

Fe, Doukouré Charles; Konin, Adou Christian; N'Guessan, Akra Mohaye Marius

Article

Economic convergence in the West African Economic and Monetary Union: a new analysis

Cogent Economics & Finance

Provided in Cooperation with:

Taylor & Francis Group

Suggested Citation: Fe, Doukouré Charles; Konin, Adou Christian; N'Guessan, Akra Mohaye Marius (2024) : Economic convergence in the West African Economic and Monetary Union: a new analysis, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 12, Iss. 1, pp. 1-20, <https://doi.org/10.1080/23322039.2024.2308671>

This Version is available at:

<https://hdl.handle.net/10419/321420>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by/4.0/>

Economic convergence in the West African Economic and Monetary Union: a new analysis

Doukouré Charles Fe, Adou Christian Konin & Akra Mohaye Marius N'Guessan

To cite this article: Doukouré Charles Fe, Adou Christian Konin & Akra Mohaye Marius N'Guessan (2024) Economic convergence in the West African Economic and Monetary Union: a new analysis, Cogent Economics & Finance, 12:1, 2308671, DOI: [10.1080/23322039.2024.2308671](https://doi.org/10.1080/23322039.2024.2308671)

To link to this article: <https://doi.org/10.1080/23322039.2024.2308671>



© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



Published online: 04 Feb 2024.



Submit your article to this journal [↗](#)



Article views: 1331



View related articles [↗](#)




View Crossmark data [↗](#)



Citing articles: 1 View citing articles [↗](#)

Economic convergence in the West African Economic and Monetary Union: a new analysis

Doukouré Charles Fe^a , Adou Christian Konin^b and Akra Mohaye Marius N'Guessan^b

^aEnseignant-chercheur à l'Ecole Nationale Supérieure de Statistique et d'Economie Appliquée (ENSEA) d'Abidjan, Chercheur sénior à la Cellule d'Analyse de Politique Economique du Centre Ivoirien de Recherches Economiques et Sociales (CAPEC), Abidjan, Ivory Coast; ^bElève Ingénieur Statisticien Economiste à l'Ecole Nationale Supérieure de Statistique et d'Economie Appliquée (ENSEA) d'Abidjan, Abidjan, Ivory Coast

ABSTRACT

This paper uses a structural approach to analyse economic convergence within the West African Economic and Monetary Union (WAEMU) countries. This Regional Economic Community has recorded several postponements of the convergence horizon defined by the Economic Commission. However, it is a framework that is supposed to lead to economic growth and living conditions. So, we estimate a structural convergence model over 1996–2021 for the WAEMU panel of countries. We apply the Generalized Moment Method to address the endogeneity issue in evaluating the coefficient. The analysis confirms no economic convergence within WAEMU countries during this period. This finding means that the economic structures of the WAEMU countries do not come closer over time. Therefore, policymakers must continue implementing initiatives to harmonise regional policies and reinvigorate the regional economic program.

ARTICLE HISTORY

Received 19 October 2023
Revised 8 December 2023
Accepted 17 January 2024

KEYWORDS

Economic convergence;
structural characteristics;
growth; income disparity;
Development

REVIEWING EDITOR

Yamini Sharma, Taylor and Francis, India

SUBJECTS



Economics, Development
Studies, Development policy

JEL CLASSIFICATION

CODES
C13; O47

1. Introduction

The West African Economic and Monetary Union (WAEMU) is an intergovernmental organisation bringing together 8 West African countries sharing the CFA Franc's same currency. They are Benin, Burkina Faso, Côte d'Ivoire, Guinée Bissau, Mali, Niger, Sénégal, Togo. Its mission is to create a solid economic zone to promote the economic and social development of the populations in the Member States. The economic Literature evokes the notion of real convergence of economies to analyse the achievement of economic and social growth in a regional financial community. It refers to the convergence of living standards, productivity levels, and economic structures. It is concerned with equalising the standard of living in the Member States as measured generally by Gross Domestic Product (GDP) per capita in purchasing power parity. According to Beaumont, convergence is the long-term equalisation trend of the growth rate of per capita income or output of different geographical areas. When this convergence highlights the homogenisation of the production conditions of the economies analysed, we will speak of structural convergence. Real convergence is opposed to nominal convergence, which concerns approximating specific macroeconomic indicators (inflation, interest rates, and public deficit). This convergence is also known as the concept of economic policy convergence. Monetary policy convergence requires several countries to

CONTACT Doukouré Charles Fe  fe.doukoure@ensea.ed.ci  Enseignant-chercheur à l'Ecole Nationale Supérieure de Statistique et d'Economie Appliquée (ENSEA) d'Abidjan & Chercheur sénior à la Cellule d'Analyse de Politique Economique du Centre Ivoirien de Recherches Economiques et Sociales (CAPEC), 08 BP 03, Abidjan, 08, Ivory Coast

© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

pursue cooperative economic policies based on shared objectives and compliance monitored by a multi-lateral surveillance mechanism (Fouda Owoundi, 2010). These shared objectives are translated into nominal convergence criteria, and the surveillance mechanisms ensure compliance with these criteria, which reflect the adequacy of national economic policies and the goals previously set by all countries.

Since its creation, WAEMU, aware of the challenges to achieving its convergence objective, instituted 1999¹ a convergence pact entitled 'Convergence, Stability, Growth and Solidarity Pact'. The idea behind this Pact would be to promote nominal convergence and induce real and structural convergence of the Member States in the long term. However, it is clear that after more than two decades of effort, the results of this Pact are still waiting for the WAEMU and the member countries, particularly in reducing income gaps and equalising the countries' living standards of the region. Indeed, according to data from the African Development Bank, the level of GDP per capita in 1999, in PPP² (Purchasing Power Parity), the highest within the WAEMU was 4258.2 dollars (Côte d'Ivoire), while the lowest was 978.8 dollars (Niger). In 2020, with Côte d'Ivoire still in the lead and Niger lagging, GDP per capita in PPP amounted to \$5181.3 for Côte d'Ivoire and \$1221.3 for Niger. As can be seen, almost 20 years after implementing the Convergence, Stability, and Solidarity Pact, the extent of GDP per capita in PPP of the WAEMU countries increased from 3312 dollars in 1999 to 3960 dollars in 2020, a growth of 19.6%. This situation means the gap is growing over time regarding GDP per capita in PPP.

WAEMU has been presented as a successful experience of regional integration in West Africa (Decaluwé et al., 2001). In addition, faced with the non-achievement of the objectives, the WAEMU Commission postponed the end of the convergence of economies. In fact, after adopting the other activities on the convergence pact in 1999, States had three years to comply with all the criteria. Unfortunately, they could not meet this requirement, so the convergence horizon was postponed to 2005.³ The deadline was extended to 20,084, 20,135, and 20,206 for various reasons. Among other reasons, we can mention the socio-political crises in the States (The post-electoral crisis in Côte d'Ivoire in 2010, coup d'état in Mali in 2020 and 2021, and coup d'état in Burkina Faso in 2022), the slow implementation of reforms, the unfavourable national and international situation (decline in commodity prices in 2017), the COVID19 health crisis.

This paper aligns with economic growth theories, and economic convergence has been the subject of several theoretical developments in Economic Literature. Existing theoretical approaches can be divided into two categories: the first concerns ancient methods, and the second modern ones. For old approaches, two theories can be presented: the neoclassical theory of growth and the endogenous growth theory. The neoclassical growth theory is based on de Solow's work (1956). Solow proposes a model for predicting countries' economic convergence towards the same GDP per capita level. It assumes diminishing returns, a space in which economies are similar regarding preferences and technologies. For him, trade integration and the liberalisation of capital movements are catalysts for the economic convergence of countries.⁴

Contrary to the neoclassical view, endogenous growth theories do not predict the economic convergence of countries in space even when the movement of goods and capital is free (Lucas, 1988; Romer, 1986). Indeed, by rejecting the diminishing returns on capital hypothesis, these models exclude the economic mechanism that generates the convergence process. This work further supports the persistence of per capita income disparities because increasing yields reinforce the initial advantages characterising countries. Moreover, the catalysts for economic convergence in the neoclassical model appear here as inhibitors of reducing per capita income inequality (Lucas, 1988). Indeed, in this model, trade openness and integration between countries may lead them to specialise in sectors in which they have comparative advantages. However, the latter's learning effects may be low, so income inequalities widen further between economies and countries' spaces.⁵

As for so-called modern approaches, growth poles and geographical economics theories explain economic convergence. Developed by François (1955) and then deepened by Hirschman (1998, 2021), the theory of growth poles distinguishes two main economic growth categories: driving and follower sectors. This theory focuses on the diffusion of growth effects to all economic sectors, starting from the driving sectors to others. This theory states that convergence depends on the confrontation between two opposing effects of integration. The first effect is unfavourable to the developing countries (constituting the periphery), tending to strengthen the competitive advantage of the rich countries (forming

the centre) and attract the factors of production to them. Unlike the former, the latter effect is pro-poor, as it encourages aspects of production and economic activity to leave the centre for the periphery due to the congestion effects suffered by the former.⁶

As an extension of this centre-periphery analysis, the theory of geographical economics developed with the work of Baumont et al. (2000), Krugman (1997), and Krugman and Venables (1995). These authors show that the evolution of disparities between regions depends on the confrontation between the forces of dispersion and those of agglomeration and regional integration policies. The latter can increase the spatial concentration rate of production systems. These factors influence the growth rate of a geographical area but cannot improve the economic convergence of countries in the same region. In this context, structural differences between countries, the location, and the structure of the neighbourhood explain fundamental differences in per capita income. As a result, the spatial organisation of productive activities can influence the relative growth rate of countries in a region, justifying disparities between countries in terms of economic performance.

