Structural breaks in some selected WAMZ macroeconomic time series

Emmanuel T. Adamgbe

Cletus C. Agu

Structural Breaks in Some Selected WAMZ Macroeconomic Time Series

Emmanuel T. Adamgbe and Professor Cletus C. Agu*

Abstract

Anecdotal evidence shows that country-specific inflation has remained largely persistent and heterogeneous across the West African Monetary Zone (WAMZ). Uncertainty about the nature of inflation persistence often undermines regional convergence due to the asymmetric responses from monetary authorities. Consequently, the objective of this paper is to identify whether or not structural breaks exist in the price level of member countries. The paper uses the method of Lee and Strazicich (2003) with multiple breaks to identify if there were spurious rejections in the ADF tests of selected macroeconomic variables of WAMZ countries. The result fails to reject the existence of the null hypothesis of unit root for fifteen (15) variables and a second root for twenty (20) variables. With the exception of Ghana, the CPI for other member countries has a second root, indicating that inflation is explosive with hysteresis effect. This feature of inflation is associated with a similar structural dysfunction in other macroeconomic indicators, including the exchange rate, nominal gross domestic product, money supply and the lending rate. In other words, breaks in these fundamentals are important sources of persistence and hysteresis in the price level.

I.   Introduction

Sequel to the creation of the West African Monetary Zone (WAMZ), the West African Monetary Institute was established in 2001 to carry out the necessary technical and preparatory work towards the realization of a monetary union, in particular, for the Anglophone countries. Eventually, the WAMZ article of agreement was acceded to by The Gambia, Ghana, Guinea, Nigeria and Sierra Leone. This was against the backdrop that the French speaking Francophone countries - the West African Economic and Monetary Union (UEMOA) already operates a single currency – the CFA. The WAMZ project was a direct result of the Fast Track initiative of ECOWAS to allow any 2 or more countries outside the UEMOA – largely Anglophone - to implement the region's economic and monetary integration programmes. It was envisaged that with these countries

---

adopting the second currency in the sub-region, the two zones, i.e. WAMZ and UMEOA will merge into a single ECOWAS monetary zone. The four primary convergence criteria established for the WAMZ were: a single digit inflation; fiscal deficit to GDP ratio not exceeding 3 per cent; external reserves enough to cover at least three months of imports; and central bank financing of fiscal deficit should not exceed 10 per cent of previous year's tax revenue. In addition, other structural harmonization programmes have been put in place to enhance trade integration, financial integration and statistical harmonization, among others.

Over a decade of preparatory work, price levels in the zone are still characterized by significant volatility and persistence. There is enough evidence in the literature to suggest that persistence in the price level can result in negative implications in the efforts towards achieving low and stable inflation in the long run. Johansen (1992, pp. 313-334) stated that "Some time series such as the log of prices (P), have the property that even the inflation rate ΔP is nonstationary, whereas the second difference $\Delta^2 P$ is stationarity." Clements and Hendry (2003, p305) noted that 'shifts in deterministic terms (intercepts and linear trends) are the major source of forecast failure.' The works of Dornbusch (1976), Taylor (1979) and Ball (1993) clearly provides insight on the plausibility of dynamic inconsistency if the central bank operates on a path of loss function not fitted for example, with a stationary inflation.

The corollary is that if the price level is mean-reverting, very useful information can be obtained from the historical inflation path to generate forecasts. A random walk in the inflation data would therefore, imply that a shock to prices will be permanent. These concerns provide the intuition to investigate fundamental gaps yet to be articulated relating to structural breaks in the data which pose risks to monetary policy in the West African Monetary Zone (WAMZ) and nominal inflation convergence.

Recent studies on inflation dynamics in the WAMZ such as Essien, et al. (2007a, 2007b), Onwioduokit, et al. (2007), Kitcher, et al. (2007) and Abradu-Otoo and Doyina-Ameyaw (2007) have largely focused on country specific determinants and policy mix that will deliver single digit inflation. These analyses largely ignored issues of unit root with endogenous breaks.

