

# Does Macroeconomic Convergence Lead to Growth? The Case of Africa

Hakim BEN HAMMOUDA,  
Stephen N. KARINGI,  
Angelica E. NJUGUNA  
Mustapha SADNI JALLAB\*

## Abstract

This article aims at determining whether there is a macroeconomic convergence in the African Regional Economic Communities (RECs), and if such convergence leads to growth. It presents empirical evidence on the progress and prospects of the integration process in Africa by assessing the level and rate of macroeconomic and financial convergence. The macroeconomic component of the integration corresponds to the complementary dimensions of convergence. This article presents the results of the analysis of the convergence of macroeconomic stability indicators for the various RECs. The analysis of income convergence shows that there is no evidence of convergence in the different RECs, with the exception of the West African Economic and Monetary Union (UEMOA).

## 1. Introduction

From the income convergence analysis, there is very little evidence that countries in the various RECs are converging, except in UEMOA. However, with more stringent testing that is founded on economic growth theories, very slow convergence of the per capita incomes could be seen. The implication of the slow per capita incomes convergence is that unless a major structural shift occurred, it would take at least more than half a century for the economies of most RECs to converge and attain one of the expected outcomes of regional integration initiatives in Africa — where poor countries in the continent are able to attain levels of development that overcome the

---

\* The authors are staff members of the Trade, Finance, and Economic Development Division of the United Nations Economic Commission for Africa. This paper should be attributed only to the authors. It is not meant to represent the positions or opinions of the United Nations or its members, nor the official position of any UN staff member. The corresponding author, Mustapha Sadni Jallab, may be contacted at: msadni-jallab@gmail.com

---

Does Macroeconomic Convergence Lead to Growth? / 415

---

disparities in per capita incomes. It is evident from this observation that the integration policies would have to address the lack or slow pace of convergence in per capita incomes.

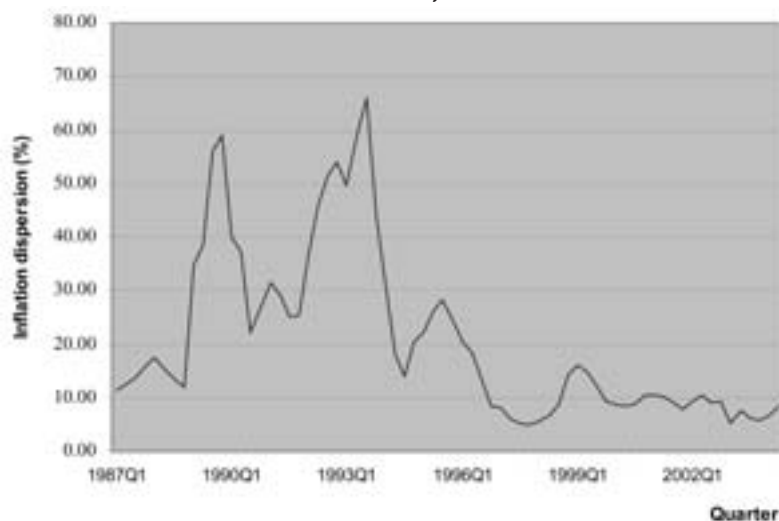
But what is the evidence on the macroeconomic convergence front? RECs are faced with the reality that they cannot achieve economic union status unless there is clear and sustainable macroeconomic convergence. On this, results are presented about the status of macroeconomic convergence in the RECs under study. We have looked at the two primary criteria for macroeconomic convergence. They are inflation for monetary policy and budget balance for fiscal policy.

Monetary and fiscal policies are the key instruments at the disposal of the governments to steer their economies towards economic integration, while the macroeconomic anchors that indicate movement towards attaining macroeconomic convergence include inflation, fiscal balance, current account balance, and real exchange rate, among others.

The objective of this paper is to assess if there is any macroeconomic convergence in RECs in Africa, and investigate if such convergence leads to any growth path. This paper provides empirical evidence on the progress and prospects of integration in Africa. It does so by assessing the level and rate of convergence of the macroeconomic and financial components. The macroeconomic component of integration relates to three complementary dimensions of convergence. First, it is anticipated that true integration cannot take place unless economies of participating countries in an integration area deal with economic shocks harmoniously. Second, and possibly one of the most important objectives of integration attempts in Africa, is to work towards the convergence of per capita incomes among the economies of participating countries. Consequently, a major emphasis of this paper will be to assess whether there is evidence of convergence of per capita incomes across the integrating countries in each of the RECs under study. The results from various formal tests applied for income and macroeconomic convergence for selected African RECs are discussed.

The paper is structured as follows: In the second section, results from the analysis of convergence of macroeconomic stability indicators for various RECs are reported. The methodology for analysing macroeconomic convergence is outlined in Appendix 1. It is the same as the one employed for income convergence analysis, involving sigma tests, unit root tests, and cointegration analysis. Evidence of macroeconomic convergence in the selected indicators of convergence could be an indication that policy co-ordination in the RECs is achieving desired macroeconomic outcomes. From that perspective, we first look at the monetary policy (Section 2), and then the fiscal policy (Section 3). This would provide the necessary foundation for moving the REC through the various phases of integration towards monetary unions as argued in optimal currency area theories. The results on monetary and fiscal policy outcomes are captured by inflation and fiscal balance as a proportion of GDP. Section 4 concludes this article.

**Figure 2.1. Dispersion (standard deviation) of inflation across SADC countries, 1987Q1-2004Q2.**



## 2. Macroeconomic Convergence: Monetary Policy

In investigating macroeconomic convergence in the different RECs, inflation was used to analyse convergence in monetary policy, which is the central bank process of managing money supply to achieve specific goals, such as to contain inflation, maintain an exchange rate, and achieve full employment or economic growth. The results involving convergence in monetary policy from sigma tests, unit root test, and cointegration analysis are presented in Appendices 2, 3 and 4, respectively.

### a. Convergence in SADC

Figure 2.1. shows the plot of the standard deviation of inflation within the SADC countries<sup>1</sup> from 1987Q1 to 2004Q2. It can be seen from the figure that the variability in inflation among the SADC countries decreased in general over time. It started with a low figure in the first quarter of 1987 and ended with a slightly lower figure in the fourth quarter of 2004. In between, particularly in the first half of the 90s, the variability in inflation was high and volatile, reaching a maximum of around 66 percent in quarter four of 1993. The dispersion in inflation reached the lowest point of five percent in the fourth quarter of 1997. From that period to the second quarter of 2004, the

1. This particular set includes Botswana, Lesotho, Madagascar, Malawi, Mauritius, Namibia, South Africa, Swaziland, Tanzania, and Zambia. Other SADC countries such as Angola, Mozambique, and Zimbabwe do not have sufficient data to be included in the analysis from 1987Q1 to 2004Q2. DR Congo was eliminated from the analysis due to its erratic and highly volatile inflation values. Also, in some quarters, its inflation values are extremely high, such as 73,529 percent in 1994Q3.

---

Does Macroeconomic Convergence Lead to Growth? / 417

---

inflation variability was relatively low and stable, demonstrating a tendency among SADC countries to have a macroeconomic convergence, particularly in monetary policy.

