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Does ECOWAS Make Sense?

Nilanjan Banik¹ And C. A. Yoonus²

Abstract: This paper investigates empirically the possibility of forming an Optimum Currency Area (OCA) among member countries of Economic Community of West African States (ECOWAS) region. Under OCA, member countries share a common currency (like, the Euro), while foregoing their autonomy with respect to their use of monetary policy instruments. We say that the countries are good candidates for forming an OCA if there is a long run relationship in the trend (permanent) component of output. Our results indicate existence of long run relationship in the trend component of GDP among the member countries in the ECOWAS region. Hence is the plausibility for forming an OCA.

Keywords: Monetary Union, ECOWAS, Beveridge-Nelson Decomposition

JEL classification:C32, F02, F15.

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1. INTRODUCTION

Despite ongoing controversy over the hypothetical and empirical merits of regional trade agreements in and of themselves and in relation to global trade liberalization, over the last two decades, regional trade agreements have gained ever increased prominence. Around 230 regional trade agreements (RTAs), notified under the General Agreement on Tariffs and Trade (GATT) and the World Trade Organization (WTO) are in force today.³ Rather than attempting to resolve the controversy regarding the merits of regional trade agreements, we have instead chosen to explore whether economic characteristics of the members of one such regional agreement, the Economic Community of West African States (ECOWAS), predispose the successful formation of an optimum currency area (OCA). ECOWAS was initiated in 1975, and includes Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo, as members. ECOWAS is one of the largest single regional trade groups in Africa. The idea behind ECOWAS was initially to form a Free Trade Area (FTA) among the member States before moving towards higher types of regional integration in the form of Customs Union (CU), Common Markets (CM) and Economic Union (EU).⁴ In fact, within ECOWAS region a monetary union was formed on January 10 1994. Known as the Union Economique Monetaire Ouest Africaine (UEMOA), or West African Economic and Monetary Union, it has Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo, as its member. UEMOA with its well built institutional and organizational structure is one of the advanced integration scheme in Africa. The rest of the paper is structured as follows: Section 2 examines characteristics that are considered to be ideal for any RTA to sustain and flourish (read, increase income in the region through rise in trade resulting from RTA). Section 3 deals with the empirical methodology that we use to examine the hypothesis, which is – how well countries in ECOWAS, and within ECOWAS, the UEMOA region have the desirable characteristics to form a RTA. Section 4 interprets the results. Finally, Section 5 concludes with some policy recommendations.

2. ECOWAS as a RTA

From the welfare perspective becoming part of any RTA is desirable if trade creation effect resulting from the country joining the RTA outweigh the trade diversion effect. Trade creation happens when more efficient producer of one country displace the less efficient producers of another member country within Free Trade Area (FTA). On the other hand trade diversion results in displacement of more efficient producers outside FTA - losing market share to less efficient producers within FTA. Unfortunately, many

³ Source: http://www.wto.org/english/tratop_e/region_e/region_e.htm Accessed: 7/23/2009.

⁴ In forming, a FTA, members remove trade barriers among themselves but keep their separate national barriers against trade with outside nations. In a CU, members not only remove trade barriers among themselves but also adopt a common set of external barriers. In a CM, members allow full freedom of factor flows (migration of labour and capital) among themselves in addition to having a CU. In an EU, members unify all their economic policies, including monetary, fiscal and welfare policies, while retaining the features of a CM. An OCA is a special type of EU where the countries operate with a single currency.

times it becomes difficult to measure the exact nature of gains and losses, and hence economists based their comments about the desirability of member countries forming a RTA on the basis of some metrics. Some of these criteria are considered below-

2.1 Country characteristics:

Member countries are likely to gain if they share similar economic characteristics (Lumsdaine and Prasad, 2002). Similarities are measured in terms of economic development and geographical proximities. The more similar are the economies, the more is the likelihood of intra-industry trade. Similarity is often measured in terms of per capita gross domestic product (GDP). This is because geographically near economies with similar level of economic development have access to similar kind of technology. Consequently they tend to produce more or less similar items and tend to trade in similar commodities (closely differentiated products as in the monopolistic competition type market structure).

2.2 Symmetric Economic Activities:

Symmetric economic activities among member nations have complementary effect towards forging for deeper economic integration, like, custom and economic union. Symmetric economic activity implies that long-run movements in real output are synchronized. Such co-movements of outputs may be due to dependence of common factors such as geographical proximity and countries sharing similar industrial profile. When countries share a similar industrial profile and are located closely, then the demand shocks in one country may affect other countries in the region. Symmetry in economic activity implies that there is a lesser contradiction in terms of formulating internal and external macroeconomic policies – something which is prerequisite for forming a deeper economic integration.

2.3 Extent of Trade:

If the country is more likely to trade with other member countries in the RTA, then it makes sense to join that RTA. In fact, RTA is more likely to happen when trade happens in similar commodities, that is, intra-industry trade, like Japan exporting Toyota cars to the US, and at the same time importing Ford cars from the US. The likelihood that industry association will demand more protection is less in case of intra-industry trade.

Against this background, we analyze how well the countries in the ECOWAS region, UEMOA regions (a subset of ECOWAS region), and non-UEMOA region (other countries in the ECOWAS region sans UEMOA member countries), fulfill these desirable criteria. We carry out this analysis under three broad headings-

2.4 Economic Characteristics of ECOWAS Nations:

When observed in terms of economic characteristics, countries in the ECOWAS region are generally similar in terms of - (a) per capita income – predominantly less

developed countries with annual per capita income well below \$1000; (b) percentage of population living in rural areas; (c) demographic profile - very few percentage of the population belongs to the group aging 65 and above; (d) value addition of industrial sector to national income, which constitutes roughly a fourth of GDP in most member countries; and (e) development indicators measured in terms of fertility rate (total births per woman), and infant mortality rates. Except for few outliers, like, Burkina Faso, Guinea, and Sierra Leone, saving as proportion of GDP are also similar across these economies. The other thing that we observed is that within the ECOWAS region, countries that are part of UEMOA seem to be more homogenous relative to non-UEMOA group of countries. For any particular variable, we measure similarity or dissimilarity across countries in terms of first two moment conditions – mean, standard deviation and coefficient of variation, that is, ratio of standard deviation over mean (See Table 1a).

Now let us comment about the factors such as, inflation rates, fiscal deficit, external debt and level of tariffs; that might affect the value of exchange rates. A stable exchange rate in the region is desirable before group of countries contemplate about entering into an economic union. Greater variation in macroeconomic variables of the member nations will have an impact in terms of reducing efficiency of any common demand and exchange rates management policy.

For instance, if few member countries experience high inflation rates, whereas, the majority others experience recession; then an expansionary demand management policy is actually going to aggravate situation for the high inflation countries.

It is, therefore, essential to examine economic fundamentals of any aspirant country before it is allowed to become part of any monetary union. This is because a country with higher inflation rates might have other consequences. It will see a fall in the value of its domestic exchange rates. If this country is operating under a fixed exchange rate regimes where the value of its currency is pegged to French franc (say), a continuation of domestic inflation rates will imply the relative market price of domestic currency will fall against the French franc. In this event, any effort to prevent value of domestic currency from falling further will require Central Bank of this country to raise domestic interest rates. A rise in domestic interest rate is seen as a measure to attract foreign funds. However, rise in domestic interest rates also mean a fall in domestic investment and domestic consumption, which might eventually push this economy towards recession. This is what has exactly happened in case of Thailand during the South East Asian crisis.

