Monetary Reactions in the West African Monetary Zone: Evaluation of Homogeneity and Expected Loss of Monetary Independence

By

Peter Kehinde Mogaji
(University of Sunderland in London)

Abstract

The West African Monetary Zone formally came into existence in 2000. Currently the monetary zone has six members: The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone. The objective of the WAMZ is to establish a monetary union characterised by a common central bank and a single currency (the eco), to replace the existing national currencies of members. The focus of this paper is to assess monetary reactions across the WAMZ and determine if these monetary reactions are closely similar across the proposed monetary zone. Further to this, the degree of monetary independence loss by five member countries of the WAMZ in the event of the take-off of the proposed monetary integration are also evaluated. The theoretical foundation of this paper is the general monetary theory postulation that a dual relationship exists between monetary policy actions and how some variables (real/nominal) develop. Monetary policy impacts real and nominal variables (at least in the short run); but the monetary policy actions in themselves are however subject to prior realisation of the particular variable. Monetary policy reaction functions are estimated to account for that relationship. The response of policy instrument to movements in fundamental macroeconomic variables of inflation and output gap is simply the reaction function. This paper models the monetary policies of the WAMZ member countries in line with the hybrid McCallum-Taylor Rule (HMTR) which is a modification of the popular Taylor Rule. This HMTR reaction function expresses the money supply growth rate as a function of the output gap growth and inflation gap growth. Since it is not automatic for a country joining a monetary union to lose its monetary autonomy given the principle that a country can only lose what it has. Therefore, the WAMZ countries making up the proposed monetary union can only lose monetary autonomy only if they actually have such autonomy, away from the influence of the anchor country's (Nigeria) monetary policy or rather if their respective monetary policy is independent of the anchor country's (Nigeria) policy. Countries joining a monetary union are therefore expected to incur economic cost of formally adopting a common monetary policy by joining the full monetary union. This hypothesis is tested in the second aspect of this paper with the application of a simple McCallum monetary base related model, augmented with Nigerian policy variable to determine the degree of monetary policy independence loss by the five WAMZ countries that would eventually abandon their respective countries' currencies and be part of the proposed monetary union. Annual data of nominal GDP, inflation rate, money supply, and commodity price index for the WAMZ countries were applied in these assessments. These data cover the period 1980 to 2014. The Hodrick-Prescot method was applied to filter the potential (trend) from the actual data. The monetary reaction homogeneity assessments have evidence to suggest that all things being equal and if past behaviour of the macroeconomic variables evaluated for the WAMZ countries are factors of significance and relevance, a single monetary policy may not be suitable for the future monetary zone. The main proof here are the diverse forms of reactions of the monetary policy instrument to inflation and output. Evidence from the evaluation of the extent of expected loss of monetary independence by the WAMZ countries indicate that the degree of loss of monetary independence would be high in The Gambia and Liberia, the extent of this loss would be low in the cases of Ghana and Sierra Leone.

1.1 Introduction

The Economic Community of West African (ECOWAS) has a long term objective of establishing an economic and monetary union between all member countries.When ECOWAS revised its Treaty in 1993, the crucial aim was to accelerate the economic integration process and strengthen political cooperation. The revised objectives heralded the formation of a second monetary zone, the West African Monetary Zone (WAMZ) which formally came into existence on 15 December, 2000 when five prospective member countries (The Gambia, Ghana, Guinea, Nigeria and Sierra Leone) signed the Articles of Agreement of the zone. This Accra Declaration established the WAMZ. At the ECOWAS, the thinking was that the successful launch of the WAMZ would aid the merger with the CFA zone and that this would usher-in the ECOWAS single currency, the *eco*. The establishment of a monetary union characterised by a common central bank and a single currency (*the eco*) which is to replace the existing five national currencies is the main objective of the WAMZ which was initially scheduled to take-off in January 2003. Liberia later joined the WAMZ in 2010.

A mid-term convergence assessment in 2002 revealed that despite some achievements by WAMZ member countries, these were not adequate enough support the take-off of the monetary union in January 2003. A major problem was the inadequate commitment of member countries of WAMZ to support their commitment expressed with actions. This consequently led to the extension of the WAMZ programme to 30 June, 2005 so that the common central bank and the common currency would take off on 1 July 2005. Another deadline of 31 December, 2009 was set for the single currency and the common central bank to be effective from 1 January 2010. Due to same reasons this could not be met. The official reason for this action was stated as "the global economic and financial crisis which has put constraints on member state's ability to meet the convergence criteria individually and collectively". The last agreed take off date of 1 January 2015 actually became unrealistic thus bringing about heavy

cloud over the take-off of the monetary union.[1] It is necessary to state that as at date, the WAMZ has no definite take-off date.