This paper will draw lessons from the correlation between the breaks in the price level and those of the other variables in order to provide insights on the sources of structural change and persistence in the inflation rates. This paper is yet to find any recent contributions to the unit root debate with structural breaks determined

endogenously in the price level data and other selected macroeconomic time series originating from the West African Monetary Zone.

An examination of the nature of structural breaks provides a clear understanding of the nature and extent of the long-run adjustment path of price levels for convergence and predictability of not only the loss function but also the forecast of inflation. An examination of the unit root with breaks properties of WAMZ price level and selected macroeconomic data deserves investigation as convincing evidence suggests that the non-stationarity of macroeconomic time series poses important implications for inflation convergence. Cochrane (1994) notes that the absence of mean reversion in real output 'challenges a broad spectrum of macroeconomic theories designed to produce and understand transitory fluctuations'.

The main aim of this paper, therefore, is to employ the method of Lee and Strazicich (2003a & b) test to examine the existence and significance of structural breaks in some selected macroeconomic series of some WAMZ member countries using quarterly data. In particular, the paper re-examines the validity of trend stationarity in the inflation rates of five (5) WAMZ countries using quarterly data. Identification of structural breaks within this time series produces a new evidence of the impact of integration arrangements, institutional and regulatory reforms since the commencement of the zone.

The paper is structured in five sections. Section 2 reviews some empirical literature on unit root analysis of WAMZ macroeconomic data. Section 3 presents the theoretical basis of the Lee and Strazicich (2003a & b) approach to unit root testing and data. Section 4 discusses the findings from the unit root testing, while section 5 concludes the paper.

II.   Some Empirical Literature

Although several studies have shown that macroeconomic time series display some degree of stochastic non-stationarity, linear-based approaches to unit root testing have been shown to have a low power and considerable size distortions. Thus, linear tests such as the ADF, Phillip-Perron may fail to differentiate unit root processes from stationary processes that exhibit large persistence (Arize, 2011; Froot and Rogoff, 1995) and non-linearities (Arize, 2011). In studies on the WAMZ, the ADF and Phillips – Perron have become popular toolkits in unit root analysis, while the empirical literature on unit root testing with structural breaks on macroeconomic time series is sparse. Some of the recent literature point to potential weakness in the power of the test of linear framework to unit root

testing. It will suffice to highlight a few of the studies that have characterized the recent unit root debate on macroeconomic time series.

Arize, et al. (2005) in a study of inflation and structural shift in fifty developing countries (including five African countries, namely Gabon, Ghana, Kenya, Mauritius and Morocco) using the fractional integration test of Geweke and Porter-Hudak (1983, GPH hereafter), the authors find that inflation can be modeled as a nonstationary variable.

Kumar, et al. (2011) in a study to evaluate the stability of the money demand function in Nigeria applied the ADF and Elliot-Rothenberg-Stock (ERS) tests on real money, real income, nominal rate of interest, real exchange rate and inflation rate over the period 1960-2008. This study finds for the ADF test that the unit root test under the null of no unit root in these variables cannot be rejected at the 5 per cent level (except for the inflation rate). However, the ERS test suggests that all the levels of the variables are non-stationary. Unlike the ADF test, the ERS test finds that the inflation rate is a non-stationary series.

In a related study, Chukwu, et al. (2010) investigated the presence of cointegration and structural breaks in the Nigerian long-run money demand function and finds that the Ng – Perron test for unit root suggests that the null hypothesis of a unit root in real money demand, real income, inflation and the spread between the lending and deposit rates in their levels cannot be rejected. However, the Ng – Perron test rejects the null that their first differences have unit roots.