We assumed the objective of any economic integration is to promote the development of its member countries by ensuring better living conditions for its inhabitants. As highlighted in previous studies, the reduction in living standards in WAEMU suggests that this objective is achieved independently of structural convergence. Given the recent performance of the WAEMU as well as the rescheduling of the convergence deadlines of the Convergence, Stability, Growth, and Solidarity Pact, given that the current pace has provided for the convergence horizon at the end of December 2019,⁷ it seems necessary to us to revisit structural convergence in the WAEMU. We ask ourselves: How could economic convergence in the West African Economic and Monetary Union be understood today? Do community policies help to reduce differences in the structures of WAEMU economies?

The lack of structural convergence in WAEMU is of interest for two reasons. First, the timeline has been changed every time with the postponements of the convergence horizons. Second is the growing gap between members. Furthermore, even more so since according to the provisions of Additional Act No. 01/2015/CCEG/UEMOA establishing the new Pact, the convergence phase was planned for the period from 1 January 2015 to 31 December 2019, while the stability phase would begin no later than 1 January 2020.

From this perspective, this paper aims to re-examine the convergence process in the West African economic and monetary union using a structural convergence approach applying the GMM estimation technique to deal with the endogeneity issue. So, this analysis has two contributions to the existing Literature. First, it updates the state of economic convergence within the West African Economic and Monetary Union (WAEMU) after more than 25 years of integration experience. Therefore, This analysis contributes to this debate, which remains relevant for developing countries, particularly the West African Economic and Monetary Union members. Second, it gives an assessment to show to what extent economic convergence is working nowadays between WAEMU countries using a structural approach, considering both the characteristics of economies and exogenous factors.

The research hypothesis along the previous questions and these specific objectives are: (i) economic convergence in WAEMU fails again today; (ii) differences between countries' economic structure are widening yearly within WAEMU.

The rest of the article is organised into four sections. The first section presents a brief empirical literature review on economic convergence in the West African Economic and Monetary Union. The second section focuses on the methodology and data. The third section analyses the estimation results before concluding and giving policy recommendations.

2. Economic convergence in the West African Economic and Monetary Union: a brief empirical literature review

This section reviews previous studies on economic convergence in developing countries, particularly WAEMU. The theoretical framework of endogenous growth combined with the theory of geographical economics adapts better to this review of economic convergence in the WAEMU, integrating the structural characteristics of the member countries.

According to the empirical literature, real structural convergence analysis refers to economic growth analysis by considering explanatory variables to explain the heterogeneity of growth rates between countries. The literature considers two approaches to analysing structural convergence (Chassem, 2012). The first is a demand-side analysis. In this case, the convergence equation thinks the effect of primary factors as measured by the main determinants of economic growth with which other control variables are associated (Lucas, 1988; Romer, 1986; Solow, 1956). The latter are characteristic variables of economies. They make it possible to assess the effect of structural characteristics on the growth dynamics and, consequently, on the convergence process of the economies. It is also known as conditional beta convergence. It differs from sigma convergence, which reflects a narrowing of the countries' real per capita income gap. The second approach is instead an analysis of the supply side. According to this approach, convergence is examined through the overall productivity of the factors of production (Baumol, 1986). From one method to another, the analysis highlights the catching up of advanced countries by least developed countries in a given set of countries. Examining if developing countries have made progress in economic convergence, Johnson and Papageorgiou (2020) show that they have yet to. Moreover, they find that despite the lack of progress on cross-country convergence, global inequality has tended to fall since 2000.

Two observations emerge from the empirical Literature regarding the analysis of structural convergence in the West African Economic and Monetary Union (WAEMU). The first concerns the approach used by the authors, and the second relates to the existence of studies on structural convergence. The demand-side method was the most widely used, generally because of the availability of detailed data over a long period on the productivity of the factors of production (labour, capital). All told, both approaches should lead to similar conclusions.

Empirical studies on the issue of convergence in general in the WAEMU have focused more on real and absolute beta convergence for the most part. On the conditional convergence side, Ehuitché (2016) finds that WAEMU countries are experiencing a conditional convergence process. Then, he shows that improving economic and social infrastructure within countries leads to significant gains in per capita income growth for each country.

As Gbohoui (2015) says, WAEMU has chosen convergence on nominal variables convergence through the Pact of stability, growth, and convergence. Following the European Union, WAEMU expects to reach real convergence by reducing income per capita gaps within countries. In this empirical Literature, real convergence mainly uses the sigma convergence examination, as in the case of WAEMU. The authors analyse the evolution of the volatility of per capita income in the WAEMU. However, results on real convergence in WAEMU could be more precise. Some authors should have shown evidence of absolute convergence in WAEMU. Bah (2015), using the methodology of Carlino and Mills (1993), shows heterogeneity within WAEMU countries and supports no economic convergence because countries are structurally different.

Nevertheless, several studies on WAEMU have shown that real convergence is a reality (Fe, 2013; Hammouda et al., 2007, 2009; Lamine, 2002). However, these studies do not explain the dynamics of convergence. They suggest that real convergence is observed over the entire study period. Accordingly, Chassem (2012) displayed that the process is not linear. He argues that in WAEMU, there are periods of convergence and divergence. Other studies on real convergence in the WAEMU have focused on analysing nominal convergence by examining the sigma convergence of the convergence criteria. These studies examine the dispersion of nominal convergence criteria to examine real convergence in the WAEMU (Ary Tanimoune & Plane, 2005; Diarra, 2016; Fouda Owoundi, 2010).

Regarding absolute beta convergence, most studies are based on Solow's growth model (1956). However, they do not use the augmented model by taking structural variables apart from factors explaining economic growth (capital, labour). The only studies we have been able to list on WAEMU have mixed results. According to Chassem (2012), the WAEMU countries are experiencing structural convergence. Prao (2015) states that structural convergence is not achieved in the WAEMU. These two authors clearly show that the capacity of WAEMU countries to converge structurally depends on important exogenous (Chassem, 2012) and endogenous factors, such as the economic policies these countries adopt and the heterogeneity of natural capital (Prao, 2015).

The Literature on the link between real and structural convergence then deserves to be examined. Indeed, whether there is a better link between real and structural convergence, which of the two concepts involves the other? Note that this question dates back to the work of Solow (1956). According to Solow's growth model, real convergence between several is conditioned by structural convergence. Indeed, according to him, real convergence is achieved if countries have the same long-term equilibrium growth path. Then, these countries have the same structural characteristics because these structural characteristics determine this long-term growth path. Therefore, structural convergence is a necessary condition for achieving real convergence. This idea is supported by Desdoigts (1997), who stresses the importance of other structural factors such as the level of technology, preferences, saving rate, population growth rate, or market structures. Elmslie (1995), in the same vein, had shown that technology transfer could induce real convergence.

Therefore, structural convergence would be necessary for achieving real convergence in general. Nevertheless, in the case of WAEMU, previous studies on real convergence show that countries are experiencing a reduction in per capita income inequality with the sigma convergence approach. This approach even extends to analysing the dispersion of the nominal convergence criteria. However, the analyses leave aside the situation of economic convergence in the macroeconomic policy harmonisation context. Do community policies help to reduce differences in the structures of WAEMU economies?

3. Methodology and data

3.1. Justification of the structural approach for the review of convergence in the WAEMU

The empirical approach adopted is the structural approach. How could we explain a permanent gap in the economic convergence indicator in WAEMU? To this question, we can give two possible answers. Differences in initial allocations between countries could explain this discrepancy. According to the Literature, it is essential to distinguish between initial conditions and structural characteristics, which are the critical variables of Solow's model and control variables.

If the initial conditions are to be considered in the analysis, at least in part, it is wise to examine convergence between countries by looking for convergence clubs. These convergence clubs would then consist of countries with similar initial conditions, namely the initial level of human capital and the initial stock of physical capital. In the case of WAEMU, this is not the case a priori because member countries have substantial heterogeneity in initial allocations in these critical factors. There are eight such countries, and virtual club formation could result in two clubs from relatively rich countries with above-average GDP per capita and clubs from developing countries with below-average GDP per capita. Such an analysis would be trivial and of little interest for such a review.

On The other hand, without considering initial conditions in the explanation, we analysed in terms of convergence conditional on the structure of the economies. In this case, the analysis considers the heterogeneity of the structure of economies in examining the convergence process. In the case of the WAEMU countries, the latter approach has been adopted to carry out this review of convergence. Indeed, stylised facts have revealed income gaps that persist over time. Each economy would have a clean growth path explained by differences in economic structures. According to this approach, the analysis will make it possible to isolate what depends on structural differences to highlight the link between the growth rate and the initial income level.

3.2. Model specification and estimation method

The specification chosen is based on the work of Caselli et al. (1996), Islam (1995), and Lee et al. (1997). It is based on panel data following the equation:

$$Y_{i,t} = \alpha + c_i + \beta \ln(Y_{i,t-1}) + \delta x_{i,t} + \varepsilon_{i,t} \quad (1)$$

$Y_{i,t}$ the country's GDP per capita growth rate at the period and a set of structural variables refer to country-specific effects to account for the impact of initial conditions it $x_{i,t}c_i$ (Durlauf et al., 2005; Durlauf &

Quah, 1999). The specification incorporates the structural characteristics of WAEMU economies, including political stability, Quality of regulation, the proportion of intra-WAEMU exports, life expectancy at birth, net inflows of foreign direct investment, population growth rate, and capital stock as a proportion of GDP. These two variables are introduced to account for the Member States' physical factor allocations. Equation (1) describes a dynamic panel model. Consider the following general dynamic panel model, characterised by the inclusion of the lagged dependent in the equation:

$$Z_{i,t} = \alpha + \rho Z_{i,t-1} + \beta X_{i,t} + u_{i,t} \quad (2)$$

With $u_{i,t} = \mu_i + v_{i,t}$. We make the following assumptions: $\mu_i \sim iid(0, \sigma_\mu^2)$; $v_{i,t} \sim iid(0, \sigma_v^2)$ et $\mu_i \perp v_{i,t} \forall i, t$. The choice of this model specification, including the lagged dependent, makes it possible to analyse the adjustment dynamics of the phenomena. However, such a model specification raises two problems:

- Autocorrelation caused by the presence of $Z_{i,t-1}$ among explanatory variables;
- Presence of μ_i that characterises individual heterogeneity.

