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## ► To cite this version:

Amélie Charles, Olivier Darné, Jean-François Hoarau. Does the real GDP per capita convergence hold in the Common Market for Eastern and Southern Africa?. 2009. hal-00422522

**HAL Id: hal-00422522**

**<https://hal.science/hal-00422522>**

Preprint submitted on 7 Oct 2009

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## **Does the real GDP per capita convergence hold in the Common Market for Eastern and Southern Africa?**

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2009/25

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# **Does the real GDP per capita convergence hold in the Common Market for Eastern and Southern Africa?**

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## **Abstract**

This article examines the convergence of real GDP per capita in the Common Market for Eastern and Southern Africa (COMESA) during the period 1950-2003. Income departures across countries were evaluated from several panel data unit root tests, especially we consider the absolute and conditional convergence. We find no evidence supporting the existence of convergence process for the income in the COMESA. Nevertheless, applying economic development criterion allows to identify two absolute convergence clubs into the COMESA, one for the most four developed countries (Egypt, Libya, Mauritius, Seychelles), and one other for the fourteen less developed ones. Thus, we show that most economies of COMESA are locked into a sustained poverty trap process.

*Keywords:* Regional integration; convergence; Eastern and Southern Africa; panel unit root tests.

*JEL Classification:* F15; O40; C12; C23.

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# 1 Introduction

Testing real income convergence, i.e. convergence in per capita output across different economies, remains one of the most challenges in the contemporaneous international economic literature (Islam, 2003). On the whole, there are at least three main reasons that justify the interest of study this subject. Firstly, this exercise can help to discriminate between economic growth models. On the one hand, the neoclassical model predicts that per capita output will converge to each country's steady-state or to a common steady-state, regardless of its initial per capita output level (Solow, 1956). On the other hand, endogenous growth models, by underlining the importance of initial conditions and the possibility of multiple equilibriums, show that there is no tendency for income levels to converge in the long-run (Romer, 1986, 1990). Secondly, as a consequence of the above remark, whether or not the exogenous or the endogenous version is validated induces a potential for state intervention in the growth process. Thirdly, on the empirical side, strong differences have been observed in per capita output and in growth rates across countries during the last three decades, and especially between many African economies and emerging Asian and developed economies (Maddison, 2001).

Moreover, the wave of regionalism in the 1990s has spurred academic and professional interest towards the economic effects of regional integration agreements [hereafter, RIAs]. Among these effects, a RIA is expected to strengthen trade links and hence to facilitate technological spillovers across borders. Then, income levels should converge and the initially poorer member states will catch up with the richer ones. However, in a recent theoretical article, Venables (2003) states that income dispersion across countries in a RIA will decrease only in the case of North-North integration (or at most North-South). On the contrary, South-South integration could easily lead to income divergence and unequal distribution of welfare gains.

Since the pioneer work of Baumol (1986) and Barro and Sala-i-Martin (1991, 1992), the test of the convergence hypothesis has consisted of fitting cross-country regressions. Convergence is said to occur if a negative correlation is found between the average growth rate and the initial income. However, Quah (1993, 1996) criticizes cross-country growth regression and shows that in order to evaluate the convergence hypothesis one must exploit the time series properties of the cross-country variances. Moreover, Bernard and Durlauf (1996) demonstrate that the cross-section growth re-

gressions cannot discriminate between the hypotheses of global or local convergence. Then, Bernard and Durlauf (1995, 1996) propose to considering convergence as a stochastic process, using the properties of time series, and test the convergence hypothesis from unit root tests. However, time-series unit root testing has been often criticized for its limited power and poor size properties (Haldrup and Jansson, 2006). The small number of observations available on the time-series dimension would then make the country-by-country analysis of income convergence in RIAs of recent formation particularly problematic. Therefore, Evans (1996) suggests exploiting both the time-series and the cross-section information included in the data of the per capita income in order to evaluate the convergence hypothesis. With this approach, the cross-sectional and time-series information are combined, thus inducing a significant improvement in terms of power of the test.

Only few studies (McCoskey, 2002; Paap et al., 2005; Carmignani, 2006; Cuñado and Pérez de Gracia, 2006; Guetat and Serranito, 2007; Carmignani, 2007) have been conducted to examine convergence in African countries and, in particular, in Eastern and Southern African economies. Therefore, this paper aims at pursuing investigations about economic growth convergence for the main RIA of Eastern and Southern Africa, namely the « Common Market of Eastern and Southern Africa » [COMESA] but in an original way. We apply various panel unit root tests to real GDP per capita data for 20 Eastern and Southern African countries (Angola, Burundi, Comoros, Democratic Republic of Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe): first generation tests based on the assumption of independent cross-section units (Levin et al., 2002; Im et al., 2003); and second generation tests allowing for cross-section dependence (Bai and Ng, 2004).

More precisely, two main issues are investigated: (1) is there an intra-regional convergence process?, i.e. relative to the average income level of the area, among COMESA's members and (2) if not, are there any convergence clubs within the COMESA? To this end three main criteria were used to test for convergence clubs, namely

- (i) the degree of human and economic development,
- (ii) the membership to another regional trade agreement in Africa, and
- (iii) the nature of the export base (oil producers versus non-oil producers).

