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ORIGINAL ARTICLE

Does monetary integration lead to income convergence in Africa? a study of the CFA monetary area

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Abstract

The CFA franc area is one of the oldest currency unions, but it has come under intense criticism recently for failing to promote economic growth and income convergence between member states. This paper examines the growth experience of the 14 member countries relative to a common benchmark over the period 1960–2011. In particular, we use a combination of parametric and non-parametric methods to study convergence patterns as well as growth dynamics and to identify the factors responsible for changes in relative per-capita income. The results indicate divergence tendencies that result in a bimodal distribution in the long run. The sharp devaluation of the CFA franc in 1994 increases intradistributional mobility which is directed towards lower income levels. The regression analysis suggests that openness, FDI, and financial development have a positive and robust effect on convergence in the currency union.

Keywords African monetary integration · CFA zone · Convergence · Growth factors

JEL classification F45 · O47 · O55

1 Introduction

In existence since 1945, the CFA (Communauté Financière Africaine) franc area is one of the oldest monetary arrangements in the history of currency unions. However, in recent years, it has been increasingly criticized for not only slowing down overall economic development in the region, but also deepening the differences between member states. A number of economists and African politicians have claimed that the monetary regime is profoundly asymmetrical, with France extracting greater

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benefits than it is contributing to the development of its former colonies (Seraphin 2011; Mbaye 2014; Ballong 2015; Ndao 2016, recently Nubukpo et al. 2016).[1] Accordingly, the objective of this study is to explore new aspects of the effectiveness of CFA monetary arrangement in achieving regional integration in Africa. In particular, we use a combination of parametric and non-parametric methods to conduct a rigorous empirical analysis of the dynamics of income convergence among member countries. Moreover, we employ regression analysis to identify and discuss the importance of the leading economic and institutional factors driving relative income growth in the currency union. Lastly, the paper investigates the impact of a sharp devaluation in the common currency in 1994 and its impact on relative growth dynamics.

Convergence, both in nominal and real terms, is a prerequisite for and the goal of establishing a currency union and implementing a common monetary policy. For the monetary policy in a currency union to be effective, member states need to exhibit a certain degree of similarity in terms of business cycles and levels of development. This ensures harmony with regard to the transmission mechanism of monetary policy and a reduction in the asymmetry of shocks. At the same time, a common currency promotes trade within the monetary union by reducing transaction costs and the currency risk, which, in turn, accelerates convergence.

From a historical and institutional perspective, the CFA franc area is an agreement between France and its African ex-colonies which has resulted in the creation of two currency unions – the West African Economic and Monetary Union (WAEMU) and the Economic and Monetary Community of Central Africa (CEMAC).[2] The institutional framework of both unions stipulates (i) a fixed peg to the euro (previously to the French franc), (ii) a convertibility guarantee by the French Treasury, and (iii) a set of legal, institutional, and policy requirements designed to ensure the sustainability of the arrangement. After its currency was devalued by 50% in January 1994, the CFA franc area acknowledged the need to strengthen real and financial integration by agreeing on macroeconomic convergence criteria aimed at helping coordinate macroeconomic policies and abolishing trade restrictions within each union (Banque de France 2013; Cabrillac and Rocher 2013). Our focus on income convergence stems not only from the fact that similar levels of economic development are the ultimate objective of the currency union, but also from the notion that convergence is a basic pre-condition for the effectiveness of a common monetary policy. This framework is a key component of the theories on optimal currency areas.

Although CFA francs are issued separately by BCEAO (Banque Centrale des États de l'Afrique de l'Ouest) for WAEMU and by BEAC (Banque des États de l'Afrique Centrale) for CEMAC, we argue that CFA can be treated as one common currency area. Despite some differences, both sub-areas have similar institutional, economic, and

[1] Criticism of the CFA monetary regime has intensified over time, as reflected in Julienne (1988), Coquet and Daniel (1994), Conte (1994), Monga and Tchatchouang (1996), Claveranne (2006), and Nubukpo (2007, 2011), among others.

[2] The CFA franc arrangement dates back to the colonial period when it was decided to issue a common currency in the dependent territories to avoid the need to transport cash (Bloch-Lainé, ed. 1956; Actes du symposium (1998); Hugon 1999, 2009; BCEAO 2000; Geourjon and Guillaumont-Jeanneney 2013; IMF 2015, pp. 69–72). WAEMU, in French UEMOA, is composed by Benin, Burkina Faso, Ivory Coast, Guinee Bissau, Mali, Niger, Senegal, and Togo. CEMAC (Communauté Économique et Monétaire de l'Afrique Centrale) consists of Cameroun, Central African Republic, Gabon, Equatorial Guinea, Republic of Congo, and Chad.

demographic characteristics. Moreover, the two central banks are independent from each other, with France represented on the board of both institutions. Both francs are fixed to the euro at the same rate (1 euro = 655.957 CFA franc), and each of them is convertible to the euro. Although they are not legally directly convertible to each other, the two francs are de facto mutually convertible indirectly through the euro. Each zone uses its own policies to control inflation, and the flows of capital between the zones are extremely limited. France's Treasury guarantees the peg of the CFA to the euro and provides an operations account (*comptes d'opérations*) for each of the two central banks, on which they may draw in case of reserves shortages (Lelart 1998). Although this amounts to a potentially unlimited overdraft, certain restrictions are in place. First, at least 20% of sight liabilities of each central bank must be covered by foreign exchange reserves. Second, at least 50% of foreign exchange reserves must be held in the operations accounts. Third, increasing interest rate penalties apply in the case of an overdraft. Within the limits of the fixed exchange rate arrangement, the two central banks are responsible for conducting monetary policy in their respective zones and are charged also with implementing banking supervision. Since 2000, multilateral surveillance mechanisms based on specific criteria have been implemented with the goal of strengthening the coordination between fiscal and monetary policy (*policy mix*) and of creating a suitable macroeconomic environment that promotes sustainable growth and high levels of employment. This approach, however, and the criteria it is based on have been subject to criticism. The criteria are seen as too broad and not clearly defined, lax, and in general similar to the criteria and mechanisms used by the EU to monitor convergence.