Thus, a direct estimation of the model would lead to biased and inconsistent parameter estimates because $Z_{i,t-1}$ and $u_{i,t}$ are correlated (because $u_{i,t} = \mu_i + v_{i,t}$ and $Z_{i,t-1}$ contains μ_i).

The GMM system model proposed by Blundell and Bond (1998) is obtained by combining the GMM first difference model proposed by Arellano and Bond (1991) and the GMM level model proposed by Arellano and Bover (1995). Let us consider the following simplified model:

$$z_{i,t} = \rho z_{i,t-1} + u_{i,t} \quad (3)$$

Let be the matrix form of Equation (3) of the GMM system model:

$$z^S = z_{-1}^S \rho^S + u^S \quad (4)$$

With:

$$z^S = [(\Delta z'_1, z'_1), \dots, (\Delta z'_N, z'_N)]'; \quad i = 1, \dots, N \quad (5)$$

$$z_{-1}^S = [(\Delta z'_{1,-1}, z'_{1,-1}), \dots, (\Delta z'_{N,-1}, z'_{N,-1})]' \quad (6)$$

$$u^S = [(\Delta u'_1, u'_1), \dots, (\Delta u'_N, u'_N)]' \quad (7)$$

Let us consider the matrix $\times W_i^S$ instruments specified as follows:

$$W_i^S = \begin{pmatrix} W_i^D & 0 \\ 0 & W_i^L \end{pmatrix} \quad (8)$$

with W_i^D instrument matrix for a first-difference GMM model and W_i^L matrix instrument matrix for level GMM

$$W_i^D = \begin{pmatrix} Z_{i,1} & 0 & \dots & 0 \\ 0 & Z_{i,1} & Z_{i,2} & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & \dots & Z_{i,t-3} & 0 \\ & Z_{i,1} & Z_{i,2} & \dots & Z_{i,t-3} & Z_{i,t-2} \end{pmatrix}; \quad (9)$$

$$W_i^L = \begin{pmatrix} \Delta Z_{i,2} & 0 & \dots & 0 \\ 0 & \Delta Z_{i,3} & \dots & \vdots \\ \vdots & \vdots & \ddots & \vdots \\ 0 & \dots & \Delta Z_{i,t-3} & 0 \\ & 0 & \dots & \Delta Z_{i,t-2} \end{pmatrix} \quad (10)$$

Let's $W^S = (W_1^S, W_2^S, \dots, W_N^S)'$ où $i = 1, \dots, N$. By multiplying Equation (4) by W^S (transposed de W^S), we have:

$$W^{S'} z^S = W^{S'} z_{-1}^S \rho^S + W^{S'} u^S \quad (11)$$

The moment equations are given by $E(W^S u) = 0$. Applying a GLS (Generalized Least Square) to Equation (11), we obtain a one-step system GMM estimator defined by:

$$\hat{\rho}^S = (z_{-1}^{S'W^S} Q_{N,I}^S W^S z_{-1}^S)^{-1} z_{-1}^{S'W^S} Q_{N,I}^S W^S z^S \quad (12)$$

with: $Q_{N,I}^S = \left(\frac{1}{N} \sum_{i=1}^N W_i^{S'} W_i^S \right)^{-1}$. The assumption $v_{i,t} \sim iid(0, \sigma_v^2)$ ensures a consistent GMM estimator.

The generalised moment estimator (GMM) proposed by Arellano and Bond (1991) allows consistent model estimators.⁸ The estimator proposed by these authors refers to the GMM method in the first difference. This approach eliminates specific individual effects and corrects endogeneity bias by using the delayed values of the dependent variable as instruments.

However, the lack of robustness frequently observed in the estimates has led to questions about this fragility. As Arellano and Bover (1995) show, the delayed dependent variables are small instruments in the first difference model, and the estimator obtained is biased into a small sample. Thus, Blundell and Bond (1998) then proposed a more efficient estimator, the GMM estimator, in a system based on a double set of instruments that improves the Quality of the estimators. This estimator is obtained by combining two things. The first is related to the primary difference equation in which the delayed values of the dependent variable are an instrument of the dependent variable, and the lagged values of the explanatory variables are an instrument of the primary difference of the explanatory variables. The second concerns the level equation related to the delayed dependent variable, in which the explanatory variables in level are considered with the lag of those explanatory variables. The convergence hypothesis suggests that the term is significantly harmful.

To control the robustness of our results, we take two approaches. The first approach is to make the estimates using the methods mentioned above: Arellano and Bond (1991), then Arellano and Bover (1995) and Blundell and Bond (1998). As for the second, we use another data source (cf. Table A1) and use these two estimation methods while considering other control variables in the estimates.

3.3. Data

We use panel data from 1996 to 2021 on all WAEMU countries. All variables are from African Development Bank statistics. This period considers all the episodes of the Convergence, Stability, Growth, and Solidarity Pact since its establishment. The main variables selected based on the literature review are: (i) the real GDP per capita growth rate (%), (ii) GDP per capita (current in US\$), (iii) Population growth rate (annual %), (iv) Gross Fixed Capital Formation (% of GDP), (v) Political stability and absence of violence/terrorism, (vi) Quality of regulation, and (vii) Life expectancy at birth (years).

The real GDP per capita annual growth rate is the real Gross Domestic Product (GDP) per capita, calculated as the percentage change in the real GDP per capita between two consecutive years. Real GDP per capita is calculated by dividing GDP at constant prices by a country's population. It is the dependent variable in the final specification.

Population annual growth rate represents labour as the growth equation's primary production factor. It is calculated between two years. The coefficient is expected to be positive because increased labour factor quantity in the production process leads to increased output.

Gross Fixed Capital Formation (% of GDP) designates the proxy of capital in the traditional growth model. It defines the acquisition of produced assets (including purchases of second-hand assets), including the production of such assets by producers for their use, minus disposals in percentage of GDP. As we know that investment is an engine of economic growth, we expect a positive sign in the estimations.

For governance variables (Political stability and absence of violence/terrorism, Quality of regulation), missing data were imputed by regression. For the other variables, the imputations were made by linear interpolation. The variable 'Political stability and absence of violence' measures the likelihood of destabilisation or overthrowing the government by unconstitutional or violent means, including terrorism. Political stability should strengthen the conditions for economic growth and thus promote economic convergence.

The variable 'Regulatory Quality' captures the capacity of governments to develop and implement sound policies and regulations conducive to private sector development. Like political stability, the ability of governments to enforce the right policies should also catalyse economic convergence.

4. Structural economic convergence in WAEMU: descriptive and empirical analysis

This section illustrates empirical results. First, it presents the preliminary results based on stylised facts on key economic convergence outcomes in the West African Economic and Monetary Union. Then, it shows estimations results.

4.1. Preliminary results: some stylised facts of economic convergence in the WAEMU

The stylised facts of convergence are analysed using the critical convergence variables: GDP per capita and the stock of primary factors. The primary factors used in the analysis are the total population and the capital stock represented by gross fixed capital formation. The stylised facts of convergence in the WAEMU are addressed in two points. The first point focuses on the evolution of the primary factors in each country and their variability. The second point describes the GDP per capita change and its variability.

4.1.1. Analysis of primary factor dynamics as a source of growth

Figure 1 illustrates the evolution of the capital stock as a percentage of GDP in each WAEMU country between 1996 and 2021. Figure 2 shows the change in the average absolute gap and the standard deviation of this variable over the same period. The evolution of GFCF as a percentage of GDP shows an upward trend. There was a drop in all countries between 2010 and 2011. This fall could be explained by the socio-political and military crisis in Côte d'Ivoire, which has affected all WAEMU economies.

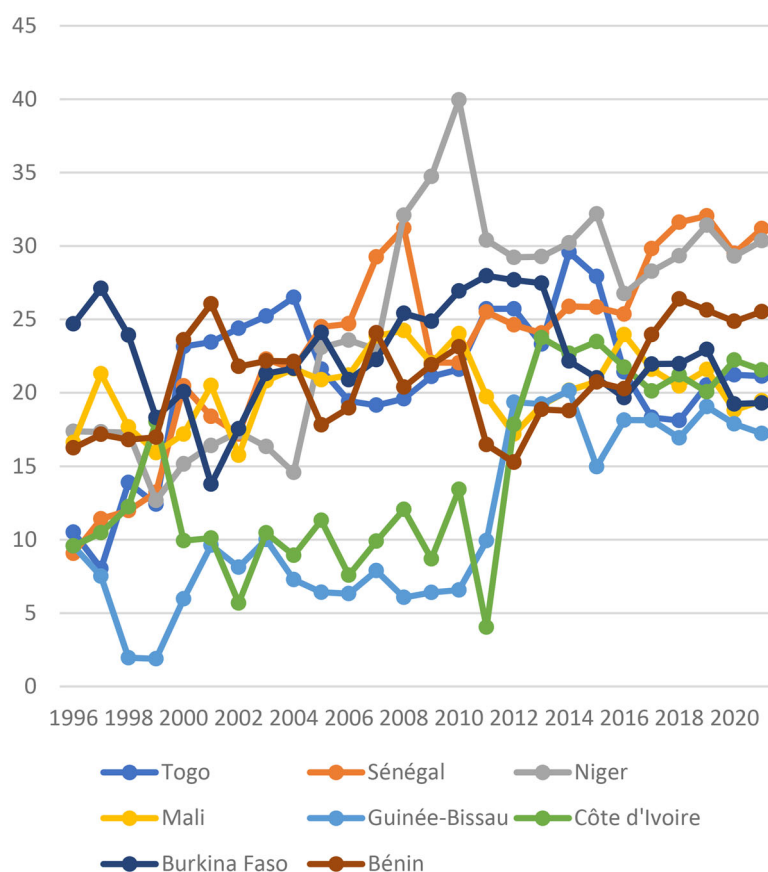


Figure 1. Evolution of GFCF as a percentage of GDP of WAEMU countries.
Source: Authors, with African Development Bank statistics.