Similarities of macroeconomic fundamental are key in a currency area, serving as huge determinant of the cost of surrendering monetary policy autonomy by countries involved in such monetary integration. With similarities in macroeconomic and monetary fundamentals, there would be no necessity for individual economic policy responses in addressing macroeconomic and monetary shocks across member countries. What this entails is that monetary factor symmetries would cause a single monetary policy for a currency area to suffice. Contrarily, when monetary fundamentals are asymmetric, individual monetary and economic policies are necessary in dealing with the monetary and economic disturbances. Therefore, the higher the degree of homogeneity of monetary reactions the better the countries involved in a monetary integration are suited as a monetary union characterised by a single monetary policy.

The aim of this paper, therefore, is to examine monetary reactions in the WAMZ, evaluating their similarities among member countries as well as investigating the degree of expected loss of monetary independence by these countries on the eventual take-off of the proposed monetary integration. A research question to answer is if there are similarities among the reactions of monetary policy instruments (money supply growth) in reaction to economic fundamentals in the WAMZ. Results generated from this paper have information for the design of a future common monetary policy for the proposed monetary union. The investigation into the expected loss (indirectly to Nigeria, a possible lead country) of monetary independence will provide answers to the research question pertaining to the level of monetary independence that would be conceded to Nigeria by the other five WAMZ

[1] From all indications, towards the January 2015 take-off of the monetary union, the WAMZ member countries found it difficult to meet the convergence criteria.

countries, given the 'domineering' big economic size of Nigeria and the expected domination of the monetary zone by Nigeria.

1.2 Theoretical Background:

A general monetary theory postulation is that a dual relationship exists between actions regarding monetary policy actions and how some variables (real/nominal) develop. Although, monetary policy impacts real and nominal variables (at least in the short run), the monetary policy actions in themselves are however subject to prior realisation of the particular variable. Monetary policy reaction functions are estimated to account for that relationship. The response of policy instrument to movements in fundamental macroeconomic variables of inflation and output gap is simply the reaction function. As a simple policy rule, the Taylor Rule (TR) reflects the reaction of short term interest rate to the deviations of inflation from its targets as well as the deviations' of output from its potentials. The TR is thus a monetary policy reaction function in which the policy interest rate reacts to shocks to inflation and also to shocks to output gap. By the implications of the reaction function, the Hybrid McCallum Taylor Rule (HMTR) reaction function applied in this paper expresses the money supply growth rate a function of the output gap growth and inflation gap growth. Whenever the rate at which output exceeds its potential is rising, this signals inflationary pressures and consequently, the monetary authority should reduce the rate of money supply growth in order to accommodate such pressure. Similarly, when the degree at which inflation rate deviates from its desire rate is fast, the policymaker should reduce money supply growth rate. The degree of homogeneity in the monetary reactions of member countries of a monetary union serves as an appropriate pointer to the magnitude of similarity of the aggregated shocks hitting these individual economies. In assessing the homogeneity of monetary policies of the WAMZ countries, it is therefore necessary to estimate monetary reaction function equations for these countries since there are tendencies that the zone's future monetary policy may

deviate from rules when aiming at accommodate macroeconomic goals other than price stability and economic growth.

During the pre-EMU formation period, there were views that when a country abandons its own national currency for a common currency, there would be a loss of a policy instrument.[2] Countries joining a full monetary union are therefore expected to incur economic cost of formally adopting a common monetary policy. Nevertheless, it is not automatic for a country joining a monetary union to lose its monetary autonomy whenever it is involved in monetary cooperation and integration. The simple principle is that a country cannot lose what it does not have, or rather a country can only lose what it has. And so, the WAMZ countries making up the proposed monetary union can only lose monetary autonomy only if they actually have such autonomy, away from the influence of the anchor country's (Nigeria) monetary policy or rather if their respective monetary policy is independent of the anchor country's (Nigeria) policy which can be used in influencing the economy.[3]

Interestingly, the hypothesis tested here is within the context of the WAMZ countries and the dominance of Nigeria within the monetary zone. For the WAMZ's five smaller economies, a simple McCallum monetary base related model, augmented with Nigerian policy variable, is appropriately employed in testing the hypothesis in order to determine the degree of monetary policy independence loss by the five WAMZ countries that would eventually abandon their respective countries' currencies and join the monetary union. Instead of nominal interest rate, McCallum rule applies monetary base as a monetary policy instrument due to: (a) the ease of control of monetary base variable by the monetary authority; and (b)

[2] There were counter opinions in the context of Eurozone creation, indicating that such view was as 'unreal'.

[3] Given the size of the economy of Nigeria, which is around 89% of the entire GDP of the WAMZ, this study consequently regards Nigeria as the potential anchor country for the proposed monetary zone; and for this reason, the evaluation of the nature of the reactions of monetary policies of other WAMZ economies to Nigeria's monetary policy was carried out.

the ambiguity in contracting or expanding the monetary policy stance when interest rate is the applied monetary policy tool. Because of the dominance of the Nigerian Naira within the proposed monetary zone, this test would check if the change in monetary base of other five members are driven by the change in the Nigerian monetary base. The determining logic is that the higher the degree of the influence of the Nigerian monetary base change on a WAMZ country's base money supply change, the lower the degree of loss of monetary autonomy on eventual formation of the second West African monetary union.