A striking feature of the CFA franc area is the heterogeneity not only between the two unions but also within each of them (see Tables 1 and 2). Per-capita income across CEMAC ranges from $371 in the Central African Republic to more than $17,000 in Equatorial Guinea. By contrast, differences are much less pronounced across WAEMU with incomes ranging between $427 in Niger and $1545 in the Ivory Coast. These disparities in income levels and economic performance reflect historically higher average growth rates in CEMAC since the 1980s and result, in part, from changes in the production structure. In recent years, Chad and Equatorial Guinea have emerged as significant oil exporters, joining Gabon, Cameroon, and Congo. Accordingly, oil revenues have been generating current account surpluses in CEMAC for years. By contrast, WEAMU's main exports are agricultural goods, such as cotton, with only one member state, the Ivory Coast, producing oil. Although WAEMU's export share in GDP is lower than for CEMAC, internal trade within WAEMU is far more advanced due to the diverse production structure of its members.

Given the large income disparities across the CFA franc area, income convergence has been the focus of a number of recent studies (Bamba N'Galadio and Diomande

Table 1 Annual Real GDP Growth in CEMAC & WAEMU (in %, average for 10 years)

	CEMAC	WAEMU
1970–1979	2.9	3.3
1980–1989	3.8	2.1
1990–1999	6.8	3.5
2000–2010	7.5	3.3

International Financial Statistics (IMF)

Table 2 GDP per capita (in current USD)

	1970	1980	1990	2000	2010	2014
WAEMU						
Benin	114	377	391	339	690	825
Burkina Faso	81	282	351	226	574	713
Cote d'Ivoire	227	1231	887	648	1236	1545
Guinee-Bissau	110	130	230	281	518	567
Mali	60	252	285	219	621	706
Niger	144	420	313	160	351	427
Senegal	242	629	760	474	998	1061
Togo	120	417	430	265	496	635
CEMAC						
Central African Republic	103	350	490	245	446	371
Cameroon	171	754	923	583	1147	1429
Congo	205	946	1172	1035	2953	3137
Gabon	548	5869	6250	4115	9388	10,208
Equatorial Guinea	228	229	297	1970	15,869	17,430
Chad	128	228	291	166	895	1024
Sub-Saharan Africa (all)	217	700	589	541	1525	1773

World Development Indicators (World Bank)

(2001); Ary Tanimoune and Plane 2004; Ary Tanimoune, 2005; Van den Boogerde and Tsangarides 2005; N'Kodia and Sarr 2007; Ramirez and Tsangarides 2007; Ndiaye, 2008; Owoundi, 2009; Dramani, 2010; Diop et al. 2010; Couharde et al. 2012; Nanfosso and Nguena 2015). Most of them employ variations of the traditional models of convergence (beta- and sigma-convergence) or studying the dynamics of the real exchange rate. In general, their findings suggest a lack of convergence across the CFA area.[3]

Our paper differs from the existing literature in several aspects. We use a longer sample period (1960–2011), which allows us to explore differences in convergence patterns across two distinct subperiods. The non-parametric methodology that we employ overcomes the limitations of traditional parametric techniques and enables us to gain deeper insights into the convergence patterns in the CFA area. In particular, this approach is based on kernel density distributions that make it possible detect convergence clubs and study intradistributional dynamics by exploring the entire distribution of per-capita income. In contrast, the standard approach of beta- and sigma-convergence focuses only on the first and second moments of the distribution. Furthermore, we use a panel model to test the influence of various factors on relative

[3] Here we indicate only the key contributions to the literature on convergence in the CFA area. For a brief review of the literature on convergence in Africa, see Diop et al. (2010), p. 266.

growth in the sample. Last but not least, we investigate the impact of the 1994 devaluation of the CFA franc on convergence in the currency union.

The key questions that we would like to answer in this paper are threefold. First, has there been income convergence within the CFA area over the period 1960–2011? Second, what were the factors that led to the emergence of convergence/divergence patterns over this period? Third, what was the effect of the sharp devaluation of the CFA franc in 1994 on growth dynamics?

The rest of the paper is organized as follows. The next section describes the non-parametric methodology for measuring convergence and presents the results of the empirical analysis. In section 3, we discuss the driving forces behind convergence based on the results of the regression analysis. The final section offers some conclusions.

2 Measuring convergence

2.1 Nonparametric methodology

Non-parametric models provide a number of advantages in measuring convergence, including flexibility and a broader focus on distributions which can help explore club convergence and intradistributional dynamics in a given sample (for more details, see Nenovsky and Tochkov 2014; Wamboye and Tochkov 2015). The source of flexibility is the fact that the data is not constrained by a particular functional form of the model as in the case of parametric specifications. Moreover, the density function allows us to explore the distribution of a given variable, which in our case is the per-capita income. The various modes of the distribution signify different groups of countries and can be interpreted as convergence clubs located at lower, average, or top levels of per-capita income.