Regarding income, different statistical tests were undertaken to establish if there was a robust convergence. First, the result from the sigma test (*see Appendix 2*) showed a significant negative coefficient of time when the standard deviation of inflation was regressed with time. This indicated a tendency of monetary policy convergence among SADC countries over time. Next, the unit root test was applied to each country data set and more than half of the countries in the set (Madagascar, Malawi, Namibia, Swaziland, Tanzania, and Zambia) rejected the presence of unit root. This implied their convergence to the regional inflation mean (*see Appendix 3, Table A3-1*). The result from pooled unit root test showed that as a group, countries had a tendency to converge to the regional mean value. The presence of unit root was rejected and these implied convergence to the regional inflation mean. Therefore, SADC countries showed some evidence of convergence in their inflation, an indication of possible co-ordination with the desired results in monetary policies. Indeed, further examination through the cointegration analysis was carried out to establish if there was co-movement in the inflation rates of the SADC member countries. Six states were included in the test namely Botswana, Lesotho, Mauritius, South Africa, Tanzania, and Zambia. The results of the cointegration tests showed that there was only partial convergence of monetary policies in SADC countries.

*b. Convergence in COMESA*

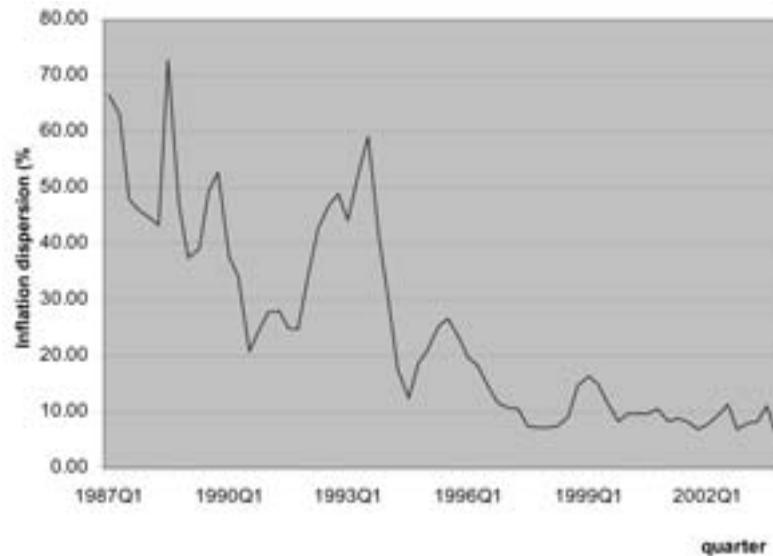
Figure 2.2 shows the plot of the standard deviation of inflation across COMESA countries<sup>2</sup> from 1987Q1 to 2002Q1. In this figure, the general decreasing trend in the variation of inflation across COMESA countries is very obvious. The figure shows the tendency of convergence in the inflation values within COMESA, indicating some convergence in monetary policies. The standard deviation across COMESA declined to around five percent in quarter four of 2003 from a high of 67 percent in quarter one of 1987. From 1987 to 1995, the variability of the inflation within COMESA was highly volatile. It became relatively low and stable from 1996 onwards.

The tendency of monetary convergence within COMESA was supported by the sigma test on the standard deviation of inflation. The test gave a negative significant coefficient of time, implying that the differences in inflation within the COMESA region were diminishing over time (*see Appendix 2*). The unit root test on the pooled data also supported convergence on

---

2. The countries included in the analysis are Burundi, Egypt, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Namibia, Rwanda, Seychelles, Swaziland, Uganda and Zambia. Other COMESA countries such as Angola, Djibouti, Sudan and Zimbabwe do not have sufficient data. Eritrea and Comoros do not have inflation data from the source while DRC was eliminated due to volatile and extremely high inflation levels.

**Figure 2.2. Dispersion (standard deviation) of inflation across COMESA countries, 1987Q1-2003Q4**



monetary policy. The results rejected the presence of unit root. However, on individual country basis, only few countries, namely Egypt, Kenya, Malawi, Namibia, Swaziland, and Zambia, supported the convergence in monetary policy. On the cointegration test, only four countries were included in the analysis – those that did not reject the presence of unit root. The cointegration test performed on these countries (Burundi, Egypt, Mauritius, and Uganda) showed that only two demonstrated co-movements.

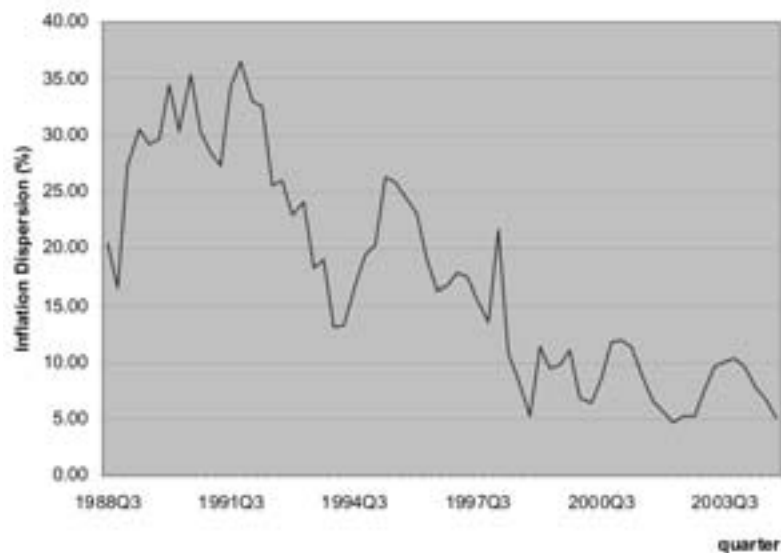
### *c. Convergence in ECOWAS*

The plot of the dispersion in the inflation series (1988Q3-2004Q4) among the ECOWAS countries<sup>3</sup> is shown in Figure 2.3. In the figure, a behaviour similar to those observed in SADC and COMESA regions can be noted – a generally decreasing variation in inflation with time. The standard deviation was more volatile from 1988Q3 to 1998Q3 with a maximum point of 37 percent. The variability in inflation became narrow and stable in the late 1990s up to 2004Q4, during which it fluctuated within the five percent to 12 percent range.

The sigma test supported the tendency of a monetary policy convergence within the ECOWAS countries (*see Appendix 2*). The result showed a significant negative coefficient of time, indicating that the differences of inflation

3. The countries included are Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. Benin, Guinea, and Liberia do not have sufficient data on quarterly inflation.

**Figure 2.3. Dispersion (standard deviation) of inflation across ECOWAS countries, 1988Q3-2004Q4**



within the ECOWAS were diminishing over time. The convergence in monetary policy within ECOWAS was further supported by the unit root test using the pooled panel data set. As a group, the countries in ECOWAS were found to be converging to the regional inflation mean (see Appendix 3, Table A3-6). On the basis of the results of the individual unit root test, most of the countries in ECOWAS reflected their tendency to convergence into the regional mean (see Appendix 3, Table A3-3). Only three countries, namely Cape Verde, Senegal, and Togo, did not reject the presence of unit root.

Lastly, the cointegration analysis including four countries (Cape Verde, Guinea Bissau, Sierra Leone, and Togo) indicated only at most one co-movement among them.

