

Convergence of Growth Rates in the West African Monetary Zone

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There have been a number of failed attempts by policy makers in West Africa to launch a second common currency, the Eco, over the past decade. This in turn has raised a number of questions about the sustainability of the proposed second monetary union within the Economic Community of West African States (ECOWAS). While most of the issues are self-inflicted, the main culprit is a lack of proper analysis of the underlying factors that ought to be considered before forging ahead with the proposed currency union. This paper contributes to the debate by establishing the extent of convergence and synchronisation of business cycles within the West African Monetary Zone (WAMZ). Both univariate and multivariate unobserved components models are employed to decompose the annual real GDP series of five countries into their cyclical and permanent components from 1970 to 2011. The results suggest dissimilarities in business cycles within the sub-region. This lack of synchronisation signifies that WAMZ countries advance different business cycle paths, which casts doubts on the equality of welfare distribution in the context of a single currency. In support of some earlier findings, we argue that the substantial divergence in the economic characteristics of member countries would result in significant costs associated with co-ordination of policies and stabilization of macroeconomic activity.

1. Introduction

Economic integration within the ECOWAS is marked by the Francophone-Anglophone divide: on the one hand is the West African Economic and Monetary Union, better known by its French acronym UEMOA (Union économique et monétaire ouest-africaine), a grouping of 8 West African states that uses the CFA Franc as a common currency³.

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³ The eight countries are Benin, Burkina Faso, Cote d'Ivoire, Mali, Niger, Senegal and Togo, all former French colonies, with Guinea-Bissau, the late entrant being the only former Portuguese colony in the group.

On the other hand is the West African Monetary Zone (WAMZ)⁴, a collection of 5 former British colonies and Guinea, intent on establishing a single currency, the Eco. The eventual goal is for the CFA Franc and Eco to merge, bringing into being a single monetary union in West Africa.

While UEMOA has made strides in achieving both customs and monetary union in West Africa, the results for the WAMZ remains mixed. Since the WAMZ's formation in 2000, policy makers had dreamt of a merged currency by the mid-2000s. However, this did not materialise on account of failure of member states to meet the convergence criteria⁵. The goal post was shifted to December, 2009 for the introduction of the Eco. This again fell flat. The last deadline for the Eco to come into force was December, 2013. This was horribly missed. And now, policy makers are looking to January 2015 where the Eco will start circulating, effectively bringing to an end the plethora of national currencies.

A look at recent economic data suggests that the January 2015 date may also be missed, and the Eco may not in fact be in circulation, going by the convergence criteria that member states are expected to meet. Using the primary convergence criteria, for instance, inflation has averaged 12.8%, 15% and 11.9% for Ghana, Guinea and Nigeria respectively from 2008 to 2011. With the exception of The Gambia which recorded single digit inflation of 4.7% over the same period, none of the members fulfilled this important criterion. A cursory look at the data also suggests that the WAMZ is a highly indebted region. Total debt outstanding as a percentage of GDP averaged 187.8% for Liberia, 47.2% for Ghana, and

⁴ The WAMZ countries are Ghana, Nigeria, Liberia, The Gambia, Sierra Leone and Guinea. Guinea is the only country that uses French.

⁵ The key macroeconomic convergence criteria include the attainment of single digit inflation; budget deficit/GDP ratio of not more than 4% (excluding grants); Central Bank financing of budget deficit not more than 10% of previous year's tax revenue; foreign exchange reserves of not less than three months of import cover. In addition to this is the requirement of attaining six secondary convergence indicators, improving the competitiveness of the economic environment, liberalising product and labour markets and rationalization and harmonization of the legal environment. The secondary indicators are zero level of domestic arrears; tax revenue to GDP ratio not less than 20%; government wage bill to tax revenue ratio not exceeding 35%; public sector investment to tax revenue ratio not below 20%; positive real interest rate, and nominal exchange rate movement to range within the band of +/-15%.

42.5% for Guinea, with Sierra Leone recording 35.5% over the period 2008 to 2011 where data is available. Nigeria stands out as the country with the lowest debt to GDP ratio of 2.7%. The high debt burden implies that a substantial amount of export receipts is spent on debt servicing, with debt service to exports ranging from 32.9% for The Gambia to 41.7% for Ghana⁶. Coupled with widening budget deficits, volatile exchange rates (the exchange rates of Ghana has come under intense pressure over the past couple of months, depreciating over 18% against major international currencies), and slow progress at harmonising trade and industrial policies, it may not be out of place for one to fault the January 2015 start for the Eco if the convergence criterion is anything to go by.

Although some amount of research work is emerging on the progress and performance of the WAMZ economies particularly with respect to the viability of the proposed second currency, they have tended to concentrate on the dynamics of exchange rates/or price level convergence. For instance, Debrun *et al.* (2005) examined the political economy questions of central bank independence and pressure exerted by the ruling elite on central banks to extract seigniorage. They argue that the inability of monetary authorities to pre-commit to price stability affect the incentives of fiscally heterogeneous countries to form a currency union. Alagidede *et al* (2008, 2012) examine price and output convergence, and Carmignani (2010) uncovers procyclicality in fiscal policy and advocates for counter cyclical measures to smooth the path of the cycles. Coleman (2010) looks at food and non-food price inflation and argues that there are significant asymmetries across states within the CFA Franc zone. And more recently, Asongu (2014) examined imbalances in macroeconomic adjustments in the WAMZ. In spite of these emerging contributions, a lot of gaps remain in the literature regarding the underlying mechanisms and processes that should help enliven the debate for a second common currency in West Africa. This paper looks at another dimension to this debate, convergence (divergence) of business cycles.

To a very large extent, asymmetry in business cycles and response to external shocks is a key variable worth considering for the WAMZ

⁶ The data cited in this section is sourced from the African Development Indicators of the World Bank, and the African Economic Outlook database.

integration. While a monetary union does not pledge the existence of harmonised cyclical dynamics among the members as the different economic structures in the countries may perhaps generate heterogeneous cyclical movements, policy makers ought to be aware of the welfare implications of income convergence over time. The purpose of the present paper is thus to ascertain the extent of convergence and synchronization in the WAMZ by employing the unobserved components modelling technique.