The analysis begins by estimating the probability density function of relative per-capita income. Let $X_1, \ldots, Xn$ be a sample of n observations on a random variable X. The density value $f(x)$ at a given point x is estimated by the following kernel density estimator:

$$\hat{f}(x) = \frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{x - X_i}{h}\right) \tag{1}$$

where h denotes the bandwidth of the interval around x and K is a Gaussian kernel function. Eq. (1) basically weights each observation in the interval, so that those farthest away from x get the smallest weight, and then adds up the frequencies at each observation to produce a density estimate. As a result, the distribution of relative per-capita income is illustrated by a smooth curve that helps identify "convergence clubs" that take the form of modes.

In the next step, we estimate a transition probability matrix that helps reveal movements within the income distribution. Let Q_t denote the distribution of relative per-capita across CFA countries at time t. The distribution at time $t + 1$ is then:

$$Q_{t+1} = M \times Q_t \tag{2}$$

where M is a finite discrete first-order Markov transition matrix that maps Q_t into Q_{t+1}. The transition matrix is given by

$$M = \begin{pmatrix} p_{11} & \cdots & p_{1N} \\ \vdots & \ddots & \vdots \\ p_{N1} & \cdots & p_{NN} \end{pmatrix} \tag{3}$$

where p_{ij} with $i, j = 1,..,N$ is the probability of moving from an initial state i at time t to a state j at time $t+1$. The main diagonal of the matrix reports the chance of an observation staying in the same state in t and $t+1$.

If the transition probabilities from t to $t+1$ do not vary across time and do not depend on transitions from previous periods, the change in intradistributional mobility can be obtained from the iteration of Eq. (2) k times. As $k \to \infty$, the iteration yields

$$\lim_{k\to\infty}\left(M^k\right)_{ij} = \delta_j > 0, \quad \sum \delta_j = 1 \tag{4}$$

The limiting probability distribution, δ_j, is the ergodic or steady-state distribution, which is independent of the initial distribution and helps determine the evolution of per-capita income for CFA countries in the long-run given the dynamics observed in the transition matrix.

As Nenovsky and Tochkov (2014) have stated, the transition probability matrix approach has some drawbacks, such as using continuous data on relative per-capita income in a discrete framework. In addition, the discretization of the state space is done in a haphazard fashion. To address these potential issues, we focus on transition probabilities in a continuous state space and, following Quah (1997a), estimate a stochastic kernel that maps the distribution Q_t into $Q_{t+\tau}$ as follows:

$$Q_{t+\tau}(x_{t+\tau}) = \int g(x_{t+\tau}|x_t) Q_t(x_t) dx_t \tag{5}$$

where the conditional density function $g(x_{t+\tau}|x_t)$ describes the probability of the transition to a certain state in $t+\tau$ given the initial state in t.[4] The results of Eq. (5) are illustrated as three-dimensional graphs with corresponding contour plots, which can be interpreted as transition matrices in continuous space.

The sample used in our study covers all 14 member countries of the CFA zone (WAEMU and CEMAC) over the period 1960–2011. The CFA franc area has 130 million inhabitants (17% of the population of sub-Saharan Africa), accounts for about 15% of African GDP, and produces 25% of the continent's oil (IMF, 2007). Per-capita GDP is measured according to the purchasing power parity in constant 2005 US dollars and is obtained from the Penn World Tables (version 8.0).[5] For the purposes of this paper, the per-capita GDP is expressed relative to the sample average (the benchmark) in a given year, which, in turn, is set equal to 100.

Our empirical model encompasses the two zones of CFA area jointly (WAEMU and CEMAC). We opted for this approach rather than focusing on each zone separately for

[4] For a more detailed discussion of the stochastic kernel, see the technical appendix in Quah (1997b).
[5] For a recent discussion on the reliance of African GDP and growth data, see Jerven (2010, Jerven 2011) and Labrousse (2014).

two main reasons. First, both zones have a similar institution, demographic and production profile and it is therefore possible to treat them as one common area (especially given that their currencies are pegged in the same way, making them pegged to each other as well). Second, the larger number of observations resulting from the joint analysis of the two zones improves the statistical properties of the nonparametric model and thus produces more reliable results.

2.2 Results and interpretations

The kernel density distributions for the full sample are shown in first row of Fig. 1 for 6 different years across the sample period (1960, 1975, 1990, 1994, 2002, 2011). The years were chosen so as to divide the sample period into approximately equal segments. At the same time, some of the years have also a special significance. In 1960, the countries of the CFA area gained independence, while in 1975 they obtained monetary sovereignty from France as the CFA central banks took over monetary matters. In 1994, the CFA franc was devalued by 50% and in 2002 the multilateral surveillance mechanisms were launched in the two zones of the CFA area.

The density functions can be interpreted in three ways. First, the height of the density function indicates that there is a higher concentration of observations and thus a higher probability of being at that level of per-capita income. Second, the modes of the distribution indicate convergence clubs. Small modes indicate that few observations are concentrated in this area, while large modes are a sign of major concentration. Third, the shifts of the modes over time can give us an idea of convergence tendencies.

In 1960, the highest density was at the average per-capita GDP, while most of the probability mass was below the average benchmark. Over the following three decades, the large mode has shifted further to the left indicating a move towards lower income levels and away from the mean. At the same time, the distribution has widened, thereby reducing the height of the peak. This was mainly the result of a minor mode representing Gabon that transitioned towards the top of the distribution. In the late 1980s and early 1990s, a new group of countries, including Senegal, Ivory Coast, and Cameroon, broke away from the main probability mass and converged towards higher levels of GDP per capita beyond the average. However, since the turn of the century, this shift was gradually reversed. The last ten years of the sample period show an increasing concentration of the probability mass in the range below the sample mean. This is a sign of convergence within the group of countries with below-average relative income per capita but at the same it is also a divergence away from the mean and towards the bottom of the distribution. At the top of the distribution, the appearance of a new mode accounts for the rapid ascent of Equatorial Guinea after the discovery of oil reserves in the late 1990s.