In a recent study, Arize (2011) investigated whether the inflation rate is non-stationary or stationary using quarterly inflation rate data from thirty-four African countries. Using linear and non-linear techniques, the null hypothesis of a unit root in inflation rate in Africa could not be rejected. In particular, the non-linear KSS test validates the non-stationarity of inflation in more countries than the linear tests. For the DF-GLS, the null hypothesis of non-stationarity of inflation could not be rejected at the 5 percent level of significance in seventeen countries implying that inflation is non-stationarity in seventeen out of thirty-four cases (Angola, Cape Verde, Chad, Cote d' Ivoire, Egypt, Gambia, Ghana, Guinea-Bissau, Mauritius, Mozambique, Niger, Nigeria, South Africa, Sudan, Swaziland, Tanzania and Togo). Also, in four additional countries the results indicate inability to reject the null hypothesis of non-stationarity of inflation using the ADF test statistic but not by DF-GLS test statistic (Botswana, Kenya, Morocco and Rwanda). Applying non-linear tests, the null hypothesis of nonstationarity of inflation rate could not be

rejected in seven more countries, using the AKSS test statistics but not the DF-GLS or ADF tests (Benin, Burkina Faso, Cameroon, Ethiopia, Gabon, Senegal and Seychelles).

III.   Data and Methodology

WAMZ member countries are characterized by various forms of structural change including structural adjustments and financial liberalization reforms since attaining independence. If such structural changes are present in the data generating process, but not captured in the empirical estimation, a researcher may incorrectly conclude that the series under investigation has a stochastic trend. As a consequence of this, any shock —whether demand, supply, or policy-induced — to the variable will persist. Piehl, et al. (1999) notes that knowledge of breakpoint is centripetal to the accurate evaluation of any program intended to bring about structural changes; such as the tax reforms, banking sector reforms and regime shift.

In this paper, the method of Lee and Strazicich (2003a & b) would be applied to test for unit root hysteresis and persistence in the price level. The single and two-break LM unit root tests are robust as it is mildly affected by breaks under the null. The choice of Lee and Strazicich (see Strazicich, et al. (2004)) is imperative for allowing for structural changes under the unit root null hypothesis, as stochastic non-stationarity may lead to size distortions. The test also has the flexibility of identifying the number of breaks given the information asymmetry about specific breakpoints. The Lagrange Multiplier (LM) unit root test takes the following form:

$$y_t = \alpha^t M_t + e_t, \qquad e_t = \rho e_{t-1} + \varepsilon_t \tag{1}$$

where M_t consists of exogenous variables and ε_t is an error term that follows the classical properties. The LM unit root test allows for structural breaks in the spirit of Perron (1989). In the case of the model with one-break test, M_t = [1, t, $D1_t$, $DT1_t$], and in the case of the model with two-break test, M_t = [1, t, $D1t$, $D2t$, $DT1t$, $DT2t$], where Djt = 1 for $t \geq TBj$ + 1, j = 1, 2, and Djt = 0 otherwise, where TBj represents the break date. Lee and Strazicich (2003a, b) use the following regression to obtain the LM unit root test statistic:

$$\Delta y_t = \alpha' \Delta M_t + \varphi \bar{s}_{t-1} + \mu_t \tag{2}$$

where $\bar{S}_t = y_t - \hat{\psi}_q - M_t \hat{\alpha}_t$, t = 2,....,T; $\hat{\alpha}$ are coefficients in the regression of Δy_t on ΔM_t; $\hat{\psi}_q$ is given by $y_t - M_t \alpha$; and y_1 and M_1 represent the first observations of y_t

and M_t, respectively. The LM test statistic is given by $\bar{\tau}$ = t-statistic for testing the unit root null hypothesis that φ = 0. The location of the structural break (*TB*) is determined by selecting all possible break points for the minimum *t*-statistic as follows:

$$\mathrm{I}nf\,\tilde{\tau}\left(\tilde{\theta}_i\right) = \ln\,f_\theta\tilde{\tau}\left(\theta\right) \qquad\qquad (3)$$

where θ = T_B /*T*. The search is carried out over the trimming region (0.15*T*, 0.85*T*), where *T* is the sample size. Critical values for the one-break case are tabulated in Lee and Strazicich (2003a), while critical values for the two-break case are tabulated in Lee and Strazicich (2003b).