Note that empirical testing of the convergence hypothesis provides several definitions of convergence, and thus different methodologies to test it <sup>1</sup>. In the convergence debate, two definitions have emerged: the absolute convergence and the conditional convergence. The former occurs when the level of per capita income of the poor countries catch-up with the one of the rich ones. This can be achieved if the growth rates of developing countries are significantly higher than those of developed countries. The latter implies that each country is converging to its own steady state and that in the long run all the growth rates will be equalized. We consider both the absolute and conditional convergence with panel unit root tests. The absolute convergence hypothesis uses a panel unit roots test with no fixed individual effects, whereas the conditional convergence requires panel unit root tests with fixed individual effects.

The remainder of the paper is organized as follows. Section 2 proposes a survey of the recent empirical works dealing with real income convergence in Eastern and Southern African countries. Section 3 briefly displays the econometric strategy retained and the convergence hypothesis considered, and describes the panel unit root tests. Section 4 presents the data and the main findings. Finally, Section 5 concludes.

## **2 Brief literature survey**

The COMESA is a regional integration grouping of African states (Angola, Burundi, Comoros, Democratic Republic of Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe) which have agreed to promote regional integration through trade development and to develop their natural and human resources for the mutual benefit of all their peoples. One of the six objectives of COMESA as enshrined in the COMESA Treaty is to contribute towards the establishment of the African Economic Treaty. <sup>2</sup>

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<sup>1</sup> See Islam (2003) for a survey on the different definitions and methodologies relative to the concept of convergence.

<sup>2</sup> The five others objectives is to to create and maintain: (i) a full free trade area guaranteeing the free movement of goods and services produced within COMESA and the removal of all tariffs and non-tariff barriers; (ii) a customs union under which goods and services imported from non-COMESA countries will attract an agreed single tariff in all COMESA states; (iii) free movement of capital and investment supported by the adoption of a common investment area so as to create a more favorable investment climate for the COMESA region; (iv) a gradual establishment of a payment union based on the COMESA Clearing House and the eventual establishment of a common monetary union with a common currency; and (v) the adoption of common visa arrangements, including the right of establishment leading

COMESA was initially established in 1981 as the Preferential Trade Area [PTA] for Eastern and Southern Africa, within the framework of the Organisation of African Unity's Lagos Plan of Action and the Final Act of Lagos. The PTA was transformed into COMESA in 1994. The PTA was established to take advantage of a larger market size, to share the region's common heritage and destiny and to allow greater social and economic co-operation, with the ultimate objective being to create an economic community.

The empirical literature highlights many works which focus on the problem of the economic growth process in Africa (e.g., Easterly and Levine, 1997; Bloom and Sachs, 1998; Collier and Gunning, 1999; Block, 2001; Bertocchi and Canova, 2002). However, little attention has been paid to the real convergence process both among the countries within the African continent and with respect to developed countries. On this subject, five papers (McCoskey, 2002; Paap et al., 2005; Carmignani, 2006; Cuñado and Pérez de Gracia, 2006; Carmignani, 2007) must be presented.

Firstly, McCoskey (2002) investigates the convergence properties of six indicators of well being <sup>3</sup> for 37 Sub-Saharan African countries. Using of both the panel unit root test of Im et al. (2003) and the panel cointegration test of McCoskey and Kao (1998), applied to pair-wise income differentials, McCoskey finds no evidence of time series convergence across the whole sample for the real GDP-based variables. Moreover, this finding still holds even for more homogeneous groups of economies sharing some institutional arrangements such as the Southern African Development Community (SADC) and the Southern African Customs Union (SACU)<sup>4</sup>.

Paap et al. (2005) address the question whether or not sub-Saharan African countries have lower average growth rates in real GDP per capita than countries in Asia, Latin America and the Middle East over the period 1960-2000. To this regard, they propose a latent-class panel time series model, which allows a data-based classification of countries into clusters such that, within a cluster, countries have the same average growth rate. Then, three clusters or three convergence clubs can be put forward, and many Eastern and Southern African countries belong to the low growth eventually to the free movement of bona fide persons.

<sup>3</sup>These indicators are (i) the government share of GDP measured in 1985 international prices, (ii) the capital stock per worker, (iii) a measurement of exports added to imports as a fraction of GDP (all measured in current prices) (iv) a measure of real GDP per capita at 1985 international prices, (v) a measurement of consumption added to government expenditure as a % of GDP and (vi) a measure of real GDP per worker at 1985 international prices.

<sup>4</sup>See Section 4 for a brief description of these RIAs.

cluster. Only Egypt, Mauritius, Malawi, Seychelles and Zimbabwe can be assigned to the middle growth class and none belong to the high growth cluster.

Carmignani (2006) focuses on the problem of macroeconomic convergence for the COMESA. The author analyzes the hypothesis of real income convergence, among others<sup>5</sup>, using data covering the period 1960-2002. Two measures of convergence based on cross-country regression are computed. The first one, i.e. the so-called  $\sigma$  convergence, is the standard deviation of per capita real GDP across member states. The second one, i.e. the so-called  $\beta$  convergence, is the estimated coefficient on initial (or lagged) per capita GDP in a regression of the rate of per capita GDP growth. Carmignani concludes that income does not appear to converge across COMESA member states. On the contrary, the gap between poorer and richer countries in the region is widening and overall distribution is probably evolving towards a bi-modal configuration.