Given the extremely high levels of GDP per capita in Gabon and Equatorial Guinea, we plotted the kernel densities for a reduced sample that excluded these two countries. The graphs at the bottom of Fig. 1 show that the convergence/divergence tendencies described above remain largely robust even after dropping the two outliers.

The intradistributional dynamics is given by the transition matrices presented in Table 3 and consist of four states with value ranges selected so as to contain an equal number of transitions. The matrices show the probabilities of moving from a given

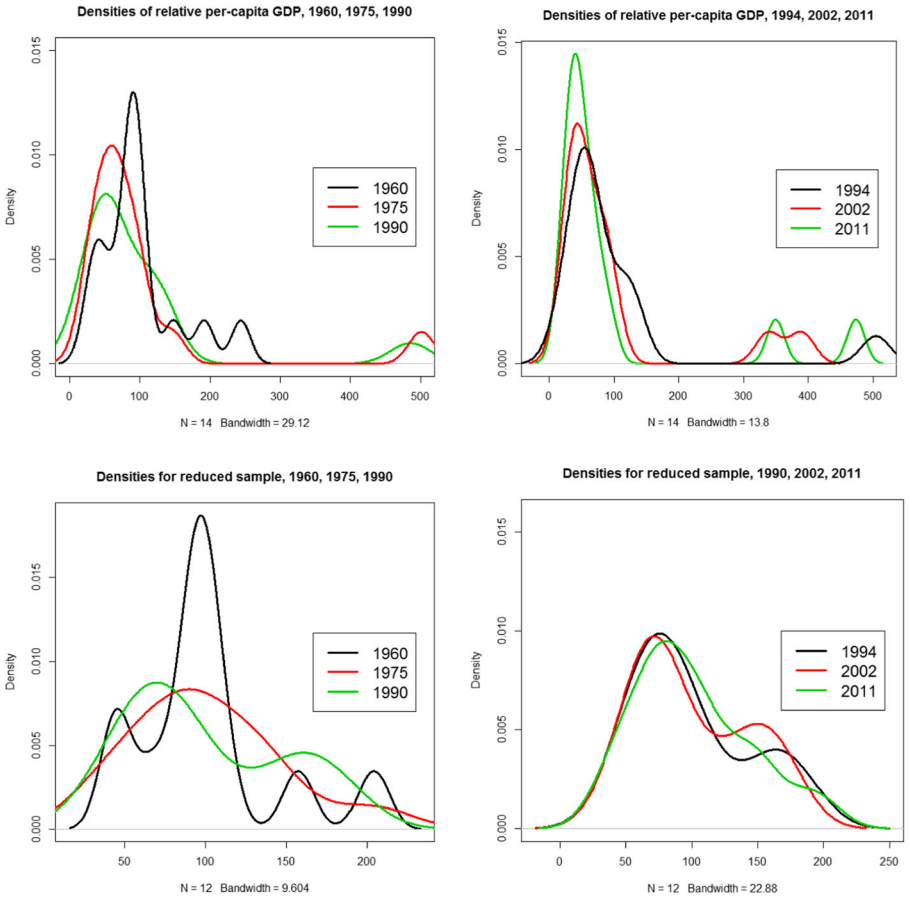

Fig. 1 Kernel density distributions of relative GDP per capita (% of sample average), 1960–2011. *Note:* The top plots are for the full sample, the bottom plots exclude Equatorial Guinea and Gabon

initial state (in the rows) to a final state (in the columns). For instance, in the first matrix of Table 3, a country with an initial per-capita income between 42% and 67% of the mean level (second row) has a 12% chance of moving to a lower level (first column) after one year but a 78% chance of staying in the same range of income (second column). This country has also a 1% chance of moving to the top income level bracket (fourth column) within a year.

The first matrix uses annual transitions over the entire sample period and illustrates the high levels of persistence (over 90%) on each end of the distribution. In addition, the poorest and the richest countries in the sample have a relatively similar chance to moving towards the average. In the middle of the distribution, the mobility is more intensive with a higher chance of transitioning towards lower values of per-capita income, which indicates divergence away from the mean. The ergodic distribution is bimodal with a large mode at the bottom and a minor one at the top of the distribution. In other words, if the intradistributional mobility patterns remain constant, the initially uniform distribution