The paper makes two main contributions to the literature: methodological and policy. First, examining convergence and divergence in growth rates inevitably faces serious statistical difficulties. For example, the results may be very sensitive to the methods employed and years under consideration. We propose unobserved components models in the spirit of Harvey (1989, 1997), Harvey and Koopman (1992, 2000). We favour this model based approach as opposed to the model free procedures such as Hodrick–Prescott (HP) filter (Hodrick and Prescott, 1980) and the Beveridge–Nelson decomposition (Beveridge and Nelson, 1981) or Structural Vector Auto-Regressive models (SVAR). By fitting both univariate and multivariate unobserved components models, we are able to effectively obviate the uninterpretable difficulties inherent in band pass filters, and analyse the trend-cycle decomposition of the series under consideration, while at the same time treating the traditional model free procedures as a special case. The components thus estimated capture the salient features of the data that are useful in examining the short run cyclical behaviour of growth rates, and the long run permanent component of GDP among member states of the WAMZ. Moreover, it is easy to incorporate changing patterns and to introduce additional features such as interventions. Unobserved components models are thus able to avoid the detection of spurious cycles in the time series and are preferable for forecasting (see Harvey and Jaeger, 1993; Harvey and Trimbur, 2003).

Second, this study is imperative due to crucial inferences it casts for policy directions besides the paucity of evidence on synchronisation and convergence of business cycles in the WAMZ. The widespread notion that disparities in real per capita income levels would lead to considerable welfare inequalities across the countries serves as motivation to unravel the correlation between business cycles among WAMZ countries. Furthermore, in the context of common monetary

policy and single currency, the commonality of the business cycles of the participant countries is of foremost concern. To this end the extent of business cycle synchronisation has become a well-recognised gauge for the readiness of different countries which intend to relinquish their currencies and policies and accede to the common currency. In the words of Mundell (1961) and McKinnon (1963), the success of a merger of sovereign states stipulates that business cycles be synchronized and well-coordinated among member countries.

The rest of the paper is organised as follows: section 2 considers the dynamics of economic growth in WAMZ and the time series properties of per capita real GDP of the five countries under consideration. Section 3 specifies the univariate unobserved component estimation technique as well as its multivariate extensions. Section 4 presents the empirical analysis for various sub components of WAMZ members. We conclude and offer some thoughts on policy in the last section.

2. Trends and Convergence of Growth in the Wamz

2.1. Convergence of growth in the West African Monetary Zone

The West African Monetary Zone which Ghana and Nigeria consented to form in April 2000 as a second monetary union in the West African sub-region to fast track the ECOWAS agenda of integration has grown to cover four more countries – The Gambia, Guinea, Liberia and Sierra Leone. Five countries agreed to the formation of the WAMZ and signed the landmark treaty that gave birth to the WAMZ before Liberia acceded in February 2010. Nigeria and Ghana are two of the biggest economies in ECOWAS, accounting for over 80% of output. The Gambia accounts for approximately 0.2% (African Development Fund, 2008), and it is by far one of the smallest countries in continental Africa. Growth in the Zone has been buoyant in the most recent decade, averaging 7% between 2000 and 2011. Guinea is the only member that has French as the official language and formerly used the CFA franc. This heterogeneity in the economies presents an interesting dynamic for the creation of the single currency.

Table 1 shows trends in real GDP growth for selected years. The evidence is very mixed. Although there has been a common perception that it is difficult for the region to achieve sustained growth, growth

accelerations and decelerations have been equally frequent. However, more worryingly there have also been collapses that led to long-lasting economic contractions, which in most instances eroded the economic gains made in the days of high growth. Quite remarkably, economic growth has increased distinctly since the middle of the 1990s. A large number of countries in sub-Saharan Africa are enjoying high rates of per capita income growth, and the growth episodes are showing some signs of unusual persistence. For instance, between 1995 and 2007 the ECOWAS as a whole saw real GDP grow at an average rate of 5%, and real per capita GDP growth averaged about 2%. This is a remarkable turnaround from the ‘lost decade’ (1980 to 1990).

Assessment of individual countries depicts some interesting observations in Table 1. Liberia's economic growth has been so enviable to the point that it was once regarded as the “fastest growing economy in the world”. In 1997, Liberia recorded its all time highest GDP growth of 106.3%, and experienced the lowest growth rate of -51% in its history in 1990.

Nigeria, Africa’s second largest economy, and powerhouse of the WAMZ, has Crude Petroleum and Natural Gas constituting about 13.5% of total GDP, although its contribution to GDP has been decreasing over the last few years. In 1970, Nigeria recorded its highest GDP growth of 25% following a devastating performance three years earlier.

Table 1: Growth rates of GDP for selected years

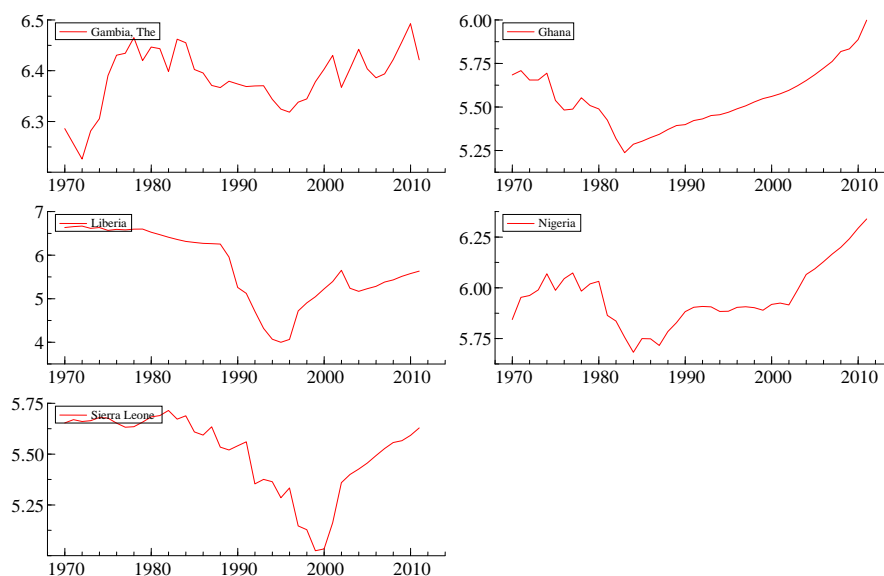
Country	1970	1975	1980	1985	1990	1995	2000	2005	2010	2011	High	Low
Gambia	6.2	12.4	6.3	-0.8	3.6	0.9	5.5	-0.9	6.5	-4.3	12.39	-4.60
Ghana	9.7	-12.4	0.5	5.1	3.3	4.1	3.7	5.9	8.0	14.4	7.8	-5.9
Liberia	6.7	-3.5	-4.1	-0.8	-51.0	-4.3	25.7	9.5	10.9	9.4	106.3	-51.0
Nigeria	25.0	-5.2	4.2	9.7	8.2	2.5	5.4	5.4	8.0	7.4	25.0	-15.7
Sierra Leone	8.6	1.7	4.8	-5.3	3.4	-8.0	3.8	7.2	4.9	6.0	16.4	-19.0
WAMZ Average	11.2	-1.4	2.3	1.6	-6.5	-1.0	8.8	5.4	7.7	6.6	20.3	-8.8