In a more general article, Cuñado and Pérez de Gracia (2006) apply time series tests to analyze both the stochastic and  $\beta$ -convergence conditions of per capita output of 43 African countries to an average of the African countries and with respect to the US economy using data for the period 1950-1999. If we just consider the results for Eastern and Southern African area, this work finds the evidence of conditional convergence only for the case of Seychelles towards the US economy. When the catch-up hypothesis is retained, i.e. by taking into account a time trend when testing the unit root hypothesis, more evidence of convergence towards the African average (Djibouti, Egypt, Kenya, Uganda and Zimbabwe) and towards the US economy (Egypt, Mauritius, and Seychelles) is found.

Finally, Carmignani (2007) investigates the extent of per capita income convergence in regional integration initiatives. To this end, panel unit root testing, developed by Im et al. (2003), is performed on 28 regional groupings among which several agreements of Eastern and Southern Africa (CBI, COMESA, SACU, SADC<sup>6</sup>). On the whole, it appears that per capita income convergence is not necessarily a prerogative of North-North integration. This hypothesis holds also for several South-South initiatives. However, this optimistic remark on the convergence properties of South-South integration needs to be qualified. In some cases, cross-country convergence appears to be taking place around a relatively flat regional growth trend. That is, while countries in some South-South RIAs do converge towards the regional average, this regional av-

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<sup>5</sup>The author studies the degree of convergence of macroeconomic policy across members and the issue of whether COMESA is an optimal currency area.

<sup>6</sup>See Section 4 for a brief description of these RIAs.



erage fails to catch-up with industrial countries' income. Conversely, there are RIAs whose average income is catching-up with industrial economies, but member states fail to converge to the regional mean. All in all, the conclusion of this paper is that South-South integration does not necessarily imply widening intra-regional disparities. However, it might lead to a form of convergence to the bottom.

### **3 The econometric strategy in a panel data framework**

Nowadays, the increasing application of the panel data techniques to the determination of time-series stochastic properties has led to the development of a wide range of new proposals in the econometric literature. The combination of the information in the time and cross-section dimensions to compose a panel data set of individuals, i.e. countries or regions, onto which performs the analysis of the stochastic properties has revealed as a promising way to increase the power of these tests. The emergence of new econometric methods has led economists to focus on the convergence debate (Gaulier, Hurlin and Jean-Pierre, 1999; Carmignani, 2007; Guetat and Serranito, 2007; Lima and Resende, 2007).

#### **3.1 The income convergence hypothesis: absolute versus conditional convergence**

Several researchers have focused on the definition of the convergence concept in a stochastic framework (e.g., Carlino and Mills, 1993; Bernard and Durlauf, 1996; Evans, 1996; Evans and Karras, 1996; Guetat and Serranito, 2007). Islam (2003) showed that this definition is relatively unambiguous for a two-economy situation. However, things are different when convergence is considered in a sample of more than two economies. Then, some have based their analysis of convergence on deviations from a reference economy although others have opted for deviations from the sample average. Following the work of Evans and Karras (1996) and Guetat and Serranito (2007), we choose the second viewpoint.

Consider a sample of economies  $1, 2, \dots, N$  that have access to the same body of technological knowledge. For each economy, the convergence hypothesis implies that a unique steady state exists, that any deviation of the state variables from their long run values is temporary, and hence that initial values of the state variables have no effects

on their long run levels. The common technical knowledge assumption further implies that the balanced growth paths of the  $N$  economies are parallel: the state variables can differ only by constant amounts. Conversely, the  $N$  economies diverge if the deviations from the steady state are permanent, and hence the initial values impact in the long run their levels.

Then, in a stochastic world, economies  $1, 2, \dots, N$  are said to converge if, and only if, a common trend  $a_t$ <sup>7</sup> and finite parameters  $\mu_1, \mu_2, \dots, \mu_N$  exist such that:

$$\lim_{i \rightarrow \infty} E_t(y_{n,t+i} - a_{t+i}) = \mu_n \quad (1)$$

for  $n = 1, 2, \dots, N$ , and  $y_{nt}$  is the logarithm of per capita output for economy  $n$  during period  $t$ . The parameter  $\mu_n$  determines the level of economy  $n$ 's parallel balanced growth path. Unless all economies have identical structures, the  $\mu$ 's should typically be nonzero.

