Empirical Assessment of Exchange Market Pressure within the West African Monetary Zone.

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by

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Abstracts

The focus of this paper is the identification of currency risks periods (or otherwise) in the WAMZ and to further test the response of exchange market pressure (EMP) to monetary policy related factors in these countries as well as movements in primary commodity prices, given the feature of these countries as primary commodity exporting countries. The first phase of the EMP analysis in this work employed the model-independent statistical method of Eichengreen, Rose and Wyplosz (1996) to derive EMP indices in determining currency crisis susceptibility of the countries under study. The second part assessed the response of EMP to monetary policy across the WAMZ as well as evaluate the similarities in the patterns and strengths of the response of EMP towards checking for compatibility across the WAMZ countries (The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone). In this respect, the Girton and Roper (1977) model of exchange market pressure was applied in the model-dependent estimations for the six countries under study. The evaluation of exchange market pressure in the WAMZ employed the use of both annual and monthly data of the WAMZ countries under assessment as well as the CPI inflation data of the US. These data spanning between 2001 and 2015. EMP index were constructed for each of the WAMZ member countries within the contexts of the US dollar and the Nigeria naira foreign exchange markets in the WAMZ. For the model dependent EMP, robust regression method was applied in the estimation. Evidences gathered revealed mixed forms of the absorption of market pressure in the WAMZ, with the majority of the member countries of the WAMZ (including the lead economy, Nigeria) absorbing exchange market pressure through domestic currency depreciation relative to reserves depletion. From the results of the assessments with both annual and quarterly data it cannot be confidently inferred that a common exchange rate and a single foreign exchange market is feasible for the WAMZ countries in the proposed single currency area. The adoption of a single exchange rate in a common foreign exchange market should therefore be considered with caution. The foreign exchange market is likely to be free from future currency crisis. Because of the possible and expected massive influence of Nigeria in the foreign exchange market, foreign inflation may not hugely impact the proposed exchange rate and the external value of the proposed single currency.

1. Introduction

In attempts to stabilise international reserve positions towards avoiding unpleasant movements in their rate of foreign exchange, monetary authorities have been experiencing foreign exchange market pressure since the beginning of the managed floating regime in the early 70s, when central banks face market pressure of this nature, the monetary model holds for exchange rates in flexible regime alone and are not likely to hold for exchange rates in a market pressurised regime. Therefore, the monetary model of exchange rate determination requires modification that would take exchange market pressure into cognisance. Furthermore, it is crucial for the monetary authority under a managed floating regime to determine the degree at which its monetary independence is being affected by exchange rate target. The currency crises around the world and the impact on the real economy as well as the contagious effects prompted the need for economic stability in which exchange rate stability is playing a crucial role. In monetary union formation process, exchange rates stability is a strong convergence criterion to fulfil by prospective members. One analytical tool appropriate for the measurement of the foreign exchange market condition and the stability of the market is exchange market pressure (EMP). Generally, exchange market pressure (EMP) relates to money market disequilibrium. This makes it important in driving the understanding of the mechanism and instrument that would assist in achieving the market equilibrium. Many different yardsticks have been developed and adopted to identify periods of crisis, out of which exchange market pressure (EMP) index has been of relative importance. Given the significance of this subject, there had been renewed theoretical and empirical attention towards ensuring that the question on whether financial crisis could be forecast and/or prevented effectively by monetary policy.[1] These make research analysis on exchange market pressure in WAMZ member countries (The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone) to be significant.

This paper on exchange market pressure identified currency risks period (or otherwise) in the WAMZ and further tests the response of exchange market pressure to monetary policy related factors in these countries as well as movements in primary commodity

[1] Many authors identified EMP analysis as one of the key tools in this respects. Some of these papers are Girton and Ropers (1977), Goldfajn and Gupta (1999), Sachs, Tornell and Velasco (1996), Eichengreen, Rose and Wyploz (1996), Kaminsky, Reinhart and Lizondo (1997), Bensiad and Jeanne (1997), Furman and Stiglitz (1998), Delke, Hsiao and Wang (1999), Bussiere and Mulder (1999), Kaminsky and Reinhart (1999), Drazen (1999), Gould and Kamin (2000), Flood and Jeanne (2000), Tanner (2001), Lahiri and Vegh (2003),

prices, given the feature of these countries as primary commodity exporting countries. These revealed the statistically and econometrically determined exchange rate stability over the years as well as the susceptibility of these countries to currency crisis. This study is novel in that there is no know or existing literature that has applied exchange market pressure in the assessment of monetary integration; and specifically in the evaluation of the WAMZ as a monetary union.

The first phase of the EMP analysis in this work employed the model-independent statistical method of Eichengreen, Rose and Wyplosz (1996) to derive EMP indices in determining currency crisis susceptibility of the countries under study. The second part assessed the response of EMP to monetary policy across the WAMZ as well as evaluate the similarities in the patterns and strengths of the response of EMP towards checking for compatibility across the WAMZ countries. In this respect, the Girton and Roper (1977) model of exchange market pressure was applied in the model-dependent estimations for the six countries under study. The specific aim was the investigation of the nature of the response of EMP to monetary variables to changes in domestic credit as scaled by base money; and to check if the responses of the EMP to monetary policy stances across the WAMZ are homogeneous in pattern.[2] These were expected to reveal similarities or otherwise in monetary management and to show if monetary policy instrument of domestic credit/base money managed exchange rate pressures in the WAMZ in similar manner. It was also expected to show if the reaction to EMP by monetary policy instruments are according to theoretical presumptions in testing the validity of the monetary model of exchange market pressure.

2. Theory and Models

Exchange market pressure (EMP) depicts money market disequilibrium. Traditionally, the two major monetary approaches used in literature to assess money market disequilibrium are: (i) monetary approach to exchange rate; and (ii) monetary approach to balance of payments. While foreign reserves variation assists in restoring the equilibrium under the balance of payments' monetary approach, the change in exchange

[2] Domestic credit is a more appropriate proxy for monetary policy in that it is directly controlled by monetary authorities. While domestic credit/base money is quantitative monetary management policy tool, interest rate is a market-based monetary management policy instrument. These two policy techniques have different implications.

rate would cause the equilibrium restoration under the monetary approach to exchange rate (Frankel, 1976 and Mussa, 1976). Foreign reserves changes or exchange rate changes (one in isolation of the other) would not provide enough guide in revealing the features and accurate picture of the external account of any economy. For instance, monetary authority can delay or avoid depreciation in exchange rate (partially) if foreign reserves are depleted so as to inject foreign currency into the foreign market. On the other hand, foreign currency could be purchased from the market to fortify foreign reserves; and this restrains the appreciation in the rate of exchange as prompted by the underlying fundamentals. These show that there would be misleading view of external position of an economy if either of the two intervention tools (foreign reserves variations and exchange rate movements) to the exclusion of the other is emphasised. This makes a good case for a composite definition and description of EMP in the model-dependent assessment. This composite description of EMP incorporates foreign reserve variations and exchange rate changes in characterising the pressure in the exchange market. This is the starting point of the first seminal work on EMP by Girton and Roper (GR) 1977 in which an EMP model was developed to reflect exchange market pressure as a composite variable. The EMP values represents the magnitude of the foreign exchange market disequilibrium which should consequently be removed by respective change in exchange rate and/or change in foreign reserve position, depending on the ruling exchange rate regime.

Exchange market pressure are measured in two ways as: (i) model-independent and (ii) model-dependent. The model independent exchange market pressure index (EMPI) measures the extent of contagion-caused market pressure on a currency vulnerability of a country to currency crisis. For a proposed currency union, it reveals if the macroeconomic fundamentals of intending members are strong for single currency and single exchange rate in exchange rate integration and further, if the underlying macroeconomic variables can withstand market tensions and exchange rate regime vulnerabilities that may arise in the future monetary union. The weighted exchange market pressure index (EMPI) appropriate for the measurement of the extent of currency pressure is expressed as:

$$EMPI_{it} = \left(\frac{1}{\alpha}\%\Delta e_{i,t}\right) + \left(\frac{1}{\beta}\Delta\left(i_{i,t} - i_t^*\right) - \left[\frac{1}{\gamma}\left(\%\Delta r_{i,t} - \%\Delta\, r_t^*\right)\right] \qquad 1$$

where $e_{i,t}$ is the price of a relative foreign currency in terms of country $i's$ currency at time t. $i_{i,t}$ is the nominal interest of country i at time t; i_t^* is the foreign country's nominal interest rate, $r_{i,t}$ is the nominal interest of country i at time t; r_t^* is the ratio of international reserves to narrow money supply (M1) in the foreign country while α, β, and γ are the respective standard deviations appropriately applied as weights. This measure of market pressure takes its roots from the idea that when there are excess demand and supply in a foreign exchange market, there can be changes in foreign exchanges price as well as changes in reserve level.

The model-dependent study focusses on developing a model that provides links between EMP and monetary policy in order to check if EMP responds to monetary policy in the right manner (according to theoretical underpinnings). Basically, the Girton-Roper model of EMP is a variant of the monetary approach to exchange rate determination. The model is based on monetary approach to balance of payment which revolves around the notion of demand for money and supply of money. The idea within the monetary approach to balance of payment is that excess money supply causes international reserve losses under the fixed exchange rate regime and by implication, this leads to balance of payments deficits. Under flexible exchange rate regime, currency depreciation absorbs the pressure on balance of payments. Therefore, the need for equilibrium between domestic money supply and money demand necessitate the evolution of the exchange market theory. Naturally, excess money supply causes increases in demand for goods and services (the implication of demand-pull inflation) which translates into increase in economic agents' demands for foreign goods and services and this in turn, causes reserve depletion in the domestic market. The modelling of exchange market pressure therefore assesses whether or not monetary authority absorbs pressure in the foreign exchange market by drawing down (depleting) reserves or by currency depreciation. The principal theoretical proposition of the modelling of EMP by Girton and Roper (1977) is that whenever the domestic money market equilibrium is disturbed, the resulting disequilibrium is restored through some combinations of international reserve outflows (or inflow) and depreciation (or appreciation) of currency. Therefore, to restore the money market disequilibrium, the excess domestic money demand will prompt a combination of reserve depletion (outflow) and depreciation of currency. In the instance of excess domestic money

supply, the consequence will be some combinations of inflow of reserves and appreciation of currency. This is a strong reason for the appropriateness of the G-R model of EMP in the fixed, managed floating and floating exchange rate regimes. Under the fixed exchange rate regime, the change in exchange rate is zero and under a floating/flexible exchange rate regime, the change in reserve is zero. Either of reserve losses and currency appreciation (or a combination of both) absorbs exchange market pressure under the managed floating system.

