 2:	6.178*	2.77*	0.067***	0.690*	2.266**	17.662*
ΔRelative Real Income:						
State1	-3.786	21.921	10.728*	-0.035	7.080	-3.049
State 2	-29.057*	262.59*	-12.489	2.124*	186.57*	115.033*
ΔRelative Nominal Interest:						
State1:	0.018***	-0.068	-0.046*	-0.05*	0.026	0.329
State 2:	0.193	0.555*	-0.016*	0.016*	0.793*	-0.210*
ΔCommodity Price Shock:						
State1:	-0.144*	-1.173*	-0.100*	-0.009	0.136	-0.117
State 2:	0.582***	0.851	-0.004	0.030*	9.861*	4.604*
Transition Probability:						
P11:	0.97	0.96	0.81	0.88	0.97	0.93
P22:	0.94	0.75	0.86	0.78	0.64	0.71
Expected Duration:						
State 1:	38.50	27.05	5.40	0.31	31.59	15.28
State 2:	16.57	3.96	7.11	8.34	2.80	3.41
Standard Deviation (Sigma):	2.176	15.46	0.43	4.54	1.97	8.94
AIC:	5.454	9.485	3.159	2.044	8.942	8.554
HQIC:	5.653	9.682	3.299	2.243	9.141	8.753
SBIC:	6.038	10.080	3.805	2.628	9.526	9.140
Log Likelihood	-79.721	-138.755	-20.161	-21.744	-139.013	-132.424
No. of Observations:	34	32	21	34	34	34

Source: Author's Estimation and Stata 14 Output

In the current regime, the lowest probability of 0.87 was recorded by Liberia as Guinea had the lowest of 0.0 in the second regime. Nigeria and Liberia recorded second regime's lowest expected duration of 1.89 and 1 years respectively. Liberia has the least process volatility of 0.35 in the RIDMM estimations, the best fitted model with the lowest AIC, HQIC and SBIC values and the model yielding the best result in the maximum likelihood estimation procedure. The Nigeria naira/WAMZ currencies exchange rates were equally applied to the two monetary models of exchange rate determination (FPMM and RIDMM) in the MSD regressions.

Table 8: Comparative Statistics and Fundamental Coefficients of Markov Switching Dynamic Regressions (US Dollar/WAMZ Currencies)

Annual Data Real Interest Rate Differential Monetary Model						
Fundamentals	***Gambia***	***Ghana***	***Guinea***	***Liberia***	***Nigeria***	***S/Leone***
ΔRelative Money Supply:						
State 1:	-1.914*	0.545*	-0.009	-0.103*	0.016	0.005
State 2:	6.276*	2.760*	-0.158*	0.242**	1.404*	14.612
ΔRelative Real Income:						
State1	-4.049	20.264	1.928*	0.108***	16.720***	-2.426
State 2	-80.450*	269.889	109.98*	1.930*	556.89*	180.952*
ΔRelative Nominal Interest:						
State1:	0.0181**	-0.06	-0.013**	0.003	0.001	0.036**
State 2:	0.317*	0.520**	0.024	0.040*	-0.288	0.367
ΔRelative Real Interest Rate						
State1:	0.003	0.016	-0.003	0.002*	-0.002	0.001
State 2:	0.046*	0.029	-0.006	0.004**	0.158*	-0.155*
ΔCommodity Price Shock:						
State1:	-0.150*	-1.115*	-0.024*	0.005	-0.01	0.065
State 2	-0.066	0.746	-1.357*	0.025	5.907*	4.497
Transition Probability:						
P11:	0.97	0.97	0.91	0.87	0.93	0.97
P22:	0.94	0.75	0.00	0.51	0.47	0.94
Expected Duration:						
State 1:	39.42	29.04	11.71	7.47	13.99	39.70
State 2:	18.14	3.96	1.00	2.04	1.89	17.35
Standard Deviation (Sigma):	2.19	15.00	1.17	0.35	9.15	5.98
AIC:	5.541	9.478	4.460	2.368	8.734	7.591
HQIC:	5.771	9.708	4.690	2.598	8.964	7.821
SBIC:	6.214	10.151	5.134	3.041	9.408	8.265
Log Likelihood:	-79.196	-146.128	-60.827	-25.255	-133.48	-114.057
No. of Observations:	34	34	34	34	34	34

Source: Author's Estimation and Stata 14 Output

The results of the regressions are displayed in Table 9 and 10 below. For the FPMM model estimations, Ghana, Guinea and Sierra Leone generated the transition probabilities, each of 0.93 and respective expected durations of 13.80, 14.18 and 14.23 years. Liberia, which exhibited the lowest probability of 0.01 in the first regime, displayed the highest of the second regime probability at 0.90 translating into the longest 10.38 years. Ghana has the lowest process volatility of 1.21, the best fitted FPMMs that gave the best estimation results.