Unfortunately, the common trend is unobservable. However, under the convergence hypothesis, an estimator of its value can be obtained. Indeed, if the deviations from the steady state are not permanent, then the cross-economy average of the per capita income must converge to the level of the common trend:

$$\lim_{i \rightarrow \infty} E_t(\bar{y}_{t+i} - a_{t+i}) = 0 \quad (2)$$

where  $\bar{y}_t = \sum_{n=1}^N y_{n,t}/N$ . Finally, Evans and Karras (1996) obtained the following condition:

$$\lim_{i \rightarrow \infty} E_t(y_{n,t+i} - \bar{y}_{t+i}) = \mu_n \quad (3)$$

According to this assumption, the deviations of  $y_{1,t+i}, y_{2,t+i}, \dots, y_{N,t+i}$  from their cross-economy average  $\bar{y}_t$  can be expected, conditional on current information to approach constant values as  $i$  approaches infinity. Note that this condition holds if, and only if,  $(y_{n,t} - \bar{y})$  have exhibited a much higher growth rate than the richer ones, and hence that a catching-up is occurring. On the other hand, the convergence will be said conditional if  $\mu_n \neq 0$  for some  $n$ . So, each economy has converged to its own steady state, and only the growth rates will be equalized in the long run. Operationally, these income convergence hypotheses require testing for the presence of a unit root in panel

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<sup>7</sup>The series  $a_t$  can be thought of as the logarithm of an index of Harrod-neutral technology available to economies  $1, 2, \dots, N$ .

data. The absolute convergence is tested by panel unit root tests with no fixed individual effects, whereas the conditional convergence is tested by implementing panel unit root tests with fixed individual effects.

### 3.2 Panel unit root tests

In this study, we apply two first generation tests proposed by Levin et al. (2002) and Im et al. (2003) which are homogeneous and heterogeneous panel unit root tests, respectively, based on the assumption of independent cross-section units. In Levin et al. (2002), the alternative hypothesis is that no series contains a unit root (all are stationary) while in Im et al. (2003) the alternative allows unit roots for some (but not all) of the series<sup>8</sup>. However, the cross-unit independence assumption of the first generation tests is quite restrictive in many empirical applications and can lead to severe size distortions (Banerjee et al., 2005; Breitung and Das, 2008). Therefore, we also consider a second generation unit root tests that allow cross-unit dependencies with the tests developed by Bai and Ng (2004). The simplest way consists in using a factor structure model. The idea is to shift data into two unobserved components: one with the characteristic that is cross-sectionally correlated and one with the characteristic that is largely unit specific. Thus, the testing procedure consists in two steps: in a first one, data are de-factored, and in a second step, panel unit root test statistics based on de-factored data and/or common factors are then proposed. The issue is to know if this factor structure allows obtaining clear cut conclusions about stationarity of macroeconomic variables<sup>9</sup>.

#### 3.2.1 Levin, Lin and Chu (2002) test

One of the most popular first generation unit root test is undoubtedly the test proposed by Levin, Lin and Chu (2002) [LLC]. The model with individual effects and no time trends, in which the coefficient of the lagged dependent variable is restricted to be homogenous across all units of the panel, is defined as

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<sup>8</sup>See Hlouskova and Wagner (2006) for a discussion on the performance of first generation panel unit root tests.

<sup>9</sup>See Banerjee (1999), Baltagi and Kao (2000), Choi (2006), Hurlin (2008) and Breitung and Pesaran (2008) for a survey on panel unit root tests. See also Gengenbach et al. (2006) and de Silva et al. (2009) for an investigation on the properties of the second generation panel unit root tests.

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{z=1}^{p_i} \beta_{i,z} \Delta y_{i,t-1} + \varepsilon_{it} \quad (4)$$

for  $i = 1, \dots, N$  and  $t = 1, \dots, T$ . The errors  $\varepsilon_{it} \sim i.i.d. (0; \sigma_{\varepsilon_i}^2)$  are assumed to be independent across the units of the sample. In this model, LLC are interested in testing the null hypothesis  $H_0: \rho = 0$  against the alternative hypothesis  $H_1: \rho = \rho_i < 0$  for all  $i = 1, \dots, N$ , with auxiliary assumptions about the individual effects ( $\alpha_i = 0$  for all  $i = 1, \dots, N$  under  $H_0$ ). This restrictive alternative hypothesis implies that the autoregressive parameters are identical across the panel.

The LLC test is based on the following adjusted t-statistic

$$t_{\rho}^* = \frac{t_{\rho}}{\sigma_T^*} - NT \hat{S}_N \left( \frac{\hat{\sigma}_{\hat{\rho}}}{\hat{\sigma}_{\hat{\varepsilon}}^2} \right) \left( \frac{\mu_T^*}{\sigma_T^*} \right) \quad (5)$$

where  $t_{\rho}$  is the standard t-statistic based on the pooled estimator  $\hat{\rho}$ , where the mean adjustment  $\mu_T^*$  and standard deviation adjustment  $\sigma_T^*$  are simulated by LLC for various sample sizes  $T$ . The adjustment term is also function of the average of individual ratios of long-run to short-run variances,  $\hat{S}_N = (1/N) \sum_{i=1}^N (\hat{\sigma}_{y_i} / \hat{\sigma}_{\varepsilon_i})$ , where  $\hat{\sigma}_{y_i}$  denotes a kernel estimator of the long-run variance for the country  $i$ . LLC suggest using a Bartlett kernel function and a homogeneous truncation lag parameter given by the simple formula  $\bar{K} = 3.21T^{1/3}$ . They demonstrate that, under the non stationary null hypothesis, the adjusted t-statistic  $t_{\rho}^*$  converges to a standard normal distribution.