Source: World Development Indicators (2013)

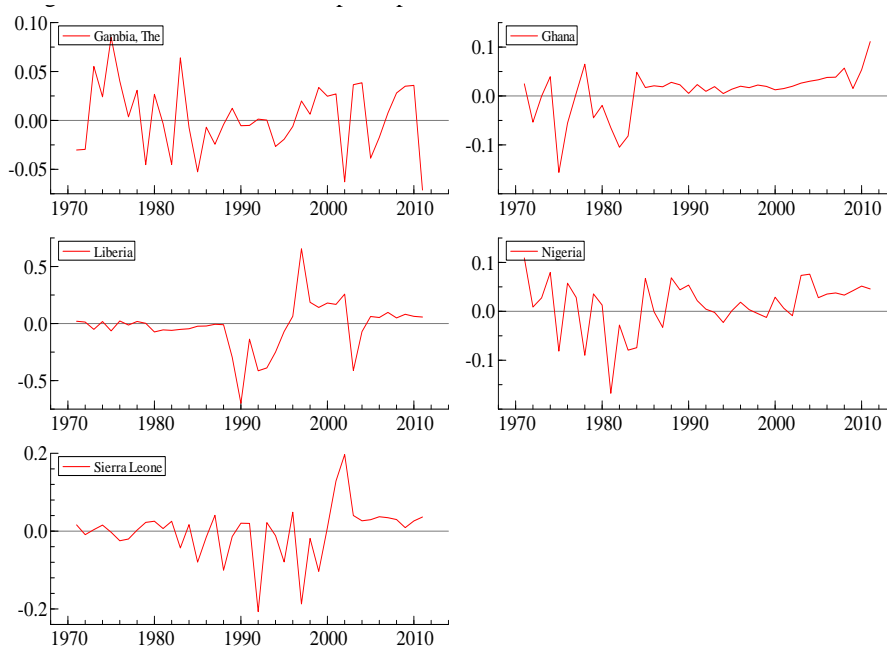
2.2. Time Series Properties of data

The data used in this study consists of annual real GDP per capita for five WAMZ member countries covering 1970 to 2011⁷. Figure 1 is a plot of the actual GDP per capita series in logarithm with its rates defined as the first differences presented in Figure 2. The figures show that most of the countries have experienced upward trends in real per capita income over the last two decades. This development has generally been attributed to the implementation of the Economic Recovery Programme and the Structural Adjustment Programme in most of these countries from the mid-1980s. Quite impressively, Ghana and Nigeria have not experienced negative growth rates since 1985. Even Sierra Leone that suffered a devastating decade-long civil war ended in 2002 has seen a steady real growth rate averaging 8.9% since 2000 compared to an average of 2.4% from 1970 until 2011. Only Gambia recorded negative growth in 2011.

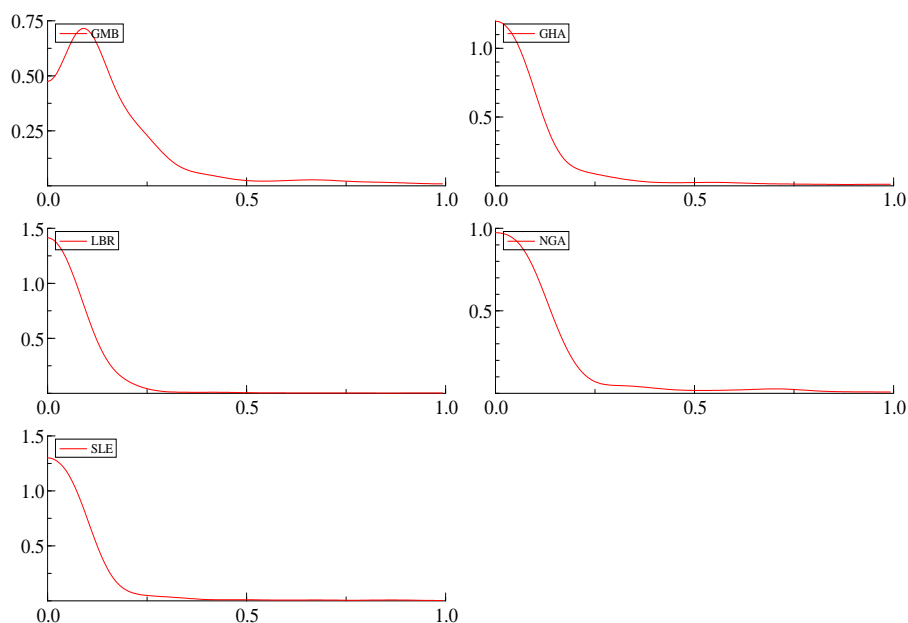
Figure 1: Annual GDP per capita (log levels)



⁷ The countries covered are The Gambia (GMB), Ghana (GHA), Liberia (LBR), Nigeria (NGA), and Sierra Leone (SLE). The data is extracted from the database of World Development Indicators published by the World Bank (2013). To be able to capture the differences in the economies, we use GDP per capita at constant 2000 US\$.