The sources of data are the statistical bulletin (various issues) of member countries and WAMZ Macroeconomic and Convergence Report (various issues) and the International Financial Statistics (IFS) of the International Monetary Fund (IMF). The key variables used in this paper on quarterly basis for the period 1980:1 to 2008:4 include the consumer price index (CPI), consumer price index excluding energy (CPIE), nominal gross domestic product (NGDP), real gross domestic product (RGDP),nominal exchange rate (NER), interest rate (LR) and money supply (BM). The quadratic linear sum was used to interpolate annual GDP into quarterly series given the paucity of quarterly data.

IV.   Analysis of Results

With some degree of anticipation, given several economic crises, changes in institutional arrangements, policy changes and regime shifts in these countries, these macroeconomic variables are subject to structural breaks and probably, the ADF test is considered biased towards not rejecting the unit root at the first difference.

The time series properties of selected macroeconomic data for The Gambia, Ghana, Guinea, Nigeria and Sierra Leone are examined first by using the ADF test during the period 1980Q1-2008Q4. As expected, the null hypothesis of a unit root in all variables under investigation cannot be rejected at the 5 per cent significance level. The ADF test results are reported in tables 2, 4, 6, 8 and 10, while those with structural breaks are reported in tables 3, 5, 7, 9 and 11 for The Gambia, Ghana, Guinea, Nigeria and Sierra Leone, respectively.
Allowing for two structural breaks in the data, *k* is the optimal number of lagged first-difference terms included in the unit root test to correct for serial correlation. *TB1* and *TB2* denote the break dates. Critical values at different breakpoints for a

sample size T = 100 are reported in Strazicich *et al.* (2003). Table 1 provides a summary result for the nature of the roots in the time series data with the test suggesting a unit root for fifteen (15) variables and a second root for twenty variables (20)[1].

 A second root in the consumer price index confirms explosive path and hysteresis effect for inflation in the WAMZ which could lead to a complex challenge for monetary authority restoring inflation to its steady state level. This is evident for the inflation in all the member countries, except Ghana. In table 1, it can be discerned that the consumer price index is not a stationary series, and hence, inflation has a unit root. As a corollary to this, other plausible determinants of the price level, the BM, NGDP, RGDP and LR, also have a second root in inflation. It is intuitive to reason that any development that will introduce a shift or change in these variables, there will be an underlying hysteresis effect on the price level making inflation to be explosive.

Table 1: Roots in the Time Series Data for Five WAMZ Member Countries

Country	Second Root Null	Unit Root Null
The Gambia	NGDP, CPI, CPIE	ER, BM, RGDP, LR
Ghana	BM, LR	ER, NGDP, RGDP, CPI, CPIE
Guinea	BM, NGDP, RGDP, CPI, CPIE, LR	ER
Nigeria	RGDP, CPI, CPIE, BM, LR	ER, NGDP
Sierra Leone	ER, RGDP, CPI, LR	BM, NGDP,CPIE

Table 2: Results of unit root tests without structural breaks - The Gambia

Variables	ADF [k]
1 Nominal GDP	-3.21622[2]
2 Real GDP	-6.00504[2]*
3 Broad Money (M2)	-5.05208[2]*
4 Exchange Rate	-3.62462[2]**
5 Consumer Price Index (CPI)	-3.05300 [2]
6 Consumer Price Index (CPI) - Core	-3.10999 [2]
7 Maximum Lending Rate	-5.21362 [2]*

Linear trend included. For ADF test, critical values at 1%, 5% and 10% significance level are -4.04366, -3.45079 and -3.15051, respectively. * denotes statistical significance at 1% level. ** denotes statistical significance at 5% level. *** denotes statistical significance at 10% level.