Table 9: Comparative Statistics and Fundamental Coefficients of Markov Switching Dynamic Regressions (Nigerian Naira/WAMZ Currencies)

Annual Data Flexible Price Monetary Model					
Fundamentals	***Gambia***	***Ghana***	***Guinea***	***Liberia***	***S/Leone***
ΔRelative Money Supply:					
State 1:	0.572	-0.160	-0.004	75.522*	0.006
State 2:	34.787*	3.430	-0.051*	3.942**	-0.785
ΔRelative Real Income:					
State1	8.064**	1.832	-1.831	-33.032	1.149
State 2	620.555*	-0.120*	-97.181*	-6.126	-79.95*
ΔRelative Nominal Interest:					
State1:	-0.022	-0.770*	-0.007	9.434*	0.036
State 2:	6.310*	0.398*	-1.537*	-0.084	-0.325**
ΔCommodity Price Shock:					
State1:	0.029	-0.337	-0.193	-15.230*	0.102
State 2:	11.067*	0.397	2.630*	0.880	4.255*
Transition Probability:					
P11:	0.93	0.57	0.93	0.01	0.93
P22:	0.73	0.62	0.30	0.90	0.74
Expected Duration:					
State 1:	13.80	2.31	14.18	1.00	14.23
State 2:	3.71	3.22	1.43	10.38	3.84
Standard Deviation (Sigma):	38.64(6.08)	1.21(4.55)	4.12	32.46	6.57
AIC:	8.830	6.809	6.961	10.957	7.921
HQIC:	9.045	7.021	7.160	11.156	8.121
SBIC:	9.459	7.450	7.554	11.541	8.505
Log Likelihood	-136.117	-94.938	-105.332	-173.277	-121.666
No. of Observations:	34	32	34	34	34

Source: Author's Estimation and Stata 14 Output

In the regressions of the RIDMM, Sierra Leone recorded the highest probability of remaining in the current regime at 0.93, with the longest expected duration of 14.26 years; and followed by Guinea and The Gambia, both at 0.93 probabilities with 13.02 and 12.41 years expected durations respectively. At regime 2, Sierra Leone also recorded the highest probability of 0.93 of remaining in the current regime, with the longest duration of 13.58 years. As we had in the FPMM for the Nigerian naira based exchange rates, Ghana generated the least process standard deviation of 2.62 for the RIDMM estimations as well as the best fitted model in the ML procedures and the best results given the lowest AIC, HQIC and SBIC statistics.

Table 10: Comparative Statistics and Fundamental Coefficients of Markov Switching Dynamic Regressions (Nigerian Naira/WAMZ Currencies)

Annual Data Real Interest Rates Differential Monetary Model					
Fundamentals	***Gambia***	***Ghana***	***Guinea***	***Liberia***	***S/Leone***
ΔRelative Money Supply:					
State 1:	-1.672	-0.004	0.000	73.788*	0.002
State 2:	74.157*	0.124**	-0.867*	3.634**	0.782
ΔRelative Real Income:					
State1	14.892	-4.873	2.254	-34.590	1.222
State 2	333.62**	25.954*	-96.410*	-6.922**	-79.481*
ΔRelative Nominal Interest:					
State1:	0.116	0.014	0.007	8.668*	0.035
State 2:	4.035*	-0.306*	-1.491*	0.108	0.320**
ΔRelative Real Interest Rate:					
State1:	0.103	-0.05*	-0.002	-0.393*	0.000***
State 2:	0.212*	-0.02*	0.017*	-0.005	0.002
ΔCommodity Price Shock:					
State1:	0.430	0.045	0.250**	-8.789*	0.102
State 2	-20.170	0.393**	2.437	0.820**	4.244*
Transition Probability:					
P11:	0.92	0.69	0.92	0.53	0.93
P22:	0.30	0.51	0.29	0.93	0.74
Expected Duration:					
State 1:	12.41	2.31	13.02	2.13	14.26
State 2:	1.43	3.22	1.41	13.58	3.88
Standard Deviation (Sigma):	32.24	2.62	3.80	20.38	6.57
AIC:	11.190	6.809	6.918	10.278	8.038
HQIC:	11.420	7.021	7.150	10.508	8.268
SBIC:	11.864	7.450	7.593	10.951	8.712
Log Likelihood	-175.23	-89.407	-105.332	-159.726	-123.537
No. of Observations:	34	32	34	34	34