Figure 2: Growth rates of GDP per capita

In Figure 3 we present the spectral density for the actual series for each country. The spectra of the time series do provide much evidence of cyclical dynamics in the data. Overall, the spectra do conform to a particular shape with the exception of The Gambia that behaves a bit differently initially. Since they exhibit similar patterns, it may perhaps be argued that the series do share strong common dynamic features. They also show that cyclical dynamics in the series are apparent and do have common features. The spectra in most countries rise to a peak at low frequencies, and decline at high frequencies, with the spectral mass mostly concentrated in the business cycle frequency band. This depicts the distinct shape that King and Watson (1996) report for several US series.

Figure 3: Spectral density of annual real GDP per capita (Log levels)

The summary statistics for the series is shown in Table 2. The null of normality is not rejected for GHA, GMB, and NGA⁸. The standard deviation is very high for LBR. The coefficient of variation (or instability), which is the ratio of standard deviation to mean, indicates a generally low variability or high degree of stability in all the countries. The asymptotic test rejects the null hypothesis for only SLE.

⁸ The test reported is based on Doornik and Hansen (1994), who employ a small sample correction, and adapt the test for the multivariate case.

Table 2: Summary statistics for WAMZ Real GDP per Capita

	Min	Max	Mean	St dev	Stability	Skewness	Kurtosis	Asy. Test	Normal
GMB	6.23	6.49	6.38	0.06	0.01	-0.67	0.24	3.27 [0.19]	3.75 [0.15]
GHA	5.24	6.00	5.54	0.17	0.03	0.50	-0.11	1.74 [0.41]	2.15 [0.34]
LBR	4.00	6.67	5.72	0.81	0.14	-0.50	-0.83	2.97 [0.22]	6.57 [0.04]*
NGA	5.68	6.34	5.96	0.15	0.03	0.58	0.10	2.37 [0.30]	2.80 [0.25]
SLE	5.02	5.72	5.51	0.19	0.03	-1.10	0.21	8.51 [0.01]*	20.97 [0.00]**

Note: *p*-values for asymptotic and normality tests are reported in []. * and ** indicate significance at the 5% and 1% levels respectively

2.3. *Pair-wise Correlation of real GDP per capita*

According to a pair-wise linear correlation matrix of the actual data shown in Table 3, a strong positive relationship is found between Ghana and Nigeria, followed by Liberia and Sierra Leone. This may suggest strong macroeconomic ties between Ghana and Nigeria as well as synchronisation of macroeconomic policies in the two countries. Interestingly, apart from the positive relationship with Nigeria, Ghana seems to diverge from all the other countries. Although Nigeria's relationship with the other countries has been positive, it is only strongly correlated with Ghana. A similar finding holds for Sierra Leone. Aside the strong correlation with Liberia and a negative coefficient for Ghana, Sierra Leone is positively related to the other countries although in a weak manner. The Gambia, Nigeria and Sierra Leone seem more integrated albeit not very strong. In conclusion, we argue that evidence based on linear correlation is not strong among the countries.

Table 3: Linear correlation matrix

	GMB	GHA	LBR	NGA	SLE
GMB	1.00	-0.04	0.08	0.24	0.11
GHA		1.00	-0.07	0.88	-0.02
LBR			1.00	-0.07	0.75
NGA				1.00	0.09
SLE					1.00

3. Empirical Methodology

This study employs the univariate and multivariate forms of unobserved components modelling technique to characterise the dynamics of business cycle synchronisation using real per capita GDP of five WAMZ countries.

3.1. Univariate unobserved component model

The univariate model applied to decompose the time series of each country y_t , into trend μ_t , cycle ψ_t , and irregular ε_t components is represented by the following general form:

$$y_t = \mu_t + \psi_t + \varepsilon_t \quad (1)$$

In this study, the cycle component is characterized by two separate processes with different periods. We do so in order to account for shorter term dynamics with the first cycle (ψ_{1t}), while the second cycle (ψ_{2t}) explains the longer term cyclical movements.

$$y_t = \mu_t + \psi_{1t} + \psi_{2t} + \varepsilon_t \quad (2)$$

The unobserved trend equation is given by the following definition:

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t \quad (3)$$

and

$$\beta_t = \beta_{t-1} + \zeta_t \quad (4)$$

where η_t and ζ_t stochastic errors normally IID distributed. An alternative specification of the trend is obtained by imposing restrictions on the variances of the parameters η_t and ζ_t . If both variances are set to zero, the trend becomes linear. The random walk with drift is obtained when $\sigma_\zeta^2 = 0$. The smooth integrated random walk can be obtained by setting $\sigma_\eta^2 = 0$. The cycle component is a stationary process. It is specified as the first component of the vector defined by:

$$\begin{bmatrix} \psi_t \\ \psi_t^* \end{bmatrix} = \rho \begin{bmatrix} \cos \lambda & \sin \lambda \\ -\sin \lambda & \cos \lambda \end{bmatrix} \begin{bmatrix} \psi_{t-1} \\ \psi_{t-1}^* \end{bmatrix} + \begin{bmatrix} k_t \\ k_t^* \end{bmatrix} \quad (5)$$

where k_t and k_t^* are IID sequences with variance σ_k^2 the parameter λ defines the average period of the cycle and the parameter $\rho, 0 < \rho < 1$, is the damping factor, which determines the concentration of the power spectrum around the frequency λ . When λ is strictly smaller than 1, and, $0 < \rho < \pi$, the cycle ψ_t and the auxiliary process are stationary ARMA(2,1) processes with variance σ_k^2 . When λ approaches zero, the cycle collapses to an AR(1) process with an autoregressive coefficient equal to ρ . A particular component is said to be deterministic when its variance is equal to zero. In this way, the deterministic cycle component is a fixed sine-cosine wave. The first order cycles can be generalized to higher order cycles as shown by Harvey and Trimbur (2003). Smoother cyclical processes can be obtained by specifying $\psi_t = \psi_t^n$ where

$$\begin{bmatrix} \psi_{i,t} \\ \psi_{i,t}^* \end{bmatrix} = \rho \begin{bmatrix} \cos \lambda & \sin \lambda \\ -\sin \lambda & \cos \lambda \end{bmatrix} \begin{bmatrix} \psi_{i,t-1} \\ \psi_{i,t-1}^* \end{bmatrix} + \begin{bmatrix} \psi_{i-1,t-1} \\ \psi_{i-1,t-1}^* \end{bmatrix} \quad (6)$$