### 3.2.2 Im, Pesaran and Shin (2003) test

Im, Pesaran and Shin (2003) [IPS] propose heterogeneous panel unit root tests based on the cross-sectional independence assumption. The model with individual effects and no time trend is given as

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{z=1}^{p_i} \beta_{i,z} \Delta y_{i,t-1} + \varepsilon_{it} \quad (6)$$

The null hypothesis is defined as  $H_0: \rho_i = 0$  for all  $i = 1, \dots, N$  and the alternative is  $H_1: \rho_i < 0$  for  $i = 1, \dots, N_1$  and  $\rho_i = 0$  for all  $i = N_1 + 1, \dots, N$ , with  $0 < N_1 \leq N$ . The alternative allows unit roots for some (but not all) of the individuals. In this context, the IPS test is based on the (augmented) Dickey-Fuller statistics averaged across groups. Let  $t_{iT}(\rho_i, \beta_i)$  with  $\beta_i = (\beta_{i,1}, \dots, \beta_{i,p_i})$  denote the  $t$ -statistics for testing unit root in the  $i$ -th country. The IPS statistic is then defined as

$$tbar_{NT} = \frac{1}{N} \sum_{i=1}^N t_{iT}(\rho_i, \beta_i) \quad (7)$$

Under the assumption of cross-sectional independence, this statistic is shown to sequentially converge to a normal distribution. IPS propose two corresponding standardized  $tbar$  statistics. The first one, denoted  $Z_{tbar}$ , is based on the asymptotic moments of the Dickey Fuller distribution. The second standardized statistic, denoted  $W_{tbar}$ , is based on the means and variances of  $t_{iT}(\rho_i, 0)$  evaluated by simulations under the null  $\rho_i = 0$ . Although the tests  $Z_{tbar}$  and  $W_{tbar}$  are asymptotically equivalent, simulations show that the  $W_{tbar}$  statistic, which explicitly takes into account the underlying ADF orders in computing the mean and the variance adjustment factors, performs much better in small samples. For each country, the values of the mean and variance used in the standardization of  $W_{tbar}$  are taken from the IPS simulations (Im, Pesaran and Shin, 2003) for the time length  $T$  and the corresponding individual lag order  $p_i$ . Individual ADF lag orders are optimally chosen according to the general-to-specific (GS) procedure of Hall (1994) with a maximum lag length set to  $4^{10}$ .

### 3.2.3 Bai and Ng (2004) test

The unit root tests by Bai and Ng (2004) [BN] provide a complete procedure to test the degree of integration of series. They decompose a series  $y_{it}$  as a sum of three components: a deterministic one, a common component expressed as a factor structure and an error that is largely idiosyncratic. The process  $y_{it}$  is non-stationary if one or more of the common factors are non-stationary, or the idiosyncratic error is non-stationary, or both. Instead of testing for the presence of a unit root directly in  $y_{it}$ , BN propose to test the common factors and the idiosyncratic components separately. Let us consider a model with individual effects and no time trend

$$y_{it} = \alpha_i + \lambda_i' F_t + \varepsilon_{it} \quad (8)$$

where  $F_t$  is a  $r \times 1$  vector of common factors and  $\lambda_i$  is a vector of factor loadings. Among the  $r$  common factors, we allow  $r_0$  stationary factors and  $r_1$  stochastic common trends with  $r_0 + r_1 = r$ . The corresponding model in first differences is

$$\Delta y_{it} = \lambda_i' f_t + z_{it} \quad (9)$$

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<sup>10</sup>Similar results have been obtained when individual lag lengths are chosen by information criteria (AIC or BIC).

where  $z_{it} = \Delta \epsilon_{it}$  and  $f_t = \Delta F_t$  with  $E(f_t) = 0$ . The common factors in  $\Delta y_{it}$  are estimated by the principal component method. Let us denote  $\hat{f}_t$  these estimates,  $\hat{\lambda}_i$  the corresponding loading factors and  $\hat{z}_{it}$  the estimated residuals. BN propose a differencing and re-cumulating estimation procedure which is based on the cumulated variables

$$\hat{F}_{mt} = \sum_{s=2}^t \hat{f}_{ms} \quad \hat{\epsilon}_{it} = \sum_{s=2}^t \hat{z}_{ms} \quad (10)$$

for  $m = 1, \dots, r$  and  $i = 1, \dots, N$ . Then, they test the unit root hypothesis in the idiosyncratic component  $\epsilon_{it}$  and in the common factors  $F_t$  with the estimated variables  $\hat{F}_{mt}$  and  $\hat{\epsilon}_{it}$ .

To test the non-stationarity of idiosyncratic components  $\hat{\epsilon}_{it}$  (the de-factored estimated components), BN suggest pooled individual ADF  $t$ -statistics from a Fisher's type statistic, denoted  $P_{\hat{\epsilon}}^c$ , rather than individual ADF  $t$ -statistics  $\text{ADF}_{\hat{\epsilon}}^c(i)$  in order to improve the power of the test (BN, 2004).

To test the non-stationarity of the common factors  $\hat{F}_{mt}$ , BN consider a ADF  $t$ -statistic, denoted  $\text{ADF}_{\hat{F}}^c(i)$ , when there is only one common factor among the  $N$  variables ( $r = 1$ ). The number of common factors is estimated according to  $IC_2$  or  $BIC_3$  criteria (see Bai and Ng, 2002) with a maximum number of factor equal to 5<sup>11</sup>.