Similarly, in an event of fixed exchange rates a higher external debt implies plausibility about domestic currency running into speculative attacks. This might eventually lead to massive devaluation of the domestic currency. Tariff might affect exchange rate in a different way. Other things remaining equal, under flexible exchange rate regimes, a lower tariff implies an increase in demand for imports, that is, a relative increase in demand for foreign currencies. However, recent literatures have suggested that tariffs measures are highly correlated with other non-tariff measures, and hence change in tariff levels have little impact in affecting value of exchange rates (Goldberg and Pavcnik, 2004).

To sum up, if we are to go by these aforementioned variables that might in any way affect exchange rates in the ECOWAS regions then it seems except for small aberration (like, Guinea with high inflation rates and high current account deficit) other

member countries have a lesser variation in terms of their economic fundamentals. In general, ECOWAS region seems to have similar economic characteristics. When countries share similar type of economic characteristics, it indicates a lower pressure to transfer funds from relatively resourceful countries to the poorer ones and hence a greater harmony in following a common fiscal and monetary policy – an indication for deeper economic integration.

Table 1a: Economic Characteristics in the ECOWAS region

Economic Characteristics	Annual Per Capita GDP (in US \$)	Population ages 15-64 (% of total)	Population ages 65 and above (% of total)	Mortality rate, infant (per 1,000 live births)	Fertility rate, total (births per woman)	Agriculture, value added (% of GDP)
UEMOA Region						
Benin	709	53.34	2.70	87.80	5.51	N/A
Burkina Faso	492	50.96	3.06	121.60	6.08	30.67
Cote d'Ivoire	1057	55.41	3.20	89.60	4.58	22.68
Guinea-Bissau	213	49.43	3.00	119.25	7.08	61.76
Mali	531	48.79	3.58	119.20	6.55	36.91
Niger	313	48.84	3.18	148.20	7.00	N/A
Senegal	915	53.82	4.26	59.90	5.30	15.87
Togo	387	53.90	3.08	69.15	4.91	N/A
Standard Deviation	295.12	2.619	0.472	30.04	0.947	1.902
Mean	558.28	51.81	3.257	101.83	5.876	17.65
Coefficient of Variation	0.528	0.050	0.145	0.295	0.161	1.902
Non-UEMOA						
Cape Verde	2925	56.80	4.21	25.00	3.45	9.09
Gambia, The	405	55.22	3.78	84.00	4.79	N/A
Ghana	690	57.74	3.66	75.95	3.95	37.39
Guinea	417	53.66	3.09	98.05	5.52	12.94
Liberia	196	50.80	2.18	157.00	6.78	N/A
Nigeria	1161	52.97	2.94	98.60	5.43	N/A
Sierra Leone	290	53.85	3.31	159.20	6.48	46.38
Standard Deviation	961.96	18.15	1.19	52.50	2.025	26.45
Mean	869.14	48.100	2.952	88.881	4.715	18.264
Coefficient of Variation	1.10	0.377	0.405	0.590	0.429	1.448
Addendum Table 1a: Economic Characteristics (Continued)						
	Gross savings (% of GDP)	FDI, net inflows (% of GDP)	Industry, value added (% of GDP)	GDP growth (annual %)	Rural population (% of total population)	Inflation
UEMOA Region						
Benin	N/A	1.32	N/A	4.10	59.50	2.986567
Burkina Faso	5.90	0.42	20.61	6.39	81.30	-0.08914

Cote d'Ivoire	14.46	1.79	26.32	0.85	54.56	5.00476
Guinea-Bissau	22.79	13.79	11.46	4.20	70.32	-0.54271
Mali	13.00	3.15	24.03	5.30	68.94	4.093471
Niger	N/A	0.56	N/A	4.80	83.00	1.816013
Senegal	18.46	0.63	23.01	2.30	58.14	3.369305
Togo	N/A	2.57	N/A	4.10	59.18	-1.90905
<i>Standard Deviation</i>	6.319	4.458	5.758	1.728	10.861	2.455
<i>Mean</i>	14.922	3.028	21.086	4.005	66.867	1.841
<i>Coefficient of Variation</i>	0.4234	1.472	0.273	0.431	0.162	1.333
Non-UEMOA						
Cape Verde	27.63	10.72	16.86	6.09	41.96	5.187737
Gambia, The	10.03	16.07	N/A	4.50	45.26	2.119709
Ghana	27.24	3.37	25.38	6.20	51.46	12.72414
Guinea	8.49	3.26	37.48	2.82	66.54	37.39349
Liberia	N/A	-12.95	N/A	7.80	41.22	9.152292
Nigeria	33.88	4.72	N/A	5.20	51.00	4.80831
Sierra Leone	9.50	4.05	24.99	7.37	58.56	11.6142
<i>Standard Deviation</i>	11.346	8.938	8.497	1.711	9.210	11.896
<i>Mean</i>	19.461	4.177	26.177	5.711	50.857	11.857
<i>Coefficient of Variation</i>	0.583	2.139	0.324	0.299	0.181	1.003
Table 1b: Macro and External Sector Variables						
	Fiscal Balance (Surplus+ / Deficit – as a % of GDP	Current Account Balance (In millions of US \$)	Exchange Rates (National Currency /US\$)	Total Public External Debt as a % of GDP¹	Average Applied Tariff (Manufactured Items)¹	Average Applied Tariff (Ores and Metals)¹
UEMOA Region						
Benin	-2	-300	445.59	16.5	12.1	7.4
Burkina Faso	-6	-954	445.59	17.7	12.1	7.4
Cote d'Ivoire	0.3	798	445.59	62.3	--	--
Guinea-Bissau	-17.3	-44	445.59	225.6	12.1	7.4
Mali	-1.0	-383	445.59	22.7	12.1	7.4
Niger	-0.8	-300	445.59	19.6	12.1	7.4
Senegal	-5.5	-888	445.59	18.5	12.1	7.4
Togo	-2.5	-152	445.59	70.5	12.1	7.4
<i>Standard Deviation</i>	5.683	543.727	0	71.591	0	0
<i>Mean</i>	-4.35	-277.875	445.59	56.675	12.1	7.4
<i>Coefficient of Variation</i>	-1.306	-1.956	0	1.2631	0	0
Non-UEMOA						
Cape Verde	-2.3	798	74.90	44.1	--	--
Gambia, The	0.3	-83	22.53	135.6	--	--

Ghana	1.8	-1033	0.97	14.9	--	--
Guinea	-8.2	-396	4346.80	105.6	--	--
Liberia	1.5	-147	42.75	181.6	--	--
Nigeria	5.6	5129	109.55	2.6	12.1	7.4
Sierra Leone	-2.5	-104	1666.67	92.9	--	--
Standard Deviation	4.35	2070.81	1637.41	65.460	0	0
Mean	-0.54	594.85	894.88	82.47	12.1	7.4
Coefficient of Variation	-8.017	3.4811	1.8297	0.7937	0	0

Note: All the figures are for the year 2007.

¹ 2006 figures.

Source: World Bank (2008) and African Union Commission (2008)

Although going by the aforementioned characteristics there are more similarities relative to dissimilarities, we find the extents of trade among various RTAs in Africa is low (See Table 2a). ECOWAS member countries trade in much greater amount with European Union relative to what they trade among themselves, and with other trading groups in Africa (See Table 2c). One reason for low value of trade among ECOWAS nations are because tradables primarily comprise of agricultural items (cocoa beans, timber, coffee, yarn, etc.) and extractive items in the form of natural resources, like, oil. Similar exports profile with respect to primary commodities discourages trade. Intra-industry trade is likely to flourish for technology intensive closely differentiated commodities, like, automobiles and computers. Disintegration of production itself leads to more trade, as intermediate inputs cross borders several times during the manufacturing process (Feenstra 1998). For example, automobile parts and finished autos are both included in trade between the United States and Canada—something clearly missing in the present context.