---

[1] 7 variables for each of the 5 cross-sections – The Gambia, Ghana, Guinea, Nigeria and Sierra Leone

Table 3: Result of Lee and Strazicich with Multiple Break Test: The Gambia

Variables	a (t-statistics)	[k]	TB1 TB2	t-statistics
Nominal GDP	-0.3837 (-4.6106)	[2]	1987:03	-3.6894
			2001:01	3.2933
Real GDP	-0.6219 (-6.7137)***	[2]	1984:01	-3.7979
			1986:03	-2.2337
Broad Money (M2)	-0.7491 (-7.4624)***	[2]	1993:03	-3.4498
			2002:01	1.8412
Exchange Rate	-0.5145 (-5.7092)**	[2]	1983:03	-5.3573
			2003:01	2.5025
Consumer Price Index	-0.4486 (-5.0700)	[2]	1985:03	2.8308
			1988:01	-3.6546
Consumer Price Index - Core	-0.3868 (-4.6745)	[2]	1987:02	-4.1755
			2001:04	1.2503
Maximum Lending Rate	-0.5755 (-6.2223)**	[2]	2002:03	3.5399
			2005:03	-0.4297

The critical values for Lee-Strazicich two break test are -6.32, -5.73 and -5.32 at 1 %, 5 % and 10% levels of significance, respectively. * (**) *** denote statistical significance at 10%, 5% and 1% levels, respectively.

The break dates characterising The Gambia's' time series data (Table 3) highlighted the control regime of the early 80s, while in 1993 there was significant weakness in the banking system and expansionary fiscal policy. The coup of 1994 led to a massive reduction in donor funds. The period 2002 – 2005 witnessed the depreciation of the exchange rate of The Gambian dallasi, high inflation and deceleration in economic output. This followed the economic structural adjustment under the IMF-ESAF that spanned 1998 to 2001.

Table 4: Results of unit root tests without structural break - Ghana

Variables	ADF [k]
1 Nominal GDP	-5.32493[2]*
2 Real GDP	-3.13500[2]
3 Broad Money (M2)	-3.99782[2]**
4 Exchange Rate	-3.91179[2]**
5 Consumer Price Index (CPI)	-5.27483 [2]*
6 Consumer Price Index (CPI) - Core	-5.89951 [2]*
7 Maximum Lending Rate	-5.08639 [2]*

Linear trend included. For ADF test, critical value at 1%, 5% and 10% significance level are -4.04366, -3.45079 and -3.15051, respectively.

Table 5: Result of Lee and Strazicich with Multiple Break Test - Ghana

Variables	a (t-statistics)	[k]	TB1 TB2	t-statistics
Nominal GDP	-0.6149 (-5.7106)**	[2]	1995:01	3.5740
			1999:04	0.6978
Real GDP	-0.5243 (-5.4779)*	[2]	1984:01	2.4050
			1991:01	2.011
Broad Money (M2)	-0.4357 (-4.5207)	[2]	1989:01	-1.5280
			1992:01	2.7155
Exchange Rate	-0.7390 (-5.6368)*	[2]	1984:01	-2.4894
			1986:03	3.8018
Consumer Price Index	-0.5154 (-5.3825)*	[2]	1986:03	-0.4188
			1997:01	-1.5540
Consumer Price Index_ Core	-0.6520 (-6.3838)***	[2]	1986:01	-0.4210
			1993:04	-0.0932
Maximum Lending Rate	-0.5164 (-5.9270)**	[2]	1995:03	-2.9179
			2000:03	2.1361

The critical values for Lee-Strazicich two break test are -6.32, -5.73 and -5.32 at 1 %, 5 % and 10% levels of significance, respectively. * (**) *** denote statistical significance at 10%, 5% and 1% levels, respectively.

In the case of Ghana (Table 5), the economic downturn witnessed in the early 80s led to the collapse of the exchange rate following extensive liberalization and adoption of structural adjustment programmes. The economic crisis that characterized the economy between 1999 and 2001 resulted in substantial drop in donor funds leading to the subsequent adoption of the ESAF. The breaks in the early 1990s were mainly occasioned by economic reforms.