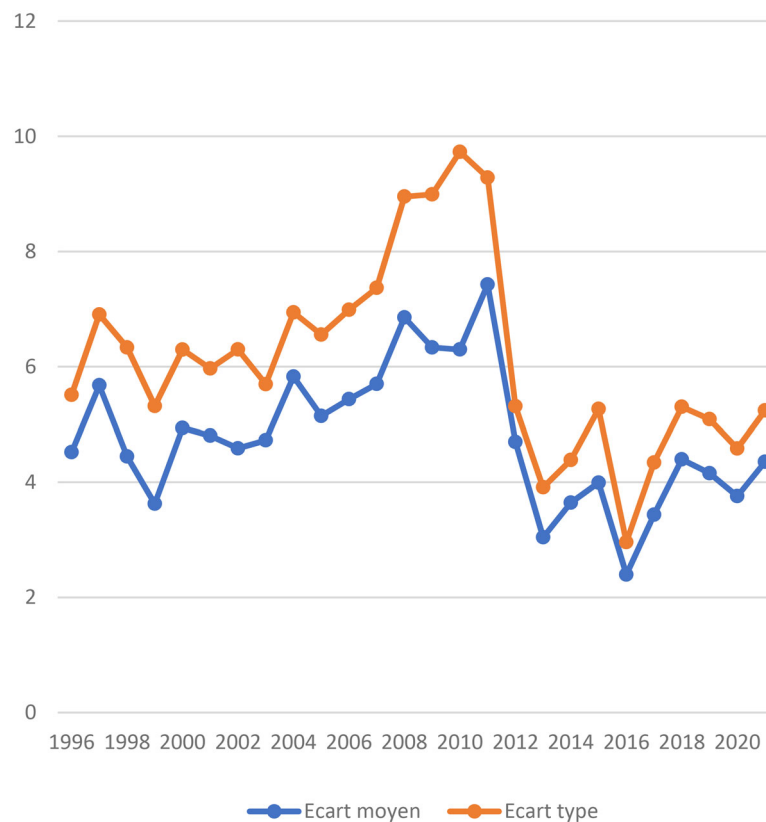


Figure 2. Evolution of the standard deviation and the average deviation of GFCF as % of GDP of WAEMU countries. Source: Authors, with African Development Bank statistics.

Also, between 2015 and 2017, the adverse shocks to commodity prices led to a decline in global economic activity. This shock has also affected the WAEMU economies. Then, almost all of them have recorded a fall in the evolution of GFCF as a percentage of GDP.

All these factors have affected the process of capital accumulation in the union's countries.

The evolution of the gaps in capital stock reveals a two-sequence trend. The first sequence shows a trend increase in spreads and volatility in the share of GFCF in GDP between 1996 and 2010. The second sequence shows a downward trend from 2010 onwards. These developments show that the gaps between countries tend to narrow in capital accumulation capacities.

Figure 3 illustrates the evolution of the total population of WAEMU countries between 1996 and 2021. Figure 4 shows the change in the standard and average deviations of the total population in the WAEMU. The population evolution in all countries follows a growing trend throughout the period, with a definite upward trend for Niger. Côte d'Ivoire is the most populous country in the union, with more than 25 million people in 2021. The least populated country in Guinea Bissau, with <5 million inhabitants over the entire period.

The evolution of the gaps shows an upward trend in the differences between populations between WAEMU member countries. The dynamics of primary factors, a source of growth, show that the initial conditions of the WAEMU countries are different. The capital stock as a percentage of GDP has increased since 1996 until reaching a peak in 2010 before falling. The downward trend after 2010 continues until 2021. However, there were erratic fluctuations with recoveries in 2015 and 2018.

This overall evolution of the capital stock gaps and variability shows heterogeneity between member countries, even if the gaps tend to narrow. This result corroborates a structural approach to analysing convergence in the WAEMU.

4.1.2. Analysis of the dynamic of Gross Domestic Product per capita

Analysing the evolution of GDP per capita, Figure 5 illustrates the performance of each WAEMU country between 1996 and 2021. In all countries, GDP per capita is on an upward trend throughout the period.

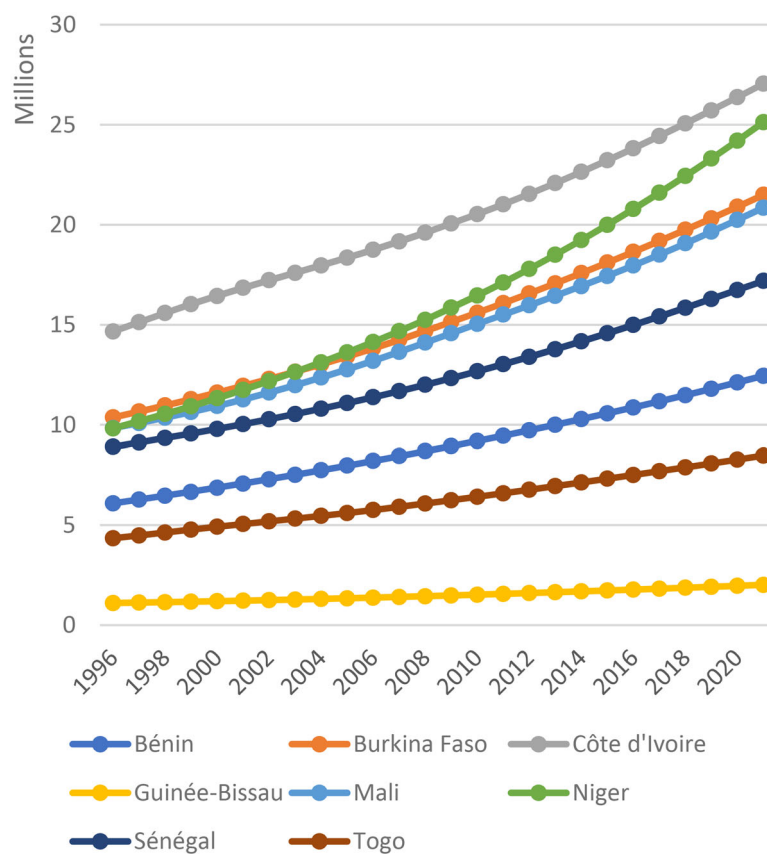


Figure 3. Total population of WAEMU countries from 1996 to 2021.

Source: Authors, with African Development Bank statistics.

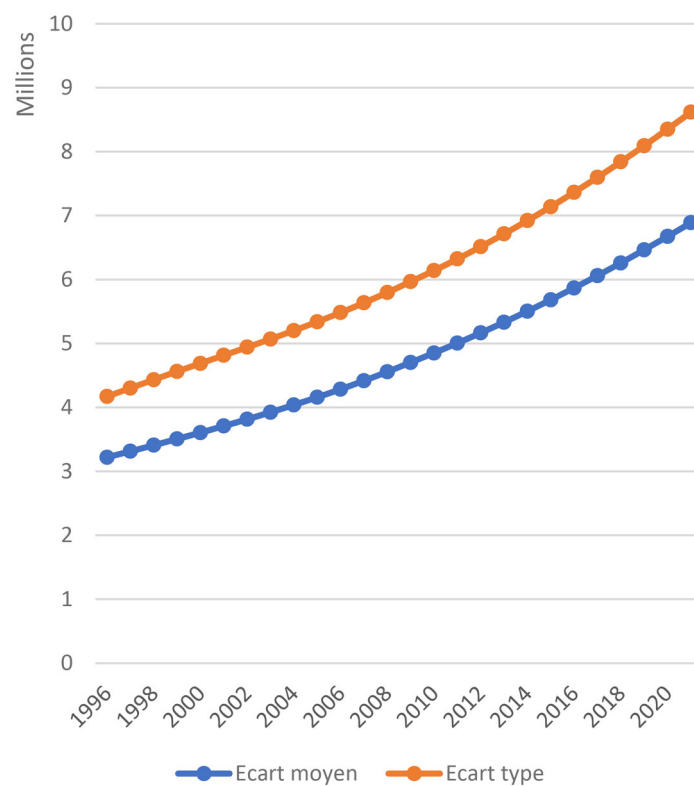


Figure 4. Standard deviation and the average deviation of the total population of the WAEMU countries.

Source: Authors, with African Development Bank statistics.