With

$$\begin{bmatrix} \psi_{1,t} \\ \psi_{1,t}^* \end{bmatrix} = \rho \begin{bmatrix} \cos \lambda & \sin \lambda \\ -\sin \lambda & \cos \lambda \end{bmatrix} \begin{bmatrix} \psi_{i,t-1} \\ \psi_{i,t-1}^* \end{bmatrix} + \begin{bmatrix} k_t \\ k_t^* \end{bmatrix} \quad (7)$$

for $i=2, \dots, n$, for $n=1$ the first order cycle is obtained

Harvey and Trimbur (2003) show with applications to real data, that the increase of the smoothness shift from order 1 to order 2 changes the extracted cycle slightly. In this paper, we will adopt an order 1 for the univariate model and an order 2 for the multivariate model. In fact, after some experimentation, we found that cycles of order 2 in the multivariate model give a reliable decomposition.

3.2. Multivariate unobserved component model

The univariate model can be generalized to the multivariate case. If we consider y_t as a vector $N \times 1$ of observable times series, the multivariate model can be applied to the N time series simultaneously. In this case, we have

$$y_t = \mu_t + \psi_t + \varepsilon_t \quad (8)$$

with the vector of trend given by:

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t \quad (9)$$

and

$$\beta_t = \beta_{t-1} + \zeta_t \quad (10)$$

In this system, each component becomes a vector of the same dimensions as y_t . Hence, the trend μ_t and cycle ψ_t are stochastic $N \times 1$ vectors with η_t and ζ_t independent NID sequences, and the covariances are respectively $\Sigma_\eta, \Sigma_\zeta$. We adopt the similar cycle model introduced by Harvey and Koopman (1997):

$$\begin{bmatrix} \psi_t \\ \psi_t^* \end{bmatrix} = \rho \begin{bmatrix} \cos \lambda & \sin \lambda \\ -\sin \lambda & \cos \lambda \end{bmatrix} \otimes I_N \begin{bmatrix} \psi_{t-1} \\ \psi_{t-1}^* \end{bmatrix} + \begin{bmatrix} k_t \\ k_t^* \end{bmatrix} \quad (11)$$

with the covariance matrix of the shocks given by:

$$E \begin{pmatrix} k_t \\ k_t^* \end{pmatrix} \begin{bmatrix} k_t & k_t^* \end{bmatrix} = I_2 \otimes \Sigma_k \quad (12)$$

The similar cycle model imposes the same period and the same damping factor to all the cycles, which means that their spectral density has the same shape. Indeed, the cycles in the different series have similar properties, for instance their movements are concentrated around the same period. This specification is reasonable if the cyclical movements arise from a source such as an underlying business cycle and makes easier the separation of trend and cycle movements when several series are jointly estimated (Harvey, 2006).

4. Empirical Results and Analysis

In this section we carry out univariate as well as multivariate analysis of synchronisation in the WAMZ. Whereas the univariate analysis enables us to see similarity of the business cycles using the periods and damping factors, the multivariate approach facilitates investigation of whether common factors govern the stochastic components of each cycle in the WAMZ. If the cycles are more synchronized, then we can conclude that there is cyclical convergence.

4.1. Univariate decomposition of growth series

We decompose the national output series into trend, cycle and irregular components using a general form of the univariate unobserved component model that is not restricted to a uniform specification. The purpose is to take into account dynamics of the business cycle in each country. Coefficient of determination indicates well specified model with the exception of The Gambia that has R^2 of 0.23. We report the estimated variances of the disturbances associated with the trend, the two cycle processes and the irregular component in Table 4. For each cycle component, the estimated frequency λ , damping factor ρ , and the period $2\pi / \lambda$ (in years) is also reported.

The estimated length of business cycle for the WAMZ countries is in the region of 5 years. The Cycle 1 length of 5 years is close to the average of the estimates of the business cycle reported. This is consistent with the short term dynamics. Nigeria has the shortest Cycle 1 length of 3.9

years followed by Liberia with 4.8 years. Most of the cycles are highly volatile with the exclusion of Ghana and Nigeria. The volatility is indicated by the variance of the shocks that drive the cycles. Again, Liberia and Nigeria have Cycle 1 below 5 years whereas Sierra Leone has a Cycle 1 length of 5.4 years.

The lengths of Cycle 2 are also consistent with the dynamics of the medium term business cycle. The Gambia, Ghana and Nigeria have their Cycle 2 estimates below 10 years. The longest duration is exhibited by Liberia that is around 12.2 years followed by Sierra Leone that has 10.9 years. In all, we find an average duration of approximately 10 years.

Table 4: Univariate model ($Y = \text{Trend} + \text{Irregular} + \text{Cycle 1} + \text{Cycle 2} + \text{Interventions}$)

	$2\pi / \lambda_1$	ρ_1	λ_1	$2\pi / \lambda_2$	ρ_2	λ_2	N	Q	R^2
GMB	5.0	1.00	1.26	8.3	1.00	0.76	0.19	5.98	0.23
GHA	5.0	1.00	1.14	8.2	1.00	0.78	3.60	9.99	0.54
LBR	4.8	1.00	1.32	12.2	0.96	0.52	8.93	6.32	0.85
NGA	3.9	1.00	1.32	9.7	0.98	0.37	7.70	8.86	0.48
SLE	5.4	1.00	1.16	10.9	1.00	0.58	1.66	6.68	0.83

Note: Parameter estimates for each component are reported. ρ is the damping (discount) parameter and $2\pi / \lambda_1$ is the period of the cycle (in years). Diagnostic test statistics for the standardized one-step ahead prediction residuals are also reported: N is the Jarque-Bera normality test (distributed as χ^2 variable with two degrees of freedom (df) and 95 percent critical value 5.99), Q is the Ljung-Box portmanteau test statistics and R squared is the goodness-of-fit statistic.