Table 3 Markov transition matrices and ergodic distributions

Annual transitions, 1960–2011					
State	[17.1; 41.7)	[41.7; 67.0)	[67.0; 99.0)	[99.0; 619.2]	n
[17.1; 41.7)	0.91	0.09	0	0	179
[41.7; 67.0)	0.12	0.78	0.09	0.01	179
[67.0; 99.0)	0	0.12	0.82	0.06	178
[99.0; 619.2]	0	0	0.07	0.93	178
Ergodic	0.33	0.25	0.2	0.22	714
3-year transitions, 1960–2011					
State	[17.6; 41)	[41; 65.5)	[65.5; 101)	[101; 612.5]	n
[17.6; 41)	0.87	0.13	0	0	60
[41; 65.5)	0.22	0.68	0.08	0.02	60
[65.5; 101)	0	0.19	0.73	0.08	59
[101; 612.5]	0	0	0.14	0.86	59
Ergodic	0.46	0.27	0.14	0.12	238
Annual transitions, 1960–1994					
State	[17.1; 42.1)	[42.1; 73)	[73; 102)	[102; 619.2]	n
[17.1; 42.1)	0.92	0.08	0	0	119
[42.1; 73)	0.08	0.87	0.05	0	119
[73; 102)	0	0.09	0.87	0.03	119
[102; 619.2]	0	0	0.03	0.97	119
Ergodic	0.33	0.32	0.17	0.18	476
Annual transitions, 1994–2011					
State	[17.6; 39.5)	[39.5; 56.5)	[56.5; 91)	[91; 527.9]	n
[17.6; 39.5)	0.9	0.1	0	0	59
[39.5; 56.5)	0.15	0.73	0.1	0.02	59
[56.5; 91)	0	0.17	0.77	0.07	60
[91; 527.9]	0	0	0.1	0.9	60
Ergodic	0.38	0.26	0.19	0.17	238

will turn into a bimodal one in the long run, whereby countries have a 33% chance of ending up at income levels below 42% of the mean.[6]

Annual transitions are affected by short-run fluctuations in income per capita, and, therefore, we test the robustness of our results by extending the transition periods to 3 years. The results in the second matrix in Table 3 confirm our initial findings. The persistence at both ends of the distribution is again very similar. At the same time, the probability of moving to lower income levels is twice as high as for moving to higher levels. The ergodic distribution has now a single peak located at the bottom of the distribution where almost half of the probability mass is concentrated.

[6] Equatorial Guinea and Gabon can be seen as outliers due to their high-income levels. We tested the robustness of our results by excluding them from the sample. This changed the benchmark average, and thus the value ranges of the four states, but the transition probabilities and convergence patterns remained almost identical to those for the full sample. These results are available from the authors upon request.

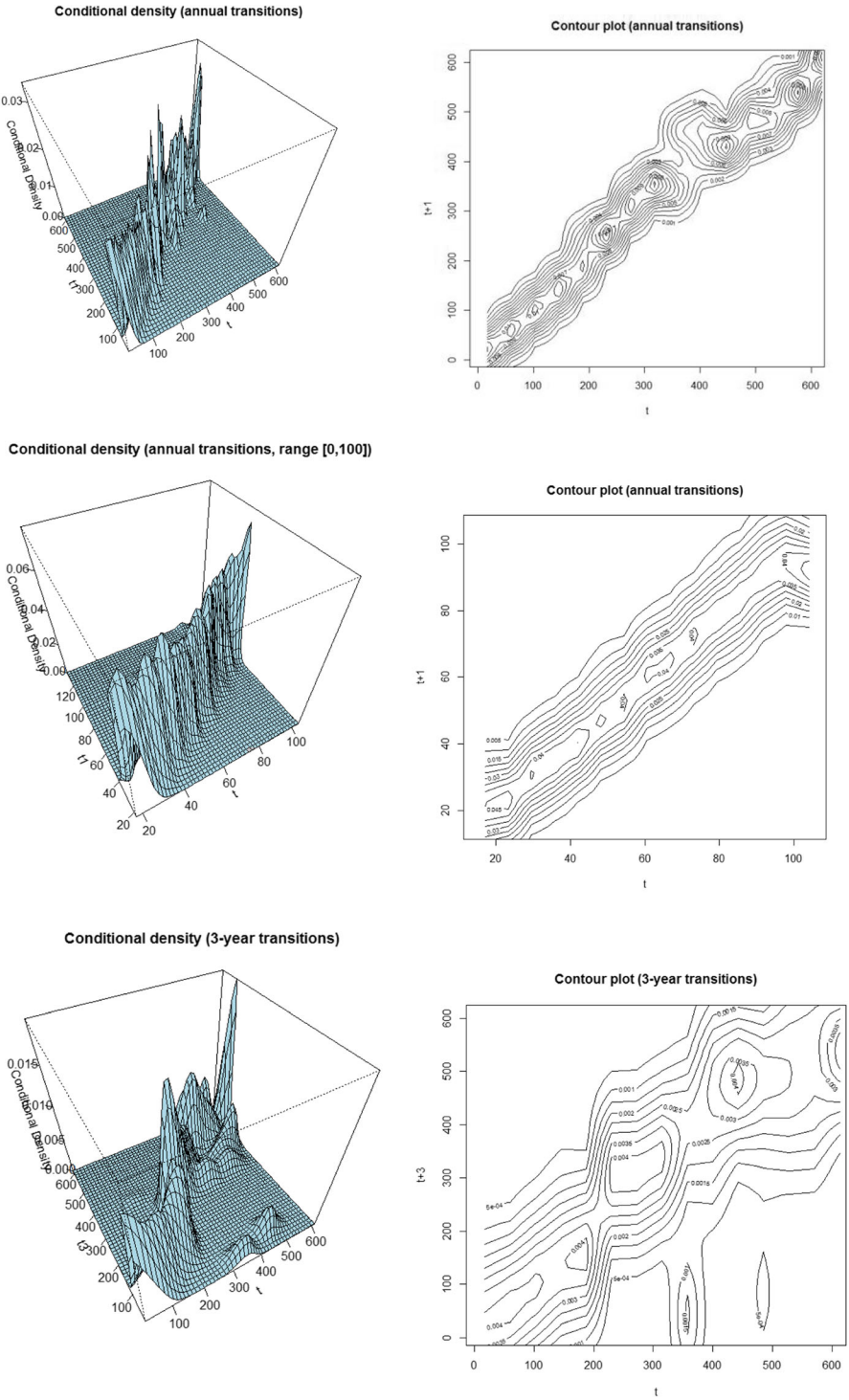

Fig. 2 Stochastic kernels of relative per-capita GDP, annual transitions, 1960–2011