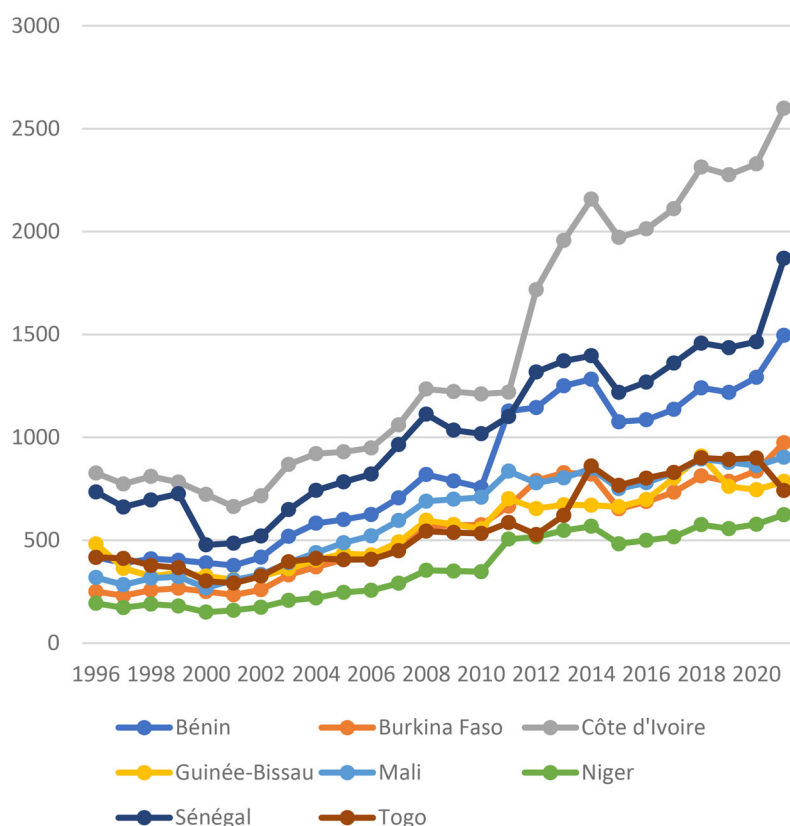


Figure 5. GDP per capita of the WAEMU countries.
Source: Authors using Data from the African Development Bank.

Côte d'Ivoire has the highest value of GDP per capita, while Niger has the lowest value over the entire period. There were reversals in the evolution of GDP per capita in all countries in 2011. And then, we see a recovery before experiencing a fall between 2014 and 2015. The adverse effects of the socio-political crisis in Côte d'Ivoire could explain the reversal of the trend in 2011. The reversal of the movement between 2014 and 2016 could be perceived as a dire global economy with the fall in commodity prices and the US dollar price.

Regarding the evolution of GDP per capita differences, it appears from [Figure 6](#) that there is a gap between per capita income in WAEMU from US\$200 to US\$700 between 1996 and 2021. It is also noted that this gap shows an upward trend over the entire period. This development reflects a trend towards non-convergence of economies since per capita income gaps increase. This observation could suggest the choice of a theoretical framework for analysing real convergence based on endogenous growth theory. Indeed, as the work of Lucas (1988) argues, with the presence of increasing yields due to learning effects combined with trade openness and the strengthening of economic integration, as is the case in the WAEMU, income inequalities are maintained and maintained over time because of the specialisation of countries based on comparative advantages.

[Figures 7](#) and [8](#) below show that real GDP per capita growth rates in the WAEMU countries from 1996 to 2021 tend to be similar.

The trend curves in [Annex Figure A1](#) show that each country's real GDP per capita growth rates do not offer a trend. The real GDP per capita growth rate is stable and is moving towards the expected average of the union, which is 1.67% (see [Table A1](#)). This development suggests a process of real convergence between these countries. Changes in real GDP per capita growth rate variance show a downward trend over time ([Table A2](#)). Indeed, the variance in real GDP per capita growth rate in the WAEMU countries decreases over time. Growth levels are getting closer over time.

This pace suggests that real sigma convergence is a reality in WAEMU, just as the results of Fe's (2013) work over a more extended period from 1970 to 2010 had shown. In this study, we analysed in 1996, 3 years before establishing the first Convergence, Stability, Growth, and Solidarity Pact. Moreover,

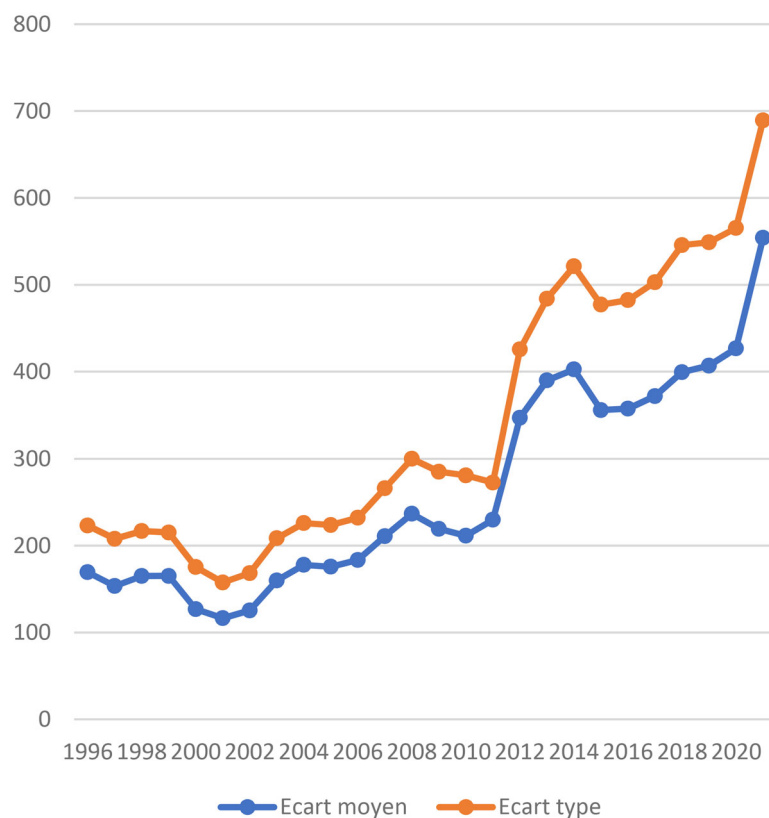


Figure 6. Standard deviation and the average deviation of GDP per capita of the WAEMU countries.
Source: Authors using Data from the African Development Bank.

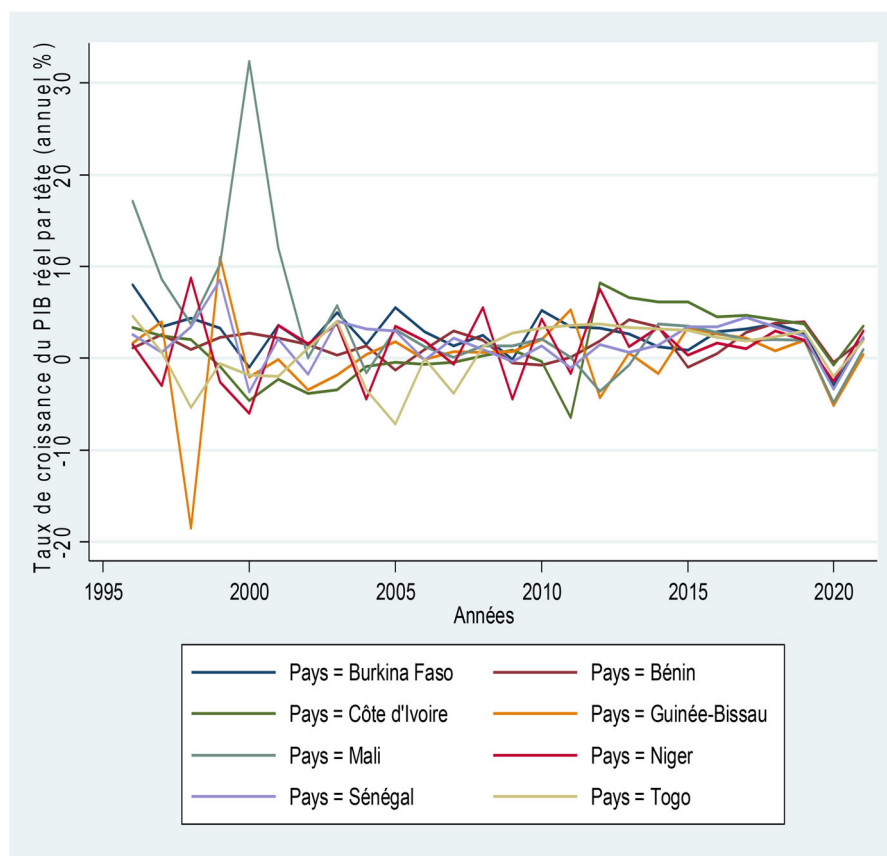


Figure 7. Real GDP per capita growth rate in WAEMU.
Source: Authors, with African Development Bank statistics.

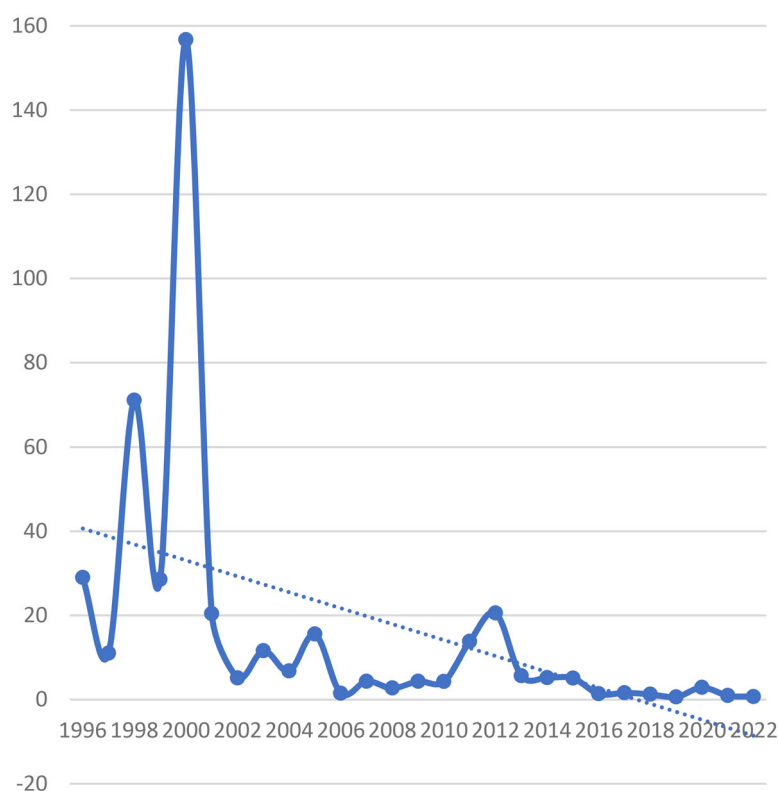


Figure 8. Standard deviation of real GDP per capita growth rate in WAEMU.
Source: Authors, with African Development Bank statistics.