Source: Author's Estimation and Stata 14 Output

The implications of high probability of remaining within the same regime for a country's currency is infrequent switches from one regime to another. From the results of the MSD regressions of the PFMM and RIDMM of the US dollar exchange rates, we can infer that The Gambia dalasi, the Nigerian naira and Sierra Leonean leone have transition probabilities higher than others implying long expected durations. However, these failed to hold for The Gambian dalasi in the Nigerian naira exchange rates estimations in which Sierra Leonean leone took the lead. The disturbing observation was that many of the coefficients of the fundaments in the two models estimations do not yield the expected and there are more statistically significant fundamental coefficients in the second regime than the first regime outcomes.

For the quarterly data evaluation of the FPMM and RIDMM in the WAMZ, the results of the unit root tests of all the variables employed are exhibited in Table 11 below. These results reflects mixed orders of integration. Majority of these variables are non-stationary. Except for two exchange rate variables (The Gambia/Sierra Leone and Liberia/Sierra Leone), nominal exchange rate variables and commodity price index variables are all stationary.

Table 11: Results of ADF Unit Roots Tests of Exchange Rates Determination Variables of the WAMZ

Home & Foreign Country	*Exchange Rate*	*Money Supply*	*Formal Real Income*	*Interest Rate*	*Inflation Differential*	*Informal Real Income*	*Commodity Price Index*
GAMBIA							
Ghana:	-1.490	-0.087	-0.235	2.185	-3.644*	-0.732	-1.098
Guinea:	-1.269	-0.947	3.904*	-1.604	-2.979**	-2.020	-1.063
Liberia:	-2.103	-1.866	4.460*	-0.759	-1.8613	-3.563*	-0.887
Nigeria:	-2.191	-1.574	-2.717**	-1.758	-3.719*	-0.981	-1.815
S/Leone:	-3.164**	-0.379	-0.907	-1.022	-2.721*	-2.732**	-3.098*
GHANA							
Gambia:	-1.490	-0.087	-2.275	-2.185	-3.644*	-0.733	-1.098
Guinea:	-1.461	-1.408	-0.235	-0.883	-3.343*	-1.608	-1.312
Liberia:	-2.281	-2.250	-4.160*	-1.584	-2.594***	-4.427*	-1.312
Nigeria:	-1.592	-0.377	-1.824	-3.906*	-4.815*	-1.832	-2.297
S/Leone:	-1.520	-0.434	-2.692	-1.798	-4.670*	-0.796	-1.095
GUINEA							
Gambia:	-1.269	-1.408	-3.904*	-1.604	-2.999**	-2.019	-1.063
Ghana:	-1.461	-0.947	-0.518	-0.883	-3.343*	-1.608	-1.312
Liberia:	-1.134	-2.270	-4.638*	-1.869	3.914*	-4.625	-1.312
Nigeria:	-1.609	-3.117**	-1.001	-1.230	4.384*	-1.449	-1.312
S/Leone:	-1.936	2.723***	-2.238	-1.592	1.715	-1.741	2.282
LIBERIA							-0.887
Gambia:	-2.103	-1.866	-4.460*	-0.758	1.861	-3.563*	-1.312
Ghana:	-2.281	-2.250	2.717**	-1.584	2.594***	-4.427*	-1.312
Guinea:	-1.134	-2.270	-4.638*	-1.869	3.914*	-4.625*	-1.312
Nigeria:	-2.208	-2.601***	-3.096**	-3.083**	2.713***	-3.299*	-1.954
S/Leone:	-3.183**	-2.714***	-3.290*	-1.555	2.071	-3.277*	-0.683
NIGERIA							
Gambia:	-2.191	-1.574	-0.907	-1.758	3.719*	-0.981	-1.815
Ghana:	-1.434	-0.377	-1.824	-3.905*	4.815*	-1.832	-2.297
Guinea:	-1.608	-3.117**	-1.001	-1.230	4.384*	-1.449	-2.282
Liberia:	-2.208	-2.601***	-3.096*	-3.014**	2.713**	-3.299*	-1.954
S/Leone:	-2.288	2.683***	-2.213	-1.497	3.858*	0.103	-1.843
S/LEONE							
Gambia:	-3.164**	-0.380	-2.275	-1.022	2.721***	-2.732**	-3.098**
Ghana:	-1.520	-0.434	-2.692**	-1.798	4.670*	-0.796	-1.095
Guinea:	-1.936	2.723***	2.238	-1.591	1.715	-1.741	-1.040
Liberia:	-3.183**	2.714***	-3.290*	-1.355	2.071	-3.277*	-0.683
Nigeria:	-2.288	2.683***	-2.213	1.497	3.858*	0.103	-1.843