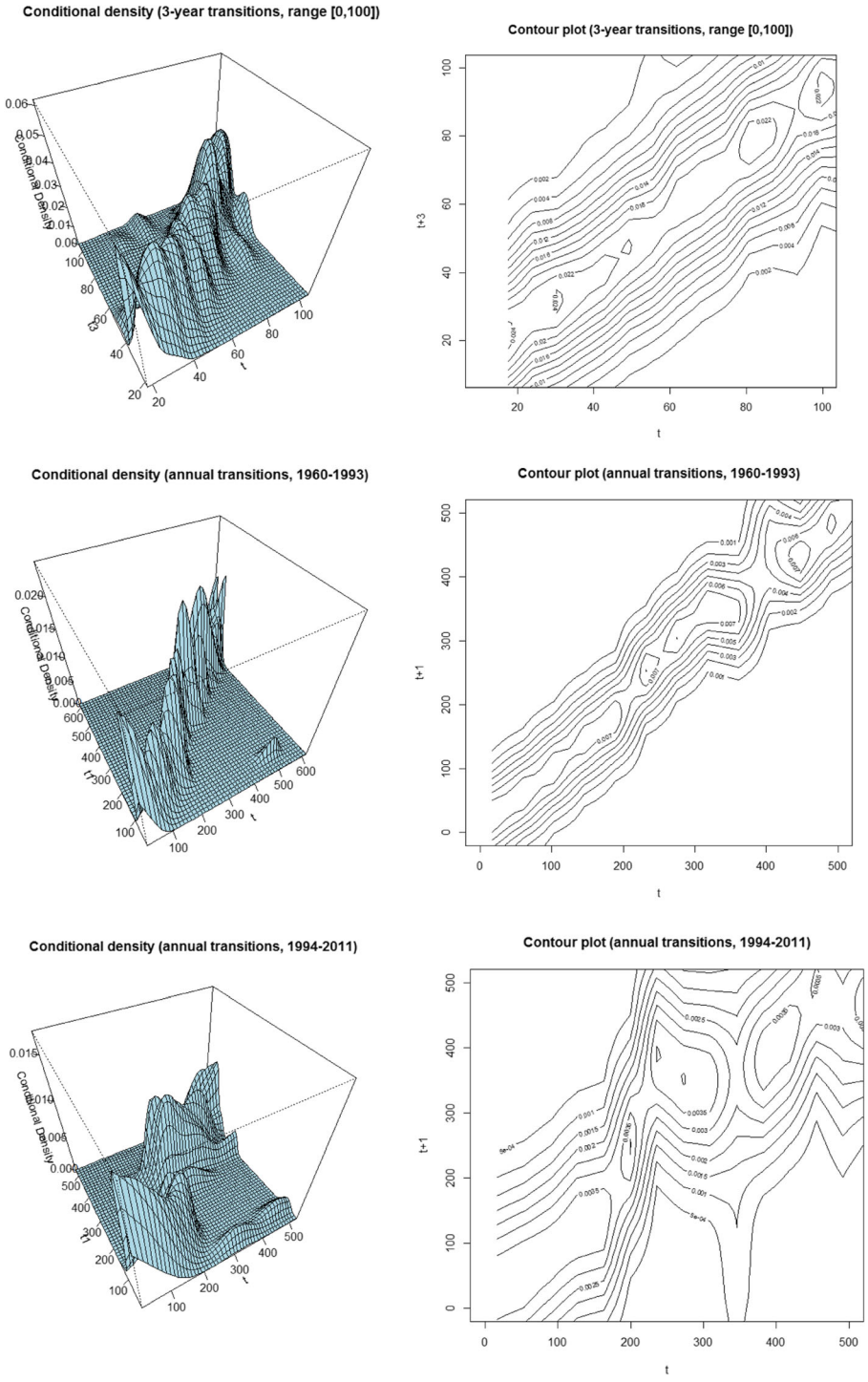

Fig. 2 (continued)

We further present the annual transition matrices for two subperiods. Before 1994, countries at the bottom and top income ranges had barely any chance of escaping from their initial situation. The transition probabilities and the ergodic distribution are similar to those for the entire sample period. For the years after 1994, persistence in all states along the diagonal of the matrix decreases indicating increasing mobility which is again directed more strongly towards lower income levels. Accordingly, the ergodic distribution after 1994 exhibits a much stronger concentration of the probability mass at the bottom.

Figure 2 shows the stochastic kernels for various sample periods. The three-dimensional graphs and their corresponding contour plots show the densities for each income level (t + 1 axis) conditional on the corresponding density in the previous year (t axis). The graphs for the full sample period (first row) suggest relatively high levels of persistence as the lines are concentrated closely along the diagonal. If we focus only on the range below the average where most of the probability mass is located (second row), we see an analogous pattern. The relatively similar dispersion of the lines around the diagonal suggests similar probabilities for moving towards the top and bottom of the distribution. The main exceptions are the countries at or just above the mean of 100. There the concentration of lines on the contour plot is clearly located below the diagonal indicating higher probability of convergence towards the bottom of the distribution. This is in line with our findings from the Markov transition matrices.