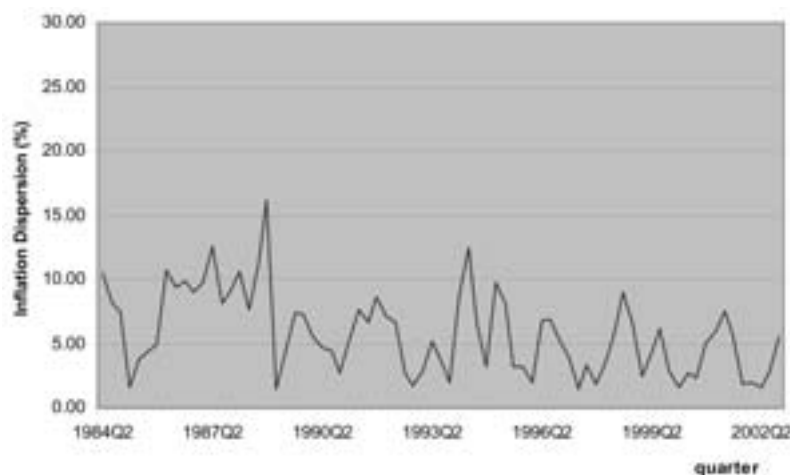
#### *d. Convergence in CEMAC*

Figure 2.4 shows the plot of the standard deviation of inflation within the CEMAC countries<sup>4</sup> from 1984Q2 to 2002Q2. CEMAC is the French acronym for Economic and Monetary Community of Central Africa.

It is interesting to note that the dispersion in inflation is relatively low and stable in this region compared to the other RECs under study. In the period under review, the variability of inflation within CEMAC fluctuated only between a high of 16 percent and a low of 1.4 percent, suggesting a

4. The countries included are Cameroon, Central African Republic, Chad, and Gabon. The Republic of Congo and Equatorial Guinea do not have sufficient data.

**Figure 2.4. Dispersion (standard deviation) of inflation across CEMAC countries, 1984Q2-2002Q4**



higher possibility of realising the REC objective of attaining convergence in the monetary policy.

The sigma test also supported this tendency within CEMAC (*see Appendix 2*). The coefficient of time had a significantly negative trend over the period, indicating that the differences in inflation within CEMAC was decreasing over time. The unit root tests, both on the pooled data and individual countries, also confirmed the tendency within CEMAC to attain monetary policy convergence. The cointegration test for CEMAC countries was not conducted because all countries rejected the presence of unit root in the actual level of inflation.

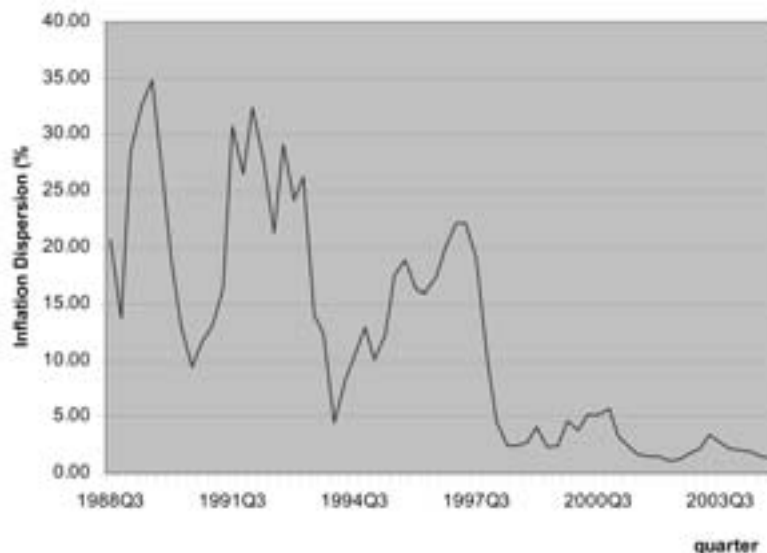
#### *e. Convergence in UEMOA*

Figure 2.5 shows the plot of the standard deviation of inflation within the UEMOA countries<sup>5</sup> from 1988Q3 to 2004Q4. Like in most RECs under study, the dispersion of inflation within UEMOA is highly volatile and unstable in the earlier period of the study, in this case from 1988Q3 to 1997Q4. However, the variability in UEMOA is relatively low compared to the ones observed in SADC and COMESA, but similar to the level experienced across ECOWAS.

From the late 1990s up to 2004Q4, the variability in inflation within UEMOA decreased remarkably, fluctuating only within the range of 1.4 percent to about 5.1 percent. This observation is a clear evidence of monetary policy convergence within UEMOA countries. Again, the evidence is supported by the sigma test, which resulted in a significant negative trend in stan-

5. The countries included are Burkina Faso, Cote d'Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo. Only Benin is not included due to insufficient data.

**Figure 2.5. Dispersion (standard deviation) of inflation across UEMOA countries, 1988Q3-2004Q4**



standard deviation over time. The unit root tests on both pooled panel data and on individual countries also confirmed the evidence of monetary convergence in UEMOA. Only two countries were included for the cointegration test. The result was, however, not conclusive as it failed to reject any of the hypothesis statements.

### 3. Macroeconomic Convergence: Fiscal Policy

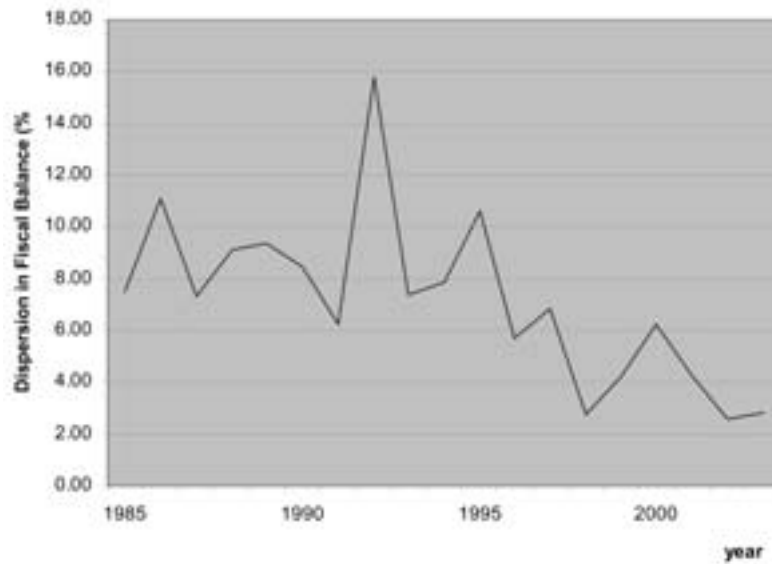
The second interest in the study is to observe the convergence in fiscal policies within different RECs. Fiscal policy is a government mechanism for setting the level of public expenditure and how that spending is funded. Convergence in fiscal policy can also be used as a measure of macroeconomic convergence. Here, fiscal balance<sup>6</sup> is applied as test variable to capture the results for the convergence in the fiscal policies within different RECs. The different statistical tests, such as the sigma tests, unit root test, and cointegration analysis are presented in Appendices 2, 3, and 4, respectively.