## 4 Empirical analysis

### 4.1 The data

The data of the study consists of annual real per capita GDP data from Maddison (2007) database for 20 COMESA economies in common 1990 Geary-Khamis PPP-adjusted dollars, and spans from 1960 to 2003. Note that these data are expressed in common 1990 Geary-Khamis PPP-adjusted dollars, which correct for the differences in prices of commodities across countries<sup>12</sup>. The countries represented are Angola, Burundi, Comoros, Democratic Republic of Congo, Djibouti, Egypt, Eritrea<sup>13</sup>, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe. Note that all variables are expressed in logs. Moreover, output differentials are defined with respect to the corresponding

<sup>11</sup>BN (2004) also consider the case when there are more than one common factors ( $r > 1$ ) from a sequential procedure. In our study, we find only one common factor.

<sup>12</sup>See Maddison (2003) for a discussion on the Geary-Khamis approach.

<sup>13</sup>Ethiopia and Eritrea are added into a same item.

panel average.

In addition, we check if there are some exogenous convergent clubs in the COMESA by analyzing some groups of COMESA countries. Country groups are shaped by reference to three criteria (Table 1):

- (i) the degree of economic development: The importance of economic development (human capital, health, infrastructure, ...) have been demonstrated since a long time ago (Gillis et al., 1987). Recently, the New Growth Theory insisted on the crucial impact of the initial development conditions for economic growth and convergence. For that purpose, we first focused on the classification of the United Nations Development Program based on the Human Development Indicator [HDI]. Nevertheless, we fixed a threshold value of 0.6 so that we have two groups: the High/Moderate Human Development Indicator [HMHDI] group and the relatively Low Human Development Indicator [LHDI]. We also retained the concept of Less Developed Countries [LDC] established by the United Nation Conference on Trade and Development<sup>14</sup>.
- (ii) the membership to another regional trade arrangement: On the whole, all COMESA countries belong to at least one another African trade arrangement. This can have a significant influence on the various convergence processes in the extent that some trade agreements are more integrated than others. More precisely, five such organizations are concerned, namely the Indian Ocean Commission [IOC], the East African Community [EAC], the Southern African Development Community [SADC], the Economic Community of Central African States [ECCAS], the Arab Maghreb Union [AMU], Intergovernmental Authority for Development [IGAD] and the Cross-Border Initiative [CBI]<sup>15</sup>.

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<sup>14</sup>Note that a country is classified as a Least Developed Country (LDC) if it meets three criteria based on: (i) low-income (three-year average GNI per capita of less than US \$750, which must exceed \$900 to leave the list), (ii) human resource weakness (based on indicators of nutrition, health, education and adult literacy) and (iii) economic vulnerability (based on instability of agricultural production, instability of exports of goods and services, economic importance of non-traditional activities, merchandise export concentration, and handicap of economic smallness, and the percentage of population displaced by natural disasters).

<sup>15</sup>The CBI was established in 1992 and consists of 14 countries (Burundi, Comoros, Kenya, Madagascar, Malawi, Mauritius, Namibia, Rwanda, Seychelles, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe). The SADC was established in 1992 and consists of 10 countries (Angola, Botswana, Lesotho, Malawi, Mozambique, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe). The ECCAS was created in 1985 and consists of 10 countries (Angola, Burundi, Cameroon, Central African Republic,

(iii) the importance of oil in the production and the export structures: Most countries belonging to COMESA have a poor diversified export base. Some of them strongly depend on oil resources. One more time, we can build two groups from this criterion: the oil countries group, that is to say those which belong to the African Petroleum Producers Association [APPA] and the non-oil countries group [Non-APPA].

Table 1: COMESA's countries shaped following the three criteria.

Regional integration agreement	Country
COMESA	Angola, Burundi, Comoros, Democratic Republic of Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe
IOC	Comoros, Madagascar, Mauritius, Seychelles
EAC	Kenya, Tanzania, Uganda
SADC	Angola, Malawi, Swaziland, Tanzania, Zambia, Zimbabwe, Mauritius, D.R. Congo, Madagascar
ECCAS	Angola, Burundi, D.R. Congo
AMU	Egypt, Libya, Sudan, Djibouti, Comoros
IGAD	Djibouti, Eritrea, Ethiopia, Kenya, Sudan, Uganda
CBI	Burundi, Comoros, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe
Economic development criterion	Country
HMIDH	Egypt, Libya, Mauritius, Seychelles
LHDI	Angola, Burundi, D.R. Congo, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Rwanda, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe
LDC	Angola, Burundi, D.R. Congo, Comoros, Djibouti, Eritrea, Ethiopia, Madagascar, Malawi, Rwanda, Sudan, Tanzania, Uganda, Zambia
Economic structure criterion	Country
APPA	Angola, D.R. Congo, Egypt, Libya, Sudan
Non-APPA	Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe

Chad, Congo, Equatorial Guinea, Gabon, São Tomé and Príncipe, and D.R. Congo). The IOC was established in 1984 and consists of 5 countries (Comoros, France (La Réunion), Madagascar, Mauritius et Seychelles). The EAC was created in 1999 and consists of 3 countries (Kenya, Uganda and Tanzania) with Burundi and Rwanda joining in 2007. The IGAD was established in 1986 and consists of 7 countries (Djibouti, Ethiopia, Eritrea, Kenya, Somalia, Sudan and Uganda).