1.3 Models Specifications

Member countries of the WAMZ are developing/emerging economies. Due the underdevelopment of financial markets (money and capital markets) in these developing/emerging countries, it is common that the effect of interest rate on inflation as manifested in the monetary policy transmission mechanisms in these countries are very sluggish and should not have attracted much attention being offered by the TR, at least in the case of these developing economies. Furthermore, in these developing countries of inflation targeting, money aggregate may be playing more pronounced significant roles. For these reasons, monetary base aggregate is introduced here as a variable. This appears to be a more appropriate alternative monetary reaction function for developing/emerging countries.[4] This novel step deviate from many studies on monetary reactions analyses.

The central point of reasoning here is that the monetary base could better be manipulated to control inflation thus:

$$\Delta M_t = \alpha - V_t + \gamma inf g_t \qquad 1$$

[4] McCallum (1988)

Where ΔM_t is the growth rate of monetary base (M_1), and $V_t$is the monetary base velocity γ is the parameter indicating how output deviation reach its target value with monetary base (which is the policy instrument in this case). If the equation (1) is adapted into the TR, it becomes the hybrid McCallum-Taylor rule (HMTR) modelled as:

$$\Delta M_t = \alpha + \beta \Delta inf g_t + \gamma \Delta y g_t + \varepsilon_t \quad 2$$

In lending weight to the views of Goodhart and Hofman, (2002), because the decision making process of the policymaker depends on many economic indicators apart from output gap and deviations from inflation, there may be spurious and questionable estimation results if some relevant variables are omitted. Therefore, for developing open economies of the WAMZ countries, this study considers the inclusion of the deviations of annual percentage change of primary commodity price from its potentials, in the model of monetary policy rules for the WAMZ. In justifying the inclusion of the percentage change in commodity price in the monetary policy rule, it is more appropriate for a commodity exporting economy to take movements in commodity price index into cognisance. The justification here is that such commodity price movements cause huge fluctuations in exchange rates and real economic activity. For inflation targeting open economies, the reaction function respond first to external disturbances, among a collection of extensive information. Thus the necessity for taking cognisance of the relevance of commodity exports in monetary policy. For the purposes of money supply growth rate smoothing and the associated inertia, the HTMR was augmented with one-period lagged growth rate of money supply. To this effect, the four variables of interest for the purpose of assessing the similarities in monetary reactions in the WAMZ in this novel contributions are annual change of inflation deviation from its potentials, growth rate of output gap, the growth rate of the deviation of the WAMZ country specific average commodity price from its potential and the lagged money supply growth.

Generally, policymakers make policy decisions based on the evaluation of future economic condition rather than contemporaneous condition, even as monetary policy is effective only with the incorporation of lags. TR is essentially 'forward-looking' if the CB as policymaker reacts to some expectations of inflation and output. CBs are able to establish the incorporation of past or current economic condition and the significant inclusion of economic forecasts in their macroeconomic policy statements and some authors have asserted the consistency of forward-looking monetary policy reaction functions with observed behaviour of CBs.[5]

In order to control for past effects and expectations of the growth rates of these variable, their one-period leads and lags were added to the right hand side of the model as independent variable. For the purposes of money supply growth rate smoothing and the associated inertia, the HTMR was augmented with one-period lagged growth rate of money supply. Time trend is introduced into account from the pattern of the shift in the equation function and to determine across the WAMZ countries, the relevance of time in the determination of the influence of independent variable as well as the degree of its impact on annual growth rate of money supply. Given these, applying the OLS estimation method, the model to estimate (with reflects the leads and lags of the three independent variables), is expressed as:

$$\Delta M_t = \alpha + \beta_1 \Delta M_{t-1} + \beta_2 yg_t + \beta_3 infg_t + \beta_4 cmpg_t + \gamma_1 yg_{t-1} + \gamma_2 infg_{t-1} + \gamma_3 cmpg_{t-1} + \delta_1 yg_{t+1} + \delta_2 infg_{t+1} + \delta_3 cmpg_{t+1} + \theta T_t + \varepsilon_t \quad 3$$

where T is the time trend. β_1 is the parameter of the degree of 'monetary policy inertia'; this, in addition to β_2 , β_3 and β_4, are the parameters of interest for monetary reaction comparison across the WAMZ.