Source: Author's Estimations and EView 10 Output

These results have implication for long-run relationship assessment because cointegration tests require all variables to be stationary. If these time series variables are of different orders of integration, there cannot be long run relationships and by

implications, there cannot be cointegration. In order to verify this assumption, applying quarterly data, this study carried out three residual-based cointegration tests of the relationships in the FPMM and RIDMM (Phillips-Oualiaris, Engle-Granger and Park's Added Variable tests) on the residuals of the estimates of FMOLS cointegrating regressions.

Table 12: Results of Cointegration Tests for FPMM Exchange Rates and Fundamentals in the WAMZ

		Phillips-Oualiaris Tests		***Engle-Granger Tests***		***Park's Added Variable Tests***
Home Country	**Foreign Country**	***tau-statistics***	***z-statistics***	***tau-statistics***	***z-statistics***	***Chi-Square***
GAMBIA	***Ghana***	-4.2644	-34.8145***	-4.7296***	-46.2723*	4.4676**
	Guinea	-4.2866	-27.6101	-4.2444	-27.5379	7.1792*
	Liberia	-3.8466	-24.7272	-3.5542	-59.6930*	0.0057
	Nigeria	-3.5058	-21.9782	-3.2145	-18.2674	2.0873
	S/Leone	-3.4620	-22.6037	-3.6094	-26.4736	0.5426
GHANA	***Gambia***	-4.2644	-34.8144**	4.7297***	-46.2724*	4.4676**
	Guinea	-3.6801	-23.4686	-3.4920	-21.1204	0.0288
	Liberia	-4.1760	-30.5085	-4.3934	88.7412*	37.5387*
	Nigeria	-3.8472	-3.5925	-23.1743	-26.6976	0.0148
	S/Leone	-3.8461	-28.8650	-4.2194	-39.1089**	0.3606
GUINEA	***Gambia***	-4.2886	27.6101	-4.2444	-27.5379	7.1792*
	Ghana	-3.6801	-23.4686	-3.4920	-21.1204	0.0288
	Liberia	-3.4475	-18.1775	-3.4276	-18.3140	1.8616
	Nigeria	-3.5080	-21.1241	-4.1117	35.2443**	1.8871
	S/Leone	-3.3443	-20.4331	-3.0625	-14.1025	0.2384
LIBERIA	***Gambia***	-3.8466	-24.7272	-3.5542	59.6930*	0.0058
	Ghana	-4.1760	-30.5085	-1.3934	-88.7412*	37.5387*
	Guinea	-3.4475	-18.1775	-3.4275	-18.314	1.8616
	Nigeria	-3.0905	-19.1442	-3.2087	-21.9772	2.8405***
	S/Leone	-3.4430	-23.4745	-3.3912	-74.0705*	
NIGERIA	***Gambia***	-3.5058	-21.9782	-3.2148	-18.2674	2.0873
	Ghana	-3.8472	-26.6976	-3.5925	-23.1743	0.0148
	Guinea	-3.5080	-21.1240	-4.1117	-35.2443**	1.8871
	Liberia	-3.0905	-19.1442	-3.2087	-21.9772	2.8404***
	S/Leone	-3.5678	-22.8613	-3.2180	-18.2893	14.0251*
S/LEONE	***Gambia***	-3.4620	-22.6067	-3.6094	-26.4735	0.5426
	Ghana	-3.8461	-28.8650	-4.2194	-39.1089**	0.3606
	Guinea	-3.3443	-20.4331	-3.0624	-17.1025	0.2384
	Liberia	-3.4430	-23.4750	-3.3912	-74.0705*	9.7987*
	Nigeria	-3.5678	-22.8613	-3.2179	-18.2893	14.0251*