The basic 'implicit' and 'explicit' conditions for the G-R model are: (i) the money market equilibrium condition; and (ii) the imposition of the purchasing power parity (PPP). Therefore in deriving the G-R model, it is necessary to begin with the formulation of the money market and the PPP. In the first instance, for equilibrium in the money market to hold, it is necessary to have:

$$M^d = M^s \qquad 2$$

where M^d is the demand for money and M^s is money supply. Money demand and money supply can further be specified as:

$$M^d = kPY \qquad 3$$

and

$$M^s = m(B) \qquad 4$$

where is k a constant, P is domestic price level, Y is real output, m is money multiplier and is B monetary base. This makes money supply to be the product of money multiplier (m) and monetary base (B) in a functional relationship in which:

$$B = R + D \qquad 5$$

Where R is net foreign assets (which is the foreign component of monetary base) and D is domestic credit (which is the domestic component of monetary base). In working towards the derivation of the G-R model, the PPP theory is incorporated at this point:

$$E = \frac{P^*}{P} \qquad 6$$

or

$$P = E(P^*)$$

where E is the nominal exchange rate, P is the domestic price level and P^* is the foreign price level. It is important to note here that the nominal exchange rate in this modelling is the number of units of foreign currency per unit of domestic currency. If Equation 3 and 4 above are substituted into Equation 2 above, we will have:

$$kPY = m(R + D) \quad 7$$

If the equivalent of P in Equation 6 above is made to substitute for P, in Equation 7, this yields:

$$k\left(\frac{P^*}{E}\right)Y = m(R + D) \quad 8$$

Assuming that people hold a fraction of nominal income in the form of cash, as constant k, we can express Equation 8 in percentages form thus:

$$P^* - e + y = m + r + d \quad 9$$

where P^* is percentage change in foreign price level, e is percentage change in nominal real exchange rate, y is percentage change in real output, a is percentage change in money multiplier, r is percentage change in reserve and d is percentage change in domestic credit. The rearrangement of the terms in Equation 9 leads to the G-R exchange market pressure model expressed as:

$$r + e = P^* + y - m - d \quad 10$$

where $(r + e)$ represents exchange market pressure.

The intuition of the G-R model is that increase in domestic credit (and/or money multiplier): (i) stimulates proportionate loss of foreign reserve (with no change in exchange rate); or (ii) stimulates a proportionate depreciation of domestic currency (with no change in reserve) or (iii) a combination of the two, all at a given rates of growth of domestic income and foreign prices. On the other hand, when there is increase in domestic income and/or foreign price, the effect is proportional inflow of international reserves and proportional appreciation of domestic currency. It is established in literature that Equation 10 could be augmented with a variable b, which is $\left(\frac{e}{r}\right)$ in order to check the response of monetary authority in the absorption of exchange market pressure through the draw-down of reserve or by exchange rate depreciation.

The augmented equation becomes:

$$r + e = P^* + y - a - d + b \qquad 11$$

When the coefficient of b is positive and significant, this means that currency depreciation is applied by the monetary authority to absorb exchange market pressure. A negative and significant coefficient of b shows that reserve depletion is the tool employed by monetary authority in the absorption of exchange market pressure. When the coefficient of b is insignificant, this is an indication of the lack of sensitivity of monetary authority to these components of exchange market pressure.

3. Data and Methods

The evaluation of exchange market pressure in the WAMZ employed the use of both annual and monthly data of the WAMZ countries under assessment as well as the CPI inflation data of the US. These data spanning between 2001 and 2015 and sourced from the databases of the EIU, the IMF and the World Bank, are for nominal interest rates, international reserves, nominal exchange rate (US dollar), domestic credit, narrow money supply, net foreign assets and real GDP. For the construction of the exchange market pressure index (EMPI), related annual data (2001 to 2014) were applied while monthly data (2001M1 to 2015M12) which were converted from the sourced annual data were used in the case of model dependent analysis of exchange markets pressures across the WAMZ. EMPI were constructed for each of the WAMZ member countries within the contexts of the US dollar and the Nigeria naira foreign exchange markets in the WAMZ. The span of the period for the exchange market pressure estimations were made shorter so as to avoid the possible distorting influences and effects of the civil wars in Liberia and Sierra Leone on their exchange markets as well as other exchange markets within the zone. Variables involved in the construction of the EMPI were relatively measured against those obtained in the US (for the US dollar/WAMZ exchange rates) and in Nigeria, the strongest WAMZ economy (for the Nigerian naira/WAMZ countries exchange rates).[3] For each WAMZ country, currency crisis thresholds were estimated as the sum of the standard deviation and mean of the weighted exchange

[3]Nigeria is the strongest economy with over 80% of the zone's total GDP and by implication forming around same proportion of the total size of the entire proposed monetary zone's foreign exchange markets.

market pressure index derived from the estimation of Equation 1 over the sample period thus:

$$T = \sigma_{EMPI} + \mu_{EMPI} \quad 12$$

where T indicated threshold while σ and μ denote the EMPI sample standard deviation and mean respectively. This links crisis with the extent of volatility and the average pressure in the foreign exchange market. A country is therefore susceptible to currency crisis if the weighted EMPI is greater than the applied threshold. There are no arbitrary weighting of market volatilities and averages as many researchers did. This was perceived inappropriate for the exchange market realities in developing economies, the category in which the WAMZ countries belong. In determining if the WAMZ countries are currency crisis vulnerable, this research work applied the following five different currency crisis thresholds situation for the WAMZ countries: (i) WAMZ country-specific threshold (US dollars exchange markets); (ii) WAMZ country-specific threshold (Nigerian naira exchange markets); (iii) WAMZ average threshold (US dollars exchange markets); (iv) WAMZ average threshold (Nigerian naira exchange markets); and (v) Nigeria currency crisis threshold.

For the model dependent EMP, robust regression method was applied in the estimation of Equations 10 and 11above. A robust regression is that which: (a) is reasonably efficient and unbiased; (b) small deviation from the assumptions of the model will not substantially impair the performances of the estimated model; and (iii) large deviation does not invalidate the model completely. OLS regression is not robust with outliers because it can yield results that are misleading if such outliers are undetected. If outliers, influential observations and heavy-tailed distribution can hinder the efficiency of OLS regression, then an alternative in robust regression is appropriate. Robust statistics aim at describing the structure best fitting the bulk of the data, identify deviating data points (outliers) for further treatments, identify (or warn about) highly influential data points (leverage points), deal with unsuspected serial correlation. Consequently, robust regression devises estimators that are not so strongly affected by outliers in order to produce resistant results in the presence of outliers as it dampens the influences of outlying observations so as to provide better fit for the majority of the data and thereby achieve the necessary stability. Theoretically, what apply in explaining

the performance of robust regression are the properties of efficiency, breakdown points and high leverage points.

The process of the evaluation of the model-dependent EMP across the WAMZ in this assessment started with the OLS estimation of the augmented EMP model as expressed in Equation 11, in order to check for outliers in the variables involved in the modelling of EMP for the six WAMZ countries. The output of the OLS estimations were not be reported since the purpose was to check for the possible presence of outliers in justifying the use of the robust least square (RLS) regression method for same purpose. The RLS estimation performed here used the M-estimation option (which has a function that provides less weight to outliers) and applied the Welsch objective specification with Huber Type I covariance estimates (on which the z-statistics estimations are based) and zero-centered Median Absolute Deviation (MAD) estimator. MAD is regarded as a robust measure of central tendency and unlike mean and standard deviation, it is not sensitive to the presence of outliers. MAD is the median absolute value of the residuals (which are deviations from the median of the data), measuring statistical dispersions. Since standard deviation can easily be influenced by outliers because the distance from mean are squared in standard deviation, large deviations are consequently weighted heavily. However, with MAD applied here, deviations of outliers are not relevant. For the iteration control, this study allows for 500 maximum iteration and 0.0001 convergence. In robust least square (RLS) regression, R-squared and Rw-squared statistics are the two measures of goodness-of-fit. This study applied Rw-squared which was deemed a better measure of fit than the R-square reported in the RLS regression. One other special statistic reported by RLS is Rn-square statistic which is the robust version of the Wald test of the true value of the coefficients, based on sample estimate. This (calculated by applying the standard Wald test quadratic form) tests the hypothesis that all the coefficients are equal to zero. Therefore, a p-value of 0.00 of the Rn-squared statistics depicts strong rejection of the null hypothesis that all non-constant coefficients are equal to zero.

4. Results and Findings

To benchmark for currency crisis susceptibility, the estimated thresholds for individual WAMZ countries as well as the related averages under the two exchange markets situations are highlighted in Table 1 below.

Table 1: Exchange Market Pressure Index Thresholds

US Dollar Nominal Exchange Rates							
	Gambia	***Ghana***	***Guinea***	***Liberia***	***Nigeria***	***S/Leone***	***Average***
Threshold	3.2907	2.6959	2.2261	1.7115	4.1698	2.7095	2.8006
Nigeria Naira Nominal Exchange Rates							
	Gambia	***Ghana***	***Guinea***	***Liberia***	***Nigeria***	***S/Leone***	***Average***
Threshold	1.0597	1.5006	1.3268	-0.0216	na	0.3526	0.8436

Source: Author's Estimation

Table 2: Currency Crises Definitions with Country Specific Threshold (US Dollar Exchange Markets)