## 4.2 Empirical results

The adopted strategy to test for income convergence is straightforward. Firstly, for each group, we apply panel unit root tests with no fixed individual effects in order to check if an absolute convergence process is present in the sample considered. Secondly, for the groups where the null of unit root can not be rejected, the same panel unit root tests but with fixed individual effects are implemented to pin down a possible conditional convergence dynamics. Finally, if the unit root hypothesis always holds, then we consider that the group is characterized by stochastic divergence. Table 2 reports for the whole COMESA the panel unit root tests with no individual effects suggested by Levin et al. (2002) [ $LLC_1, t_p^*$ ] and with individual effects by Levin et al. (2002) [ $LLC_2, t_p^*$ ], Im et al. (2003) [IPS,  $tbar_{NT}$ ] and Bai and Ng (2004) [ $BN_c$  and  $BN_i$  for common factors ( $ADF_{\hat{F}}^c$ ) and idiosyncratic shocks ( $P_{\hat{\epsilon}}^c$ ), respectively.]. Table 3 displays the outcomes resulting from the same tests but for the different convergence clubs presented in Table 1.

Table 2: Panel unit root tests for absolute and conditional convergence: Results for the whole COMESA.

References	LLC <sub>1</sub>	LLC <sub>2</sub>	IPS	BN <sub>c</sub>	BN <sub>i</sub>
The COMESA average	3.82 (0.99)	1.43 (0.92)	3.04 (0.99)	−1.55 (0.50)	32.48 (0.80)
The African average	3.38 (0.99)	2.31 (0.99)	2.62 (0.99)	−0.34 (0.92)	30.90 (0.85)
The world average	8.88 (1.00)	3.46 (0.99)	6.22 (1.00)	1.20 (0.99)	41.13 (0.42)

\* and \*\* Significant at the 5% and 10% level, respectively. LLC<sub>1</sub> and LLC<sub>2</sub> denote the Levin, Liu and Chin (2002) panel unit root test with no individual effects and with individual effects respectively. IPS denotes the Im, Pesaran and Shin (2003) unit root test with individual unit root processes. BN<sub>c</sub> and BN<sub>i</sub> denote the Bai and Ng (2004) second-generation unit root test for common factors ( $ADF_{\hat{F}}^c$ ) and idiosyncratic shocks ( $P_{\hat{\epsilon}}^c$ ), respectively. Note that all these three tests are done with individual effects.

### 4.2.1 The regional integration criterion

Implementing the unit root tests on the COMESA<sup>16</sup> and the memberships to another African regional trade agreement (IOC, EAC, SADC, ECCAS, AMU, IGAD, CBI) gives, with few exceptions, strong support for rejecting the hypotheses of absolute

<sup>16</sup>For the whole COMESA, Table 2 shows that the finding of no absolute and conditional convergence holds even if other income references (an African average and a world average) are used.

Table 3: Panel unit root tests for absolute and conditional convergence: Results for the convergence clubs.

Groups	LLC <sub>1</sub>	LLC <sub>2</sub>	IPS	BN <sub>c</sub>	BN <sub>i</sub>
Grouping by the regional integration criterion					
ECCAS	0.61 (0.73)	2.22 (0.99)	2.71 (1.00)	−1.25 (0.65)	2.96 (0.94)
SADC	4.82 (1.00)	4.78 (1.00)	5.96 (1.00)	0.83 (0.99)	15.29 (0.50)
EAC	−0.79 (0.22)	1.25 (0.89)	1.63 (0.95)	−1.42 (0.57)	15.69* (0.02)
AMU	−1.26 (0.11)	−0.69 (0.25)	−0.16 (0.44)	2.77 (0.99)	−1.37 (0.56)
CBI	4.68 (1.00)	3.07 (1.00)	5.61 (1.00)	0.34 (0.98)	32.26 (0.19)
IGAD	−2.24* (0.01)	—	—	—	—
IOC	4.57 (1.00)	3.27 (1.00)	4.00 (1.00)	0.48 (0.99)	8.18 (0.41)
Grouping by the economic structure criterion					
APPA	−0.15 (0.44)	−0.61 (0.27)	0.29 (0.61)	−1.29 (0.63)	2.56 (0.98)
NON-APPA	4.34 (1.00)	3.49 (0.99)	5.83 (1.00)	0.37 (0.98)	37.45 (0.16)
Grouping by the economic development criterion					
LHDI	−0.32 (0.38)	1.42 (0.92)	2.70 (0.99)	−1.67 (0.45)	27.83 (0.68)
HMHDI	−1.42** (0.08)	—	—	—	—
LDCs	−2.45* (0.01)	—	—	—	—

\* and \*\* Significant at the 5% and 10% level, respectively. LLC<sub>1</sub> and LLC<sub>2</sub> denote the Levin, Liu and Chin (2002) panel unit root test with no individual effects and with individual effects respectively. IPS denotes the Im, Pesaran and Shin (2003) unit root test with individual unit root processes. BN<sub>c</sub> and BN<sub>i</sub> denote the Bai and Ng (2004) second-generation unit root test for common factors ( $ADF_{\beta}^c$ ) and idiosyncratic shocks ( $P_{\epsilon}^c$ ), respectively. Note that all these three tests are done with individual effects.