Source: Author's Estimations and EView 10 Output

The results of the FPMM and RIDMM cointegration tests are displayed Tables 12 above and 13 below respectively, where Phillip-Oualiars and Engle-Granger tests clearly revealed at 5% significance level, the null hypothesis that the series are not cointegrated cannot be rejected. What this implies is that there are no long run relationships from all directions of the bilateral relationships investigated. This thus confirmed what the general results of the unit roots tests denote. The connotation of 'no cointegration'

between exchange rates and the fundamentals as revealed in these FPMM and RIDMM models of exchange rate determination in the cases of the foreign exchange bilateral relationships across the WAMZ is that the monetary fundamentals of money supply, formal nominal output, informal nominal output, inflation, interest rates as a well as commodity price in both monetary models do not affect exchange rates in the long run, though they may do in the short-run.

Table 13: Results of Cointegration Tests RIDMM Exchange Rate and Fundamentals in the WAMZ

		Phillips-Oualiaris Tests		***Engle-Granger Tests***		***Park's Added Variable Tests***
Home Country	**Foreign Country**	***tau-statistics***	***z-statistics***	***tau-statistics***	***z-statistics***	***Chi-Square***
GAMBIA	***Ghana***	-2.7074	-12.9736	-4.6988	-45.6813**	3.0203***
	Guinea	-4.2867	-27.6646	-4.2396	-27.4966	5.8363***
	Liberia	-4.9019***	-42.4387**	-3.6245	-54.6091	2.2429
	Nigeria	-3.5541	-22.7469	-3.2603	-18.9580	0.0227
	S/Leone	-3.5709	-23.9763	-3.7879	-28.9101	0.0497
GHANA	***Gambia***	-2.7074	-12.9736	-4.6988	-45.6813**	-3.0203***
	Guinea	-3.6669	-22.9318	-3.4528	-20.1925	2.5968***
	Liberia	-4.0102	-27.0140	-4.2720	-69.2145*	86.2247*
	Nigeria	-3.8003	-26.0786	-3.5475	-22.6233	0.0957
	S/Leone	-3.0307	-15.9841	-4.7316	-47.7123**	0.5009
GUINEA	***Gambia***	-4.2867	-27.6646	-4.2396	-27.4967	-5.8363**
	Ghana	-3.6669	-22.9318	-3.4528	-20.1925	-2.5968***
	Liberia	-3.8341	-24.4380	-3.8630	-25.4275	-31.5968*
	Nigeria	-3.7672	-24.9817	-4.1116	-35.2429***	2.1581
	S/Leone	-3.7717	24.0565	-3.5901	-21.7325	0.1084
LIBERIA	***Gambia***	-4.9019***	-42.4387***	-3.6245	-54.6091*	2.2429
	Ghana	-4.2010	-30.2506	-4.2720	-69.2145*	86.2247*
	Guinea	-3.8341	-24.4380	-3.8630	-25.4275	31.9363*
	Nigeria	-3.0538	-18.7378	-3.1873	-21.6174	3.9340**
	S/Leone	-3.5825	-25.0867	-3.3428	-70.2468*	22.9438*
NIGERIA	***Gambia***	-3.5541	-22.7469	-3.2603	-18.9580	0.0227
	Ghana	-3.8003	-26.0786	-3.5475	-22.6233	0.0957
	Guinea	-3.7672	-24.9817	-4.1116	-35.2429***	2.1581
	Liberia	-3.0538	-18.7378	-3.1873	-21.6174	3.9340**
	S/Leone	-3.7452	-25.4206	-3.2393	-18.5031	13.1894*
S/LEONE	***Gambia***	-3.5709	-23.9763	-3.7879	-28.9101	0.0497
	Ghana	-3.0307	-15.9841	-4.7316	-47.7123*	0.5009
	Guinea	-3.7717	-24.0565	-3.5901	-21.7325	0.1684
	Liberia	-3.5825	-25.0867	-3.3429	-70.2468	-22.9438*
	Nigeria	-3.7452	-25.4206	-3.2393	-18.5030	-13.1894*