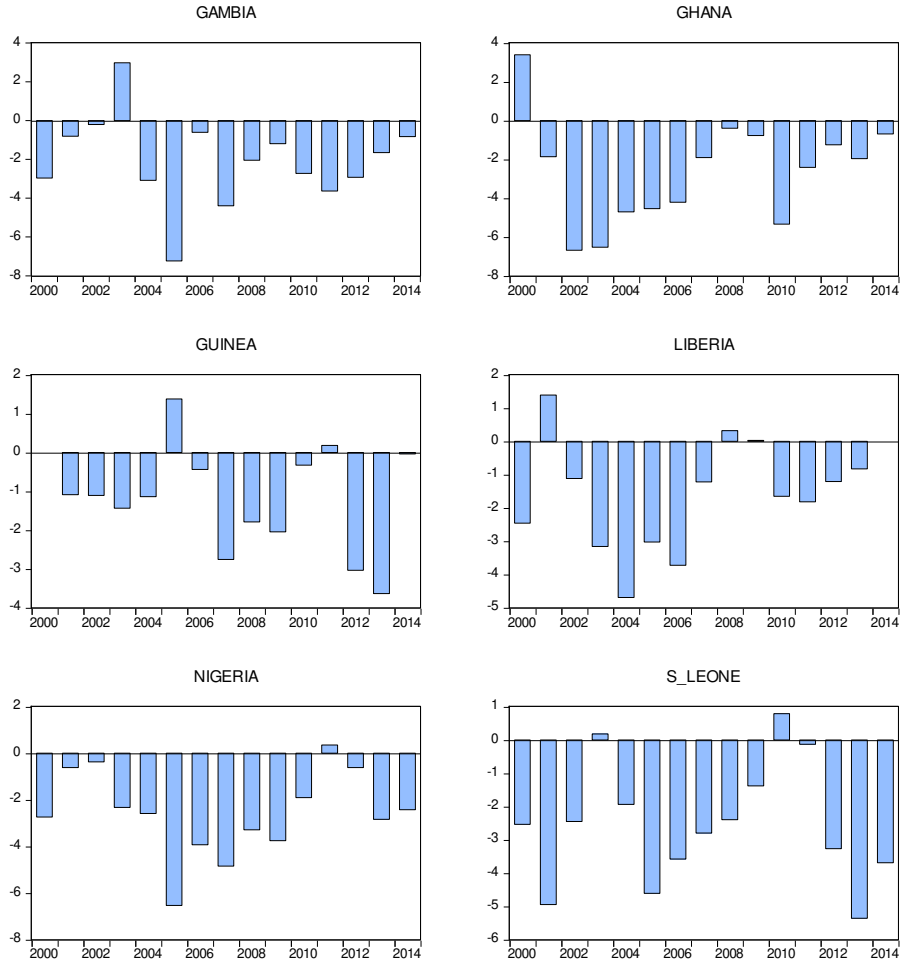
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Gambia (3.29)	0.33 (N)	2.48 (N)	3.09 (N)	6.27 (Y)	0.21 (N)	-3.94 (N)	2.68 (N)	-1.1 (N)	1.24 (N)	2.1 (N)	0.57 (N)	-0.34 (N)	0.36 (N)	1.64 (N)	2.46 (N)
Ghana (2.70)	6.09 (Y)	0.84 (N)	-3.98 (N)	-3.83 (N)	-2 (N)	-1.84 (N)	-1.51 (N)	0.79 (N)	2.3 (N)	1.93 (N)	-2.64 (N)	0.29 (N)	1.45 (N)	0.74 (N)	2.01 (N)
Guinea (2.22)	na	1.13 (N)	1.11 (N)	0.78 (N)	1.08 (N)	3.6 (Y)	1.78 (N)	-0.54 (N)	0.43 (N)	0.17 (N)	1.89 (N)	2.4 (Y)	-0.82 (N)	-1.42 (N)	2.18 (N)
Liberia (1.71)	-0.75 (N)	3.1 (Y)	0.59 (N)	-1.45 (N)	-2.99 (N)	-1.32 (N)	-2.02 (N)	0.49 (N)	2.03 (Y)	1.74 (N)	0.06 (N)	-0.11 (N)	0.5 (N)	0.88 (N)	na
Nigeria (4.17)	1.43 (N)	3.55 (N)	3.8 (N)	1.84 (N)	1.58 (N)	-2.37 (N)	0.24 (N)	-0.68 (N)	0.88 (N)	0.41 (N)	2.26 (N)	4.52 (Y)	3.55 (N)	1.33 (N)	1.74 (N)
S/Leone (2.71)	0.17 (N)	-2.24 (N)	0.26 (N)	2.89 (Y)	0.77 (N)	-1.9 (N)	-0.87 (N)	-0.09 (N)	0.31 (N)	1.33 (N)	3.5 (Y)	2.58 (N)	-0.56 (N)	-2.65 (N)	-0.98 (N)

Source: Author's estimations

Note: 'Y' denotes susceptibility to currency crisis, while 'N' means non-susceptibility to currency crisis.

For the US dollar market country-specific threshold, Table 2 above shows that over the period covered by this study, The Gambia (in 2003), Ghana (in 2000), and Nigeria (in 2011) were susceptible to currency crisis once while the vulnerability of Guinea (in 2005 and 2011), Liberia (in 2001 and 2008) and Sierra Leone (in 2003 and 2004) to currency crisis were twice during the period covered by this study. Figure 1 below shows the diagrammatic representations of the information in Table 3. In these charts (and subsequent related charts in this section), point zero line is the currency crisis cut-off point and the sizes of the bars indicate the magnitudes of currency crisis 'susceptibility' and 'non-susceptibility'. When bars are located above point zero, they depict periods of susceptibility to currency crisis while bar below the zero point are periods of non-susceptibility to currency crisis.

Figure 1: Country Specific Threshold Currency Crises Definitions (US Dollar Exchange Markets)



Source: Author's Estimation and Eviews 9.5 Output

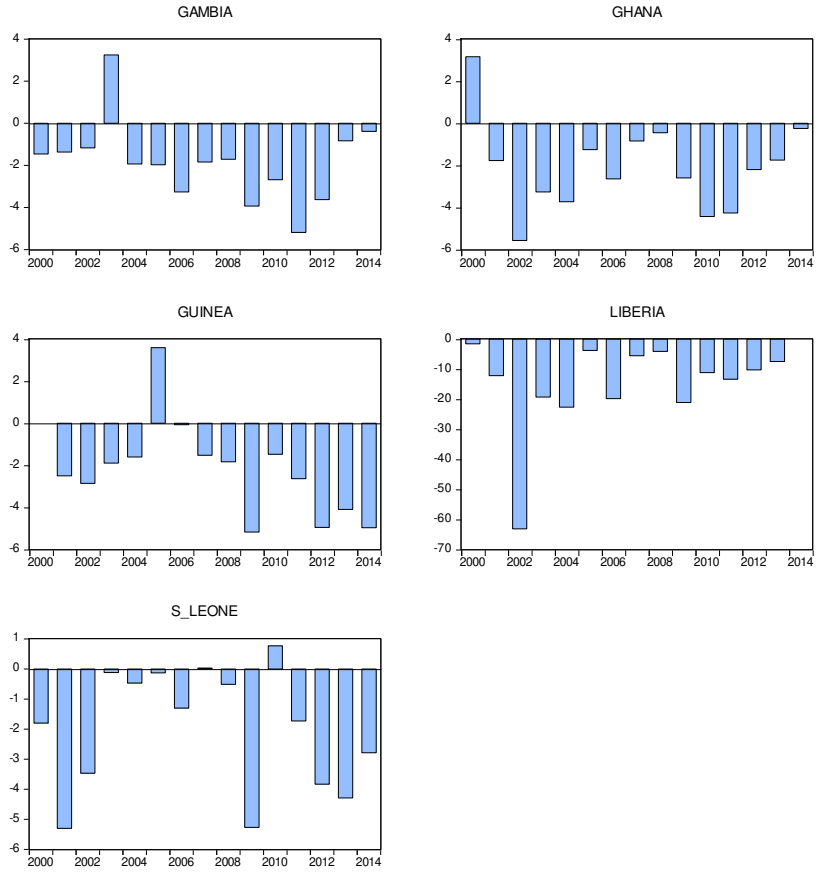
In comparison with the scenario of the Nigerian naira bilateral exchange markets, country-specific crisis threshold, The Gambia (in 2003), Ghana (in 2000) , Guinea (in 2005) and Sierra Leone (in 2010 were susceptible once and Liberia was not vulnerable according to the information in Table 3 below and as reflected in Figure 2 below.

Table 3: Country Specific Threshold Currency Crises Definitions (Nigerian Naira Exchange Markets)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Gambia (1.06)	-0.4 (N)	-0.31 (N)	-0.1 (N)	4.31 (Y)	-0.87 (N)	-0.9 (N)	-2.2 (N)	-0.8 (N)	-0.6 (N)	-2.9 (N)	-1.62 (N)	-4.13 (N)	-2.57 (N)	0.23 (N)	0.68 (N)
Ghana (1.50)	4.66 (Y)	-0.27 (N)	-4.0 (N)	-1.8 (N)	-2.23 (N)	0.25 (N)	-1.14 (N)	0.66 (N)	1.05 (N)	-1.1 (N)	-2.93 (N)	-2.76 (N)	-0.7 (N)	-0.2 (N)	1.26 (N)
Guinea (1.33)	na	-1.17 (N)	-1.5 (N)	-0.6 (N)	-0.28 (N)	4.92 (Y)	1.26 (N)	-0.2 (N)	-0.5 (N)	-3.85 (N)	-0.15 (N)	-1.31 (N)	-3.63 (N)	-2.8 (N)	-3.6 (N)
Liberia (-0.02)	-1.6 (N)	-12.2 (N)	-63.2 (N)	-19.3 (N)	-22.6 (N)	-3.8 (N)	-19.8 (N)	-5.5 (N)	-4.1 (N)	-21.1 (N)	-11.2 (N)	-13.3 (N)	-10.2 (N)	-7.5 (N)	na
S/Leone (0.35)	-1.4 (N)	-4.95 (N)	-3.1 (N)	0.23 (N)	-0.12 (N)	0.22 (N)	-0.95 (N)	0.38 (N)	-0.2 (N)	-4.92 (N)	1.12 (Y)	-1.38 (N)	-3.48 (N)	-3.9 (N)	-2.4 (N)

Source: Author's estimations.
Note: 'Y' denotes non-susceptibility to currency crisis, while 'N' means non-susceptibility to currency crisis.