Figures 3.1 – 3.5 show the plots of standard deviation of fiscal balance respectively for SADC, COMESA, ECOWAS, CEMAC, and UEMOA for the 1985-2003 period. In general, the variability in the fiscal balance within each REC under study is not too wide, which means a much faster conver-

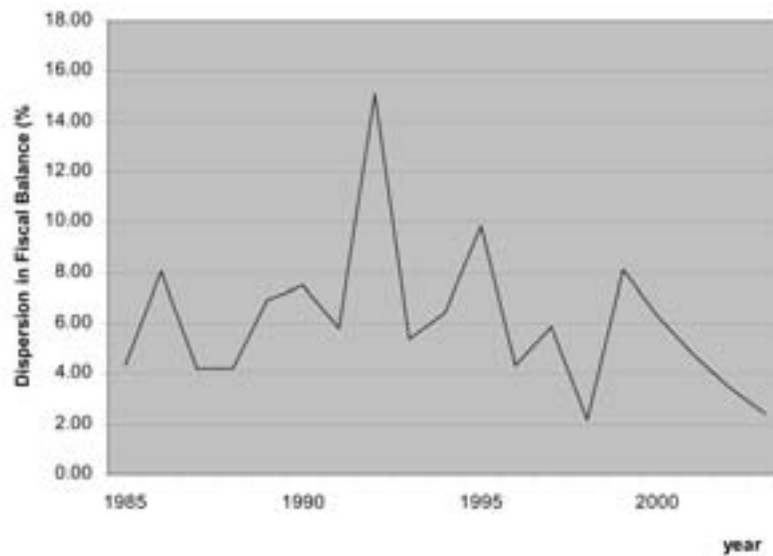
6. Here, fiscal balance represents the government deficit/surplus including grants. It represents the net financing requirement of the consolidated government expressed as percentage of current GDP in national currency (World Bank Africa Database CD-ROM 2004/5).



**Figure 3.1 Dispersion (standard deviation) of fiscal balance across SADC countries, 1985-2003**

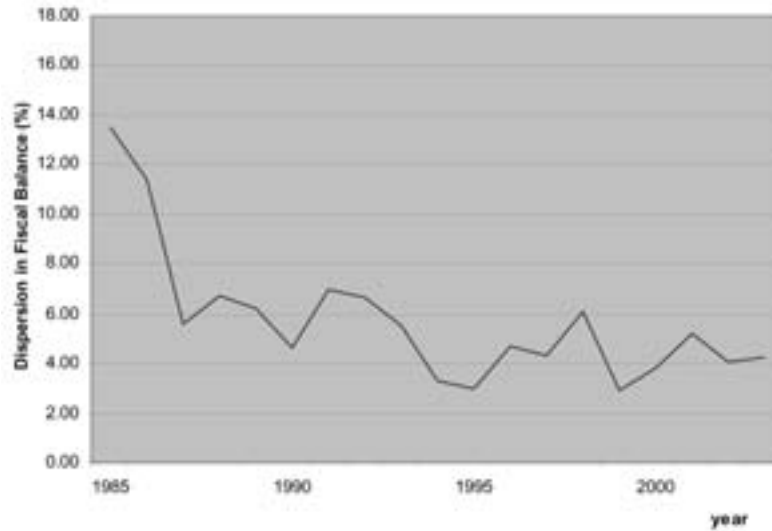


**Figure 3.2. Dispersion (standard deviation) of fiscal balance across COMESA countries, 1985-2003**

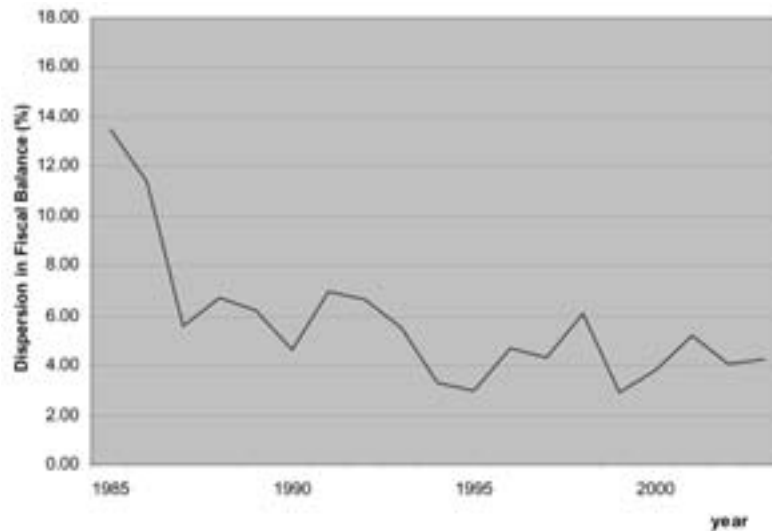


gence in fiscal policy can be realised. In most cases, the dispersion in the fiscal balance for the period under survey was below 10 percent. For most RECs, the standard deviation in the fiscal balance reached a maximum of only 15 percent, except for CEMAC, whose highest point was about 24 percent.

**Figure 3.3. Dispersion (standard deviation) of fiscal balance across ECOWAS countries, 1985-2003**

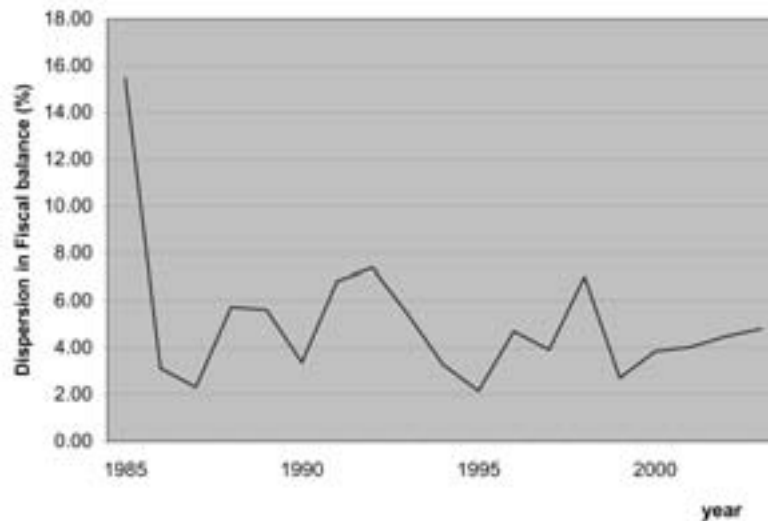


**Figure 3.4. Dispersion (standard deviation) of fiscal balance across CEMAC countries, 1985-2003**



This was experienced at the beginning of the reference period. The dispersion in the fiscal balance in SADC and COMESA reached a low of about three percent at the end of the reference period (2003). This figure is comparatively lower than the ones observed for ECOWAS, CEMAC, and UEMOA. The respective standard deviations recorded for these regions were four percent, six percent, and five percent.

**Figure 3.5. Dispersion (standard deviation) of fiscal balance across UEMOA countries, 1985-2003**



The sigma tests on the standard deviation of fiscal balance indicated significant negative coefficient of time for SADC and ECOWAS, thereby implying a tendency towards fiscal policy convergence. Although the sigma tests for COMESA, CEMAC, and UEMOA did not give a significant negative coefficient, they did not imply that there was no tendency for fiscal policy within these RECS. This is so argued because the dispersion in fiscal balance within these RECs was already low and stable. The evidence is supported by the unit root tests performed on the pooled panel data and on the individual countries. Performed in each REC, the unit root tests reject the presence of unit root, which indicate convergence tendencies towards the regional mean value. Moreover, on the basis of unit root tests on the individual countries, all member states in COMESA, CEMAC, and UEMOA reject the presence of unit root. The countries are therefore converging to their respective regional mean value. For SADC and ECOWAS, only one or two countries did not reject the presence of unit root.