Table 6: Results of unit root tests without structural break - Guinea

Variables	ADF [k]
1 Nominal GDP	-3.15264[2]
2 Real GDP	-3.56392[2]**
3 Broad Money (M2)	-3.85998[2]**
4 Exchange Rate	-4.08453[2]*
5 Consumer Price Index (CPI)	-2.12184 [2]
6 Consumer Price Index (CPI) - Core	-2.28122 [2]
7 Maximum Lending Rate	-3.59782 [2]**

Linear trend included. For ADF test, critical value at 1%, 5% and 10% significance level are -4.04366, -3.45079 and -3.15051, respectively.

Table 7: Result of Lee and Strazicich with Multiple Break test: Guinea

Variables	a (t-statistics)	[k]	TB1 TB2	t-statistics
Nominal GDP	-0.4617 (-5.0042)	[2]	1985:03	-1.1869
			1993:01	-3.1757
Real GDP	-0.4191 (-5.0988)	[2]	1989:02	-2.0646
			2002:03	-3.0796
Broad Money (M2)	-0.4568 (-5.0758)	[2]	1985:03	-1.0756
			1994:01	-2.3110
Exchange Rate	-0.4599 (-5.4129)*	[2]	1987:03	-3.5648
			2004:04	-3.4966
Consumer Price Index	-0.3346 (-4.1032)	[2]	1992:03	-2.5734
			2004:01	-0.6506
Consumer Price Index – Core	-0.2755 (-3.7751)	[2]	1990:03	-2.4633
			2003:04	2.1613
Maximum Lending Rate	-0.4392 (-5.2579)	[2]	1992:03	-4.5094
			2005:01	1.6244

The critical values for Lee-Strazicich two break test are -6.32, -5.73 and -5.32 at 1 %, 5 % and 10% levels of significance, respectively. * (**) *** denote statistical significance at 10%, 5% and 1% levels, respectively.

In Table 7, it can be discerned that structural and institutional issues were some of the challenges causing structural breaks in the time series data. Economic liberalization of the 80s, weak banking sector, political instability and declining donor funds are some of the major factors causing .structural breaks in the macroeconomic variables.

Table 8: Results of unit root tests without structural break - Nigeria

Variables	ADF [k]
1 Nominal GDP	-3.87141[2]**
2 Real GDP	-4.89358[2]*
3 Broad Money (M2)	-3.10460[2]
4 Exchange Rate	-4.04601[2]*
5 Consumer Price Index (CPI)	-2.67828[2]
6 Consumer Price Index (CPI) - Core	-2.78606[2]
7 Maximum Lending Rate	-5.54866[2]*

Linear trend included. For ADF test, critical value at 1%, 5% and 10% significance level are -4.04366, -3.45079 and -3.15051, respectively.

Table 9: Result of Lee and Strazicich Unit Root Test with Multiple Breaks - Nigeria

Variables	α (t-statistics)	[k]	TB1 TB2	t-statistics
Nominal GDP	-0.6138 (-5.7098)*	[2]	1995:04	-0.8551
			1998:04	2.5386
Real GDP	-0.4276 (-5.1934)	[2]	1998:02	-0.5993
			2000:04	0.6329
Broad Money (M2)	-0.4422 (-4.6380)	[2]	1986:03	-1.0239
			1994:03	-4.0811
Exchange Rate	-0.5317 (-5.5771)*	[2]	1990:03	-2.0900
			1994:01	-4.7089
Consumer Price Index	-0.3976 (-4.4626)	[2]	1992:03	-0.9799
			1996:04	-2.0684
Consumer Price Index – Core	-0.4431 (-4.9270)	[2]	1991:03	-1.5331
			1996:01	-3.7719
Maximum Lending Rate	-0.5613 (-6.3476)***	[2]	1993:03	-3.9006
			1996:01	-0.1987

The critical values for Lee-Strazicich two break test are -6.32, -5.73 and -5.32 at 1 %, 5 % and 10% levels of significance, respectively. * (**) *** denote statistical significance at 10%, 5% and 1% levels, respectively.