Figure 2: Country Specific Threshold Currency Crises Definitions (Nigerian Naira Exchange Markets)



Source: Author's Estimation and Eviews 9.5 Output

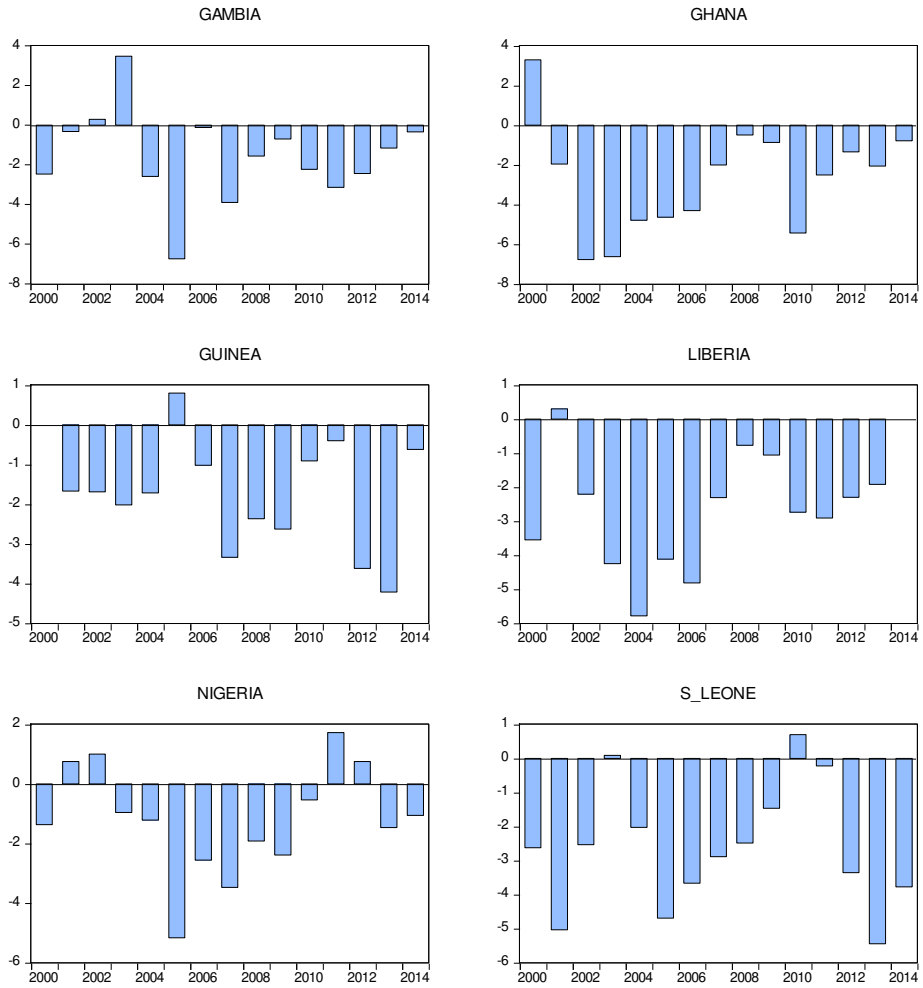
Table 4: WAMZ Average Threshold (2.80) Currency Crises Definitions (US Dollar Exchange Markets)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Gambia	0.33 (N)	2.48 (N)	3.09 (Y)	6.27 (Y)	0.21 (N)	-3.94 (N)	2.68 (N)	-1.1 (N)	1.24 (N)	2.1 (N)	0.57 (N)	-0.34 (N)	0.36 (N)	1.64 (N)	2.46 (N)
Ghana	6.09 (Y)	0.84 (N)	-3.98 (N)	-3.83 (N)	-2 (N)	-1.84 (N)	-1.51 (N)	0.79 (N)	2.3 (N)	1.93 (N)	-2.64 (N)	0.29 (N)	1.45 (N)	0.74 (N)	2.01 (N)
Guinea	na	1.13 (N)	1.11 (N)	0.78 (N)	1.08 (N)	3.6 (Y)	1.78 (N)	-0.54 (N)	0.43 (N)	0.17 (N)	1.89 (N)	2.4 (N)	-0.82 (N)	-1.42 (N)	2.18 (N)
Liberia	-0.75 (N)	3.1 (Y)	0.59 (N)	-1.45 (N)	-2.99 (N)	-1.32 (N)	-2.02 (N)	0.49 (N)	2.03 (N)	1.74 (N)	0.06 (N)	-0.11 (N)	0.5 (N)	0.88 (N)	na
Nigeria	1.43 (N)	3.55 (Y)	3.8 (Y)	1.84 (N)	1.58 (N)	-2.37 (N)	0.24 (N)	-0.68 (N)	0.88 (N)	0.41 (N)	2.26 (N)	4.52 (Y)	3.55 (Y)	1.33 (N)	1.74 (N)
S/Leone	0.17 (N)	-2.24 (N)	0.26 (N)	2.89 (Y)	0.77 (N)	-1.9 (N)	-0.87 (N)	-0.09 (N)	0.31 (N)	1.33 (N)	3.5 (Y)	2.58 (N)	-0.56 (N)	-2.65 (N)	-0.98 (N)

Source: Author's estimations

Note: 'Y' denotes non-susceptibility to currency crisis, while 'N' means non-susceptibility to currency crisis.

Figure 3: WAMZ Average Threshold (2.80) Currency Crises Definitions (US Dollar Exchange Markets)



Source: Author's Estimation and Eviews 9.5 Output

When the WAMZ average threshold of 2.80 was set in the US dollar exchange markets, Table 4 and Figure 3 above exhibit currency crisis susceptibility in all the six countries with Nigeria (in 2001, 2003, 2011 and 2012) having the highest of four years of vulnerability. The Gambia (in 2002 and 2003) and Sierra Leone (in 2003 and 2010) had two while Ghana (in 2000) and Guinea (in 2005) and Liberia (in 2001) were prone to crisis once. Nigeria, the lead foreign exchange market recorded the highest number of currency crisis vulnerability according to the WAMZ average threshold. This is a result that comes with negative implications for the exchange market integration of the WAMZ.

Table 5 and Figure 4 below give crisis information when the WAMZ average for the Nigerian naira exchange markets in which an average crisis threshold of 0.84 was set. Under this scenario, Liberia shows no sign suggesting crisis. The Gambia (in 2003) and

Sierra Leone (in 2010) had once, Ghana (in 2000, 2008 and 2014) and Guinea (in 2005 and 2006) had twice.

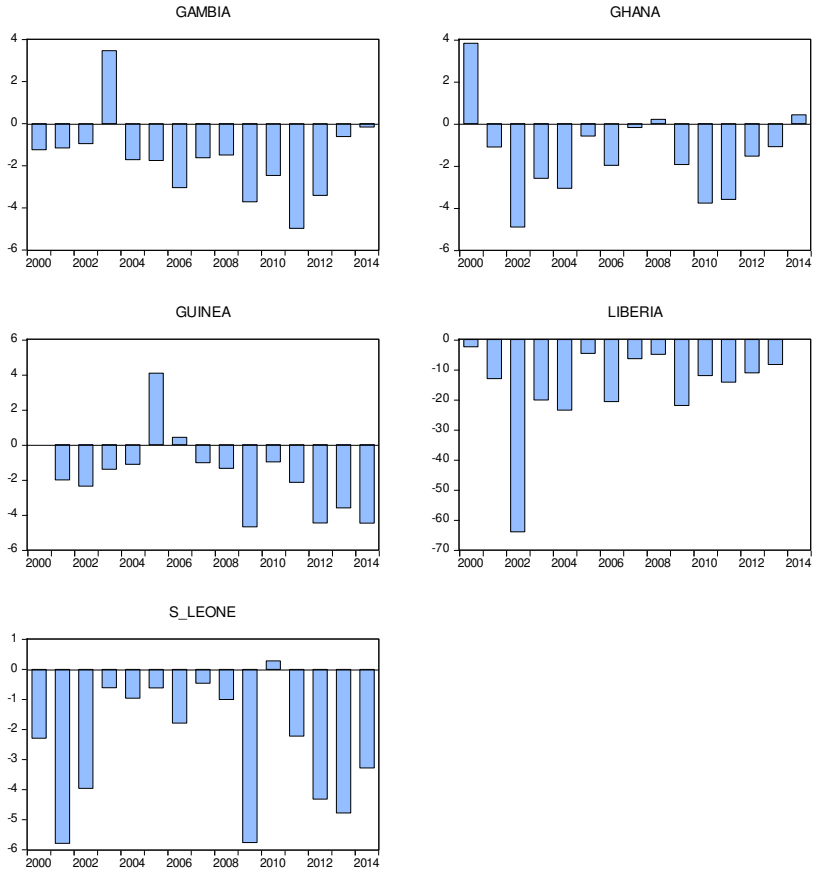
Table 5: WAMZ Average Threshold (0.84) Currency Crises Definitions (Nigerian Naira Exchange Markets)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Gambia	-0.4 (N)	-0.31 (N)	-0.11 (N)	4.31 (Y)	-0.87 (N)	-0.91 (N)	-2.2 (N)	-0.78 (N)	-0.65 (N)	-2.87 (N)	-1.62 (N)	-4.13 (N)	-2.57 (N)	0.23 (N)	0.68 (N)
Ghana	4.66 (Y)	-0.27 (N)	-4.07 (N)	-1.76 (N)	-2.23 (N)	0.25 (N)	-1.14 (N)	0.66 (N)	1.05 (Y)	-1.1 (N)	-2.93 (N)	-2.76 (N)	-0.7 (N)	-0.25 (N)	1.26 (Y)
Guinea	na	-1.17 (N)	-1.53 (N)	-0.57 (N)	-0.28 (N)	4.92 (Y)	1.26 (Y)	-0.19 (N)	-0.51 (N)	-3.85 (N)	-0.15 (N)	-1.31 (N)	-3.63 (N)	-2.77 (N)	-3.64 (N)
Liberia	-1.6 (N)	-12.2 (N)	-63.2 (N)	-19.3 (N)	-22.6 (N)	-3.78 (N)	-19.8 (N)	-5.54 (N)	-4.11 (N)	-21.1 (N)	-11.2 (N)	-13.3 (N)	-10.3 (N)	-7.48 (N)	na
S/Leone	-1.45 (N)	-4.95 (N)	-3.12 (N)	0.23 (N)	-0.12 (N)	0.22 (N)	-0.95 (N)	0.38 (N)	-0.16 (N)	-4.92 (N)	1.12 (Y)	-1.38 (N)	-3.48 (N)	-3.94 (N)	-2.44 (N)

Source: Author's estimations

Note: 'Y' denotes non-susceptibility to currency crisis, while 'N' means non-susceptibility to currency crisis.