Cointegration analysis was not conducted for COMESA, CEMAC, and UEMOA. All countries in these RECs rejected the presence of unit root, which indicated that the levels of fiscal balance in all the affected countries were relatively stable and had no tendency to fluctuate uncontrollably. For SADC and ECOWAS, cointegration analysis was conducted for only a few countries, and there was no co-movements found. It was noted that even for SADC and ECOWAS, most countries had relatively stable values of fiscal balance.

#### 4. Concluding Remarks

In conclusion, the analysis shows that there is very little evidence of convergence among countries in the various RECs, except in UEMOA. However, with more stringent testing based on economic growth theories, a very slow pace of convergence of per capita incomes could be seen. Accordingly, unless there is a major structural shift, it will take more than half a century for most REC economies to converge and thus attain one of the expected outcomes of regional integration initiatives in Africa. The main contribution of this paper is the comparative analysis among the different regional economic groupings in Africa. Our study shows that the major challenge of regional integration in Africa is the gap between the political commitment and the reality of the process itself. This has an important implication in terms of economic policy. There is need to take into account the diversity of local economic situations in building the regional co-operation initiatives.

#### References

- Barro R. and X. Sala-i-Martin (1995), *Economic Growth*, McGraw-Hill, Inc.
- Ben-David D. (1993), "Equalizing exchange: Trade liberalization and income convergence", *Quarterly Journal of Economics* 108(3), pp. 653-679.
- Ben Hammouda H., S. Karingi, A. Njuguna and M. Sadni-Jallab (2006), *Diversification: Towards a new paradigm for Africa's development*, Africa Trade Policy Centre Work in Progress No. 35, Economic Commission for Africa.
- Economic Commission for Africa (2006), *Assessing Regional Integration in Africa II: Rationalizing Regional Economic Communities*, Addis Ababa, Ethiopia.
- Economic Commission for Africa (2007), *Economic Report on Africa Accelerating Africa's Development through Diversification*, Addis Ababa, Ethiopia.
- Islam N. (1995), "Growth empirics: A panel data approach", *Quarterly Journal of Economics* 110, pp. 1127-1170.
- Rivera-Batiz R. and P. Romer (1991), "Economic integration and endogenous growth", *Quarterly Journal of Economics* 56, pp. 531-555.

### Appendix 1. Methodology Overall Econometric Strategy)

The econometric strategy reflects the composite definition of convergence as provided in literature. The chapter has considered three main approaches. To fix ideas, let  $x$  be a generic economic variable,  $i$  a generic country in the region, and  $t$  a generic point in time (i.e, one year).

#### *Analysis of cross-country dispersion*

Define the standard deviation of  $x$  across countries in the region at time  $t$  as  $\sigma_t$ . One way to assess convergence is to see whether  $\sigma$  decreases over time. A formal test involves estimating the regression:

$$\sigma_t = \alpha + \varphi T_t + \varepsilon_t \quad (1)$$

In this equation,  $T$  is a time trend,  $\varepsilon$  is a disturbance, and  $\alpha$  and  $\varphi$  are the parameters to be estimated. Convergence requires the estimated  $\varphi$  to be significantly negative. Equation (1) can be estimated by pooled OLS. Henceforth, this methodology to test convergence will be referred to as **sigma test** in the same way most of the literature considers it.

#### *Unit root testing*

Define the regional average of variable  $x$  as  $x_m$ . Then, define the time varying process  $\delta_{it} \equiv x_{it} - x_m$ . In practice  $\delta$  is the time varying difference between  $x$  in country  $i$  at time  $t$ , and some regional reference value of  $x$  at the same time. A second way to assess convergence is to see whether this time varying difference exhibits any tendency to die over time. Formally, this requires estimating the following equation:

$$\delta_{it} = \phi \delta_{it-1} + \varepsilon_t \quad (2)$$

It also involves testing the null hypothesis,  $H_0 : \phi = 1$ . This is a standard test for a unit root. Rejection of the null implies that the series  $x$  is converging towards the reference value.

The unit root test can be run either country by country or for the pooled panel. In the first case, the test indicates whether each specific country is converging to the reference value. In the second case, the test indicates whether the group, as a whole, is converging towards the reference value. In this second case it is possible to keep individual heterogeneity into account by specifying the null as  $H_0 : \phi = 1$  for all  $i$ , against the alternative  $H_1 : \phi_i < 1$ ,  $i = 1, 2 \dots M_1$ ;  $\phi_i = 1$ ,  $i = M_1 + 1, M_2 + 2 \dots P$  (where  $P$  is the total number of countries in the region).

Even though it is obvious to define the reference value as the regional average, one can think of different references, i.e, the lowest or highest (depending on whether convergence is desirable to the top or to the bottom) value in the region, the average of the three lowest (or highest) values in the region, the target level established by convergence criteria.

The actual procedures for unit root testing are the DGLS (Dynamic Generalised Least Square) unit root test of Elliot *et al.* (1996) and the panel unit root test of Im *et al.* (2003). Henceforth, this approach to testing convergence will be referred to as **unit root test**.

### *Analysis of cointegration*

A third notion of convergence holds that two (or more) series converge if they share a common stochastic trend; that is, if they are cointegrated. Therefore, the test of convergence amounts to testing for cointegration in the equation:

$$x_{i,t} = \beta_0 + \beta_1 x_{-i1,t} + \beta_2 x_{-i2,t} + \dots + \beta_k x_{-ik,t} + \varepsilon_t \quad (3)$$

In this,  $-i, n$  ( $n = 1 \dots k$ ) denotes the countries other than  $i$ . Equation (3) will include only those countries for which the series  $x$  is integrated of order 1. The determination of the order of integration will be done using the same DGLS unit root test applied for **unit root test** methodology.

A finding of  $p-1$  cointegrating vectors, where  $p$  is the total number of countries (series) in the equation, will denote *full convergence*. A finding of less than  $p-1$  cointegrating vectors will denote *partial convergence*; that is, some of the countries are converging and some are not. If no cointegrating vector is identified, then this will be evidence that countries are not converging at all.

The test of cointegration will follow Johansen (1991). Henceforth, this way of estimating convergence will be referred to as **cointegration test**.

### *Shocks symmetry and business cycles convergence*

This section applies the **cointegration test** to quarterly bilateral real exchange rate data to assess the degree of shocks convergence in the region. Shocks convergence is typically regarded as a necessary condition for a region to constitute an optimal currency area. Because of limited data availability, other methods for estimating shock convergence (i.e, structural VAR, output detrending) are hardly applicable. The cointegration test applied to the real exchange rates is a valuable alternative.

The rationale for this test follows the G-PPP (Generalised Purchasing Power Parity) hypothesis of Enders and Hurn (1994), which suggests that if the real exchange rates between countries share a common stochastic trend, then it means that their fundamentals co-move and hence that they are affected by somewhat symmetric shocks.