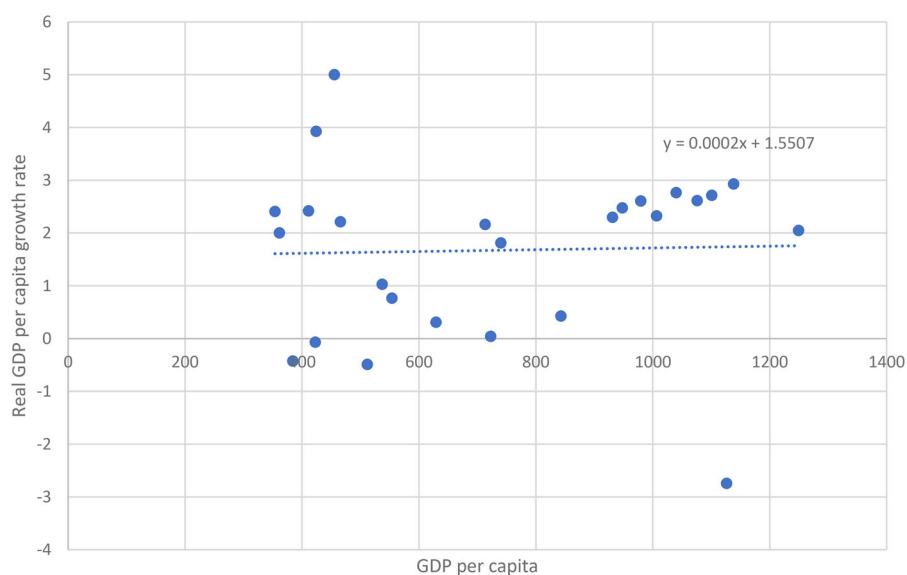


Figure 9. Relationship between real GDP per capita growth rate and GDP per capita.
Source: Authors using AfDB data.

Figure 9 illustrates a positive relationship between the real GDP per capita growth rate and the current GDP per capita on average in the WAEMU.

The slope of the adjustment line is positive, even if it is small. However, this low value could portend a low speed of convergence. Moreover, the correlation analysis between these two variables reveals a low non-significant correlation.

Stylised facts show that the income gap between WAEMU countries is permanent throughout the period.

Table 1. Results of estimates.

	Arellano-Bover/Bundell-Bond					
Dependent variable: growth rate of real GDP per capita (annual in %)	1	2	3	4	5	6
The growth rate of real GDP per capita at t-1	0.112 (2.12)**	0.078 (1.51)	0.010 (0.20)	-0.011 (0.22)	-0.008 (0.15)	-0.026 (0.49)
Ln of GDP per capita at current prices at t-1	0.149 (0.30)	-1.279 (2.12)**	-0.003 (0.00)	0.159 (0.25)	-0.087 (0.13)	1.672 (1.42)
Population growth rate (annual in %)		-2.451 (3.30)***	-2.647 (3.73)***	-3.016 (4.32)***	-2.872 (4.15)***	-2.826 (4.16)***
Gross fixed capital formation (% of GDP)		0.195 (3.66)***	0.175 (3.41)***	0.145 (2.83)***	0.184 (3.21)***	0.240 (3.75)***
Political stability			2.179 (4.35)***	1.744 (3.49)***	1.728 (3.48)***	1.449 (2.80)***
Quality of regulation				4.931 (3.48)***	5.039 (3.58)***	4.979 (3.55)***
Current account balance as % of GDP					0.110* (1.65)	0.109 (1.64)
Life expectancy at birth, total (years)						-0.282 (1.83)*
Constant	0.398 (0.12)	11.329 (2.67)***	5.273 (1.23)	8.182 (1.92)	9.346 (2.16)**	12.514 (2.73)***
N	200	200	200	200	200	200
Sargan test of overidentifying restrictions	Chi ² (227)	241.8729	248.8692			251.1211
H0: Overidentifying restrictions are valid	Prob > chi ²	0.2375	0.1524			0.1302

Note. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, () t de student.

Source: The authors.

4.2. Economic convergence assessment

This section assesses the process of economic convergence, considering the WAEMU economies' structural characteristics. Table 1 presents the results of the estimation of Equation (1). The estimates show that the coefficient associated with the variable Ln GDP per capita delayed is insignificant at the 5% level in the regression (6) we consider with the maximum structural variables. These results reflect Solow's model's structural characteristics and control variables.

This result reflects a need for more structural economic convergence in the WAEMU. In other words, the differences in per capita income between WAEMU countries are increasing, mainly due to the structural characteristics of the economies concerned.

Moreover, the stylised facts present this intuition in Figure 6. The evolution of the average absolute gap and the standard deviation of GDP per capita of the WAEMU countries shows an upward trend between 1996 and 2021. Indeed, the WAEMU economies are characterised by such heterogeneity that complicates the dynamics of economic convergence. Differences in living standards between countries have persisted over the years. According to this structural analysis, catching up with the less advanced economies is not a reality. These results are the same as those of the estimate with the Arellano & Bond approach (1991) (see Table A2), Table A3 as well as the use of another data source (cf. Table A1).

Catching up with the less advanced economies needs to be more accurate. This result is in line with Bah (2015).

The estimates show that the Quality of regulation and political stability positively influence real GDP per capita growth in WAEMU. These results justify delaying convergence horizons.

Traditional growth variables have expected signs. Labour and capital factors have positive effects on growth. This result is consistent with the conclusions of the Solow models. The population growth rate positively affects the GDP growth rate. Likewise, capital stock positively influences economic growth. The coefficient associated with the variable gross fixed capital formation is significant and positive. In addition, the governance variables are such that an environmental improvement leads to an increase in GDP per capita growth rate.

The population growth rate negatively influences real per capita income growth. The results show that an increase in the population growth rate of 1% leads to a decline in the real income growth rate of 2.8%. Furthermore, the idea that investment is an engine of growth is confirmed by the results of this estimation. Indeed, every 1% increase in the investment rate leads to an increase in real income per capita of 0.24%.

For governance indicators, an improvement in terms of strengthening stability and Quality of regulation induces growth in real income per capita. The elasticity of the growth rate of real income with the indicator of political stability and that of the Quality of regulation is 1.44 and 4.9, respectively. This result reflects that a stable environment and better regulation favour real income per capita growth.

5. Conclusion and recommendations

This study aims to re-assess the economic convergence using a structural approach. To do so, we propose an extended growth equation considering the WAEMU countries' structural characteristics. The data cover all WAEMU members from 1996 to 2021. The panel data estimation tells that WAEMU countries are not experiencing structural convergence. It means that country members are heterogeneous, and the gap widens over the years. This result can support the deadline delay of the convergence, stability, growth, and solidarity Pact.

Finally, this result confirms that the WAEMU economies have different structures, and the convergence of the economies' structures still needs to be achieved. So, we propose the following recommendations to reinvigorate the strengthening of economic integration, improve economic performance, and reduce inequality among member countries:

The harmonisation of economic policies at both global and sectoral levels within WAEMU must go ahead. Many efforts are made to improve this aspect of economic integration. However, the results seem under the expectations. So, policymakers must continue with integrative projects. However, cases of regional decisions could reflect a productive integration with variable geometry based on a territorial and industrial conception.

Initiatives to build the best regional economic infrastructure to improve the connectivity of major urban centres are a way to reduce inequalities between economies. The WAEMU Economic Commission could achieve this target by revitalising the WAEMU Regional Economic Programme. This programme is a community strategy that aims to strengthen regional integration and stimulate the emergence of countries by intensifying investment in sectors such as energy, infrastructure, and technological innovations.

Notes

1. ADDITIONAL ACT No. 04/99 on the Convergence, Stability, Growth and Solidarity Pact between the Member States of the West African Economic and Monetary Union (WAEMU).
2. Additional Act No. 03/2003 amending Additional Act No. 04/99 of 8 December 1999 on the Convergence, Stability, Growth and Solidarity Pact among the WAEMU Member States.
3. GDP per capita in purchasing power parity at constant prices 2011.
4. Additional Act No. 02/2006 amending Additional Act No. 04/99 of 8 December 1999 on the Convergence, Stability, Growth and Solidarity Pact between the WAEMU Member States.
5. Additional Act No. 05/2009/CCEG/UEMOA amending Additional Act No. 04/99 of 8 December 1999, relating to the Convergence, Stability, Growth and Solidarity Pact.
6. Additional Act No. 01/2015/CCEG/UEMOA establishing the Convergence, Stability, Growth and Solidarity Pact between the Member States of the West African Economic and Monetary Union (WAEMU).
7. The New Pact was established by Additional Act No. 01/2015/CCEG/UEMOA. According to Article 3, the convergence phase goes from 1 January 2015 to 31 December 2019, while the stability phase would begin late on 1 January 2020.
8. This method makes it possible to correct the endogeneity bias of the variable $Y_{i,t-1}$.