Breaks in Nigeria's time series data (Table 9) were associated with economic adjustment in the mid-1980s and regime shift from control to indirect monetary policy implementation technique, 1991-1993, and thereafter. The exchange rate which was hitherto fixed was devalued and the banking crisis of the late 80s, 1994-1998 caused a break in the money supply and interest rate.

Table 10: Results of unit root tests without structural break - Sierra Leone

Variables	ADF [k]
1 Nominal GDP	-3.36494[2]
2 Real GDP	-2.45437[2]
3 Broad Money (M2)	-4.13408[2]*
4 Exchange Rate	-3.49463[2]**
5 Consumer Price Index (CPI)	-3.54935 [2]**
6 Consumer Price Index (CPI) - Core	-4.16223 [2]*
7 Maximum Lending Rate	-3.96257 [2]**

Linear trend included. For ADF test, critical value at 1%, 5% and 10% significance level are -4.04366, -3.45079 and -3.15051, respectively.

Table 11: Result of Lee and Strazicich Multiple Break Test - Sierra Leone

Variables	a (t-statistics)	[k]	TB1 TB2	t-statistics
Nominal GDP	-0.7019 (-5.7842)**	[2]	1985:02	-1.5990
			1993:01	-3.7966
Real GDP	-0.4105 (-4.9023)	[2]	1995:03	-3.0223
			2001:01	-0.3795
Broad Money (M2)	-0.6538 (-5.8187)**	[2]	1989:04	-5.3079
			1994:04	0.6840
Exchange Rate	-0.4531 (-5.0025)	[2]	1985:04	-4.5831
			1989.02	-0.7528
Consumer Price Index	-0.5777 (-5.0794)	[2]	1986:02	-1.1122
			1992:03	-3.4061
Consumer Price Index – Core	-0.6996 (-6.0308)**	[2]	1985:03	-1.3517
			1992:01	-4.5546
Maximum Lending Rate	-0.5417 (-6.1282)**	[2]	1992:03	-4.4134
			1995:02	-1.0850

The critical values for Lee-Strazicich two break test are -6.32, -5.73 and -5.32 at 1 %, 5 % and 10% levels of significance, respectively. * (**) *** denote statistical significance at 10%, 5% and 1% levels, respectively.

Table 11 shows the break results for Sierra Leone. The country was hit by economic crisis in the early 80s and plunged into conflict in 1991 lasting up to January 2002. Within this period, the exchange rate and trade was liberalized. The impact of the conflict was worsened by the economic sanctions which trailed the 1997 coup following an initial restoration of peace. The exchange rate depreciated significantly and in the post-crisis era the country attained a Heavily Indebted Poor countries (HIPC) status by the end of 2006.

V.   Conclusion

The paper offers prognostic insight on the presence of persistence and unit root hysteresis under structural breaks. The unit root testing with multiple breaks using the method of Lee and Stracizich (2003) is used to identify if there were spurious rejections in the ADF tests of the selected macroeconomic variables of WAMZ countries. The unit root test results with breaks fails to reject the existence of the null hypothesis of unit root for fifteen (15) variables and a second root for twenty (20) variables. With the exception of Ghana, the CPI for other member countries has a second root, indicating that inflation is explosive with hysteresis effect. This feature of inflation is associated with a similar structural dysfunction in other macroeconomic indicators, including the exchange rate, nominal gross domestic product, money supply and the lending rate.

Specifically, the results indicate that breaks in the consumer price level are associated with breakpoints in output, exchange rate, interest rate and money supply. In other words breaks in these fundamentals are important sources of persistence and hysteresis in the price level. Confirmatory results from a reverse hysteresis equation shows hysteresis to be a real inflation phenomenon in Ghana and Guinea. It is concluded that assuming away inflation persistence and breaks in the data can lead to sub-optimal outcomes for monetary policy as a means of achieving stable and low inflation.

References

Abradu-Otoo, P. and S. Donyina-Ameyaw (2007). Inflation Dynamics in Ghana in West African Monetary Zone: Studies in Inflation Dynamics. *West African Monetary Institute*.