Exports to	2001	2002	2003	2004	2005	2006
Africa	3511	4109	4535	6168	7371	8974
AMU	105	132	152	189	168	232
CEN-SAD	2334	3233	3163	4531	5688	6133
COMESA	36	48	52	72	137	120
EAC	6	5	5	21	14	13
ECCAS	417	399	699	732	934	1189
ECOWAS	2242	3136	3037	4366	5497	5957
IGAD	4	3	4	6	53	10
SADC	334	534	717	971	822	1731
Import from						
Africa	3910	3746	4847	6722	8197	9213
AMU	2217	267	265	356	476	584
CEN-SAD	2969	2793	3623	5183	6463	7216
COMESA	103	142	140	168	234	183
EAC	14	23	35	40	48	59
ECCAS	73	151	131	173	228	281

ECOWAS	2696	2478	3293	4719	5835	6538
IGAD	20	31	35	52	45	56
SADC	511	487	737	1012	1186	1314

Table 2b: Percentage of Import and Export in two regions

		90-94	95-99	00-04	2005	2006	2007
Import	UEMOA Region	34.23%	37.71%	32.27%	30.46%	29.99%	32.01%
	Non-UEMOA	65.77%	62.29%	67.73%	69.54%	70.01%	67.99%
Export	UEMOA Region	24.52%	30.28%	24.18%	19.17%	19.22%	22.21%
	Non-UEMOA	75.48%	69.72%	75.82%	80.83%	80.78%	77.79%

Table 2c: ECOWAS Trade with European Union (In Million US \$)

Countries	Imports			Exports		
	2000	2001	2002	2000	2001	2002
<i>UEMOA Region</i>						
Benin	205	202	359	15	20	40
Burkina Faso	216	213	256	67	69	76
Cote D'Ivoire	1047	1123	1272	1605	1685	2314
Guinea Bissau	34	37	38	40	40	41
Mali	260	363	351	130	158	158
Niger	89	94	126	67	78	76
Senegal	745	894	1126	322	331	365
Togo	164	153	158	41	21	25
<i>Non-UEMOA</i>						
Cape Verde	174	191	204	9	8	9
The Gambia	120	84	87	4	5	7
Ghana	1131	2183	612	1179	1215	1014
Guinea	234	210	216	401	334	349
Liberia	62	63	63	43	51	51
Nigeria	3010	3095	3202	6212	4096	4026
Sierra Leone	53	77	79	1	8	17
Total	7544	8982	8149	10136	8119	8568

Source: African Union Commission (2008), and ECOWAS handbook of International Trade, (2008).

Another reason for low intra-ECOWAS trade is because of poor infrastructure in the region. As is evident from Table 3, the region is not well served by a good network of roads and railways, crucial for the movement of goods in the region. Only Nigeria and Cape Verde have somewhat more miles of paved road relative to unpaved roads. The railway network is highly fragmented, with very little addition has been made to the

existing network inherited from the colonial rule. In general, railway lines coverage as percentage of total surface area is less than 0.5 percent for most African countries, which is quite low when compared to some emerging economies in Asia. For example, railway lines coverage as a percentage of total surface area for China, India, South Korea and Vietnam are, 0.78, 1.92, 3.40, and 0.79 percent, respectively (World Development Indicators, 2008). Absence of proper road and rail connectivity with the urban market has implication on median income on rural household, as the latter group depends upon urban markets as an outlet for their produce. This has an important implication on regional income distribution. In addition, political and social conflicts in Liberia, Sierra Leone, Guinea Bissau and Niger, has also prevented national governments to divert adequate funds for development of both physical and social infrastructures.

Table 3: Roads and Railway Network in the ECOWAS Region

	Paved Roads (miles)	Unpaved Roads (miles)	Paved/Unpaved Ratio	Railways (Miles)	Railway Lines as a percentage of Total Surface Area
UEMOA Region					
Benin	2656	5604	0.46	578	0.51
Burkina Faso	2001	1050	0.19	622	0.23
Cote d'Ivoire	3579	42752	0.08	660	0.20
Guinea-Bissau	444	3906	0.11	None	None
Mali	1773	13003	0.14	641	0.05
Niger	779	9084	0.08	None	None
Senegal	4214	10366	0.4	904	0.46
Togo	2376	5143	0.46	525	0.92
Non-UEMOA					
Cape Verde	858	242	3.5	None	None
Gambia	932	1708	0.55	None	None
Ghana	9353	28208	0.33	953	0.40
Guinea	4964	25306	0.2	1086	0.44
Liberia	628	9652	0.06	490	0.44
Nigeria	26005	6100	4.26	3557	0.39
Sierra Leone	1284	10390	0.12	84	0.12

Source: Central Intelligence Agency (CIA) – The World Factbook (Various Issues).

The other factor that these West African countries need to figure about is how to ease labor mobility in the region. Because of language and institutional barriers presently labor mobility is low among the West African nations. However, this is not a major reason for concern as it requires political willingness to ease movement of labors. Labor mobility will help to absorb any shocks arising from persistence of unemployment in any particular member States. Therefore to sustain the RTA in its present form there is a need to encourage greater flow of goods, services and labors, in the ECOWAS region.

Finally, let us examine this hypothesis whether economic activities are symmetric. We based our analysis by examining how the key economic variable, namely the outputs of the ECOWAS member countries, respond to external shocks. We considered GDP as a proxy for output. Changes in the level of output over time are due to permanent and

transitory disturbances. There is a general consensus among macroeconomists that the transitory part of the GDP (also known as cycle) is of temporary in nature and is caused by demand shocks. The trend part of the GDP (also known as permanent component) is explained by supply shocks and is of permanent nature. In order to show synchronized movement in output we have to consider the permanent part of GDP and test whether there is any long term relation (read, cointegration) among them. The temporary part of GDP by definition is stationary and therefore cannot be tested for cointegration to ascertain presence of any long term relation.

3. Methodology

We use Beveridge-Nelson (1981) methodology to decompose the output data into its cyclical component and permanent component. Although vector autoregression (VAR) method as employed by Blanchard and Quah (1989) does a better job in terms of identifying structural shocks – demand and supply side shocks – in addition to identifying cyclical and permanent component of output, we stick to Beveridge Nelson methodology as unemployment data necessary to perform Blanchard and Quah decomposition are not available for the ECOWAS members. Beveridge and Nelson show that any ARIMA model can be represented as a stochastic trend plus a stationary component where a stochastic trend is defined to be random walk, possibly with a drift. For any data generating process y_t , using Beveridge-Nelson methodology, we can decompose it as follows:

$$y_t = y_t^p + y_t^s$$

$$\text{where } y_t^p = \mu t + h \sum_{r=1}^t \varepsilon_r \text{ and } y_t^s = d(L)\varepsilon_t$$

$$\text{or } y_t^p = \mu + y_{t-1}^p + h\varepsilon_t \tag{2}$$

y_t^p which is the permanent component, is a stochastic trend and is modeled as random walk with a drift μ . y_t^s is the stationary component and is a function of moving average components. The permanent and the stationary components of the time series are both proportional to the disturbance term ε_t and are thus perfectly correlated. Beveridge and Nelson (1981) defined the permanent part as that part of y_t which will be continued into the future, whereas the temporary part is purely a stationary random process.