[5] Clarida, Gali and Gertler (2000) and Orhanides (1998)

For expected loss of monetary independence, coming from the McCallum monetary base theoretical underpinnings, the equation that would reveal how the five smaller economies within the WAMZ (The Gambia, Ghana, Guinea, Liberia, and Sierra Leone) respond to changes in monetary base of the possible anchor economy, Nigeria reflecting the elongation on the right hand of the model with the Nigerian base money supply changes, is given as:

$$\Delta m_t = (\pi_t - \pi^*)_t + (y_t - y_t^*)_t + \Delta m_t^N \quad 4$$

Where $(y_t - y_t^*)_t$ is the output gap at time t, $(\pi_t - \pi^*)_t$ is the inflation deviation at t, Δm_t^N is the potential anchor monetary base growth rate (that is, monetary base of Nigeria) while Δm_t is monetary base change in the five smaller WAMZ countries at time t. Generally, there have been strong supports for the inclusion of lagged variables in OLS regressions to be more valuable in yielding unbiased results. Hence, for the purpose of determining the expected loss of monetary independence by the five smaller WAMZ economies, the contemporaneous and backward-looking monetary base models estimated are respectively specified as:

$$\Delta m_t = \alpha + \beta_1(\pi_t - \pi^*)_t + \beta_2(y_t - y_t^*)_t + \beta_3 \Delta m_t^N + \varepsilon_t \quad 5$$

and

$$\Delta m_t = \alpha + \gamma_1(\pi_t - \pi^*)_{t-1} + \gamma_2(y_t - y_t^*)_{t-1} + \gamma_3 \Delta m_{t-1}^N + \varepsilon_t \quad 6$$

In these models, for the purpose of meeting the research objectives here, the parameters of interest are β_3 and γ_3.

1.4 Data and Methods

Annual data of nominal GDP, inflation rate, money supply, and commodity price index were employed in these assessments. These data span over the period between 1980 and 2014. Nominal GDP and money supply data taken in the local currency units are expressed in

logarithmic form. Inflation rate is taken as the year-on-year changes in inflation calculated with the GDP deflator. The country-specific primary commodity prices employed in this work were constructed as the average of the prices of the top three exports primary commodities of each country; and the annual percentage change in the average commodity price were estimated and applied. In the calculation of the deviations from the potential, of nominal GDP, of inflation rate and of the country-specific commodity prices, the Hodrick-Prescot (with lambda (λ) =100 for annual data) filter method was applied to filter the potential (trend) from the actual data.

To ensure the stationarity of the variables used, the Augmented Dickey-Fuller (ADF) unit root tests were carried out as the pre-estimation stage diagnosis. The OLS method was employed in estimating the monetary reactions coefficients for the countries under assessment and reactions of the monetary base changes in the five WAMZ countries to the Nigerian monetary base change (depicting the extent of loss of monetary independence by the five WAMZ countries). In order to ensure parameter stability and avoid biased, inefficient and spurious estimations, some post-estimation diagnostic tests were carried out and necessary adjustments made.

1.5 Results and Findings

In Table 1 below, we have the outcomes of the ADF unit roots tests on the variables employed. The results reveals that at 5% level of significance, inflation gap and commodity price gaps are stationary at their levels. For five WAMZ countries (excluding Nigeria), output gap is stationary, but made stationary for Nigeria at the second order differencing.

Table 1: Results of the ADF Unit Roots Tests

	Gambia	*Ghana*	*Guinea*	*Liberia*	*Nigeria*	*S/Leone*
Δ***Money Supply***						
(Level):	-6.9600*	-5.3255*	-5.9122*	-3.030**	-3.3691**	-5.4827*
(1st Difference):				-7.5763*	-8.1889*	
Δ***Nominal Output Gap***						
(Level):	-6.4725*	-5.6319*	-3.8685*	-5.3692*	-2.5475	-5.2661*
(1st Difference):					-2.7687***	
(2nd Difference):					5.6281*	
Δ***Inflation Gap***						
(Level):	-6.4505*	-4.6722*	-3.7486*	-5.5274*	-6.6187*	-5.6038
Δ***Commodity Price Gap***						
(Level):	-6.6687*	-6.3313*	-6.2279*	-6.3313*	-6.1138*	-6.3313*

Source: Author's Estimation and EViews 7 Output
Note: For the unit roots tests *, ** and ** denote 1% and 5% levels of significance respectively.

The estimation of the augmented HMTR models exhibited in Table 2 below show that the leads and lags of output gap, inflation gap and commodity price gap are generally not statistically significant at 5% level. It is also apparent that apart from the statistical significance at 10% of commodity price gap, only in the case of Guinea, this variable is not significant in other cases. Due to these, these insignificant variables were deleted form the model of HMTR.