Author contributions

Doukouré Charles Fe: the conception and design of the study, analysis, and interpretation of data, revising the paper for intellectual content, and final approval of the version to be published. Adou Christian Konin: data collection, descriptive analysis, interpretation of the data, revising the paper for intellectual content, and drafting of the paper. Akra Mohaye Marius N'Guessan: final estimation, interpretation of estimation results, drafting of the final version of the paper, and revising the paper for intellectual content.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This paper has not received any funding. The analysis reflects only the authors' views.

About the authors

Doukouré Charles Fe Lecturer-Researcher at Ecole Nationale Supérieure de Statistique et d'Economie Appliquée (ENSEA), Abidjan (Côte d'Ivoire). I teach International trade theory, Macroeconomics and Statistics. He earned my PhD in Economics from the University Paris 1 Pantheon Sorbonne in France. I am a senior associate researcher at the Economic Policy Analysis Unit of the Ivoirian Centre for Economic and Social Research. My research interests focus on regional trade agreements, international economics, and applied statistics.

Adou Christian Konin and **Akra Mohaye Marius N'Guessan** Master Student in Statistics and Applied Economics at Ecole Nationale Supérieure de Statistique et d'Economie Appliquée (ENSEA), Abidjan (Côte d'Ivoire). Both are currently in the last year of training when they carried this paper.

ORCID

Doukouré Charles Fe  <http://orcid.org/0000-0002-2838-0864>

Data availability statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

References

- Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, 58(2), 277–297. <https://doi.org/10.2307/2297968>
- Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68(1), 29–51. [https://doi.org/10.1016/0304-4076\(94\)01642-D](https://doi.org/10.1016/0304-4076(94)01642-D)
- Ary Tanimoune, N., & Plane, P. (2005). Performance et convergence des politiques économiques en zone franc. *Revue Française D'économie*, 20(1), 235–268. <https://doi.org/10.3406/rfeco.2005.1569>
- Bah, M. S. (2015). Real convergence in West African Economic and Monetary Union (WAEMU). *Economics Letters*, 135, 19–23. [10.1016/j.econlet.2015.07.020](https://doi.org/10.1016/j.econlet.2015.07.020)
- Baumol, W. J. (1986). Productivity growth, convergence, and welfare: What the long-run data show. *The American Economic Review*, 1072–1085.
- Baumont, C., Ertur, C., & Le Gallo, J. (2000). *Convergence des régions européennes (une approche par l'économétrie spatiale)* (p. 27 p., Graph, ref. bib. : 2 p.) [Research Report]. Laboratoire d'analyse et de techniques économiques (LATEC). Retrieved from <https://hal.archives-ouvertes.fr/hal-01526961>
- Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1), 115–143. [https://doi.org/10.1016/S0304-4076\(98\)00009-8](https://doi.org/10.1016/S0304-4076(98)00009-8)
- Boyle, G. E., & McCARTHY, T. G. (1999). Simple measures of convergence in per capita GDP: a note on some further international evidence. *Applied Economics Letters*, 6(6), 343–347. [10.1080/135048599353041](https://doi.org/10.1080/135048599353041)
- Carlino, G. A., & Mills, L. O. (1993). Are US regional incomes converging?: A time series analysis. *Journal of Monetary Economics*, 32(2), 335–346. [10.1016/0304-3932\(93\)90009-5](https://doi.org/10.1016/0304-3932(93)90009-5)
- Caselli, F., Esquivel, G., & Lefort, F. (1996). Reopening the convergence debate: A new look at cross-country growth empirics. *Journal of Economic Growth*, 1(3), 363–389. <https://doi.org/10.1007/BF00141044>
- Chassem, N. P. (2012). Y a-t-il convergence réelle et structurelle des pays de L'UEMOA? In E. T. Ayuk & S. T. Kaboré (Éds.), *S'intégrer pour s'enrichir: Intégration régionale et réduction de la pauvreté en Afrique de l'ouest* (pp. 73–94). Springer. https://doi.org/10.1007/978-1-4614-1234-2_4
- Decaluwé, B., Dissou, Y., & Patry, A. (2001). Union douanière au sein de l'UEMOA. Une analyse quantitative. *Revue Économique*, 52(4), 811–830. <https://doi.org/10.3917/reco.524.0811>
- Desdoigts, A. (1997). Vers une convergence globale ou locale?. *Economie Internationale*, 71(3), 43–74.
- Diarra, S. (2016). Analyse rétrospective du respect des nouveaux critères de convergence de l'UEMOA. *Revue D'économie du Développement*, 24(1), 79–98. <https://doi.org/10.3917/edd.301.0079>

- Durlauf, S. N., Johnson, P. A., Temple, J. R. W., Aghion, P., & Durlauf, S. N. (2005). Chapter 8: Growth econometrics. In *Handbook of economic growth* (Vol. 1, pp. 555–677). Elsevier. [https://doi.org/10.1016/S1574-0684\(05\)01008-7](https://doi.org/10.1016/S1574-0684(05)01008-7)
- Durlauf, S. N., & Quah, D. T. (1999). Chapter 4: The new empirics of economic growth. In *Handbook of macroeconomics* (Vol. 1, pp. 235–308). Elsevier. [https://doi.org/10.1016/S1574-0048\(99\)01007-1](https://doi.org/10.1016/S1574-0048(99)01007-1)
- Ehuitché, B. T. (2016). Basic infrastructure, growth and convergence in WAEMU. In D. Seck (Ed.), *Accelerated economic growth in West Africa* (pp. 197–211). Springer International Publishing. https://doi.org/10.1007/978-3-319-16826-5_10
- Elmslie, B. T. (1995). Retrospectives: The Convergence Debate Between David Hume and Josiah Tucker. *Journal of Economic Perspectives*, 9(4), 207–216. [10.1257/jep.9.4.207](https://doi.org/10.1257/jep.9.4.207)
- Fe, D. C. (2013). *Accords commerciaux régionaux: Dynamique de l'intégration, des échanges et du développement dans l'UEMOA*. 203.
- Fouda Owoundi, J. P. (2010). La convergence des politiques économiques dans la zone franc: Où en est-on 15 ans après? *L'Actualité Économique*, 85(3), 319–354. <https://doi.org/10.7202/044880ar>
- François, P. (1955). *Note sur la notion de pôle de croissance*. Economc Appliqué.
- Gbohoui, W. (2015). Economic integration in WAEMU: Nominal convergence and growth dynamics. *Regional Integration and Policy Challenges in Africa*, 43–68.
- Hammouda, H. B., Karingi, S. N., Njuguna, A. E., & Jallab, M. S. (2009). Why doesn't regional integration improve income convergence in Africa? *African Development Review*, 21(2), 291–330. <https://doi.org/10.1111/j.1467-8268.2009.00211.x>
- Hammouda, H. B., Karingi, S. N., Njuguna, A. E., & Jallab, M. S. (2007). *Does macroeconomic convergence lead to growth ? The case of Africa*. African Economic Conference (AEC), AfDB Group. Retrieved September 11, 2020, from https://www.afdb.org/fileadmin/uploads/afdb/Documents/Knowledge/Conference_2007_anglais_17-part-IV-1
- Hirschman, A. O. (1998). *Crossing boundaries: Selected writings*. Zone Books. <https://doi.org/10.2307/j.ctv1c9hq5x>
- Hirschman, A. O. (2021). *Crossing boundaries: Selected writings*. Zone Books. <https://doi.org/10.2307/j.ctv1c9hq5x>
- Islam, N. (1995). Growth empirics: A panel data approach. *The Quarterly Journal of Economics*, 110(4), 1127–1170. <https://doi.org/10.2307/2946651>
- Johnson, P., & Papageorgiou, C. (2020). What remains of cross-country convergence? *Journal of Economic Literature*, 58(1), 129–175. <https://doi.org/10.1257/jel.20181207>
- Krugman, P. R. (1997). *Development, geography, and economic theory* (Vol. 6). MIT Press.
- Krugman, P., & Venables, A. J. (1995). Globalization and the inequality of nations. *The Quarterly Journal of Economics*, 110(4), 857–880. <https://doi.org/10.2307/2946642>
- Lamine, D. (2002). Convergence nominale et réelle : Une application des concepts de la sigmaconvergence et de la beta-convergence aux économies de la CEDEAO. *Banque Centrale Des États De L'Afrique De L'Ouest, Note D'information Statistique*, 531.
- Lee, K., Pesaran, M. H., & Smith, R. (1997). Growth and convergence in a multi-country empirical stochastic Solow model. *Journal of Applied Econometrics*, 12(4), 357–392. [https://doi.org/10.1002/\(SICI\)1099-1255\(199707\)12:4<357::AID-JAE441>3.0.CO;2-T](https://doi.org/10.1002/(SICI)1099-1255(199707)12:4<357::AID-JAE441>3.0.CO;2-T)
- Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22(1), 3–42. [https://doi.org/10.1016/0304-3932\(88\)90168-7](https://doi.org/10.1016/0304-3932(88)90168-7)
- Prao, S. (2015). La convergence des économies: une application du modèle de solow aux pays de l'UEMOA. *Revue Européenne du Droit Social*, 1(26), 196–215.
- Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94(5), 1002–1037. <https://doi.org/10.1086/261420>
- Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1), 65–94. <https://doi.org/10.2307/1884513>

Appendices

Table A1. Databases for control estimates.

Variables	Data source
GDP at constant prices in 2017	PWT
GDP per capita (2011 constant international PPP \$)	World Bank
Population	PWT
Urban population	World Bank
Infant mortality rate under five years (per 1,000)	World Bank
Population growth ()	World Bank
Gross capital formation ()	World Bank
Fixed telephony subscriptions ()	World Bank
Political stability and absence of violence/terrorism	WGI
Effectiveness of government	WGI
Regulatory quality	WGI
Rule of law	WGI
Control of corruption	WGI
Voice and accountability	WGI
Export to WAEMU	Trade map

Source: The authors.