3.1 Data

We have GDP data for each country, namely, Benin, Burkina Faso, Cote d'Ivoire, Ghana, Liberia, Niger, Nigeria, Senegal, Sierra Leone and Togo. Cape Verde, Gambia, Guinea, Mali and Mauritania are excluded from the analysis as relevant data for all time periods for these countries are not available. The results of the analysis will not change

much as these countries are smaller economies, with, Cote d'Ivoire, Nigeria, Ghana and Senegal being the largest economies. The data consisted of 48 annual observations from 1960 to 2007. The data used in this study are real GDP data measured in current US dollars. The data is obtained from World Development Indicators, World Bank.

Table 4: Descriptive Statistics for Gross Domestic Product*

<i>GDP</i> ¹	Mean	Median	Standard Deviation	Maximum	Minimum
UEMOA Region					
Benin	1.49	1.27	1.25	5.42	.226
Burkina Faso	1.97	1.76	1.54	6.76	.330
Cote d'Ivoire	7.59	8.39	5.14	19.57	.546
Niger	1.66	1.80	.878	4.17	0.44
Senegal	3.67	3.20	2.49	11.15	6.79
Togo	.979	.927	.642	2.49	.121
Non-UEMOA					
Ghana	4.78	4.42	2.96	15.24	1.21
Liberia	.512	.431	.283	1.03	.132
Nigeria	35.43	28.14	34.00	165.64	4.19
Sierra Leone	.755	.696	.322	1.67	.322

* Measured in current US dollars.

¹ Figures are in billions of US dollars.

Source: World Development Indicators, World Bank.

4. Interpretation of the Results

The first step involves testing the data series for stationary. To test for nonstationarity, we used Augmented Dickey-Fuller tests (ADF). Using this test statistic, we found evidence of nonstationarity for the GDP. The result of the ADF test in Table 5 show that for all the sample countries data exhibit unit root, suggesting that these variables are not mean reverting but are I(1) processes. Specifically, we estimated the regression model

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + \sum_{j=1}^n \alpha_j \Delta y_{t-j} + \varepsilon_t,$$

where, y_t is the logarithm of the GDP series for each countries, and β_1 is the ADF parameter. To determine appropriate specification for the number of lagged GDP terms,

we use the standard lag-length diagnostic tests, such as AIC and Schwarz Criterion. The most parsimonious specification is obtained choosing a lag-length of $n = 3$. The partial t -statistics on second and third-order lagged output were not statistically significant (P -value >0.10). Loss functions, such as AIC and Schwarz Criterion, were roughly minimized in the neighborhood of $n = 3$. Given the MacKinnon (1996) critical values of 2.61, we fail to reject the null hypothesis of a unit root at the 5% level of significance. Taking first difference of the data, we reject the null hypothesis of a unit root at the 1% level of significance. Hence, the GDP data are non stationary.

Table 5: Augmented Dickey-Fuller (ADF) Test Results

Statistic / Diagnostic	y_t^{ben}	y_t^{bur}	y_t^{cote}	y_t^{gha}	y_t^{lib}	y_t^{nig}	y_t^{nige}	y_t^{sen}	y_t^{sie}	y_t^{tog}
ADF Test ^a	0.13	0.25	2.21	0.29	2.20	.458	1.03	.318	1.19	1.58
AIC	-1.28	-1.32	-1.33	-1.28	-0.66	-0.22	-1.27	-1.31	-0.55	-1.18
Schwarz Criterion	-1.20	-1.24	-1.25	-1.21	-0.54	-0.14	-1.15	-1.23	-0.48	-1.10
Durbin Watson	2.19	1.57	1.95	1.70	2.29	1.79	1.89	1.66	1.82	1.90

Note: y_t^{ben} , y_t^{bur} , y_t^{cote} , y_t^{gha} , y_t^{lib} , y_t^{nig} , y_t^{nige} , y_t^{sen} , y_t^{sie} and y_t^{tog} represent the natural logarithm of GDP of Benin, Burkina Faso, Cote d'Ivoire, Ghana, Liberia, Niger, Nigeria, Senegal, Sierra Leone and Togo.

^aIn absolute value and compared to the MacKinnon (1991) critical value of 2.61 for a 10% level of significance.

Having identified the data as non-stationary, we take the first difference of the level data series and make them stationary. The autocorrelation and the partial autocorrelation function of the first difference of the log of output (y_t), for the ten countries were then examined. They were identified and estimated as an ARIMA process. The Beveridge and Nelson (1981) decomposition is now applied to compute the permanent and the temporary component of y_t . The results of the estimated model for each of the ten countries are summarized below⁵.

UEMOA Region

Benin

$$\text{Identification: } \Delta y_t = 0.0673 - 0.3055 \varepsilon_{t-4} + \varepsilon_t$$

(5.305) (2.076)

$$\text{Solution: } y_t = y_0 + 0.0673 \cdot t + 0.6945 \sum_{r=1}^t \varepsilon_r + 0.3055 \cdot (\varepsilon_t + \varepsilon_{t-1} + \varepsilon_{t-2} + \varepsilon_{t-3})$$

⁵ Estimation was performed using the econometric software package EVIEWS 6. Let y be the name used for the series, log of real output, in a EVIEWS session. The ARIMA (1,1,1) model was estimated using the EVIEWS commands: $y = c + AR(1) + MA(1)$.

Burkina Faso

Identification: $\Delta y_t = \underset{(4.6374)}{0.0650} - \underset{(24.73)}{0.850} \varepsilon_{t-14} + \varepsilon_t$

Solution: $y_t = y_0 + 0.065 \cdot t + 0.15 \sum_{r=1}^t \varepsilon_r + 0.85 \cdot (\varepsilon_t + \varepsilon_{t-1} + \varepsilon_{t-2} + \dots + \varepsilon_{t-13})$

Cote d'Ivoire

Identification: $\Delta y_t = \underset{(2.831)}{0.07511} + \underset{(2.230)}{0.3187} \Delta y_{t-1} + \varepsilon_t$

Solution: $y_t = y_0 + 0.1103 \cdot t + 1.4678 \sum_{r=1}^t \varepsilon_r$

Niger

Identification: $\Delta y_t = \underset{(1.84)}{0.0476} + \underset{(0.29)}{0.229} \Delta y_{t-1} + \underset{(0.53)}{0.1275} \varepsilon_{t-1} + \varepsilon_t$

Solution: $y_t = y_0 + 0.0618 \cdot t + 1.4624 \sum_{r=1}^t \varepsilon_r - 0.1654 \cdot \varepsilon_t$

Senegal

Identification: $\Delta y_t = \underset{(2.16)}{0.0619} + \underset{(19.22)}{0.835} \varepsilon_{t-11} + \varepsilon_t$

Solution: $y_t = y_0 + 0.0619 \cdot t + 1.835 \sum_{r=1}^t \varepsilon_r - 0.835 \cdot (\varepsilon_t + \varepsilon_{t-1} + \varepsilon_{t-2} + \dots + \varepsilon_{t-10})$

Togo

Identification: $\Delta y_t = \underset{(2.41)}{0.065} + \underset{(1.79)}{0.261} \Delta y_{t-1} + \varepsilon_t$

Solution: $y_t = y_0 + 0.08796 \cdot t + 1.353 \sum_{r=1}^t \varepsilon_r$

Non-UEMOA Region

Ghana

$$\text{Identification: } \Delta y_t = 0.05585 - 0.8586 \varepsilon_{t-14} + \varepsilon_t$$

(4.36) (27.93)