Figure 4: WAMZ Average Threshold (0.84) Currency Crises Definitions (Nigerian Naira Exchange Markets)



Source: Author's Estimation and Eviews 9.5 Output

These currency crisis information generated with the application of the WAMZ average thresholds calculations are essential for the future single exchange rate market within the WAMZ. The size of the Nigerian economy within the WAMZ, having direct effect and influence on the size of the expected common foreign exchange market in the proposed

monetary union, prompted the setting of the Nigerian currency crisis threshold of 4.17 against the EMP indices of the other five WAMZ countries; and the results of crisis vulnerability estimations for the five countries, in this context for the US dollar exchange market are shown in Table 5 below. In this result, only The Gambia (in 2003) and Ghana (in 2000) exhibit crisis vulnerability over the period of study.

Table 6: Nigerian Threshold (4.17) Currency Crises Definitions (US Dollar Exchange Markets)

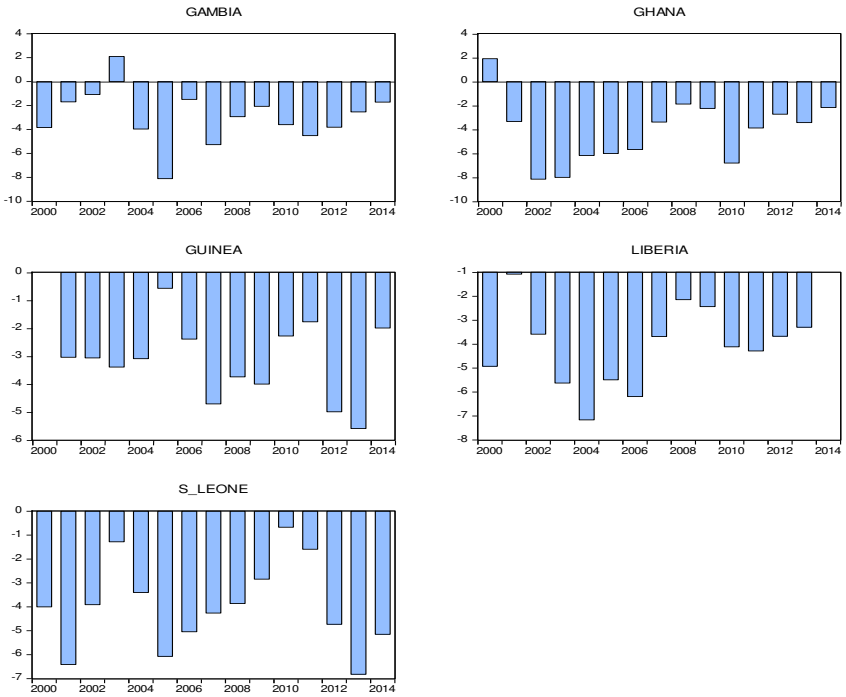
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Gambia	0.33 (N)	2.48 (N)	3.09 (N)	6.27 (Y)	0.21 (N)	-3.94 (N)	2.68 (N)	-1.1 (N)	1.24 (N)	2.1 (N)	0.57 (N)	-0.34 (N)	0.36 (N)	1.64 (N)	2.46 (N)
Ghana	6.09 (Y)	0.84 (N)	-3.98 (N)	-3.83 (N)	-2 (N)	-1.84 (N)	-1.51 (N)	0.79 (N)	2.3 (N)	1.93 (N)	-2.64 (N)	0.29 (N)	1.45 (N)	0.74 (N)	2.01 (N)
Guinea	na	1.13 (N)	1.11 (N)	0.78 (N)	1.08 (N)	3.6 (N)	1.78 (N)	-0.54 (N)	0.43 (N)	0.17 (N)	1.89 (N)	2.4 (N)	-0.82 (N)	-1.42 (N)	2.18 (N)
Liberia	-0.75 (N)	3.1 (N)	0.59 (N)	-1.45 (N)	-2.99 (N)	-1.32 (N)	-2.02 (N)	0.49 (N)	2.03 (N)	1.74 (N)	0.06 (N)	-0.11 (N)	0.5 (N)	0.88 (N)	na
S/Leone	0.17 (N)	-2.24 (N)	0.26 (N)	2.89 (N)	0.77 (N)	-1.9 (N)	-0.87 (N)	-0.09 (N)	0.31 (N)	1.33 (N)	3.5 (N)	2.58 (N)	-0.56 (N)	-2.65 (N)	-0.98 (N)

Source: Author's estimations

Note: 'Y' denotes non-susceptibility to currency crisis, while 'N' means non-susceptibility to currency crisis.

The implications of the results in Table 6 above is that if the currency market pressure in Nigeria is the core currency crisis determinant, three WAMZ countries (Guinea, Liberia and Sierra Leone) are not likely vulnerable to currency crisis, given the past trends of currency susceptibility.

Figure 5: Nigerian Threshold (4.17) Currency Crises Definitions (US Dollar Exchange Markets)



Source: Author's Estimation and Eviews 9.5 Output

Positive enough, Nigeria showed signs of currency crisis susceptibility just once (in 2011) in the results of the US dollar market threshold estimation in Table 1 above when its own threshold of 4.17 (applied for investigation yielding results in Table 6) is set against its EMP index. The susceptibility of the WAMZ countries in this scenario is shown graphically in Figure 5 above.

What the information generated under this section suggest is that the WAMZ is not currency crisis susceptible, given the low degrees of currency crisis susceptibility (of between 7% lowest and 27% highest) exhibited by the WAMZ countries over the 15-year period covered by this study. These high currency-crisis-free results portend stability in the WAMZ's future single exchange rate and single foreign exchange market.

For the estimations of the model-dependent exchange market pressure, as the first step, ADF unit root roots tests for stationarity was performed on all the data applied in this exchange market pressure evaluation at 5% level of significance as displayed in Table 7 below.

Table 7: Results the ADF Unit Roots Tests for the Variables of Exchange Market Pressure

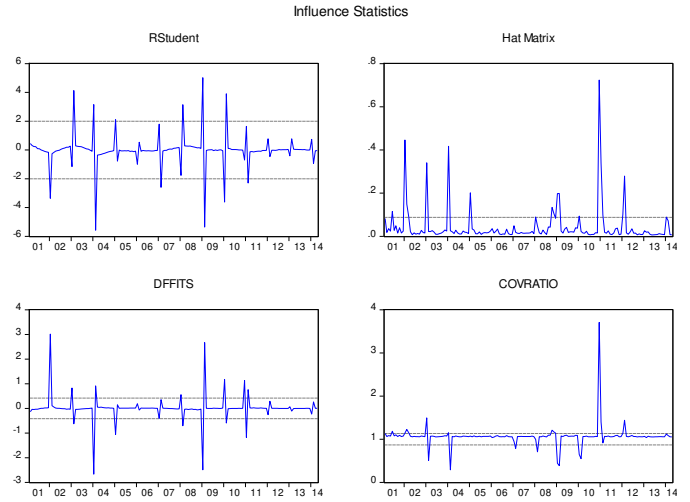
Variables	*Gambia*	*Ghana*	*Guinea*	*Liberia*	*Nigeria*	*S/Leone*
Exchange Market Pressure	-3.1214**	-3.4065*	-3.9046*	-7.6934*	-3.2906*	-4.8507*
ΔDomestic Credit/Money Base	-4.0200*	-3.5298*	-1.8202	-11.0540*	-2.9593*	-2.3718
Domestic Real GDP Growth	-5.6633*	-3.0180**	-4.9966*	-3.0330**	-4.1619*	-0.4969
ΔMoney Multiplier	-17.6505*	-15.3650*	-14.2086*	-17.6906*	-11.7025*	-13.3079*
Monetary Response Variable	-12.8013*	-13.3738*	-13.2085*	-13.1097*	-4.4156*	-13.3808*
Foreign (US) Inflation (-1.8961)						
ΔCommodity Index (-8.7045*)						
Critical values of ADF Unit Roots Test						
1%	***5%***			***10%***		
-3.9591	-3.0810			-2.6813		

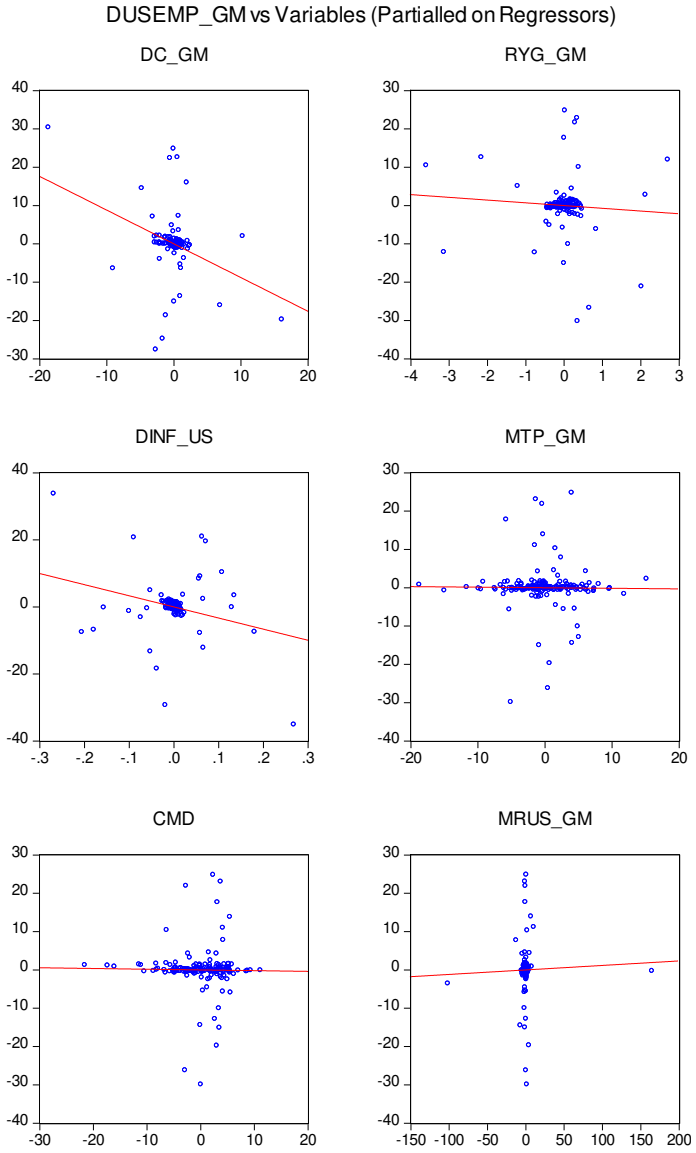
Source: Author's estimations and EViews 7 Output

The data for foreign inflation, domestic credit/base money change for Guinea and Sierra Leone as a well as domestic real GDP growth for Sierra Leone were not stationary at levels, and were made stationary at first difference so that they can be used for regression. Every other variables employed were stationary at levels in the 'with constant' ADF unit root tests. Influence statistics and the leverage plots resulting from the OLS estimates are displayed in Figure 6 below.