Table 2: Results of the Estimation of the Augmented HMTR Monetary Reactions

Dependent Variable: ΔMoney Supply						
	Gambia	***Ghana***	***Guinea***	***Liberia***	***Nigeria***	***S/Leone***
ΔMoney Supply(t-1)	-0.2613	-0.2962***	-0.7033**	-0.4141***	-0.3121	0.4103***
ΔOutput Gap	0.9122*	-0.0006	0.7538*	0.0210	-0.0689	0.8400*
ΔInflation Gap	-0.9497	-0.3213*	-0.8478*	0.5450	-0.0403	-0.9494*
ΔCommodity Price Gap	0.0049	0.0890	0.0216***	-0.0309	-0.0624	0.0517
ΔOutput Gap(t-1)	0.2237	-0.0081	0.4696	-0.1101	-0.0441	-0.2811
ΔInflation Gap(t-1)	-0.2462	-0.1690***	-0.5078	0.6177	-0.0122	0.3529
ΔComm. Price Gap(t-1)	-0.0141	0.0969	0.0147	-0.0812	-0.0352	0.0465
ΔOutput Gap(t+1)	-0.0207	0.0699	-0.2097	0.1561**	0.0007	-0.0263
ΔInflation Gap(t+1)	0.2300	-0.1552	0.1413	-1.0753	-0.0050	0.0661
ΔComm. Price Gap(t+1)	-0.0044	0.0491	0.0174***	-0.1258	-0.0244	0.0561
Time Trend	0.0004	0.0025	-0.0009*	-0.000	-0.0009	0.0015
R2	0.88	0.57	0.88	0.47	0.29	0.80
DW-Statistics	1.57	2.19	1.42	2.20	2.07	1.83
F-Statistics	13.7778	2.4358	9.6011	1.5283	0.6717	7.4914
	(0.00)	(0.04)	(0.00)	(0.20)	(0.75)	(0.00)
Diagnostic Tests						
JB Statistics for	5.8675	2.5983	0.3791	14.6123	0.0953	0.7932
Normality	(0.05)	(0.27)	(0.83)	(0.00)	(0.95)	(0.67)
Breusch-Godfrey	3.1045	3.9608	3.3809	1.3028	0.5218	0.1796
Autocorrelation	(0.08)	(0.05)	(0.07)	(0.25)	(0.47)	(0.67)
Breusch-Pagan-Godfrey	12.2058	11.6859	14.0756	4.7036	8.2562	12.5194
Heteroscedasticity	(0.35)	(0.39)	(0.23)	(0.94)	(0.69)	(0.53)
Ramsey-RESET	0.0909	1.1924	1.4723	0.3498	1.6656	0.6867
Functional Form	(0.93)	(0.25)	(0.16)	(0.73)	(0.11)	(0.50)

Source: Author' Estimation and EViews 7 Output

Note: *, ** and ** denote 1% and 5% levels of significance respectively. The p-values are in parentheses.

Following the deletion of the insignificant variables from the earlier estimated model, in a consequential HMTR model estimated, the results in Table 3 below indicate that output gap coefficients are positive for all countries apart from the coefficient for Nigeria, while inflation gap coefficients reflect negative signs for all the WAMZ countries. The coefficients of determination (R^2) measuring the goodness of fit of the model are low for in three countries. The Durbin-Watson (DW) statistics testing serial correlation are reasonably good. However, the closeness to 2 of the DW statistics may be as a result of distortions brought about by the inclusion of lagged dependent variable (lagged money supply growth) in the model. The post-estimation diagnostic tests however show that The Gambia, Ghana and Liberia failed the essential residual normality tests as revealed by the significance at 5% level of significance of J-B statistics and there is serial correlation in the case of Guinea. The functional form

Regression Error Specification Test (RESET) is significant at 5% level, only for Liberia, thus suggesting non-linearity of the explanatory variables. Multicollinearity checks were performed through the estimation of the variance inflation factors (VIF) which reveal some collinearity, following the standard in which a VIF of more than 4 calls for further analysis while a VIF of greater than 10 signals high level of collinearity.

Table 3: HMTR Monetary Reactions Augmented (with money supply growth smoothing and time trend)

Dependent Variable: ΔMoney Supply						
	Gambia	***Ghana***	***Guinea***	***Liberia***	***Nigeria***	***S/Leone***
ΔMoney Supply(t-1)	-0.0307	-0.1192	-0.2442**	0.3538***	0.3878**	0.1839**
ΔOutput Gap	0.9038*	0.0034	0.9461*	0.0625	-0.0423	0.9025*
ΔInflation Gap	-0.9433*	-0.1928*	-1.0108*	-0.5109	-0.0592	-1.0128*
ΔTime Trend	0.0002	0.0020**	-0.0007	0.0057	0.0011	0.0020
R2	0.86	0.35	0.80	0.35	0.31	0.75
DW-Statistics	2.15	1.77	2.53	2.06	1.98	1.65
F-Statistics	45.0620	3.785	22.6849	3.7344	3.0973	21.2541
	(0.00)	(0.01)	(0.00)	(0.01)	(0.03)	(0.00)
Diagnostic Tests						
JB Statistics for Normality	6.5787	7.4332	2.7208	7.8234	0.9882	1.4346
	(0.04)	(0.02)	(0.26)	(0.02)	(0.61)	(0.49)
Breusch-Godfrey Autocorrelation	0.5115	0.0187	3.4044	0.2122	0.6623	1.4075
	(0.47)	(0.89)	(0.07)	(0.65)	(0.42)	(0.24)
Breusch-Pagan-Godfrey Heteroscedasticity	7.7089	2.1732	3.1987	3.8302	5.5550	0.6275
	(0.13)	(0.70)	(0.53)	(0.43)	(0.23)	(0.96)
Ramsey-RESET Functional Form	0.0054	0.0045	1.7502	9.2321	0.4331	1.2642
	(0.94)	(0.95)	(0.20)	(0.00)	(0.52)	(0.27)
Variance Inflation Factors:						
ΔMoney Supply(t-1)	1.928	1.197	1.821	1.795	1.250	1.372
Output Gap	30.535	1.161	40.977	1.460	3.238	29.998
Inflation Gap	33.937	1.127	42.791	1.117	3.522	26.835