Solution:

$$y_t = y_0 + 0.05585 \cdot t + 0.1414 \sum_{r=1}^t \varepsilon_r + 0.8586 \cdot (\varepsilon_t + \varepsilon_{t-1} + \varepsilon_{t-2} + \dots + \varepsilon_{t-13})$$

Liberia

$$\text{Identification: } \Delta y_t = 0.0344 + 0.354 \Delta y_{t-2} + 0.439 \varepsilon_{t-1} + \varepsilon_t$$

(.5853) (2.25) (1.50)

$$\text{Solution: } y_t = y_0 + 0.0533 \cdot t + 2.228 \sum_{r=1}^t \varepsilon_r - 0.679 \cdot \varepsilon_t$$

Nigeria

$$\text{Identification: } \Delta y_t = 0.0813 + 0.2796 \varepsilon_{t-4} + \varepsilon_t$$

(2.153) (1.923)

$$\text{Solution: } y_t = y_0 + 0.0813 \cdot t + 1.2796 \sum_{r=1}^t \varepsilon_r + 0.2796 \cdot (\varepsilon_t + \varepsilon_{t-1} + \varepsilon_{t-2} + \varepsilon_{t-3})$$

Sierra Leone

$$\text{Identification: } \Delta y_t = 0.032 - 0.357 \varepsilon_{t-2} + \varepsilon_t$$

(1.97) (2.48)

$$\text{Solution: } y_t = y_0 + 0.032 \cdot t + 0.643 \sum_{r=1}^t \varepsilon_r + 0.357 \cdot (\varepsilon_t + \varepsilon_{t-1})$$

Note: Results derived using EVIEWS 6 Software. Absolute t -statistics are reported in the bracket. All the variables are significant at 5% level of significance. In all the equation Y_0 refers to the log of real output for each of the individual countries for the base year 1960. t takes value 1 for the year 1963 and takes value 45 for the year 2007.

The permanent and the temporary components can now be easily calculated using the solution to the above difference equations. For example, in case of Nigeria the permanent component of GDP is given as $y_0 + 0.0813 \times t + 1.2796 \sum_{r=1}^t \varepsilon_r$. y_0 is the log

value of Nigeria's GDP for the year 1960, and $t = 1 \dots 45$. The permanent component of the log output for Nigeria for the year 1963 is given as $y_{1960}^{Nigeria} + .0813 \times 1 + 1.2796 \varepsilon_{1963}$. Similarly, the permanent of the log output for Nigeria for the year 1964 is given as $y_{1960}^{Nigeria} + .0813 \times 2 + 1.2796(\varepsilon_{1963} + \varepsilon_{1964})$. Repeating for each point in the data sets for Nigeria, starting 1963 and ending 2008, will yield the permanent component. We follow the same rule in calculating the permanent component of GDP for other countries. As one of the model specifications, that is, in case of Liberia involving an *AR(2)* process, we lose three initial observations (one due to differencing the data and the other related to *AR(2)* process). Since we want to examine cointegrating relation among permanent components of all the sample countries, t takes value 1 for the year 1963 and takes value 45 for the year 2007, to address comparability.

Once we have estimated the permanent component we can easily calculate the temporary component by subtracting permanent component from the actual data sets. As the GDP series for each country are expressed in natural log, the temporary and permanent component of GDP are also in natural log format. The permanent component and temporary components of log GDP are reported in Table 6 and Table 7 (in Appendix) respectively.

In the final step we test for cointegration or presence of long term relationship among the permanent component of GDP and examine the correlation matrix of the temporary component of GDP across the member countries. Cointegration refers to a linear combination of nonstationary variables. Hence, we need to examine nonstationarity in the permanent component of GDP in their level form. Using Augmented Dickey-Fuller tests (ADF), we found evidence of nonstationarity in the permanent component of GDP for the sample countries. The data series can now be tested for cointegration.

The identification of the cointegration between output is based on an unrestricted model (i.e. we will use a Vector Autoregressive (VAR) Model). There are ten I(1) process in the data, implying there can be, at most, nine cointegrating relations across ten countries (Johansen and Juselius, 1995). Results indicate on the basis of maximum eigenvalue and the trace tests at a 95 percent level of significance, there are three cointegrating relationship among the output variables (See Table 8).

Table 8: Johansen Cointegration Test Results

Null Hypothesis ^a	Alternative Hypothesis	Eigenvalue	λ_{trace} value	5% Critical Value
λ_{trace} tests		λ_{trace} value		
$r = 0$	$r > 0$	0.84	336.38	239.24
$r \leq 1$	$r > 1$	0.80	256.28	197.37
$r \leq 2$	$r > 2$	0.75	186.17	159.53
$r \leq 3$	$r > 3$	0.57	127.23	125.62

$r \leq 4$	$r > 4$	0.49	91.16	95.75
$r \leq 5$	$r > 5$	0.39	62.41	69.82
$r \leq 6$	$r > 6$	0.34	41.00	47.86
$r \leq 7$	$r > 7$	0.30	23.38	29.80
$r \leq 8$	$r > 8$	0.17	8.11	15.49
$r \leq 9$	$r > 9$	0.00	0.17	3.84
λ_{\max} tests		λ_{\max} value		
$r = 0$	$r = 1$	0.84	80.10	64.50
$r = 1$	$r = 2$	0.80	70.11	58.43
$r = 2$	$r = 3$	0.75	58.94	52.36
$r = 3$	$r = 4$	0.57	36.06	46.23
$r = 4$	$r = 5$	0.49	28.75	40.08
$r = 5$	$r = 6$	0.39	21.41	33.88
$r = 6$	$r = 7$	0.34	17.62	27.58
$r = 7$	$r = 8$	0.30	15.27	21.13
$r = 8$	$r = 9$	0.17	7.94	14.26
$r = 9$	$r = 10$	0.00	0.17	3.84

^a r is the cointegrating rank.

The relationship:

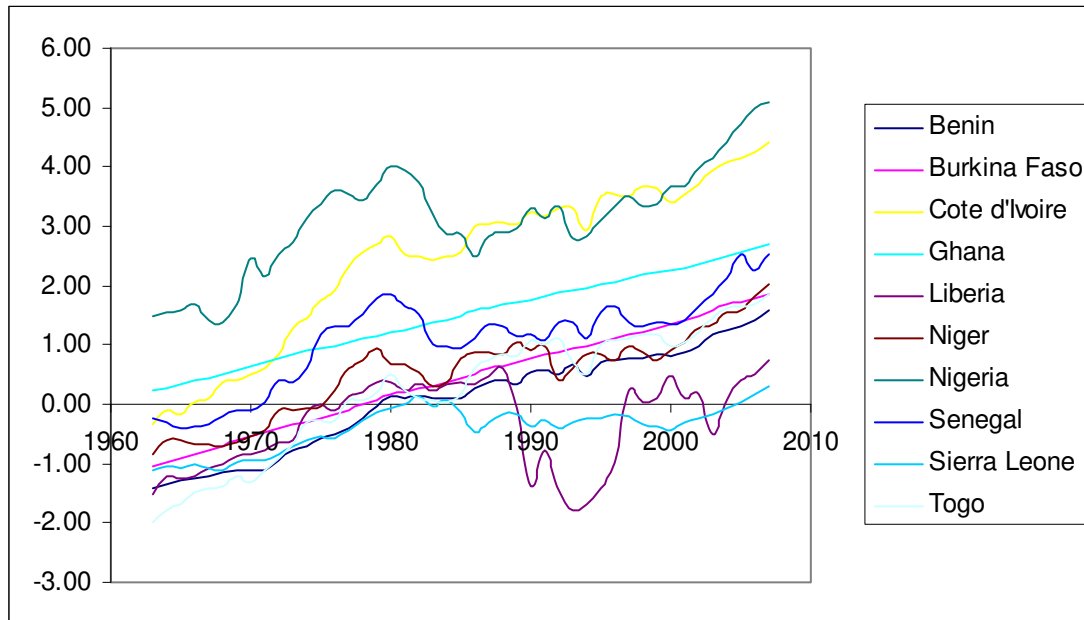
$$\begin{aligned}
 & y^{Benin} - 1.63 y^{BurkinaFaso} - 0.381 y^{Cote} + 0.875 y^{Ghana} - 0.079 y^{Liberia} - 0.581 y^{Niger} \\
 & \quad (0.726) \quad (0.118) \quad (0.886) \quad (0.019) \quad (0.099) \\
 & + 0.268 y^{Nigeria} - 0.547 y^{Senegal} + 0.449 y^{SierraLeone} + 0.837 y^{Togo} = 0 \\
 & \quad (0.044) \quad (0.092) \quad (0.094) \quad (0.1215)
 \end{aligned} \tag{3}$$