The damping (discount or persistence) factor ρ indicates how tightly clustered the random components are at the central frequency λ_0 . If ρ is close to 0, there is no clustering of the random components. Since ρ is 1, we conclude that the random components are tightly distributed at the central frequency λ_0 . This further illustrates that ρ controls the dispersion of the important components at λ_0 . The cycle process is nonstationary for all the countries because $\rho = 1$ for all Cycle 1 processes. In the case of Cycle 2, only Liberia and Nigeria have $\rho < 1$ but almost 1. The graph shows that the random components that make up the cyclical component are tightly distributed around the central frequency.

4.2. Cyclical dynamics of the West African Monetary Zone

The estimated Cycle-1 and Cycle-2 for the WAMZ sub-region is 7.9 years ($\rho=0.98$) and 11.8 years ($\rho=1.00$) respectively. Compared to the individual economies, the estimated Cycle 1 for the WAMZ is longer than all the countries. Similar to the Cycle-1, the estimated Cycle-2 length from the multivariate model also has a longer length than the average cycle of the individual WAMZ countries. However, Liberia has a longer Cycle 2 period than the WAMZ cycle. The length of Cycle-2 for the individual countries ranges from 8.2 years (for Ghana) to 12.2 years (for Liberia).

We consider the variance/correlation matrix reported in Tables 6 and 7 as a measure of degree of cyclical synchronisation or co-movement in the WAMZ for Cycle 1 and Cycle 2 respectively. Their respective graphics are also reported in Figures 4 and 5. From Table 6, the WAMZ is segregated rather than integrated. For example, the group seem sub-divided with Ghana, Nigeria and Liberia forming one synchronised group whereas Sierra Leone and The Gambia also form another synchronised group. Both The Gambia and Sierra Leone have strong negative correlations with the rest of the members. This result reflects strong short-term relationships within the WAMZ even though not among all members. The Gambia appears far apart from Ghana, Nigeria and Liberia in the short-term. Also, per the long term dynamics reported in Table 6, only Sierra Leone remains secluded in the long term. Fascinatingly, as The Gambia becomes synchronised with the other cluster its links with Sierra Leone turns opposite in the Cycle 2, notwithstanding the fairly strong Cycle 1 correlation between Sierra Leone and The Gambia. However, it appears that the negative correlation between them is not so strong.

Another interesting finding from the Cycle 2 movements is that, the strength of the correlation between Liberia *vis a vis* Ghana and Nigeria is reducing indicating a somewhat gradual drift from the union. As Ghana and Nigeria seem to bridge the gap with Sierra Leone, Liberia maintains a near perfect negative correlation. This is a bit interesting because if it happens this way it would suggest that all the five countries cannot have their cyclical dynamics converging at some point. The cyclical dynamics reported in Figure 4 confirms the behaviour of the unobserved

components. We confirm that two sub-groups emerge within the WAMZ. Ghana, Liberia and Nigeria belong to one side, as The Gambia and Sierra Leone seem more harmonised per the dynamics of the short cycle. The Cycle 2 depicts that only Sierra Leone fails to synchronise with the rest. The smooth cycles are shown in Figure 7 and 8.

Table 5: Multivariate Decomposition for the WAMZ⁹

	Level var	Slope var	Cycle1 var	Cycle2 var	Irregvar	N	Q	R ²
GMB	0.00	0.00	0.00	0.00	0.000234822	1.46	9.79	0.41
GHA	7.56521e-005	8.23259e-005	5.21438e-005	3.06732e-012	0.000412166	18.72	17.21	0.42
LBR	3.53904e-006	0.00294354	0.000401045	0.0120663	0.00260851	31.32	8.80	0.39
NGA	2.39720e-005	9.81422e-005	0.00	0.00	0.000362428	7.70	21.05	0.28
SLE	7.24698e-007	0.00	0.000430161	0.00	0.000408445	11.94	9.52	0.27

Note: The dependent variable, Y, contains all the 5 countries. Parameter estimates for each component are reported. Var denotes variances, ρ is the discount parameter and p is the period of the cycle (in years). Diagnostic test statistics for the standardized one-step ahead prediction residuals are also reported: N is the Jarque-Bera normality test (distributed as a X^2 variable with two degrees of freedom (df) and 95percent critical value 5.99), Q is the Ljung-Box portmanteau test statistics and R squared is the goodness-of-fit statistic. Cycle 1 p is 7.9 years and damping factor 0.98. Cycle 2 p is 11.8 years and damping factor of 1.00.

Table 6: Cyclical variance/correlation matrix

<i>Cycle-1 variance/correlation</i>					
	GHA	LBR	NGA	SLE	GMB
GHA	0.00	0.97	0.97	-0.74	-0.99
LBR		0.00	0.99	-0.84	-0.99
NGA			0.00	-0.88	-0.96
SLE				0.00	0.71
GMB					0.00

<i>Cycle-2 variance/correlation</i>					
	GHA	LBR	NGA	SLE	GMB
GHA	0.00	0.74	0.95	-0.61	0.84
LBR		0.00	0.48	-0.99	0.26
NGA			0.00	-0.33	0.97
SLE				0.00	-0.10
GMB					0.00

⁹The estimation indicates the following significant outliers: GHA (1974), LBR (1990 & 2002), NGA (1978), GMB (1982). Breaks are also found in LBR (1997) and SLE (1992).