The cointegration test can be integrated by additional quantitative information concerning the depth of trade integration in the region, the correlation of terms of trade across countries and their volatility/dispersion, the degree of flexibility of prices and wages, and the extent of labour mobility across the borders.

## Appendix 2. Convergence Tests

**Table A2.1. Sigma tests results for macroeconomic variables**

Series	SADC	COMESA	ECOWAS	CEMAC	UEMOA
<b>1. Inflation</b> (Quarterly)					
Coeff. of time	-0.429*** (5.445)	-0.759*** (-12.723)	-0.422*** (-13.710)	-0.067*** (-4.420)	-0.410*** (-10.178)
R-squared	0.304	0.710	0.746	0.211	0.618
DW	0.250	0.586	0.567	1.261	0.534
<b>2. Fiscal Balance</b> (Annual)					
Coeff. of time	-0.372*** (-3.437)	-0.121 (0.976)	-0.328*** (-3.898)	-0.234 (-1.117)	-0.179 (-1.490)
R-squared	0.410	0.053	0.472	0.068	0.115
DW	2.295	2.168	1.019	1.493	1.618

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent

## Appendix 3. Unit Root Tests

**Table A3-1. Unit root tests for SADC individual country series deviation from regional mean.**

	Inflation (Quarterly: 1987Q1-2004Q2)		Fiscal Balance <sup>b</sup> (Annual: 1985-2003)	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Angola	-	-	-2.538**	-
Botswana	-0.960	-1.279	-1.383	-
DRC	-	-	-	-
Lesotho	-1.019	-0.991	-4.310***	-
Madagascar	-2.617***	-2.974*	-1.421	-
Malawi	-3.140***	-3.351**	-3.260***	-
Mauritius	-1.487	-2.653	-1.984**	-
Mozambique	-	-	-2.078**	-
Namibia	-3.623***	-3.676**	-2.642**	-
South Africa	-1.128	-1.234	-2.524**	-
Swaziland	-2.235**	-2.429	-	-
Tanzania	-0.509	-4.746***	-1.993**	-
Zambia	-2.176**	-2.511	-3.308***	-
Zimbabwe	-	-	-3.434***	-

<sup>a</sup>Automatic selection of lag length based on Schwarz Information Criterion.

<sup>b</sup>Test critical values were calculated for 20 observations and may not be accurate for this particular series.

(-) means insufficient data.

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent. See MacKinnon (1996) for asymptotic critical values.

**Table A3-2. Unit root tests for COMESA individual country series deviation from regional mean.**

Country	Elliot-Rothenberg-Stock DF-GLS test-Statistics <sup>a</sup>			
	Inflation (Quarterly 1987Q1-2003Q4)		Fiscal Balance <sup>b</sup> (Annual:1985-2003)	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Angola	-	-	-2.613**	-
Burundi	-1.196	-2.379	-3.189***	-
Comoros	-	-	-5.245***	-
DRC	-	-	-	-
Egypt	-3.135***	-3.201**	-	-
Ethiopia	-0.667	-2.386	-2.749***	-
Kenya	-2.579**	-3.496**	-3.063***	-
Madagascar	-1.476	-2.275	-1.726*	-
Malawi	-2.532**	-3.262**	-3.404***	-
Mauritius	-1.536	-3.504**	-2.064**	-
Namibia	-3.003***	-3.937***	-2.974***	-
Rwanda	-1.576	-3.524**	-	-
Seychelles	-0.262	-2.567	-	-
Sudan	-	-	-	-
Swaziland	-1.901**	-3.756***	-	-
Uganda	-0.084	-0.774	-2.808***	-
Zambia	-2.113**	-2.419	-3.212***	-
Zimbabwe	-	-	-2.336**	-

<sup>a</sup>Automatic selection of lag length based on Schwarz Information Criterion.

<sup>b</sup>Test critical values were calculated for 20 observations and may not be accurate for this particular series.

(-) means insufficient data.

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent. See MacKinnon (1996) for asymptotic critical values.



**Table A3-3. Unit root tests for ECOWAS individual country series deviation from regional mean.**

Country	Elliot-Rothenberg-Stock DF-GLS test-Statistics <sup>a</sup>					
	Per Capita Income (Annual: 1980-2003)		Inflation (Quarterly: 1988Q3-2004Q4)		Fiscal Balance <sup>b</sup> (Annual:1985-2002)	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Benin	-0.189	-	-	-	-	-
Burkina Faso	-0.921	-	-2.646**	-4.393***	-	-
Cape Verde	1.816	-	-1.085	-1.935	-3.29***	-
Cote d'Ivoire	-0.789	-	-2.151**	-3.543**	-1.86*	-
Gambia	-1.693*	-	-1.831*	-2.473	-1.03	-
Ghana	-1.495	-	-4.179***	-4.256***	-1.99**	-
Guinea-Bissau	-1.188	-	-1.623*	-3.973***	4.120***	-
Guinea	-	-	-	-	-	-
Liberia	-0.682	-	-	-	-	-
Mali	-0.424	-	-1.861*	-2.421	-3.96***	-
Niger	-0.968	-	-2.010**	-4.239***	-3.68***	-
Nigeria	-1.750*	-	-2.762***	-3.224**	-	-
Senegal	-1.608*	-	-1.096	-4.622***	-5.06***	-
Sierra Leone	-0.118	-	-1.882*	-2.306	-2.37**	-
Togo	-2.079**	-	-1.420	-2.412	-2.61**	-

<sup>a</sup>Automatic selection of lag length based on Schwarz Information Criterion.

<sup>b</sup>Test critical values were calculated for 20 observations and may not be accurate for this particular series.

(-) means insufficient data.

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent. See MacKinnon (1996) for asymptotic critical values.

**Table A3-4. Unit root tests for CEMAC individual country series deviation from regional mean.**

Country	Elliot-Rothenberg-Stock DF-GLS test-Statistics <sup>a</sup>			
	Inflation (Quarterly: 1984Q2-2002Q4)		Fiscal Balance <sup>b</sup> (Annual:1985-2003)	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Cameroon	-3.405***	-4.668***	-4.320***	-
CAR	-2.301**	-3.444**	-	-
Chad	-2.813***	-3.432**	-	-
Congo, Rep	-	-	-2.932***	-
Eq. Guinea	-	-	-	-
Gabon	-5.326***	-4.839***	-3.177***	-

<sup>a</sup>Automatic selection of lag length based on Schwarz Information Criterion.

<sup>b</sup>Test critical values were calculated for 20 observations and may not be accurate for this particular series.

(-) means insufficient data.

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent. See MacKinnon (1996) for asymptotic critical values.

**Table A3-5. Unit root tests for UEMOA individual country series deviation from regional mean.**

Country	Elliot-Rothenberg-Stock DF-GLS test-Statistics <sup>a</sup>			
	Inflation (Quarterly: 1988Q3-2004Q4)		Fiscal Balance <sup>b</sup> (Annual:1985-2003)	
	Intercept	Trend + Intercept	Intercept	Trend + Intercept
Benin	-	-	-	-
Burkina Faso	-2.281**	-3.986***	-	-
Côte d'Ivoire	-2.036**	-2.969*	-3.188***	-
Guinea Bissau	-1.489	-3.787***	-3.978***	-
Mali	-2.087**	-3.835***	-2.659**	-
Niger	-0.868	-3.074*	-4.037***	-
Senegal	-1.810*	-3.249***	-3.921***	-
Togo	-2.811***	-3.914***	-2.670**	-

<sup>a</sup>Automatic selection of lag length based on Schwarz Information Criterion.