where y is the permanent component of log output from restrictive countries.⁶ The standard errors are reported in the parentheses. The cointegrating relationship (3) implies

⁶ The normalized cointegrating vector in this case is (1, -1.63, -0.381, 0.875, -0.079, -0.581, 0.268, -0.547, 0.449, 0.837).

that the permanent components of GDP for these ten countries tend to move proportionally in the long term. The fact that there is co-movement in the permanent component of GDP is also seen graphically. Figure 1 suggests co-movement, implying a possible long-term relationship among the variables.

Figure 1: Co-movement in the permanent component of GDP



Evidence of common trend is indicative of the fact that fluctuation in real output of the ten West African nations is synchronized. Such co-movements of outputs may be due to dependence on common factors, such as geographical proximity and similar trade composition of the West African nations.

We extended this analysis of long-term association for the UEMOA and non-UEMOA group of nations. Interestingly, we figure out existence of one cointegrating relation among the supply side components of output for the UEMOA group of nations, whereas for the non-UEMOA group there is no such relation (Table 11a and 11b in the Appendix). For the UEMOA group of economies the relation is:

$$y^{Benin} - 0.637 y^{BurkinaFaso} - 0.425 y^{Cote} - 0.7266 y^{Niger} + 0.1676 y^{Senegal} + 0.6095 y^{Togo} = 0$$

(0.043) (0.069) (0.0702) (0.0426) (0.089)

The above relation suggests economies within UEMOA framework nations are more homogenous as compared with other ECOWAS nations belonging to non-UEMOA framework.

Finally, we examined the correlation matrix of the temporary component of GDP (see Table 9) and found that little or no correlation in the temporary component of GDP. This corroborates the fact that the cyclical components of GDP across member countries are not related. Economic boom in one country does not necessarily suggest recession in other member countries. However, the permanent components of the GDP across member countries are highly correlated (see Table 10). From the above analysis a crucial

inference can be made. A common macroeconomic policy (a combination of monetary and fiscal policies) can be followed without any conflict of interest among the member countries. While fiscal policy can be used for development of infrastructure – an important component affecting long-term growth – monetary policy can be used for financing infrastructure and technology, factors affecting long-term growth potential. Because the permanent components of GDP are highly related with no relation among the temporary components, it can be concluded that in the long run there is a synchronized movement in output variables in among the ECOWAS nations, more specifically among the countries belonging to UEMOA region.

Table 9: Correlation matrix of the temporary components of GDP

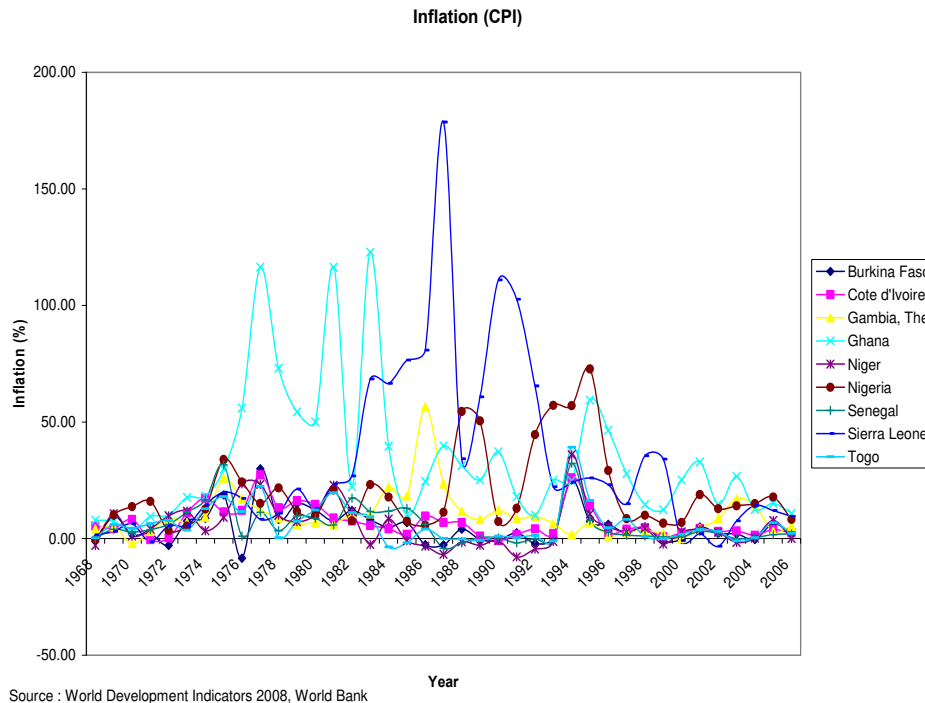
	<i>Benin</i>	<i>Burkina Faso</i>	<i>Cote d'Ivoire</i>	<i>Ghana</i>	<i>Liberia</i>	<i>Niger</i>	<i>Nigeria</i>	<i>Senegal</i>	<i>Sierra Leone</i>	<i>Togo</i>
Benin	1.00									
Burkina Faso	0.61	1.00								
Cote d'Ivoire	-0.02	0.27	1.00							
Ghana	0.27	0.63	0.75	1.00						
Liberia	-0.08	0.36	0.64	0.52	1.00					
Niger	-0.03	0.25	0.73	0.61	0.59	1.00				
Nigeria	-0.55	0.05	0.08	0.06	0.17	0.11	1.00			
Senegal	-0.66	-0.35	-0.07	-0.19	0.22	0.11	0.35	1.00		
Sierra Leone	0.49	0.08	-0.08	-0.04	-0.20	-0.20	-0.51	-0.54	1.00	
Togo	-0.01	0.27	0.99	0.74	0.65	0.72	0.07	-0.09	-0.07	1.00

Table 10: Correlation matrix of the permanent component of GDP

	<i>Benin</i>	<i>Burkina Faso</i>	<i>Cote d'Ivoire</i>	<i>Ghana</i>	<i>Liberia</i>	<i>Niger</i>	<i>Nigeria</i>	<i>Senegal</i>	<i>Sierra Leone</i>	<i>Togo</i>
Benin	1.00									
Burkina Faso	0.99	1.00								
Cote d'Ivoire	0.98	0.96	1.00							
Ghana	0.99	1.00	0.96	1.00						
Liberia	0.43	0.38	0.48	0.38	1.00					
Niger	0.95	0.92	0.96	0.92	0.56	1.00				
Nigeria	0.82	0.79	0.85	0.79	0.62	0.88	1.00			
Senegal	0.90	0.85	0.93	0.85	0.58	0.93	0.94	1.00		
Sierra Leone	0.85	0.78	0.88	0.78	0.61	0.88	0.85	0.91	1.00	
Togo	0.98	0.97	0.99	0.97	0.46	0.95	0.84	0.91	0.85	1.00