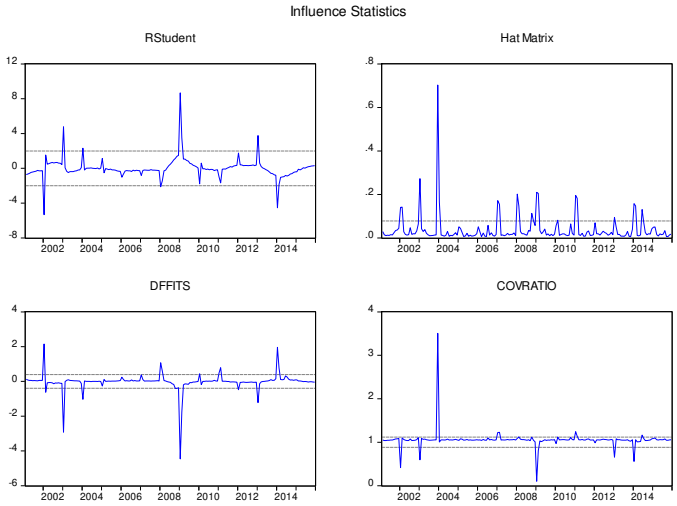
Figure 6: Plots of Influence Statistics and Leverage of OLS Estimations of EMP

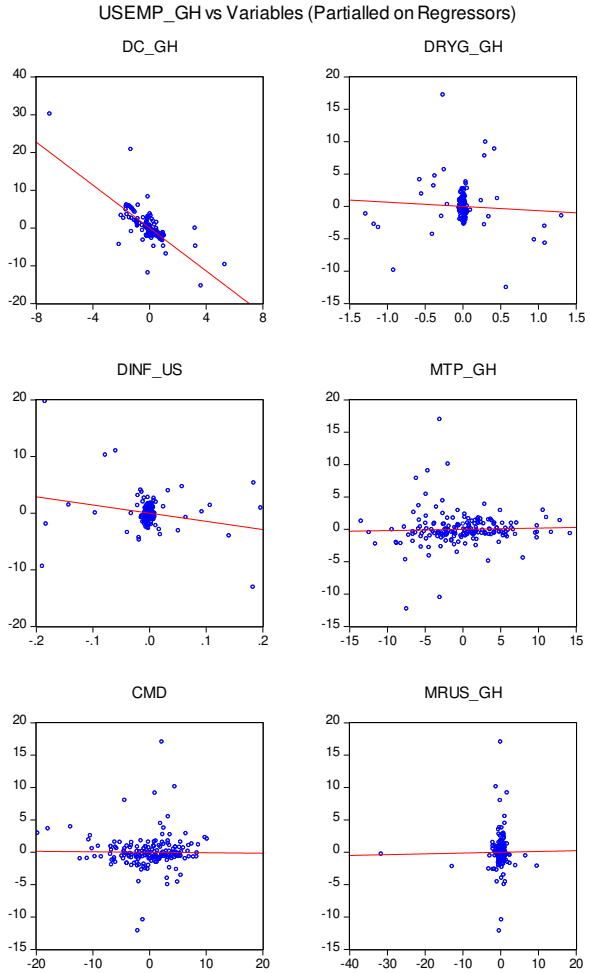
The Gambia:



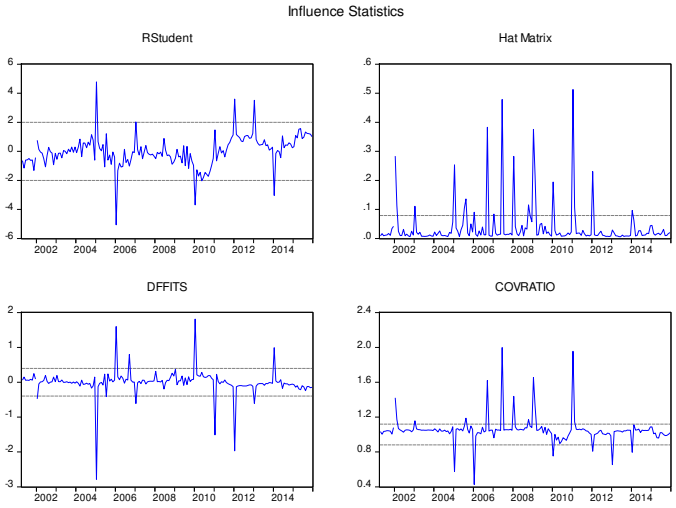


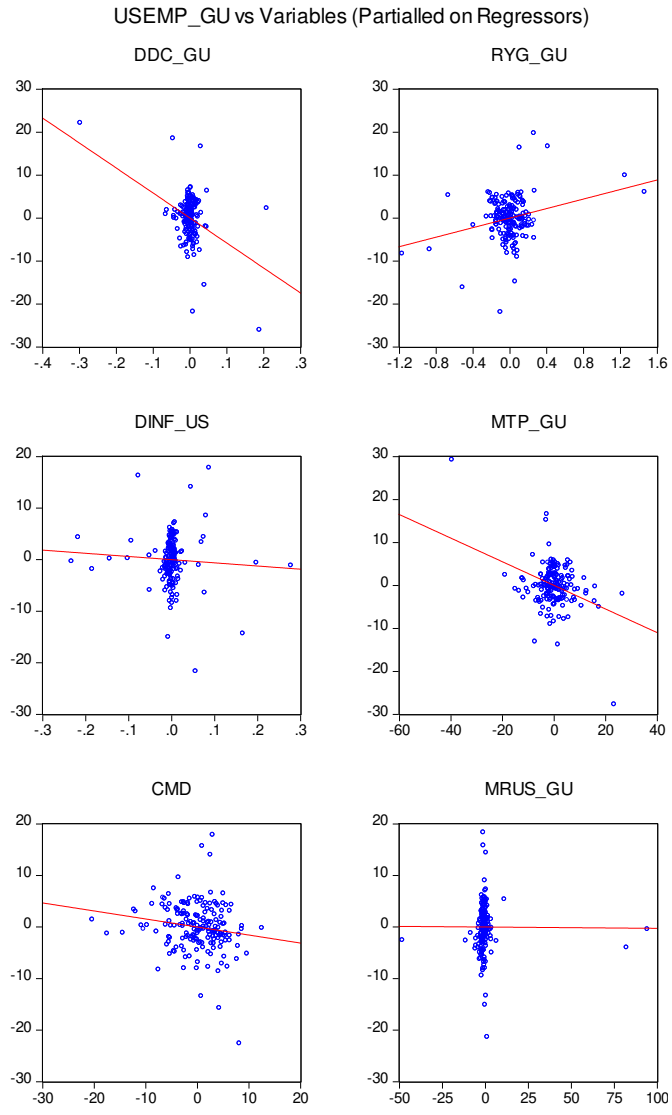
Ghana:


Influence Statistics
RStudent
Hat Matrix
DFFITS
COVRATIO

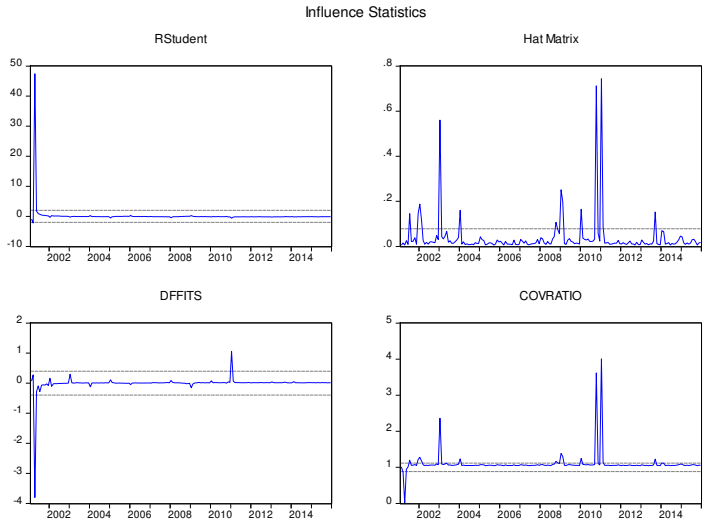

USEMP_GH vs Variables (Partialled on Regressors)
DC_GH
DRYG_GH
DINF_US
MTP_GH
CMD
MRUS_GH

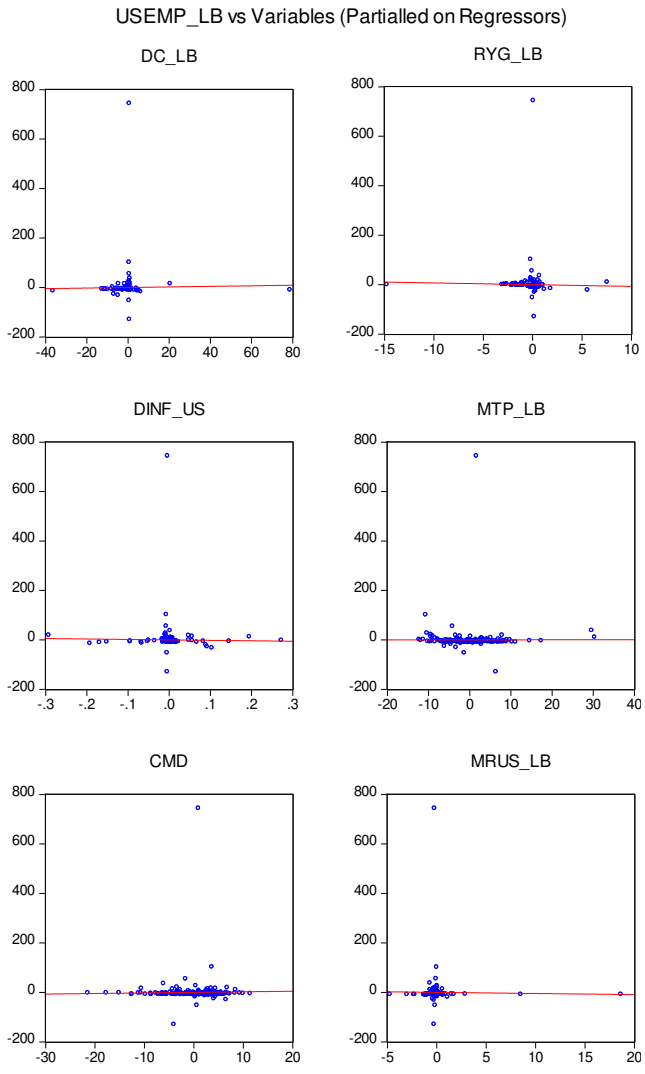
Guinea:


Influence Statistics
RStudent
Hat Matrix
DFFITS
COVRATIO

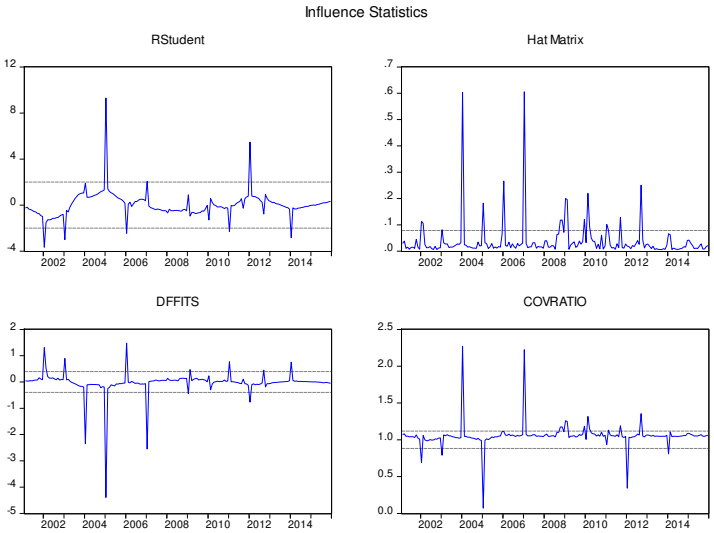

USEMP_GU vs Variables (Partialled on Regressors)
DDC_GU
RYG_GU
DINF_US
MTP_GU
CMD
MRUS_GU

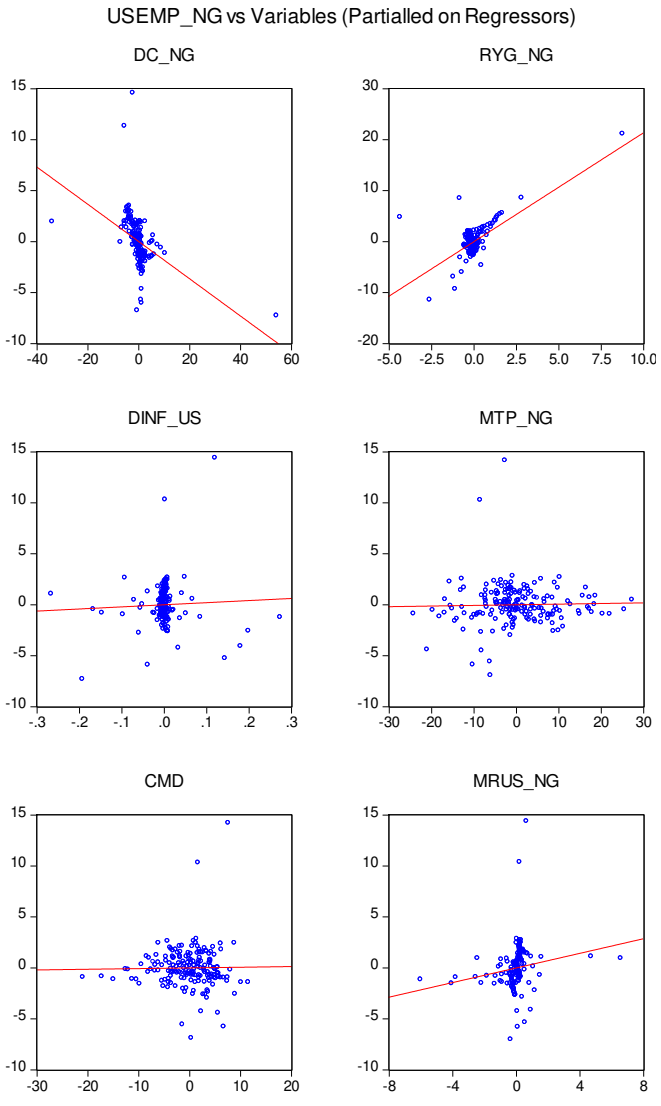
Liberia:


Influence Statistics
RStudent
Hat Matrix
DFFITS
COVRATIO

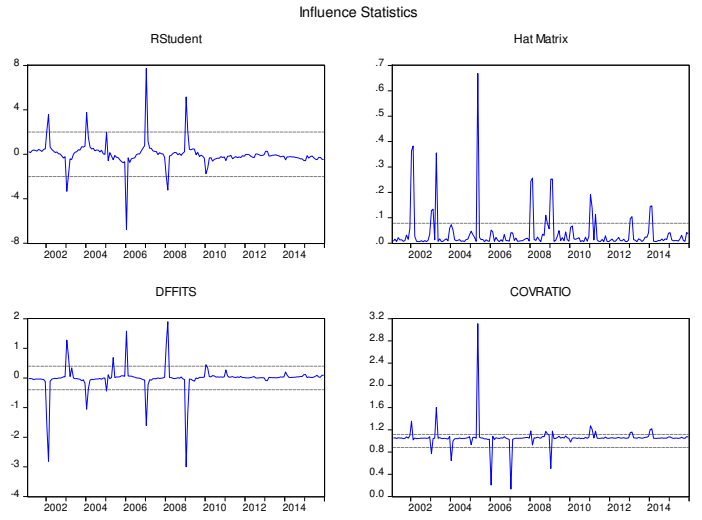

USEMP_LB vs Variables (Partialled on Regressors)
DC_LB
RYG_LB
DINF_US
MTP_LB
CMD
MRUS_LB

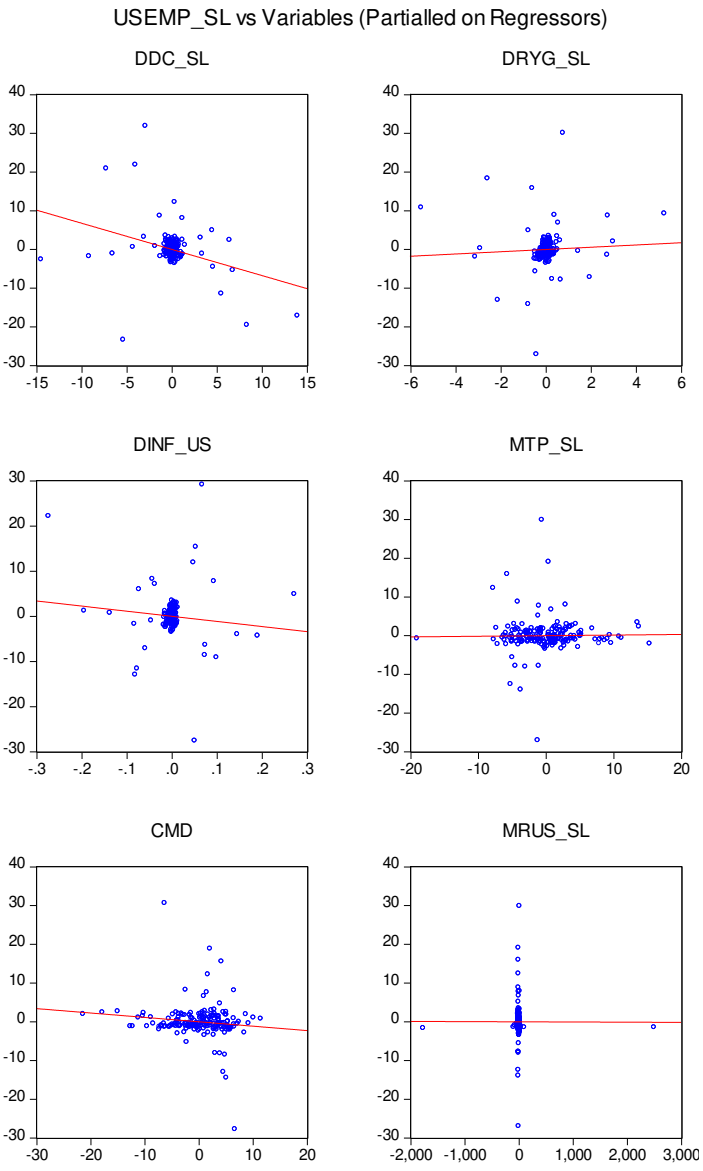
Nigeria:


Influence Statistics
RStudent
Hat Matrix
DFFITS
COVRATIO


USEMP_NG vs Variables (Partialled on Regressors)
DC_NG
RYG_NG
DINF_US
MTP_NG
CMD
MRUS_NG

Sierra Leone:





Sources: Author's Estimations and Eview 9.5 Output

The spikes in the graphs for the four measures of influence revealed a good number of outliers in the data employed in the modelling of EMP for the WAMZ countries. These were further confirmed by the various leverage plots. These provided the basis for the justification of the appropriateness of the use of the robust least square regression in this EMP evaluation. The results of the robust least square regression of the model-dependent exchange market pressure in the six WAMZ countries are exhibited below in Table 8, showing results from the model without the sensitivity factor of monetary responses and Table 9 exhibiting these sensitivity factor of monetary responses.