Source: Author' Estimation and EViews 7 Output
Note: *, ** and ** denote 1% and 5% levels of significance respectively. The p-values are in parentheses.

In proffering solution to problems detected by the post-estimation diagnostic tests, firstly, there were checks on the residual plots of The Gambia, Ghana and Liberia in efforts to attend to the related non-normality of the disturbance terms, which reveal some outliers. These outliers were removed and the model of monetary reaction was re-estimated, resulting in outcomes in Table 4 below.

Table 4: Adjusted HMTR Monetary Reactions Augmented (with monetary growth smoothing and time trend)

Dependent Variable: ΔMoney Supply						
	Gambia	***Ghana***	***Guinea***	***Liberia***	***Nigeria***	***S/Leone***
ΔMoney Supply(t-1)	-0.0675	-0.0799	-0.2442**	0.5846*	0.3582**	0.1839**
ΔOutput Gap	0.9425*	0.01552	0.9461*	-0.0625*	-0.0477	0.9025*
ΔInflation Gap	-0.9799*	-0.2033*	-1.0108*	0.2250	0.0175	-1.0128*
Time Trend	-0.001	0.0009	-0.0007	0.0018	0.0011	0.0020
R2	0.97	0.56	0.80	0.80	0.33	0.75
DW-Statistics	1.61	1.51	2.53	1.02	1.91	1.65
F-Statistics	181.0444	8.0833	22.6849	21.4489	3.3203	21.2541
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)
Diagnostic Tests						
JB Statistics for Normality	0.3882	5.2736	2.7208	0.3591	3.8664	1.4346
	(0.82)	(0.07)	(0.26)	(0.84)	(0.14)	(0.49)
Breusch-Godfrey	0.0916	2.2842	3.4044	1.5853	0.1594	1.4075
Autocorrelation	(0.76)	(0.13)	(0.07)	(0.21)	(0.69)	(0.24)
Breusch-Pagan-Godfrey	4.1098	2.4155	3.1987	4.4371	3.7520	0.6275
Heteroscedasticity	(0.39)	(0.66)	(0.53)	(0.35)	(0.44)	(0.96)
Ramsey-RESET	0.5678	3.5085	1.7502	0.5207	0.6581	1.2642
Functional Form	(0.46)	(0.07)	(0.20)	(0.48)	(0.52)	(0.27)
Variance Inflation Factors:						
ΔMoney Supply(t-1)	1.1173	1.6335	1.821	7.5338	1.252	1.372
Output Gap	13.5314	1.2732	40.977	6.4400	1.360	29.998
Inflation Gap	13.1822	1.3019	42.791	1.5518	1.330	26.835

Source: Author' Estimation and EViews 7 Output
Note: *, ** and ** denote 1% and 5% levels of significance respectively. p-values are in parentheses.

The results fail to reveal similarities in monetary reactions across the WAMZ. The output gap reactions are negative for Liberia and Nigeria, while inflation gap coefficients are significantly negative for four WAMZ countries (The Gambia, Ghana, Guinea and Sierra Leone); and for output gaps and inflation gaps, the magnitudes of reactions are significantly higher for The Gambia, Guinea and Sierra Leone. These depicts similarities just in three countries of the WAMZ. What these means is that holding inflation gap and the effects of past money supply constant, an increase by one unit of output gap, the change is expected to be positive in the Gambia, Ghana, Guinea and Sierra Leone (but negative in the case of Liberia and Nigeria). On the other hand, if inflation gap increases by one (holding the output gap and the money supply growth inertia constant), money supply growth would be positive for Liberia and Nigeria, and negative for The Gambia, Ghana, Guinea and Sierra Leone. These changes would all be at the magnitude of the parameter coefficients yielded in Table 4

above. The low coefficients of time trends across all the WAMZ countries suggest that time is not important in the determination of the impact of output gap annual growth and inflation deviation annual changes (including the effect of past money supply growth) on contemporaneous money supply growth. However, the statistical insignificance in these results are not overlooked as the implying level of confidence with which inferences are drawn here.