In addition, as is evident from Figure 2, ECOWAS countries (except for Ghana, Sierra Leone and Togo) have more or less similar inflation rates. Hence, conflicting issues resulting from loss of seignorage is also minimized.⁷

Figure 2: Inflation rates in the ECOWAS region



5. Conclusion and Policy Recommendations

In this paper, we have attempted to determine to what extent countries in ECOWAS regions are ready to form an OCA. We found that the ECOWAS region, in general has got some desirable characteristics for forming an OCA. The preliminary inferences are supported well by our empirical results. To identify temporary and permanent components of output we used the Beveridge-Nelson methodology. In the paper we find existence of long term relationship in the trend or permanent component of output among the West African countries. This implies that a common monetary and fiscal policy may be appropriate for these nations. That is, forming an OCA in ECOWAS region would be expected to result in monetary and fiscal policy settings that would not create relative advantages or disadvantages between the member states. The results are more robust for the UEMOA group of countries. This group seems to be more homogenous in terms of their economic characteristics, and also tend to exhibit cointegrating relation in the permanent component of their output.

⁷ Seignorage is the revenue government obtains by financing its budget deficit through printing money rather than selling debt. This claim about minimum loss in seignorage is however not valid for high inflation countries, like, Ghana, Togo, and Sierra Leone.

However, these similarities in economic characteristics will not work in favor if some of the present problems in the ECOWAS region are not addressed. First, there is a need to build a proper infrastructure. There is a dearth of road and railway infrastructures. Secondly, the member countries should take more initiatives to trade among themselves rather than trading with more advanced economies. Many operating companies in the ECOWAS region are headquartered in developed countries. So when agreements are concluded among member countries of ECOWAS, the dominance of these trans-national corporations reduces such policy initiatives. Also, since most of the trade in the region involves primary commodities there is a need to diversify production into higher value added manufactured items. This might lead to possibility of intra-industry trade and sustain monopolistic type competition. Third, the success of integration in West Africa should be primary goal of all stakeholders therefore the ECOWAS must seek out areas of cooperation and not conflict with the UEMOA member countries. And finally, there should be some conscious effort by the relatively resource endowed economies in West Africa, such as, Nigeria, Ghana, Senegal and Cote d'Ivoire, to undertake more initiative to trade with relatively resource poor States in West Africa. At a time when direct transfer of resources sound rather implausible, trade can help to build purchasing power in the region.

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Appendix

Table 7: Permanent Component of GDP

Year	Benin	Burkina Faso	Cote d'Ivoire	Ghana	Liberia	Niger	Nigeria	Senegal	Sierra Leone	Togo
1963	-1.42	-1.05	-0.35	0.23	-1.52	-0.84	1.47	-0.25	-1.11	-2.00
1964	-1.35	-0.97	-0.11	0.28	-1.22	-0.61	1.54	-0.29	-1.06	-1.80
1965	-1.29	-0.92	-0.18	0.34	-1.25	-0.61	1.60	-0.41	-1.07	-1.68
1966	-1.25	-0.84	0.02	0.40	-1.21	-0.68	1.67	-0.37	-1.03	-1.50
1967	-1.22	-0.77	0.09	0.45	-1.09	-0.68	1.40	-0.34	-1.08	-1.43
1968	-1.15	-0.70	0.36	0.51	-1.02	-0.70	1.39	-0.21	-1.10	-1.37
1969	-1.13	-0.61	0.40	0.58	-0.86	-0.63	1.68	-0.10	-0.98	-1.23
1970	-1.11	-0.55	0.49	0.63	-0.83	-0.54	2.47	-0.08	-0.95	-1.32
1971	-1.10	-0.48	0.62	0.70	-0.78	-0.45	2.15	0.05	-0.93	-1.12
1972	-0.94	-0.41	0.85	0.77	-0.64	-0.12	2.53	0.39	-0.85	-0.91
1973	-0.78	-0.35	1.26	0.84	-0.59	-0.10	2.71	0.38	-0.71	-0.69
1974	-0.71	-0.30	1.45	0.90	-0.14	-0.08	3.12	0.61	-0.61	-0.30
1975	-0.57	-0.23	1.74	0.94	0.00	-0.05	3.36	1.20	-0.53	-0.26
1976	-0.50	-0.18	1.93	0.98	-0.11	0.24	3.60	1.32	-0.57	-0.27
1977	-0.40	-0.10	2.31	1.04	0.14	0.62	3.53	1.33	-0.45	0.06
1978	-0.23	0.00	2.55	1.10	0.20	0.74	3.44	1.51	-0.26	0.08
1979	-0.02	0.07	2.69	1.16	0.37	0.95	3.70	1.80	-0.12	0.19
1980	0.12	0.15	2.82	1.23	0.36	0.67	4.03	1.86	-0.05	0.51
1981	0.09	0.20	2.53	1.26	0.25	0.67	3.95	1.67	0.00	0.23
1982	0.13	0.25	2.49	1.31	0.34	0.53	3.74	1.52	0.12	0.09
1983	0.09	0.31	2.43	1.37	0.23	0.29	3.22	1.02	-0.03	0.08
1984	0.11	0.36	2.51	1.42	0.35	0.38	2.85	0.98	0.07	0.04
1985	0.09	0.42	2.57	1.48	0.36	0.79	2.88	0.96	-0.14	0.16
1986	0.28	0.52	3.00	1.57	0.34	0.89	2.50	1.10	-0.46	0.61
1987	0.37	0.59	3.05	1.62	0.49	0.88	2.84	1.34	-0.31	0.74
1988	0.40	0.66	3.06	1.67	0.60	0.83	2.91	1.31	-0.16	0.84
1989	0.35	0.72	3.02	1.71	-0.08	1.06	2.96	1.14	-0.18	0.80
1990	0.54	0.78	3.22	1.76	-1.40	0.90	3.29	1.17	-0.36	1.08
1991	0.59	0.85	3.17	1.83	-0.79	0.98	3.14	1.09	-0.26	1.02
1992	0.49	0.89	3.31	1.88	-1.45	0.42	3.35	1.37	-0.41	1.12
1993	0.66	0.95	3.30	1.92	-1.80	0.59	2.79	1.39	-0.29	0.69
1994	0.48	0.99	2.92	1.96	-1.70	0.84	2.83	1.11	-0.24	0.52
1995	0.70	1.06	3.50	2.02	-1.41	0.85	3.09	1.56	-0.23	1.01
1996	0.74	1.12	3.55	2.07	-0.98	0.74	3.33	1.65	-0.16	1.09
1997	0.77	1.16	3.49	2.12	0.22	0.97	3.52	1.38	-0.22	1.10
1998	0.77	1.22	3.67	2.18	0.02	0.87	3.35	1.33	-0.34	1.19
1999	0.85	1.29	3.64	2.23	0.11	0.74	3.38	1.39	-0.38	1.18
2000	0.82	1.35	3.41	2.25	0.47	0.92	3.67	1.36	-0.45	0.98
2001	0.87	1.42	3.55	2.30	0.10	1.04	3.67	1.40	-0.31	1.06
2002	0.99	1.50	3.70	2.36	0.17	1.30	3.99	1.64	-0.24	1.23
2003	1.18	1.59	3.96	2.43	-0.50	1.35	4.15	1.86	-0.15	1.45
2004	1.26	1.67	4.09	2.49	0.06	1.54	4.40	2.13	-0.08	1.62
2005	1.31	1.73	4.15	2.57	0.40	1.60	4.72	2.51	0.03	1.65
2006	1.40	1.78	4.24	2.64	0.51	1.80	4.97	2.26	0.16	1.70
2007	1.57	1.85	4.43	2.70	0.75	2.02	5.08	2.52	0.31	1.87