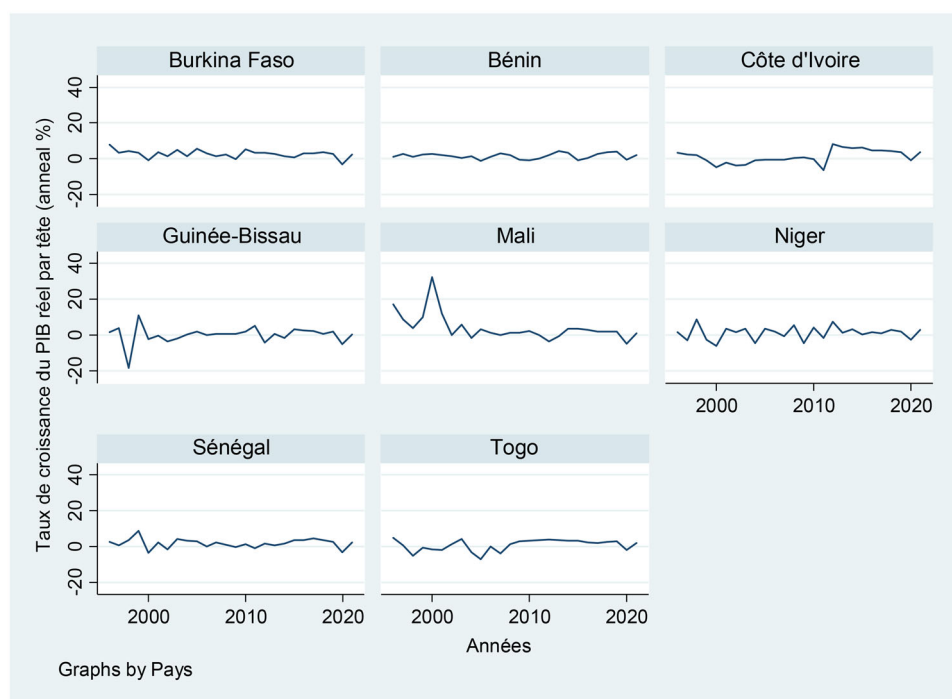


Figure A1. Evolution of the Real GDP per capita growth rate of the WAEMU countries.

Source: Authors using data from the African Development Bank.

Table A2. Summary statistics of study variables.

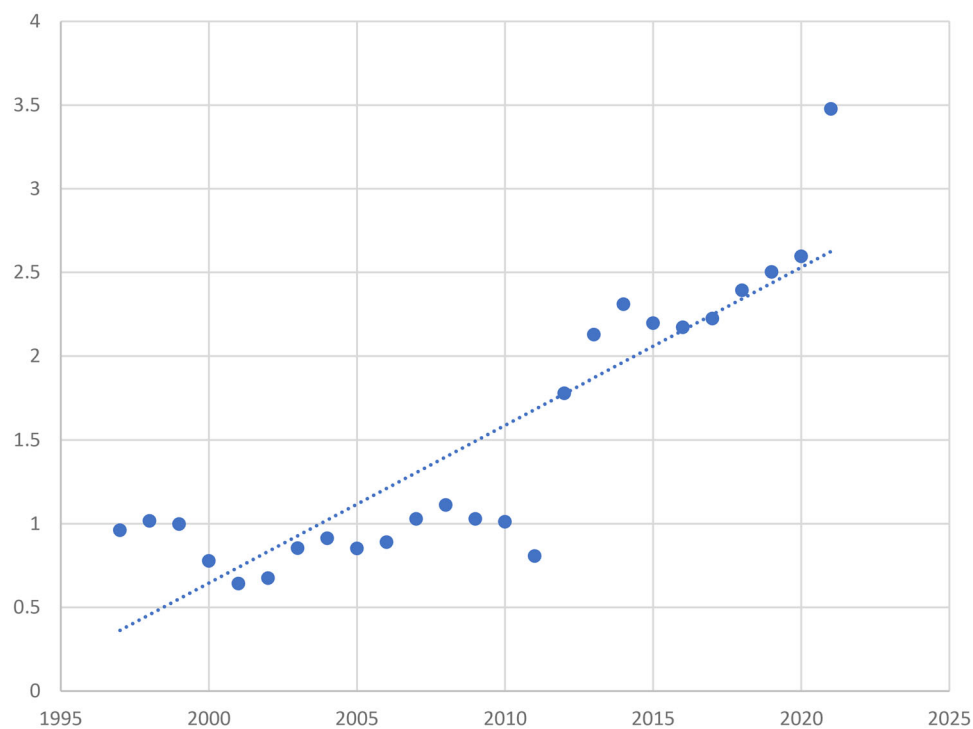
Variables		Average	Typical deviation	Min	Max	Comments
The growth rate of real GDP per capita (annual %)	Total	1.67369	4.134808	-18.48	32.3	$N = 208$
	Inter		1.218958	0.1240841	4.063302	$n = 8$
	Intra		3.973692	-16.93039	29.91039	$T = 26$
The growth rate of GDP per capita (%)	Total	1.045098	0.1123742	0.6584022	1.490093	$N = 208$
	Inter		0.0121575	1.025045	1.058482	$n = 8$
	Intra		0.1117945	0.6591136	1.478718	$T = 26$
GDP per capita (current value in US\$)	Total	735.6683	454.513	151	2599	$N = 208$
	Inter		335.5197	364.3269	1398.596	$n = 8$
	Intra		328.0312	1.072115	1936.072	$T = 26$
Population growth rate (annual %)	Total	2.298077	0.4915677	1	3	$N = 208$
	Inter		0.360215	1.865385	3	$n = 8$
	Intra		0.3571482	1.432692	3.182692	$T = 26$
Gross Fixed Capital Formation (% of GDP)	Total	19.81678	6.802342	1.89	39.95	$N = 208$
	Inter		4.613806	11.2558	24.90692	$n = 8$
	Intra		5.24934	5.622637	34.85987	$T = 26$
Population, total	Total	1.20E + 07	6388286	1110833	2.71E + 07	$N = 208$
	Inter		6056790	1503032	2.03E + 07	$n = 8$
	Intra		2925067	5535581	2.08E + 07	$T = 26$
Political stability	Total	-0.5187697	0.710633	-2.264047	1.04893	$N = 208$
	Inter		0.4497626	-1.222313	0.3399849	$n = 8$
	Intra		0.5719646	-2.104736	0.7383824	$T = 26$
Quality of regulation	Total	-0.54544	0.3184202	-1.263349	-0.047789	$N = 208$
	Inter		0.2981541	-1.133669	-0.1866812	$n = 8$
	Intra		0.1524198	-0.9356445	-0.1676055	$T = 26$
	Total	298672.5	360373.7	6.529	1564958	$N = 208$

(continued)

Table A2. Continued.

Variables		Average	Typical deviation	Min	Max	Comments
Intra-WAEMU export						
	Inter		322062.4	422.9042	969156.4	$n = 8$
	Intra		196652.2	-198546	948784.8	$T = 26$
Current account balance (% GDP)	Total	-5.907211	4.89117	-24.48	10.373	$N = 208$
	Inter		3.449134	-11.39225	0.1958869	$n = 8$
	Intra		3.669304	-18.99496	5.502703	$T = 26$
Life expectancy at birth, total (years)	Total	55.83894	4.849849	46	68	$N = 208$
	Inter		3.208204	52.51923	62.34615	$n = 8$
	Intra		3.804146	47.49279	63.49279	$T = 26$
Inflows Investment direct foreign (at current prices in millions)	Total	230.2919	272.5875	-183.3876	1480.501	$N = 208$
	Inter		146.0653	15.62251	429.5148	$n = 8$
	Intra		235.681	-145.6759	1329.351	$T = 26$

Source: Authors using data from the African Development Bank.

**Figure A2.** Evolution of the (Boyle and McCARTHY, 1999).

Source: Authors using AfDB data.

Table A3. Results of estimates.

Dependent variable: growth rate of real GDP per capita (annual in %)	Arellano-Bond dynamic panel-data estimation				
	1	2	3	4	5
The growth rate of real GDP per capita at $t-1$	0.117 (1.66)	0.073 (1.04)	−0.030 (0.43)	−0.032 (0.45)	−0.034 (0.48)
Ln of GDP per capita at current prices at $t-1$	0.104 (0.15)	−1.265 (1.54)	0.905 (0.99)	1.372 (0.69)	1.197 (0.61)
Population growth rate (annual in %)		−1.605 (1.83)	−2.776 (3.32)**	−2.788 (3.23)**	−2.739 (3.13)**
Gross fixed capital formation (% of GDP)		0.186 (2.74)**	0.110 (1.66)	0.112 (1.60)	0.119 (1.66)
Political stability			2.366 (3.69)**	2.399 (3.37)**	2.399 (3.32)**
Quality of regulation			3.321 (1.68)	3.448 (1.77)	3.702 (1.87)
Intra-WAEMU export				−0.000 (0.33)	−0.000 (0.16)
Life expectancy at birth, total (years)				−0.030 (0.13)	0.013 (0.05)
Inflows Foreign direct investment					−0.001 (0.62)
Constant	0.678 (0.15)	9.481 (1.79)	3.041 (0.56)	1.994 (0.31)	0.754 (0.12)
N	192	192	192	192	192
Sargan test of overidentifying restrictions					
H0: Overidentifying restrictions are valid					
Chi ² (180)	166.2474	180.0102	183.5559	181.8926	183.0464
Prob > chi ²	0.7608	0.4858	0.4124	0.4465	0.4228

Note. ** $p < 0.01$, () t de student.

Source: The authors.