Source: Author's Estimations and EView 10 Output

The fully modified ordinary least square (FMOLS) estimation results of the quarterly data FPMM for both directions of bilateral exchange rate relationships across the WAMZ are exhibited in Table 14 below showing the explanatory powers and signs yielded by the fundamentals. The outputs show that differentials of money supply and interest rates are hugely significant at 10% level of significance except for the cases of Nigeria/Sierra Leone

money supply as well as the interest rate differential cases of Ghana/Liberia Guinea/Nigeria and Liberia/Nigeria, and these were also the three cases in which interest rate differentials failed to yield the hypothesised positive signs.

Table 14: Results of FMOLS Estimations of Explanatory Powers and Theoretical Signs of the Fundamentals in FPMM Exchange Rates in the WAMZ

Home Country	Foreign Country	*Money Supply Differential*	*Formal Output Differential*	*Interest Rate Differential*	*Informal Output Differential*	*Commodity Price Differential*
GAMBIA	***Ghana***	1.2400*	-1.8708*	0.1610*	-0.0839	-0.3104**
	Guinea	0.3367***	0.3490	0.4478*	-0.1476	0.1723
	Liberia	0.3051*	-0.0308	0.3140*	-0.2832	-0.3874
	Nigeria	0.3662***	-4.6418*	0.1632***	2.010*	1.4046*
	S/Leone	0.8141*	-0.6400*	0.1242*	-0.3799***	0.6558
GHANA	***Gambia***	1.2401*	-1.8708*	0.1610*	-0.0840	-0.3104**
	Guinea	0.6273*	1.3419**	0.2453*	-0.3972***	-0.3972***
	Liberia	0.5944*	3.7715**	-0.0843	-4.5048**	0.7887*
	Nigeria	0.8345*	-3.1073**	0.3132*	2.9818	0.4516***
	S/Leone	1.2709*	0.3172	0.1339*	-0.3659	-0.3800***
GUINEA	***Gambia***	0.3367***	0.3490	0.4478*	-0.1476	0.1724
	Ghana	0.6273*	1.3419**	0.2453*	-0.3972***	-5.0024*
	Liberia	0.3561***	0.5227	0.2038*	-0.2071	1.3027*
	Nigeria	0.2320**	-2.8950*	-0.0362	1.4000*	-0.9491*
	S/Leone	0.8957*	0.2465	0.1731*	-0.6615**	0.2438
LIBERIA	***Gambia***	0.3051*	-0.0308	0.3140*	-0.2832	-0.3894
	Ghana	0.5944*	3.7715**	-0.0843	-4.5048**	0.7887*
	Guinea	0.3561**	0.5227	0.2038*	-0.2071	1.3027
	Nigeria	0.3384**	1.2745	-0.0573	-2.2115	0.6314**
	S/Leone	0.4100*	0.6825**	0.2633*	-1.2596*	-0.3116
NIGERIA	***Gambia***	0.3661***	-4.6418*	0.1632***	2.0097*	1.4046*
	Ghana	0.8345*	-3.1043**	0.3132*	2.9818	0.4516***
	Guinea	0.2320**	-2.8950*	-0.0362	1.4000*	-0.9491*
	Liberia	0.3384**	1.2747	-0.0573	-2.2115	0.6314**
	S/Leone	-0.1442	1.7723**	0.2195*	-2.7639*	0.9718*
S/LEONE	***Gambia***	0.8141*	-0.6400*	0.1241*	-0.3799***	0.6558
	Ghana	1.2709*	0.3172	0.1339*	-0.3659	-0.3800***
	Guinea	0.8957*	0.2465	0.1731*	-0.6615**	0.2438
	Liberia	0.4100*	0.6825**	0.2633*	-1.2596*	0.1315
	Nigeria	-0.1442	1.7723**	0.2195*	-2.7639*	0.9718*