The graphs for the 3-year transitions (third row) exhibit significantly larger movements. Countries with income levels twice as large as the average and lower are more likely to converge towards the bottom of the distribution. In contrast, those with income above 200% of the average are more likely to diverge away from the mean. These details were not visible from the transition matrices in Table 3 because all countries with above-average income levels were grouped together in one discrete state. In the range below the average (fourth row), countries with income levels between 70% and 100% of the average have a higher probability of diverging away from the mean towards the bottom of the distribution due to the high concentration of lines below the diagonal of the contour plot. This concurs perfectly with the patterns described by the corresponding transition matrix in Table 3.

The plots for the periods before and after 1994 are very different but both provide evidence for the robustness of our previous findings. As we showed with the transition matrices, the persistence in the middle of the distribution is significantly lower for the period after 1994. The wide dispersion of lines in the corresponding contour plot (sixth row) confirms this, especially when contrasted with the plot for the period before 1994 (fifth row).

3 Explaining the dynamics of relative per-capita income

The second part of our analysis is focused on identifying the factors that influence the dynamics of convergence.[7] We use a fixed-effects panel-data model, which includes the

[7] For some recent empirical studies on growth and convergence factors in Africa, including institutional one, see Tumwebaze and Ijjo (2015); Nanfosso and Nguena (2015), Golit and Adamu (2014); Mijiyawa (2013); Ondoa (2013); Diop et al. (2010).

Table 4 Descriptive statistics of the main regression variables, 1960–2011

Variable	Units	mean	SD	min	max
FDI	Net flows as % of GDP	3.01	10.39	−8.59	161.82
Fuel exports	Oil share in % of exports	14.11	25.60	0.00	94.39
Openness	Trade as % of GDP	71.34	55.60	13.48	531.74
Financial deepening	M2 as % of GDP	18.62	8.29	0.02	68.87
Price stability	CPI inflation in %	7.24	13.61	−31.57	112.89
Physical capital	Fixed capital as % of GDP	20.17	11.72	2.73	113.58
Human capital	yrs. of schooling	2.72	1.91	0.19	8.17
Fiscal policy	gov. spending as % of GDP	13.91	6.24	2.74	84.51

standard variables considered to affect economic growth, such as fixed capital formation (as % of GDP), human capital (years of schooling), openness (trade as % of GDP), FDI (as % of GDP), price stability (CPI inflation in %), fiscal policy (government consumption as % of GDP), financial deepening (M2 as % of GDP), corruption (from the *World Governance Indicators*), reliance on natural resources (oil share in exports), as well as a dummy for the devaluation in 1994. The dataset was compiled and crosschecked form various sources, including BCEAO, BEAC, Banque de France, African Development Bank, World Bank's Development Indicators, and the Barro-Lee Educational Attainment Database. Descriptive statistics of the main regression variables are presented in Table 4.

We estimate the following empirical specification:

$$\Delta y_{it} = \beta_0 + \alpha_i + \eta_t + \beta_1 K_{it} + \beta_2 HK_{it} + \beta_3 OPEN_{it} + \beta_4 FDI_{it} + \beta_5 PR_{it} + \beta_6 FIS_{it} + \beta_7 FIN_{it} + \beta_8 COR_{it} + \beta_9 OIL_{it} + \beta_{10} D_{1994} + \varepsilon_{it} \quad (6)$$

The dependent variable in the regression is the annual growth of per-capita GDP relative to the benchmark for the sample in a given year. In other words, a positive (negative) sign for estimated coefficients would indicate that the corresponding variable causes convergence (divergence) from the benchmark. The independent variables consist of fixed capital formation (K), human capital (HK), openness (OPEN), foreign direct investments (FDI), price stability (PR), fiscal policy (FIS), financial deepening (FIN), corruption (COR), oil share of exports (OIL), and a dummy that takes the value of 1 for the years after 1994.

These variables are included in the standard growth models, as they are considered to affect economic growth. Physical capital accumulation and human capital are key inputs in the production process. Trade and FDI are usually associated with positive effects on growth because they allow a country to benefit from exports and attract foreign capital and technology, which improve the efficiency of the domestic economy. Stables prices and a balanced budget are major signs of macroeconomic stability. High inflation and persistent budget deficits have adverse effects on consumption and investment decisions. Financial development allows firms and individuals to have greater access to capital markets and reduce risk and uncertainty. Corruption stands for the general institutional environment in the country. Weak institutions create an

Table 5 Regression results for relative per-capita GDP growth (full sample)

	Annual			3-year periods		
	(1)	(2)	(3)	(1)	(2)	(3)
Fixed capital formation	0.156** (0.062)	0.244*** (0.061)		0.326** (0.126)		
Openness	0.105*** (0.022)	0.099*** (0.021)			0.240*** (0.038)	
FDI			0.559*** (0.058)			0.486*** (0.112)
Fiscal policy	−0.139 (0.116)	−0.185 (0.114)	−0.088 (0.148)	0.097 (0.324)	0.023 (0.297)	0.420 (0.419)
Price instability	0.074* (0.039)	−0.018 (0.043)	0.146*** (0.044)	0.031 (0.139)	0.095 (0.124)	0.327** (0.154)
Financial deepening	0.079 (0.077)	0.018 (0.093)	0.190 (0.099)	0.419** (0.199)	0.320* (0.179)	0.662*** (0.240)
1994–2010 dummy	−0.035*** (0.010)		−0.030*** (0.011)	0.006 (0.026)	−0.017 (0.024)	0.008 (0.031)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	No	No	No	No
R^2	0.13	0.29	0.20	0.06	0.16	0.13
F-test	12.95***	4.54***	20.45***	3.18***	10.21***	6.27***
Nr. of observations	602	602	472	193	199	152

Robust standard errors are in parenthesis.