Table 8: Results of the Robust Least Square Regression Estimation of Exchange Market Pressure Model

Independent Variables	***Gambia***	***Ghana***	***Guinea***	***Liberia***	***Nigeria***	***S/Leone***
Constant	-0.0908*	-0.7621*	-1.4502*	2.8136*	-2.4704*	-0.1373*
ΔDomestic Credit/Money Base	-0.1986*	-2.570*	-69.418*	-0.0306*	-0.1730*	0.1825
Domestic Real GDP Growth	0.7012*	-0.0353	3.4222*	-1.1530*	2.6761*	0.1010*
Foreign (US) Inflation	-34.535*	10.2066*	-5.0205*	12.7280*	-6.1774*	3.0914*
ΔMoney Multiplier	0.0008	0.0347*	-0.0473*	0.0326*	0.0107*	0.0015
ΔCommodity Price Index	-0.134*	-0.0205*	0.1336*	-0.0060	-0.0266*	-0.0199*
R^2	-0.01	0.45	0.03	0.08	0.43	0.03
Rw^2	0.84	0.75	0.33	0.17	0.81	0.06
Deviance	60.65	227.25	2132.41	3726.38	324.34	559.30
Prob. (Rn-Square Statistics)	0.00	0.00	0.00	0.00	0.00	0.00
JB-Statistics (Prob.)	0.00	0.00	0.00	0.00	0.00	0.00
No. of Observations	159	177	177	179	179	179

Source: Author's Estimation and EViews9.5 Output

In the results in Table 8 above and Table 9 below, the estimations of the RLS regression show that almost all the coefficients are significant at 1% level of significance except for The Gambia's money multiplier, Ghana's and Sierra Leone's real GDP growth and commodity price index change for Liberia. In the estimation of EMP without the inclusion of the sensitivity factor, Table 9 reveals that for all the WAMZ countries, correct theoretical signs were reported for domestic credit growth (except for Sierra Leone), for domestic real GDP growth (except for Ghana and Liberia). For the countries with the correct signs in domestic credit growth, these are indications that currency depreciation and depletion of reserves in these countries were caused by this factor. What the results of the domestic real GDP growth portend is that through reserve accumulation and domestic currency appreciation, this variable only influences EMP in The Gambia, Guinea, Nigeria and Sierra Leone. Foreign (US) inflation only yielded the

correct theoretical sign in the cases of Ghana, Liberia and Sierra Leone indicating these as countries in which foreign inflation affects EMP. By the implication of this, foreign inflation does not affect exchange market pressures in Nigeria, the lead economy. Money multiplier produced the correct sign only for Guinea with the implication that virtually in all countries of the WAMZ (except Guinea), increase in money neither led to international reserve depletion nor domestic currency depreciation. Primary commodity index change yielded the correct sign only for Guinea, meaning that apart from Guinea, commodity price change does not increase reserves and does not cause domestic currency appreciation. This could be attributed to the global financial downturn and the downward trend in the prices of primary commodity over the period covered by this study. Explanatory powers of these coefficients are strong, particularly strongest across board in foreign inflation. For the measure of goodness-of-fit, R_w-squared (which is more appropriate for RLS regression) is high at 84% and 81% explanations of variations in the model in the cases of The Gambia and Nigeria respectively, but very poor at 6% for Sierra Leone. The p-values of 0.00 of the R_n-squared statistics reported for all the WAMZ countries indicate the strong rejection of the null hypothesis (the RLS version of Wald test) that all the non-constant estimated parameters are equal to zero, implying that all the variables employed could be included in the model. However, the p-values of the Jarque-Bera (J-B) statistics at 0.00 across all estimations points to the rejection, at 1% level of significance, of the null hypothesis of normal distribution of the residuals. Generally across the WAMZ, the results of the evaluation of the EMP (without the monetary response factor) reveal a quite good number of similarities in the parametric responses from the estimated augmented G-R model of EMP. It is significant that the results for the lead economy in the WAMZ are all according to theoretical postulations and with high goodness-of-fit. When the sensitivity factor of monetary authority's response was introduced into the EMP model, the results in Table 9 below show significant coefficients (at 1% level of significance) of the variable of sensitivity factor for the WAMZ countries (except for Guinea); and positive for all the countries (except for Liberia).

Table 9: Results of the Robust Least Square Regression Estimation of Exchange Market Pressure Model (With Monetary Response)

Independent Variables	*Gambia*	*Ghana*	*Guinea*	*Liberia*	*Nigeria*	*S/Leone*
Constant	-0.1036*	-0.7547*	-1.4507*	2.8422*	-2.4097*	-0.1369*
ΔDomestic Credit/Money Base	-0.2014*	-2.2472*	-69.4250*	-	-0.1720*	0.1825*
Domestic Real GDP Growth	0.7311*	-0.0517	3.4200*	0.03636*	2.6536*	0.1010*
Foreign (US) Inflation	34.714*	10.2191*	-5.0092*	-1.1595*	-5.3313*	3.0906*
ΔMoney Multiplier	0.0010	0.0362*	-0.0472*	13.2776*	0.0094*	0.0014
ΔCommodity Price Index	-0.0149*	-0.0203*	-0.1334*	0.03775*	-0.0240*	-0.0197*
Monetary Response	0.0055*	0.0185*	0.009	-0.0042	0.2819*	0.00***
				-0.1601*		
R^2	-0.00	0.45	0.03		0.44	0.03
Rw^2	0.85	0.75	0.33	0.09	0.82	0.06
Deviance	56.59	232.91	2131.38	0.18	300.05	559.69
Prob. (Rn-Square Statistics)	0.00	0.00	0.00	3336.60	0.00	0.00
JB-Statistics (Prob.)	0.00	0.00	0.00	0.00	0.00	0.00
No. of Observations	159	179	179	0.00	179	179
				179		

Source: Author's Estimation and EViews9.5 Output

What the significance of the variable of monetary response denote is that monetary authorities in The Gambia, Ghana, Nigeria and Sierra Leone (given the positive and significant coefficients) absorb more pressure through the depreciation of domestic currency, relative reserve depletion, while in Liberia, more market pressure were absorbed by reserve depletion, relative to currency depreciation. Monetary authority in Guinea was sensitive to none of the EMP components. One general implication here is that if Nigeria, with the strongest positive significant coefficient of the monetary authority sensitivity factor at 0.2819 going to control over 90% of the economy of the WAMZ, it is therefore of high expectation that exchange market pressure will be absorbed more by depreciating the common currency. This is more appropriate in an exchange market integration.

5. Conclusions

The investigations of exchange markets pressures conducted in this research study to determine the vulnerability of the WAMZ countries to possible currency crisis (given past trends) produced the evidence to suggest that the six WAMZ countries may not likely to be vulnerable to currency crisis which may mar the eventual exchange market integration. The RLS estimations of the G-R model of exchange market pressure revealed uniform parametric responses to exchange pressures across the WAMZ. It is also significant that foreign (US) inflation has no influence on exchange market pressure

in the WAMZ's leading economy. However, evidences gathered revealed mixed forms of the absorption of market pressure in the WAMZ, with the majority of the member countries of the WAMZ (including the lead economy) absorbing exchange market pressure through domestic currency depreciation relative to reserves depletion. These prompts the conclusion that in the eventual monetary union, foreign exchange market pressures are likely to be absorbed more by depreciation of the common currency rather than the depletion of reserves.

Further assessments with higher frequency quarterly data revealed the failure of the models of exchange rate to hold while the cointegration of exchange rates and the fundamentals could not be established. Although, there were some few similarities in signs and magnitude of the explanations offered by exchange rate determination fundamentals, these similarities were not strong enough. Consequently, from the results of the assessments with both annual and quarterly data it cannot be confidently inferred that a common exchange rate and a single foreign exchange market is feasible for the WAMZ countries in the proposed single currency area. The adoption of a single exchange rate in a common foreign exchange market should therefore be considered with caution. The foreign exchange market is likely to be free from future currency crisis. Because of the possible and expected massive influence of Nigeria in the foreign exchange market, foreign inflation may not hugely impact the proposed exchange rate and the external value of the proposed single currency.

References

Bensaid, B., and Jeanne O. (1997). "The Instability of Fixed Exchange Rate Systems When Raising the Nominal Interest Rate Is Costly." *European Economic Review* 41(8):1461–178.

Bussiere, M and Mulder, C. (1999). 'External Vulnerability in Emerging Market Economies: How High Liquidity Can Offset Weak Fundamentals and the Effects of Contagion.' *IMF Working Paper* No, 98/99. July.

Dekle, R. Hsiao, C. and Wang, S. [1999] "Interest Rate Stabilization of Exchange Rates and Contagion in the Asian Crisis Countries," paper presented at the 1999 Pacific Basin Conference, San Francisco (September).

Eichengreen, B., Rose, A., and C. Wyplosz (1996). 'Contagious Currency Crises' *NBER Working Paper* No. 5681, July 1996.

Flood, R. P., and Jeanne, O. (2000). "An Interest Rate Defense of a Fixed Exchange Rate?" *International Monetary Fund Working Paper* WP/00/159. Washington, D.C.

Frenkel, J. A. (1976). 'A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence'. *Scandinavian Journal of Economics*, 1976, 78(2):200-24.

Frenkel, J. and Rose, A. (1996),' A Panel Project on Purchase Power Parity: Mean Reversion within and Between Countries', *Journal of International Economics*, 40 pp. 209-224.

Furman, J., and Stiglitz, J. E. (1998). "Economic Crises: Evidence and Insights from East Asia." Brookings Papers on Economic Activity 2. Washington, D.C.: Brookings Institution.

Girton, L. and D. Roper (1977) 'A Monetary Model of Exchange Market Pressure Applied to the Postwar Canadian Experience'. *American Economic Review*, 67, pp. 537-548.

Goldfajn, I., and P. Gupta. (1999). "Does Monetary Policy Stabilize the Exchange Rate Following a Currency Crisis?" *International Monetary Fund Working Paper* WP/99/42. Washington, D.C.

Gould, D. M., and Kamin, S. B. (2000). "The Impact of Monetary Policy on Exchange Rates During Financial Crises." International Finance Discussion Paper 669. Board of Governors of the Federal Reserve System, Washington, D.C.

Gujarati, D. (2015). '*Econometrics by Example'*. London: Palgrave Macmillan Publisher.

Gujarati, D. N. and Porter, D.C. (2010). '*Essentials of Econometrics'*. New York: McGraw Hill.

Hill, R.C., Griffiths, W.E. and G. C. Lim (2008). '*Principles of Econometrics'*. New Jersey: John Wiley & Sons.

Kaminsky, G. L., and Reinhart, C. M. (1999). "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems." *American Economic Review*, 89 (3): 473-500.

Lahiri, A. and Vegh, C. A. (2003). "Delaying The Inevitable: Interest Rate Defense And Balance Of Payments Crises," *Journal of Political Economy*, 3(2):404-424.

Mussa, M. (1976). 'The Exchange Rate, the Balance of Payments and Monetary and Fiscal Policy under a Regime of Controlled Floating.' *Scandinavian Journal of Economics*, 78(2):229-48.

Sachs, J., Aaron Tornell, A. and Velasco, A. (1996). 'Financial Crises in Emerging Markets: The Lessons from 1995.' *Brookings Papers on Economic Activity*, 1996, No. 1 (vol. 27): 147-199.

Tanner, E. (2001). 'Exchange Market Pressure and Monetary Policy: Asia and Latin America in the 1990s' *IMF Staff Paper*, 47 (3).