Source: Author's Estimation and EViews 10 Output

The only relationship where the expected signs failed to reflect in the relative money supply is the Nigeria/Sierra Leone case. Apart from the cases of The Gambia/Ghana and Sierra Leone/ Ghana, the explanatory powers of money supply were lower than unity as hypothesised. Both formal and informal output differentials yielded some few expected negative signs, but with better results by informal output differential. The explanatory powers of these two fundamentals were huge in relationships involving Ghana and Nigeria which are the strong economies of the WAMZ. These quarterly data FPMM estimations results were closely similar to what were obtained for the annual data estimations of the model.

Table 15: Results of FMOLS Estimations of Explanatory Powers and Theoretical Signs of the Fundamentals in RIDMM Exchange Rates in the WAMZ

Home & Foreign Country	*Money Supply Differential*	*Formal Output Differential*	*Interest Rate Differential*	*Inflation Differential*	*Informal Output Differential*	*Commodity Price Differential*
GAMBIA						
Ghana:	1.2743*	-1.8848*	0.1553*	0.0005	-0.1601	-0.3425***
Guinea:	0.2786	0.4070	0.4107*	0.0024	0.0757	0.2356
Liberia:	0.3210*	0.4233	0.3759*	0.0133**	0.0972	-0.8184
Nigeria:	0.3959**	-3.8340*	0.1238	-0.0062**	1.4448*	1.1271*
S/Leone:	0.8202*	-0.7036*	0.0981*	0.0026	-0.1341	0.6933
GHANA						
Gambia:	1.2743*	-1.8848*	0.1553*	0.0004	-0.1601	-0.3425**
Guinea:	0.5950*	1.2566**	0.1740*	0.0048***	-0.0933	-5.2977*
Liberia:	0.6548*	3.3288***	-0.1314	0.0034	-4.1695**	0.9278*
Nigeria:	0.8484*	-2.7666	0.2795*	0.0034	2.3848	0.5078***
S/Leone:	1.2555*	0.2332	0.0887**	0.0029	0.0801	-0.4879**
GUINEA						
Gambia:	0.2786	0.4070	0.4107*	0.0024	0.0757	0.2357
Ghana:	0.5950*	1.2566**	0.1740*	0.0047***	-0.0933	-5.2977*
Liberia:	0.1306	0.2845	0.1117**	0.0131*	-0.0521	1.7475*
Nigeria:	0.2476***	-2.8898*	-0.0353	-0.0005	1.3913*	-0.9744*
S/Leone:	0.7637*	0.0068	0.1077*	0.0060*	-0.2273	0.2400
LIBERIA						
Gambia:	0.3210*	-0.4233	0.3759*	0.0133**	0.0972	-0.8184***
Ghana:	0.6548*	3.3288***	-0.1314	0.0034	-4.1695**	0.9278*
Guinea:	0.1306	0.2845	0.1117**	0.0131*	-0.0521	1.7475*
Nigeria:	0.3046***	0.4184	-0.0005	-0.0060	-1.1891	0.5252
S/Leone:	0.4190*	0.7437*	0.2737*	0.0008	1.3250*	0.3339
NIGERIA						
Gambia:	0.3959**	-3.8340*	0.1238	-0.0062**	1.4448*	1.1271*
Ghana:	0.8484*	-2.7666	0.2795*	0.0033	2.3848	0.5078***
Guinea:	0.2476**	-2.8898*	-0.0353	-0.0005	1.3973*	0.9744*
Liberia:	0.3046***	0.4184	-0.0005	-0.0060	-1.1891	0.5252
S/Leone:	-0.0062	1.4734**	0.2134*	-0.0036	-2.9376*	1.0631*
S/LEONE						
Gambia:	0.8201*	-0.7036*	0.0981*	0.0026	-0.1341	0.6933
Ghana:	1.2555*	0.2322	0.0887**	0.0030	0.0801	-0.4879**
Guinea:	0.7638*	0.0068	0.1077*	0.0060*	-0.2273	-0.2400
Liberia:	0.4190*	0.7437*	0.2737*	0.0008	-1.3250*	0.3339
Nigeria:	-0.0062	1.4734**	0.2134*	-0.0036*	-2.9376*	1.0631*