Table 8: Temporary Component of GDP

Benin	Burkina Faso	Cote d'Ivoire	Ghana	Liberia	Niger	Nigeria	Senegal	Sierra Leone	Togo
0.04	0.11	0.07	0.20	-0.08	0.30	0.17	0.12	0.06	0.05
0.04	0.08	0.03	0.26	-0.22	0.07	0.17	0.23	0.07	0.01
0.05	0.05	0.09	0.38	-0.15	0.21	0.17	0.36	0.05	0.00
0.05	0.00	-0.01	0.35	-0.12	0.32	0.18	0.35	0.05	-0.04
0.03	-0.03	-0.02	0.10	-0.18	0.27	0.24	0.32	0.03	-0.03
0.04	-0.07	-0.11	0.00	-0.18	0.26	0.26	0.25	-0.01	-0.05
0.02	-0.12	-0.09	0.09	-0.25	0.16	0.21	0.08	0.09	-0.09
0.01	-0.24	-0.12	0.16	-0.22	0.11	0.05	0.10	0.12	-0.06
0.00	-0.25	-0.17	0.19	-0.22	0.08	0.07	0.00	0.06	-0.14
0.05	-0.13	-0.24	-0.01	-0.28	-0.18	-0.02	-0.15	0.09	-0.18
0.10	-0.04	-0.34	0.06	-0.27	0.05	0.00	0.01	0.16	-0.21
0.13	0.01	-0.33	0.17	-0.49	0.10	0.09	-0.10	0.17	-0.28
0.18	0.17	-0.38	0.09	-0.48	0.10	-0.03	-0.39	0.14	-0.22
0.14	0.15	-0.39	0.03	-0.32	-0.18	0.00	-0.50	0.05	-0.21
0.12	0.23	-0.48	0.12	-0.44	-0.36	0.05	-0.49	0.08	-0.31
0.16	0.39	-0.48	0.20	-0.41	-0.17	0.16	-0.55	0.22	-0.28
0.19	0.49	-0.48	0.23	-0.46	-0.20	0.16	-0.63	0.22	-0.31
0.22	0.50	-0.50	0.26	-0.41	0.25	0.14	-0.60	0.15	-0.39
0.17	0.38	-0.39	0.18	-0.32	0.11	0.14	-0.51	0.11	-0.27
0.11	0.31	-0.47	0.09	-0.39	0.17	0.16	-0.38	0.14	-0.29
0.00	0.16	-0.50	0.03	-0.33	0.29	0.34	0.00	0.02	-0.34
-0.06	0.02	-0.59	0.06	-0.41	0.00	0.49	0.01	0.01	-0.37
-0.05	0.02	-0.63	0.02	-0.43	-0.42	0.47	0.13	-0.02	-0.44
0.01	0.19	-0.78	0.17	-0.42	-0.25	0.50	0.33	-0.25	-0.55
0.07	0.27	-0.74	0.00	-0.52	-0.08	0.31	0.28	-0.05	-0.52
0.08	0.30	-0.74	-0.02	-0.57	-0.01	0.22	0.30	0.21	-0.52
0.06	0.25	-0.74	-0.05	-0.16	-0.28	0.21	0.45	0.11	-0.50
0.07	0.35	-0.85	0.01	0.44	0.01	0.06	0.57	-0.07	-0.59
0.04	0.30	-0.82	0.06	-0.26	-0.13	0.17	0.64	0.01	-0.54
-0.01	-0.08	-0.90	-0.02	-0.05	0.43	0.13	0.42	0.02	-0.59
0.09	-0.10	-0.90	-0.13	-0.03	-0.12	0.27	0.34	0.03	-0.48
-0.08	-0.35	-0.81	-0.27	-0.32	-0.40	0.33	0.25	0.14	-0.54
0.00	-0.19	-1.11	-0.15	-0.59	-0.22	0.24	0.03	0.09	-0.74
0.06	-0.17	-1.06	-0.13	-0.85	-0.06	0.24	-0.03	0.10	-0.70
0.00	-0.27	-1.03	-0.19	-1.44	-0.36	0.07	0.16	0.06	-0.69
0.08	-0.19	-1.12	-0.17	-1.04	-0.14	0.12	0.29	-0.05	-0.73
0.02	-0.18	-1.11	-0.19	-0.92	-0.04	0.17	0.25	-0.03	-0.73
-0.01	-0.39	-1.06	-0.64	-1.05	-0.34	0.16	0.19	-0.01	-0.69
-0.01	-0.39	-1.19	-0.63	-0.71	-0.38	0.20	0.18	0.09	-0.78
0.04	-0.31	-1.26	-0.55	-0.75	-0.52	0.09	0.04	0.17	-0.84
0.09	-0.14	-1.34	-0.40	-0.39	-0.38	0.06	0.06	0.14	-0.88
0.14	-0.04	-1.35	-0.31	-0.83	-0.48	0.07	-0.05	0.15	-0.90
0.14	-0.04	-1.35	-0.20	-1.04	-0.40	0.00	-0.35	0.16	-0.88
0.13	-0.02	-1.39	-0.10	-1.00	-0.52	0.02	-0.03	0.19	-0.90
0.12	0.06	-1.45	0.02	-1.07	-0.59	0.03	-0.11	0.21	-0.95

Table 11a: Johansen Cointegration Test Results for UEMOA countries

Null Hypothesis ^a	Alternate Hypothesis	Eigenvalue	λ_{trace} value	5% Critical value
λ_{trace} Test				
$r = 0$	$r > 0$	0.74	110.79	95.75
$r \leq 1$	$r > 1$	0.43	52.88	69.82
$r \leq 2$	$r > 2$	0.25	28.65	47.86
$r \leq 3$	$r > 3$	0.18	16.20	29.80
$r \leq 4$	$r > 4$	0.15	7.48	15.49
$r \leq 5$	$r > 5$	0.01	0.38	3.84
λ_{max} Test				
			λ_{max} Value	
$r = 0$	$r = 1$	0.74	57.91	40.08
$r = 1$	$r = 2$	0.43	24.23	33.88
$r = 2$	$r = 3$	0.25	12.46	27.58
$r = 3$	$r = 4$	0.18	8.72	21.13
$r = 4$	$r = 5$	0.15	7.10	14.26
$r = 5$	$r = 6$	0.01	0.38	3.84

^ar is the cointegrating rank.

Table 11b : Johansen Cointegration Test Results for non-UEMOA countries

Null Hypothesis ^b	Alternate Hypothesis	Eigenvalue	λ_{trace} value	5% Critical value
λ_{trace} Test				
$r = 0$	$r > 0$	0.30	36.42	47.86
$r \leq 1$	$r > 1$	0.29	20.82	29.80
$r \leq 2$	$r > 2$	0.13	6.11	15.49
$r \leq 3$	$r > 3$	0.00	0.06	3.84
λ_{max} Test				
			λ_{max} Value	
$r = 0$	$r = 1$	0.30	15.60	27.58
$r = 1$	$r = 2$	0.29	14.70	21.13
$r = 2$	$r = 3$	0.13	6.06	14.26
$r = 3$	$r = 4$	0.00	0.06	3.84

^br is the cointegrating rank