<sup>b</sup>Test critical values were calculated for 20 observations and may not be accurate for this particular series.

(-) means insufficient data.

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent . See MacKinnon (1996) for asymptotic critical values.

**Table A3-6. Unit root test results on pooled observations (series deviation from regional mean)**

Series	Im, Pesaran and Shin W-Stat (Ind'l unit root process) <sup>a</sup>				
	SADC	COMESA	ECOWAS	CEMAC	UEMOA
<b>1. Inflation</b>					
Intercept	-2.498*** (0.006)	-5.668*** (0.000)	-3.253*** (0.000)	-7.090*** (0.000)	-3.113*** (0.001)
Intercept + Trend	-4.616*** (0.000)	-5.005*** (0.000)	-5.938*** (0.000)	-7.381*** (0.000)	-5.693*** (0.000)
<b>2. Fiscal Balance</b>					
Intercept	-4.260*** (0.000)	-4.921*** (0.000)	-6.410*** (0.000)	-10.192*** (0.000)	-6.547*** (0.000)
Intercept + Trend	-3.746*** (0.000)	-6.219*** (0.000)	-4.930*** (0.000)	-8.335*** (0.000)	-8.054*** (0.000)

<sup>a</sup>Automatic selection of lag length based on Schwarz Information Criterion.

Values in the parentheses are probabilities.

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent

**Appendix 4. Cointegration Test**

**Table A4-1. Cointegration test on SADC countries:**

**a. Unit root test on actual values**

Country	Elliot-Rothenberg-Stock DF-GLS test-Statistics <sup>a</sup>			
	Inflation (Quarterly: 1987Q1-2004Q2)		Fiscal Balance <sup>b</sup> (Annual:1985-2003)	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Angola	-	-	-2.604**	-
Botswana	-1.286	-1.732	-1.560	-
DRC	-	-	-	-
Lesotho	-1.437	-1.283	-2.792***	-
Madagascar	-2.122**	-2.191	-2.283**	-
Malawi	-3.331***	-3.490**	-3.563***	-
Mauritius	-1.327	-1.821	-1.680*	-
Mozambique	-	-	-2.080**	-
Namibia	-4.246***	-4.160***	-2.051**	-
South Africa	0.642	-2.444	-1.654*	-
Swaziland	-3.504***	-3.997***	-	-
Tanzania	-1.075	-2.515	-2.299**	-
Zambia	-2.056	-2.434	-3.712***	-
Zimbabwe	-	-	-3.706***	-

<sup>a</sup>Automatic selection of lag length based on Schwarz Information Criterion.

<sup>b</sup>Test critical values were calculated for 20 observations and may not be accurate for this particular series.  
 (-) means insufficient data.

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent  
 See MacKinnon (1996) for asymptotic critical values.

Does Macroeconomic Convergence Lead to Growth? / 433

**Table A4-1a. Cointegration analysis of per capita income in SADC countries<sup>7</sup>**

**a. SACU**

Included observations: 22 after adjustments  
 Trend assumption: Linear deterministic trend  
 Series: BOTSWANA LESOTHO NAMIBIA SWAZILAND  
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.615491	45.02579	47.85613	0.0900
At most 1	0.503526	23.99843	29.79707	0.2005
At most 2	0.304201	8.593487	15.49471	0.4043
At most 3	0.027533	0.614220	3.841466	0.4332

Trace test indicates no cointegration at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

**b. Non-SACU**

Included observations: 22 after adjustments  
 Trend assumption: Linear deterministic trend  
 Series: ANGOLA DRC MADAGASCAR MAURITIUS MOZAMBIQUE ZAMBIA ZIMBABWE  
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.999605	372.9000	125.6154	0.0000
At most 1 *	0.987230	200.4701	95.75366	0.0000
At most 2 *	0.859424	104.5354	69.81889	0.0000
At most 3 *	0.767418	61.37130	47.85613	0.0017
At most 4	0.495655	29.28405	29.79707	0.0572
At most 5	0.440905	14.22516	15.49471	0.0770
At most 6	0.063085	1.433578	3.841466	0.2312

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

7. Cointegration analysis on per capita income for all SADC countries is not possible due to insufficient data. Therefore, we use the sub-group of SACU and non-SACU countries.

**Table A4-1b. Cointegration analysis of inflation  
 in SADC countries**

Included observations: 67 after adjustments  
 Trend assumption: Linear deterministic trend  
 Series: BOTSWANA LESOTHO MAURITIUS SER01 TANZANIA ZAMBIA  
 Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.467772	125.5677	95.75366	0.0001
At most 1 *	0.391108	83.31191	69.81889	0.0029
At most 2 *	0.319774	50.07220	47.85613	0.0305
At most 3	0.225815	24.25512	29.79707	0.1899
At most 4	0.095763	7.106877	15.49471	0.5652
At most 5	0.005394	0.362394	3.841466	0.5472

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

**Table A4-1c. Cointegration analysis of fiscal balance  
 in SADC countries**

Included observations: 17 after adjustments  
 Trend assumption: Linear deterministic trend  
 Series: BOTSWANA MAURITIUS S—AFRICA  
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.554320	21.82771	29.79707	0.3082
At most 1	0.273232	8.089105	15.49471	0.4559
At most 2	0.145024	2.663597	3.841466	0.1027

Trace test indicates no cointegration at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

**Table A4-2. Cointegration test on COMESA countries**

**a. Unit root tests on Actual Values**

Country	Elliot-Rothenberg-Stock DF-GLS test-Statistics <sup>a</sup>			
	Inflation (Quarterly 1987Q1-2003Q4)		Fiscal Balance <sup>b</sup> (Annual: 1985-2003)	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Angola	-	-	-2.602**	-
Burundi	-1.197	-1.589	-3.357***	-
Comoros	-	-	-4.745***	-
DRC	-4.611***	-4.665***	-	-
Egypt	0.159	-2.14	-	-
Ethiopia	-2.217**	-2.517	-3.025***	-
Kenya	-2.909***	-3.127**	-2.806***	-
Madagascar	-2.066**	-2.143	-2.283**	-
Malawi	-3.309***	-3.486**	-3.686***	-
Mauritius	-1.305	-1.866	-1.684*	-
Namibia	-4.175***	-3.203**	-2.054**	-
Rwanda	-3.406***	-3.525**	-	-
Seychelles	-3.118***	-2.493	-	-
Sudan	-	-	-	-
Swaziland	-3.606***	-4.001***	-	-
Uganda	-0.054	-0.840	-4.171***	-
Zambia	-2.040**	-2.411**	-3.529***	-
Zimbabwe	-	-	-2.992***	-

<sup>a</sup>Automatic selection of lag length (maxlag=4 (annual series);=11(quarterly series) based on Schwarz Information Criterion.

<sup>b</sup>Test critical values were calculated for 20 observations and may not be accurate for this particular series.