The results of the diagnostic tests show tremendous improvement over those yielded by the earlier estimation. However, With the VIFs in 40s, 20s and 10s, The Gambia, Guinea and Sierra Leone still failed the multicollinearity tests evidencing high degree of inflation of the variances of the estimated coefficients of output gaps and inflation gaps as well as correlation between these two independent variables. Solving these problems at this level, the 'centring' solution was made in which the respective mean of output gaps and inflation gaps for these three countries were calculated and new variables of output gap and inflation gap generated as the deviation of the original value of these variables from the calculated mean value. These efforts yield no different results.

Findings gathered from the monetary reaction analyses is that monetary reactions in the WAMZ are only significantly similar around The Gambia, Guinea and Sierra Leone (at similar magnitude) higher than those of the dissimilar results of the other three countries (Ghana, Liberia and Nigeria) where we can infer relationships with very low level of confidence. What this results suggests is that a single monetary policy may not be suitable for the future monetary zone as evident by the diverse forms of reaction of the monetary policy instrument to inflation and output, all things being equal and if past behaviour of the macroeconomic variables evaluated for the WAMZ countries are factors to reckon with.

Table: 5: Monetary Reactions to Anchor Country's (Nigerian) Monetary Base Change (1980-2014)

Contemporaneous Augmented McCallum Monetary Base Model					
Dependent Variable: ***Change in Monetary Base***					
	Gambia	***Ghana***	***Guinea***	***Liberia***	***S/Leone***
ΔNigerian Monetary Base:	0.0004*	1.4473*	0.2221**	0.0010*	0.1119*
	(0.0001)	(0.1253)	(0.1067)	(0.0012)	(0.0224)
Output Gap:	-0.0001	-0.0216	1.6752	0.0001	0.0895
	(0.0002)	(0.1445)	(5.7172)	(0.0003)	(0.2544)
Inflation Deviation:	-0.0017	-3.4812	14.642***	0.0162	-0.4252
	(0.0021)	(3.8976)	(8.3557)	(0.0216)	(0.4131)
R^2*:*	0.49	0.83	0.26	0.53	0.54
F-probability:	0.00	0.00	0.09	0.00	0.00
Observations:	34	34	25	32	34
One-period Lagged Augmented McCallum Monetary Base Model					
Dependent Variable: ***Change in Monetary Base***					
	Gambia	***Ghana***	***Guinea***	***Liberia***	***S/Leone***
ΔNigerian Monetary Base:	0.0006*	1.3888*	-0.2670	0.0015*	0.1547*
	(0.0001)	(0.3725)	(0.1782)	(0.0004)	(0.0372)
Output Gap:	-0.0010	-0.0168	-9.9120	0.000	0.1044
	(0.0002)	(0.2827)	(6.1776)	(0.0003)	(0.2770)
Inflation Deviation:	-0.0001	-6.7631	-2.871	0.0017	-0.4712
	(0.0020)	(7.6524)	(8.8374)	(0.0266)	(0.4563)
R^2*:*	0.55	0.37	0.16	0.42	0.46
F-probability:	0.00	0.00	0.30	0.00	0.00
Observations:	33	33	31	31	33

Source: EIU and IMF databases, Author's Estimations and Stata 14 Output.
Notes: The standard errors are in parentheses. * indicates significance at 1% significant level, ** at 5% significance level and *** at 10% level of significance.

Table 5 above shows the results of the estimations of the two augmented McCallum monetary base models for the WAMZ's smaller economies over the period between 1980 and 2014.[6]

Generally, in both estimations, the standard errors are low in the cases of The Gambia and Liberia while the coefficient of determination (R-Squared) is at the lowest in Guinea which also lacks joint significance at 5% and insignificant at this for. The results of interest are those yielded for the response of the monetary policy changes in these smaller economies to the anchor country's (Nigerian) monetary policy changes which are significant at 1% and 10% levels of significance. From the results it is apparent that while output gap and inflation

[6] Except for Guinea's 1987-2014 period.

deviation are statistically insignificant at 5% level of significance (except for Guinea), the Nigerian policy stance mostly have positive influence on monetary policies in all the five WAMZ countries. If the extent of the influence of Nigerian monetary base change is high, this is an indication of low the degree of loss of monetary independence.

From the contemporaneous McCallum model results Ghana, Guinea and Sierra Leone demonstrated the lowest degree of expected loss of monetary autonomy since the Nigerian policy influence is higher in these two countries (though at low magnitude). For Guinea, the joint significance is at 0.09 while the coefficient of determination (R^2) stands at the lowest of 0.26, casting doubt over the ability of the Nigerian monetary policy instrument to explain the Guinea monetary policy stance. On the other hand, The Gambia has the comparatively highest measure of expected loss of monetary policy autonomy, followed by Liberia.