Figure 4: Dynamics of shorter cycles in the WAMZ

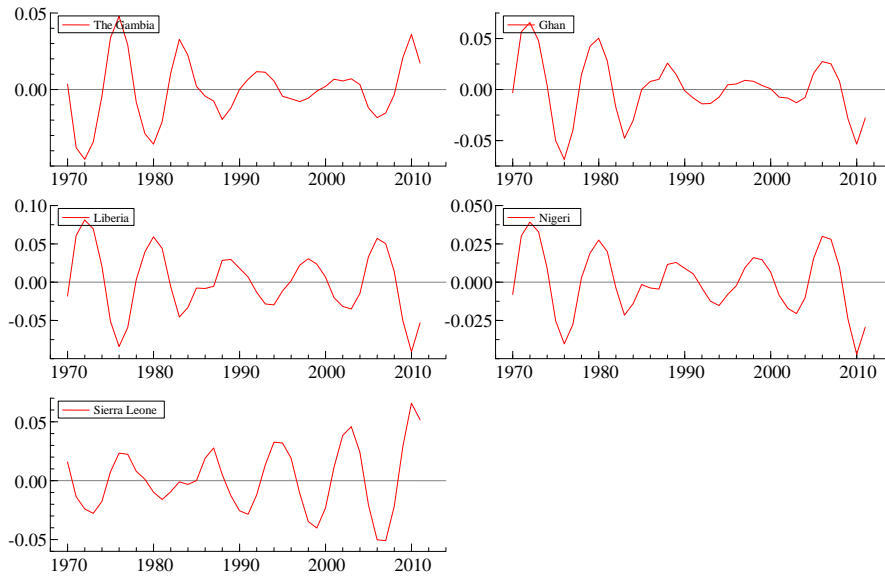


Figure 5: Dynamics of longer cycle in the WAMZ

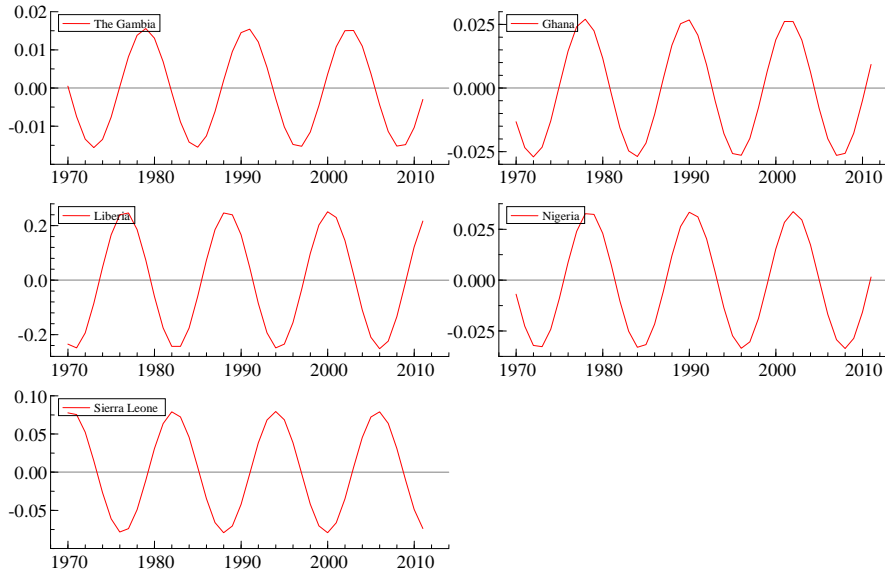


Figure 6: Dynamics of Irregular Components

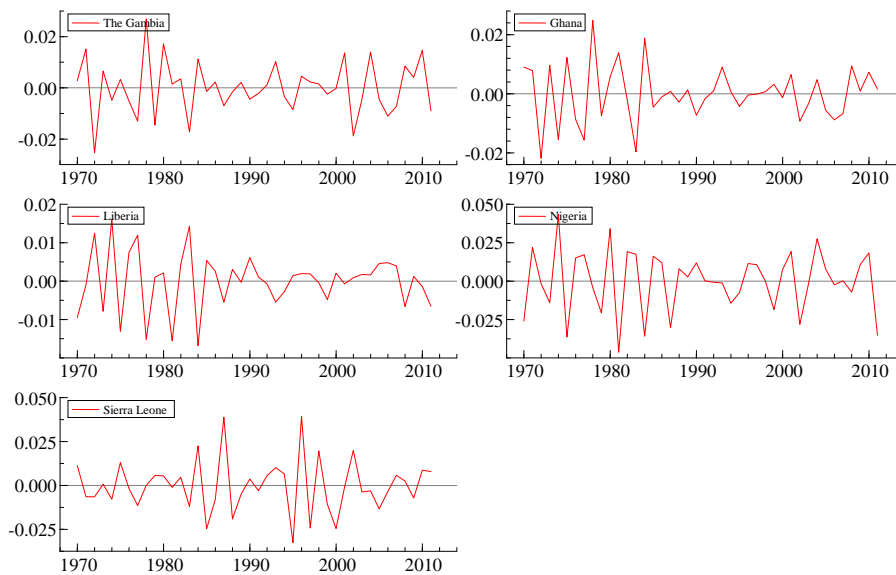


Figure 7: Smooth short cycle components

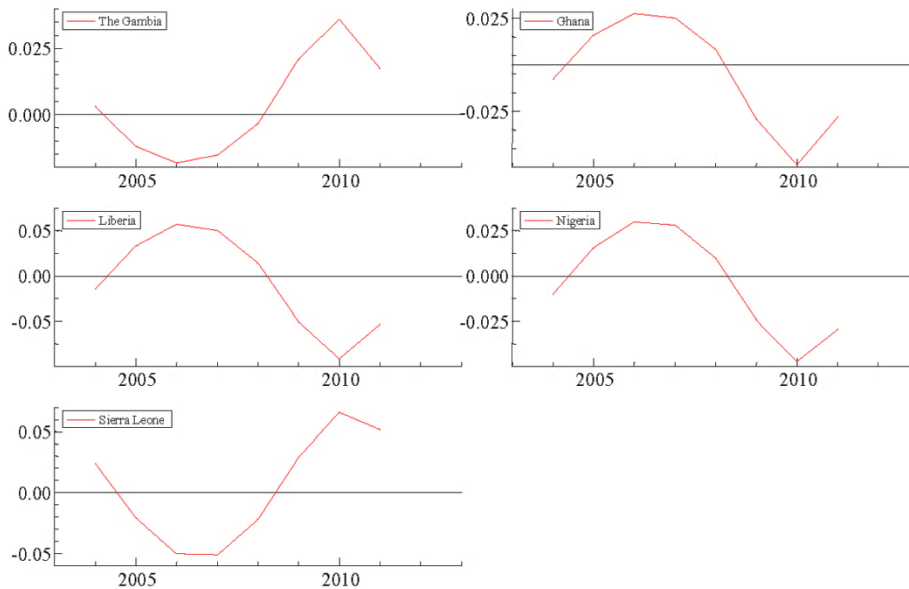
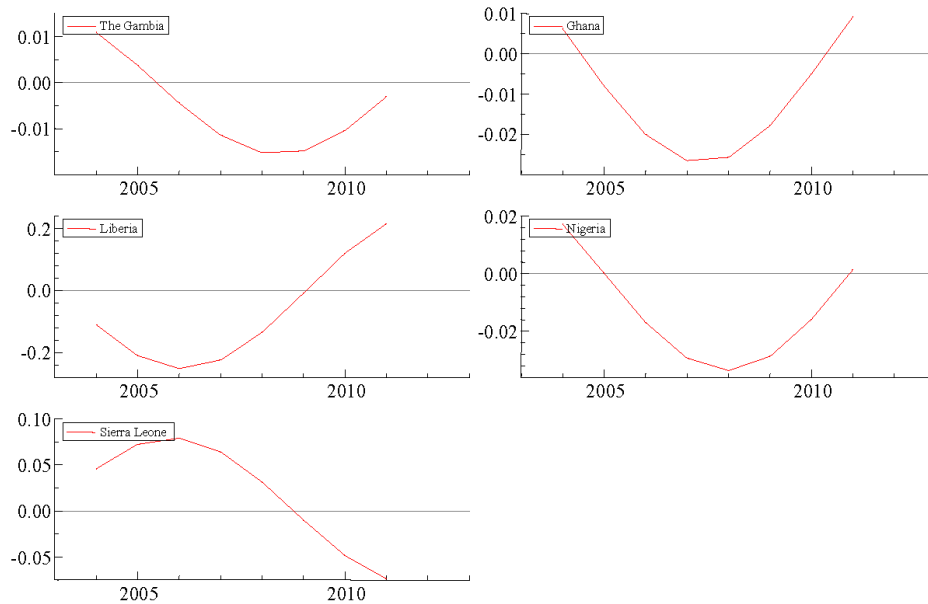


Figure 8: Smooth longer cycle components

5. Conclusion and Policy Recommendations

In this paper we have considered both the univariate and multivariate unobserved components models for annual real GDP per capita series for five WAMZ countries from 1970 to 2011. The main motivation for developing the models is to capture the properties of business cycle and the relations among countries within the WAMZ, and establish the convergence or otherwise of business cycles in the zone. In the context of single currency and common monetary policies, the similarity of the business cycles of the participant countries is a major concern. The paper also presents evidence on the degree of synchronisation and coordination between real incomes with the help of cyclical correlations.

The results based on the univariate model indicate that most of the countries hover around the mean of the Cycle 1 which spans 5 years. The mean length of the second cycle is 9.9 years, with 3 out of the 5 countries under consideration having their estimated Cycle 2 less than 10 years. More particularly, only Liberia and Sierra Leone have their lengths above the mean. A multivariate model of the WAMZ countries present evidence on the short cycle dynamics of two sub-groups in

which Ghana, Liberia, and Nigeria are highly synchronised whereas The Gambia and Sierra Leone form another synchronised group. In the long term, only Sierra Leone fails to synchronise with the rest of the members.

One interesting finding is that, the strength of the correlation between Liberia *vis a vis* Nigeria and Ghana diminishes in the long term. This presents some difficulty in finding clear cut evidence in support of long term synchronisation in the region. This lack of evidence on synchronisation signifies that WAMZ countries advance different business cycle paths, which casts doubts on the equality of welfare distribution in the context of common monetary policies with a single currency.