(-) means insufficient data.

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent

**Table A4-2b. Cointegration analysis of inflation in COMESA countries**

Included observations: 66 after adjustments  
 Trend assumption: Linear deterministic trend  
 Series: BURUNDI EGYPT MAURITIUS UGANDA  
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.415465	66.92641	47.85613	0.0003
At most 1 *	0.240070	31.48844	29.79707	0.0316
At most 2	0.115791	13.36950	15.49471	0.1019
At most 3 *	0.076428	5.247421	3.841466	0.0220

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

Note: The test is not possible for fiscal balance as all the series rejected the presence of unit root.

**Table A4-3. Cointegration Tests for ECOWAS countries**

**a. Unit root tests on actual values**

Country	Elliot-Rothenberg-Stock DF-GLS test-Statistics <sup>a</sup>			
	Inflation (Quarterly:1988Q3-2004Q4)		Fiscal Balance <sup>b</sup> (Annual:1985-2002)	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Benin	-		-	-
Burkina Faso	-3.886***		-	-
Cape Verde	-1.185		-3.40***	-
Cote d'Ivoire	-3.526***		-1.41	-
Gambia the	-2.034**		-2.09**	-
Ghana	-3.856***		-2.11**	-
Guinea-Bissau	-1.395		-4.09***	-
Guinea	-		-	-
Liberia	-		-	-
Mali	-2.913***		-1.86*	-
Niger	-3.012***		-3.34***	-
Nigeria	-2.219**		-	-
Senegal	-2.853***		-4.02***	-
Sierra Leone	-1.804*		-2.13**	-
Togo	-1.864*		-2.274**	-

<sup>a</sup>Automatic selection of lag length based on Schwarz Information Criterion.

<sup>b</sup>Test critical values were calculated for 20 observations and may not be accurate for this particular series.

(-) means insufficient data.

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent. See MacKinnon (1996) for asymptotic critical values.

**Table A4-3b. Cointegration analysis of inflation in ECOWAS countries**

Included observations: 63 after adjustments

Trend assumption: Linear deterministic trend

Series: CAPE—VERDE GUINEABISS S—LEONE TOGO

Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.353902	55.22179	47.85613	0.0087
At most 1	0.270783	27.70317	29.79707	0.0856
At most 2	0.093787	7.808803	15.49471	0.4861
At most 3	0.025147	1.604498	3.841466	0.2053

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

Does Macroeconomic Convergence Lead to Growth? / 437

**Table A4-3c. Cointegration analysis of fiscal balance in ECOWAS countries**

Included observations: 17 after adjustments  
 Trend assumption: Linear deterministic trend  
 Series: CIV MALI  
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.471591	12.71034	15.49471	0.1259
At most 1	0.103971	1.866303	3.841466	0.1719

Trace test indicates no cointegration at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

**Table A4-4. Cointegration results for CEMAC countries**

**a. Unit root test on actual values**

Country	Elliot-Rothenberg-Stock DF-GLS test-statistics <sup>a</sup>	
	Inflation (Quarterly: 1984Q2-2002Q4)	Fiscal Balance <sup>b</sup> (Annual:1985-2003)
	Intercept	Intercept
Cameroon	-2.311**	-2.180**
CAR	-3.624***	-
Chad	-1.759*	-
Congo	-	-2.802***
Gabon	-3.718***	-3.330***

<sup>a</sup>Automatic selection of lag length based on Schwarz Information Criterion.

<sup>b</sup>Test critical values were calculated for 20 observations and may not be accurate for this particular series.

(-) means insufficient data.

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent . See MacKinnon (1996) for asymptotic critical values.

Note: No cointegration test for inflation and fiscal balance series. The presence of unit root is rejected in all countries except Chad (based on 5 percent critical value).



**Table A4-5. Cointegration tests for UEMOA countries**

**a. Unit root test on actual values**

Country	Elliot-Rothenberg-Stock DF-GLS test-Statistics <sup>a</sup>			
	Inflation (Quarterly: 1984Q2-2002Q4)		Fiscal Balance <sup>b</sup> (Annual:1985-2003)	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Benin	-	-	-	-
Burkina Faso	-3.887***	-3.897***	-	-
Côte d'Ivoire	-3.526***	-3.558**	-1.408	-
Guinea Bissau	-1.395	-4.572***	-4.090***	-
Mali	-2.913***	-3.268**	-1.858*	-
Niger	-3.012***	-3.236**	-3.316***	-
Senegal	-2.853***	-2.998*	-4.020***	-
Togo	-1.870*	-1.974	-2.275**	-

<sup>a</sup>Automatic selection of lag length based on Schwarz Information Criterion.

<sup>b</sup>Test critical values were calculated for 20 observations and may not be accurate for this particular series.

(-) means insufficient data.

\*\*\*Significant at 1 percent; \*\*significant at 5 percent; \*significant at 10 percent. See MacKinnon (1996) for asymptotic critical values.

**Table A4-5b. Cointegration analysis of the inflation series  
in UEMOA countries**

Included observations: 63 after adjustments  
 Trend assumption: Linear deterministic trend  
 Series: GUINEA—B TOGO  
 Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.192736	17.43531	15.49471	0.0252
At most 1 *	0.060724	3.946693	3.841466	0.0470

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

**Table A4-5c. Cointegration analysis of fiscal balance series  
in UEMOA countries**

Included observations: 17 after adjustments  
Trend assumption: Linear deterministic trend  
Series: CIV MALI  
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.473307	12.74771	15.49471	0.1244
At most 1	0.103026	1.848381	3.841466	0.1740

Trace test indicates no cointegration at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

## APPENDIX 6. List of countries under different RECs

### I. Common Market for East and Southern Africa (COMESA)

1. Angola
2. Burundi
3. Comoros
4. Democratic Republic of Congo (DRC)
5. Djibouti
6. Egypt
7. Eritrea
8. Ethiopia
9. Kenya
10. Madagascar
11. Malawi
12. Mauritius
13. Namibia
14. Rwanda
15. Seychelles
16. Sudan
17. Swaziland
18. Uganda
19. Zambia
20. Zimbabwe

### II. Economic Community of West African States (ECOWAS)

1. Benin
2. Burkina Faso
3. Cape Verde
4. Cote d'Ivoire
5. Gambia

440 / Proceedings of the African Economic Conference 2007

---

6. Ghana
7. Bissau Guinea
8. Guinea
9. Liberia
10. Mali
11. Niger
12. Nigeria
13. Senegal
14. Sierra Leone
15. Togo

**III. Southern African Development Community (SADC)**

1. Angola
2. Botswana
3. DR Congo
4. Lesotho
5. Madagascar
6. Malawi
7. Mauritius
8. Mozambique
9. Namibia
10. South Africa
11. Swaziland
12. Tanzania
13. Zambia
14. Zimbabwe

**IV. Central African Monetary and Economic Community (CEMAC)**

1. Cameroon
2. Central Africa Republic
3. Chad
4. Congo
5. Equatorial Guinea
6. Gabon

**V. West African Economic and Monetary Union (UEMOA)**

1. Benin
2. Burkina Faso
3. Cote d'Ivoire
4. Bissau Guinea
5. Mali
6. Niger
7. Senegal
8. Togo