and conditional convergence. Indeed, we cannot reject the null hypothesis of non-stationarity for all trade arrangements whatever the specification retained, i.e. with or without a fixed individual effect, except for the African trade arrangements IGAD and EAC. For the IGAD group the panel unit root test with no individual effects LLC does not reject the null hypothesis of a unit root at the 5% level, implying an absolute convergence across Djibouti, Eritrea-Ethiopia, Kenya, Sudan and Uganda, i.e. the level of per capita income of the poor countries (Burundi and Eritrea-Ethiopia) in this

group catch-up with the one of the rich ones (Kenya). For the EAC group the panel unit root test with individual effects  $BN_i$  does not reject the null hypothesis at the 5% level, suggesting a conditional convergence across Kenya, Tanzania and Uganda, i.e. each economy has converged to its own steady state, and only the growth rates will be equalized in the long run. This property of non-stationarity is due to the behavior of the common component (growth trends).

However, note that this finding of no convergence process for the trade arrangement criterion does not reveal that regional integration is not an efficient strategy to make developing countries to converge. In our point of view, these results just tell us that the ongoing process of integration is not adapted in this part of Africa. In accordance with the so-called Spaghetti Bowl effect of Bhagwati et al. (1998), the high number of trade agreements in Eastern and Southern Africa contributes to this bad performance in terms of income convergence.

#### **4.2.2 The economic structure criterion**

If we use the economic structure criterion, no clubs convergence appears. The null of a unit root is not rejected by all the tests both for the absolute and conditional convergence hypothesis whatever the group considered (APPA, Non-APPA). Moreover, taking into account the presence of cross-sectional dependence does not change the results. The reject of the convergence for these two groups is not very surprising. The discrimination by the oil criterion is not sufficient to constitute homogeneous groups in the case of the COMESA. Several members reveal a production structure more diversified as for instance Egypt, Mauritius or Seychelles.

#### **4.2.3 The economic development criterion**

Finally, the grouping by the economic development criterion gives the more interesting findings. Two out of three groups are associated with an absolute income convergence trend. In effect, the null hypothesis of a unit root can be rejected at the 5% and 10% level for the LDC and HMIDH groups, respectively, from the panel unit root test with no individual effects LLC. This result implies that the level of per capita income of the poor countries in these groups catch-up with the one of the rich ones. Concerning the last one, the LHDI group, a divergent process seems to characterize the data, i.e. the group do not converge both in level and in rate. That is not very surprising because

of the strong economic development disparities which are still present in this group. Indeed, some countries as Zimbabwe, Kenya or Swaziland reveal HDI performances close to the upper limit of 0.6. Although their economic development levels stay relatively low, they do undoubtedly better than the 14 other countries.

Thus, our work allows us to strongly support the theoretical insight. Economic development is crucial for improving the growth performances of an economy. This conjecture is more evident for the COMESA. Countries with good economic development conditions (Mauritius, Seychelles, Libya, Egypt) show a catching up process towards a high income average. But, countries with bad economic development conditions, i.e. sixteen out of twenty economies, converge towards a low income average. All in all, we can conclude from this study that there is an income convergence process towards the bottom within the COMESA. Indeed, except for four countries, all the members of this regional agreement are locked into the poverty trap.

## **5 Conclusion**

In this paper, we proposed to detect the possibility of stochastic convergence of real per capita GDP for a set of Eastern and Southern African countries, all members of the COMESA's trade agreement. Using the panel unit-root tests developed by Levin et al. (2002), Im et al. (2003) and Bai and Ng (2004), our results rejected the presence of stochastic convergence for the whole COMESA.

However, in the extent that most COMESA countries are largely heterogeneous, we tried to put forward the potential existence of convergence clubs within the trade agreement by three criteria, namely (i) the membership to another regional agreement, (ii) the economic structure (dependence from oil production) and (iii) the degree of global economic development. Two main findings emerged from the results. Firstly, no evidence of stochastic absolute and conditional income convergence holds for all the groups belonging to the regional trade agreement and the economic structure criteria. Concerning the former criterion, contrary to the conceptual conclusion of Venables (2003) about South-South integration, the lack of convergence in our case does not imply that regional integration does not stimulate the setting up of a catching up process. Actually, in our point of view, this bad performance results from the so-called « Spaghetti Bowl » effect of Bhagwati et al. (1998). Thus, this region needs a strategy based on a rationalization of the number of trade agreements before

deepening the trade and financial relations between the different economies. Secondly, the testing procedures highlighted strong support for absolute income convergence for two groups (HMDH, LDC) belonging to the economic development criterion. This result led us to conclude that a convergence process towards the bottom is at work for the COMESA members, except for the most four developed countries, that is Mauritius, Seychelles, Libya and Egypt. This result corroborates the findings of the New Growth Theories in the extent that initial economic development conditions determine the long-run economic growth processes. A related outcome is the necessary intervention of both local governments and international institutions to create a climate of sustainable development and get these under-development economies out of the poverty trap.

Further research should investigate the convergence in the COMESA by using panel unit root tests taking into account a break as in, e.g., Carrion-i-Silvestre et al. (2005).

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