Barring few earlier findings that dissent on WAMZ integration, our evidence provides some optimism for business cycle synchronicity that paves the way for successful WAMZ integration. To some extent, the current attempts made to integrate the WAMZ economies has successfully synchronised the business cycles of majority of the member countries. Considering the long-term dynamics, one would believe that full convergence in the region is achievable given a few more years. It is very difficult to find evidence of full convergence in the WAMZ given the cross-country dissimilarities in institutional, structural and macroeconomic characteristics of the countries (see Coleman, 2011; Asongu, 2013; Asongu, 2014; Alagidede *et al.*, 2008; Tsangarides and Qureshi, 2008). Debrun *et al.* (2005) applies a model of monetary and fiscal policy interactions finds that the proposed ECOWAS union is appealing for most WAMZ countries, except for fiscal distortions due to Nigeria's preponderant weight. Masson and Pattillo (2001) also finds that Nigeria's large terms of trade shocks might be disruptive. Broadly, if such heterogeneity exists in the WAMZ region, a number of policy questions would pop up about the diverse degrees of exposure to terms of trade shocks that signify lack of convergence and business cycle synchronisation. How can fiscal and monetary policies be synchronised to ensure equitable welfare distribution across the monetary union? In particular, should the common monetary policy aim to achieve output gap stabilization or be fully optimal? Is it plausible to integrate the economies of all members at once, or it may make sense to seek integration of strongly imbedded fundamentals of one group of countries versus another group?

We conclude that, inasmuch as there seems to be some homogenous sub-groups within the region, it would be worthwhile to prefer integration of fewer synchronised countries to integration of the whole zone. This proposition corresponds with Celasun and Justiniano (2005). WAMZ policymakers should advance modalities aimed at ensuring that the integration of WAMZ serves as a strategy for achieving sustainable economic growth as there is a consensus that by merging its economies and pooling its capacities, endowments and energies, the continent can overcome its daunting development challenges. However, a few caveats hold as our analysis has been purely based on real GDP per capita. Although we make attempts to justify our results, we do not suggest that the attributes of the recent past that hampered a more coordinated ECOWAS can be relevant in future analysis or judgement. As this has been based on business cycle fluctuations, other attempts could be taken from different angles and on other aspects of economic integration to uncover the salient issues associated with ECOWAS integration.

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