Source: Author's Estimations and EView 10 Outputs

On the overall here, it could be inferred that there were a good number of similarities in explanations offered by these fundamentals about exchange rate determination in the WAMZ, however, these explanations were not convincing enough to justify a conclusion that the FPMM was strongly valid across the WAMZ. The results of the RIDMM estimations in Table 15 above reveals that as obtained in the FPMM estimation results in Table 14 above, the differentials of money supply and interest rate reflected the hypothesised signs, with one exception in money supply differentials and three exceptions in interest rate differentials On inflation differentials, apart from some

negative signs yielded for the Nigeria based relationships, the hypothesised positive signs were generated for other relationships. Output differentials (formal and informal) recorded few instances of expected signs. The number of coefficients with statistical significance (at 5%) were sparse. Generally, going by the results of the estimations of the RIDMM, apart from money supply and interest rate differentials, it is apparent that the FPMM performed better than the RIDMM in the WAMZ. The explanatory powers of inflation differentials were the lowest across the WAMZ. This signified the low extent of the influence of real inflation on exchange rates determination; although, most of these coefficients lack economic meanings due to their statistical insignificance. Further to these, the evidence of the failure of cointegration of gathered in this section caused the conclusion that there are no long-run cointegrating relationships between exchange rates and the fundamentals across the WAMZ.

The FPMM and the RIDMM estimations results under these quarterly data assessments highlighted that there were some few similarities in signs and magnitude of the explanations offered by exchange rate determination fundamentals across the WAMZ. These similarities were not strong enough to confidently infer that a single foreign exchange market can suffice for the WAMZ countries. Given the possibility that the proposed monetary union's foreign exchange markets is likely to be built around Nigeria, a detailed look at the output of the Nigeria based exchange rate and the associated explanatory variables in both monetary models estimated shows that they were not encouraging due to the signs and explanatory powers and statistical significance of coefficients of these explanatory variables. Therefore, if the WAMZ should adopt a single exchange rate in a common foreign exchange market, this step should be taken with cautiously.

5. Conclusions

In determining the workability and viability of a common exchange rate for the six WAMZ countries, this paper evaluated the feasibility of the monetary integration of the West Africa from the perspective of exchange rate determination. The evidence gathered from the CCR and the DOLS regression estimations of two monetary models of exchange rates (the FPMM and RIDMM) for the US *dollar* based exchange rates and the Nigerian-*naira* based exchange rates is that The Gambian *dalasi*, the Nigerian *naira* and the Sierra Leonean *leone* are the three WAMZ currencies that are well-suited for a single exchange

rate regime in the proposed monetary integration while the evidence generated from the Nigerian *naira*-based exchange rates evaluations led to the conclusion that Sierra Leonean *leone*, the Guinea *franc* and the Ghanaian *cedi* will, as well be suitable for the single foreign exchange market. What is significant here is that Nigeria (the lead economy) is evidently suited for the single exchange rate regime. The outcomes of the random effect panel data estimations suggested that the fundamental determinants of exchange rates within the zone work well in consonance with theoretical postulations in establishing a single exchange rate for the proposed union when the largest economy within the zone is factored into the exchange rate determination. Evidences got here appear good for the operation of a single exchange rate in the WAMZ. Taking cognisance of the influence of exchange rate determination macroeconomic fundamentals, the Markov switching dynamic regressions applied to the PFM and RIDM models of the US dollar exchange rates display high probability of remaining within the same regime, implying infrequent switches from one regime to another. These suggest that The Gambia dalasi, the Nigerian naira and Sierra Leonean leone have transition probabilities higher than others, implying long expected durations. These however fail to hold for The Gambian dalasi in the Nigerian naira exchange rates estimations in which Sierra Leonean leone takes the lead. The conclusion here is that behaviour of exchange rates of The Gambia, the Nigeria and Sierra Leone depict that these countries are well suited for exchange rate integration of the proposed currency area under the US dollar-based exchange rates determination model. The Nigerian naira-based exchange rates regime model however revealed Sierra Leone, Guinea and Ghana as suited for the single exchange rate system. Liberia was not reported to be suitable in either of the two classes of estimations.

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