Arize, A. C., J. Malindretos and K. Nam (2005). Inflation and Structural Change in 50 Developing countries. *Atlantic Economic Journal*, 33, 461–471.

Arize, A. C. (2011). Are Inflation Rates Really Nonstationary? New Evidence from Non-linear STAR Framework and African Data. *International Journal of Economics and Finance*, Vol. 3, No. 3; August, 97-108

Ball, L. (1993). The Dynamics of High Inflation. *National Bureau of Economic Research Working Paper* No. 4578, December.
    (1994). Credible Disinflation with Staggered Price Setting. *American Economic Review*, vol. 84, pp. 282-289.

Chukwu, J. O., C. C. Agu, and F. E. Onah (2010). Cointegration and Structural Breaks in Nigerian Long-Run Money Demand Function. *International Research Journal of Finance and Economics*, Issue 38, 48–56.

Clements, M.P. and D.F. Hendry (2003) Economic Forecasting: Some Lessons from Recent Research. *Economic Modelling*, vol. 20, pp. 301-329.

Cochrane, J. H. (1994). Permanent and Transitory Components of GNP and Stock Prices. *Quarterly Journal of Economics* vol. 109, pp. 241–66.

Dornbusch, R. (1976). Expectation and exchange rate dynamics. *Journal of Political Economy*, vol. 84, pp. 1161–76.

Essien, E.A., E.A. Onwioduokit, E.T. Adamgbe and K.I. Obiora. (2007a). Inflation Dynamics in Nigeria in West African Monetary Zone. Studies in Inflation Dynamics, West African Monetary Institute.

Essien, E.A., E.T. Adamgbe and A. Sessay .(2007b). Inflation Dynamics in Sierra Leone in West African Monetary Zone. Studies in Inflation Dynamics, West African Monetary Institute.

Froot, K. A., and K. Rogoff (1995).Perspectives on PPP and long-run real exchange rates. In Handbook of International Economics III In M. Gene Grossman and Kenneth Rogoff, eds., New York: North Holl.

Geweke, J., and S. Porter-Hudak (1983). The estimation and application of long memory time series models. *Journal of Time Series Analysis*, 4, 221-238.

Johansen, S. (1992). Testing weak exogeneity and order of cointegration in UK money demand data.*Journal of Policy Modeling,* 14 (3), 313-334.

Kitcher, J.T., M. Sissoho and L. Jarju .(2007). Inflation Dynamics in The Gambia in West African Monetary Zone. Studies in Inflation Dynamics, West African Monetary Institute.

Kumar, S., D. J. Webber and F. Scott (2011). Money demand stability: A case study of Nigeria. *Working Papers* 2011-02, Auckland University of

Technology, Department of Economics. http://www.aut.ac.nz/data/ assets/pdf_file/0020/216029/Economics-WP-2011-02.pdf

Lee, J. and M. C. Strazicich (2003a). Minimum LM unit root test with one structural break. mimeo.

(2003b). Minimum Lagrange multiplier unit root test with two structural breaks. *Review of Economics and Statistics* vol.85, pp. 1082–9.

Owioduokit, E.A., F. Sylla, K.I. Obiora and M. Conte (2007). Inflation Dynamics in Guinea in West African Monetary Zone. Studies in Inflation Dynamics, West African Monetary Institute.

Perron, P. (1989). The Great Crash, the Oil Price Shock and the Unit Root Hypothesis. *Econometrica vol. 57*, pp. 1361–1401.

Piehl, A.M., S.J. Cooper, A.A. Braga, and D.M. Kennedy .(1999). Testing for Structural Breaks in the Evaluation of Programs. *NBER working paper 7226*.

Strazicich, M. C., J. Lee and E. Day (2004). Are Incomes Converging Among OECD Countries? Time Series Evidence with Two Structural Breaks. *Journal of Macroeconomics*, vol. 26, pp. 131–145.

Taylor, J. (1979). Staggered wage setting in a macro model. *American Economic Review* vol. 69, pp.108–13.