The results of the estimated lagged augmented McCallum model again reveal Ghana, Guinea and Sierra Leone as exhibiting low degree of expected loss of monetary independence. Interestingly, this results reveal that at the negative coefficient of -0.2670 (not significant), the Guinean monetary policy was not influenced by the Nigerian policy. Again, the ability of the independent variables to explain the variations in the Guinean case is minimal at a very low R^2 coefficient of 0.16 and F-probability of 0.30. The Gambia and Liberia, again display the higher degree of expected monetary independence loss, given their lower coefficient of the influence of the change in the Nigerian monetary base as policy instrument. Owing to the developing nature of African economies and the slow reactions of macroeconomic variables in the developing nations, greater emphasis are placed on results generated through the estimation of the lagged McCallum monetary base growth model for these WAMZ countries.

1.6 Summary and Conclusions

This paper evaluates monetary reactions in the West African Monetary Zone focusing on their similarities of monetary reactions among its member countries as well as the degree of expected loss of monetary independence by these countries on the eventual take-off of the proposed monetary integration. The research questions answered pertain to monetary reactions similarities in the WAMZ and the degree of expected loss (indirectly to Nigeria, a possible lead country) of monetary independence level of monetary independence by the other five WAMZ countries are. The modelling of monetary policies and monetary reactions of the six WAMZ member countries in this paper are according to the hybrid McCallum-Taylor Rule (HMTR), a modification of the popular Taylor Rule and the McCallum monetary base theoretical underpinnings.

The results of the monetary reaction homogeneities assessments reveal evidence to suggest that all things being equal and if past behaviour of the macroeconomic variables evaluated for the WAMZ countries are factors of significance, a single monetary policy may not be suitable for the future monetary zone. What makes these evident are the diverse forms of reactions of the monetary policy instrument to inflation and output. Evidence from the evaluation of the extent of expected loss of monetary independence by the WAMZ countries indicate that the degree of loss of monetary independence would be high in the cases of The Gambia and Liberia, as this would be low in the cases of Ghana and Sierra Leone.

References:

Asteriou, D. and Hall, S.G. (2007). '*Applied Econometrics: A Modern Approach'*. New York: Palgrave Macmillan.

Clarida, R., Gali, J. and M. Gertler (2000). 'Monetary Policy rules and Macroeconomic Stability: Evidence and Some Theory'. *Quarterly Journal of Economics*, 115 (1), pp147-180.

De Grauwe, P. (2014). '*Economics of Monetary Union'*. Oxford: Oxford University Press

ECOWAS Commission (2011) Presentation retrieved downloaded on 12 December 2011 at ECOWAS Online: www.ecowas.int.

Ezenwa, U. (1983) "*ECOWAS and the Economic Integration of West Africa*", London: C. Hurstand Co. PP 124.

Goodhart, C. and B. Hofman (2002). '*Asset Prices and the Conduct of Monetary Policy*' Retrieved: https://ideas.repec.org/p/ecj/ac2002/88.html

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

Hill, R.C., Griffiths, W.E. and G. C. Lim (2012). '*Using Eviews for Principles of Econometrics*. New York: John Wiley & Sons.

McCallum, B. T. (1987). 'The Case for Rules in the Conduct of Monetary Policy: A Concrete Example'. *Review of World Economics*, **123** (3) pp. 415-429.

McCallum, B. T. (1988). 'Robustness Properties of a Rule for Monetary Policy'. *Carnegie-Rochester Conference Series on Public Policy*, **29** (Autumn), pp.173-203.

McCallum, B. T. (1999). 'Recent Developments in the Analysis of Monetary Policy Rules'. Federal Reserve Bank of St. Louis *Review*. November/December 1999.

McCallum, B. T. (2002). 'The Use of Policy Rules in Monetary Policy Analysis'. Response to the Shadow Open Market Committee. *Research Showcase of Carnegie-Mellon University.* **11-2002**.

Orphanides, A. (2000). 'The Quest for Prosperity without Inflation'. *ECB Working Paper* 15.

Razzak, W. A. (2001). 'Is the Taylor Rule Really Different from the McCallum Rule?' *Reserve Bank of New Zealand Discussion Paper* **DP2001/07**

Stark, T. and D. Croushore (1995). 'Evaluating McCallum's Rule for Monetary Policy'. Federal Reserve Bank of Philadelphia *Business Review*, January/February 1995.

Stock, J. H. and M.W Watson (2012). '*Introduction to Econometrics'*. Harlow: Pearson Education Limited.

Sun, S., Gan, C., and B. Hu (2012). 'Evaluating McCallum Rules as Policy Guideline for China. *Journal of Asia Pacific Economy*, **17** (3) pp. 527-45.

Taylor, J. B. (1999). *'Monetary Policy Rules'* ed. J. B. Taylor. Chicago: University of Chicago Press.

Wooldridge, J. M. (2013). '*Introductory Econometrics: A Modern Approach, 5th Edition*'. South Western Cengage Learning, USA: Mason.