* $p < .10$

** $p < .05$

*** $p < .01$

unstable situation that has adverse effects on consumption and investment decisions. Lastly, oil has been both a boon and a curse for many countries. Oil revenues can boost domestic economic development but also breeds corruption and wastefulness, while making the country dependent on earnings from a commodity with volatile prices on global markets.

The model also includes country- and year-fixed effects. Robust standard errors ensure that heteroscedasticity is controlled for. Unlike standard growth regressions, endogeneity here is unlikely to pose any problems because the dependent variable measures relative growth, i.e. convergence or divergence to a benchmark.

The results of the panel regression estimation are presented in Table 5. After running several specifications with different combinations of the variables, we found that some of the coefficients are insignificant and thus excluded them from the final estimation of the model.[8] The first three columns report the estimated coefficients for the full sample. The relative growth in the period after 1994 is found to be significantly lower than in the previous decades, which indicates that the sharp devaluation of the CFA franc caused countries to exhibit slower growth relative to the average benchmark and thus amplified disparities within the currency union. This confirms the divergence in the sample and the tendency for most of the probability mass to converge towards the bottom of the distribution reported in the non-parametric section of the results. Our findings also concur with the lack of convergence in WEAMU after the devaluation reported by Van den Boogerde and Tsangarides (2005). It is important to note that the devaluation certainly had a positive impact on growth in the CFA area (Ary Tanimoune and Plane 2004, 2005; Hugon 1999, 2009). What our results show is that this impact was unevenly distributed and was thus not sufficient to help most economies move closer to the benchmark.[9] In other words, the negative sign of the dummy for 1994 means that some countries were growing faster and others slower in response to the devaluation. This has caused divergence across the CFA. In more general terms, our findings demonstrate that the common currency in the CFA has not generated long-run convergence towards the common benchmark within the zone. However, such convergence is considered the main goal for the creation of any common currency area. The key objective of the common money is the convergence and harmonization of living standards across member states.

Physical capital accumulation, openness, and FDI have positive and significant coefficients, suggesting that these three factors had a positive effect on convergence towards the benchmark and helped countries catch up with the average per-capita GDP. Financial development and fiscal policy do not achieve statistical significance, while price instability seems to have contributed to convergence. However, when year fixed effects were added to the regression, the coefficient turned negative and was not significant anymore. Therefore, the effect of inflation might be due to time variation that is not accounted for in the baseline model.[10] As for the fiscal policy coefficient,

[8] The coefficients for oil exports, human capital, and the institutional variables were not only insignificant but caused all other variables to lose their significance as well. Therefore, we excluded them from all regressions and do not report them in the tables. For the relationship between resource rent and different institutional and political variables see Arezki and Gylfason (2013), and for a short survey see Fosu 2012b).

[9] This is in line with Fosu (2012a) findings that stress the existence of growth accompanied by increasing divergence between African countries.

[10] We exclude year fixed effects from the regression for most specifications of the model to be able to account for the structural break in 1994 by introducing a dummy variable.

Table 6 Regression results for relative per-capita GDP growth (reduced sample)

	Annual			3-year periods		
	(1)	(2)	(3)	(1)	(2)	(3)
Fixed capital formation	0.058 (0.064)			0.071 (0.165)		
Openness		0.055* (0.032)			0.154* (0.082)	
FDI			0.254* (0.137)			0.530* (0.302)
Fiscal policy	−0.129 (0.116)	−0.110 (0.114)	−0.074 (0.156)	−0.228 (0.321)	−0.203 (0.311)	0.011 (0.432)
Price instability	0.107** (0.044)	0.100** (0.044)	0.135*** (0.050)	0.335** (0.148)	0.278* (0.149)	0.446*** (0.167)
Financial deepening	0.154** (0.074)	0.131* (0.076)	0.260** (0.103)	0.530*** (0.186)	0.436** (0.191)	0.730*** (0.239)
1994–2010 dummy	−0.029*** (0.010)	−0.032** (0.010)	−0.032*** (0.027)	0.015 (0.025)	0.003 (0.026)	0.010 (0.030)
R^2	0.03	0.02	0.03	0.04	0.04	0.04
F-test	3.85***	4.16***	4.16***	3.05**	3.91***	3.67***
Nr. of observations	544	549	416	175	176	134

The reduced sample consists of 12 countries (Gabon and Equatorial Guinea are excluded). All regressions include country fixed effects. Robust standard errors are in parenthesis.

* $p < .10$

** $p < .05$

*** $p < .01$

Fosu (2012a) found too that public spending did not have a significant effect on growth and attributed this to "policy syndromes" that have plagued African economies.

We further test the robustness of our results by expanding the period over which growth is measured to three years. The results are shown in the last three columns of Table 5. The estimates remain largely robust with the exception of the dummy for the period after 1994, which now turns insignificant. This means that there was no significant difference between the first and second subperiods with regard to the relative growth over longer time spans. As the non-parametric analysis indicated that the divergence over 3-year growth periods is even stronger, it is possible that our parametric finding might be driven by the fact that we have only 5 observations for each country over the period after 1994 for the 3-year specification. Furthermore, the results reveal that financial development has a significantly positive effect on convergence over longer periods.

The results in Table 5 might be driven by Gabon and Equatorial Guinea that were identified as outliers in the sample due to their oil exports and high levels of per-capita GDP. For this reason, we conducted the regression analysis on a reduced sample that excludes these two countries. The estimated coefficients in Table 6 reveal some important differences. Financial development makes a significant contribution to convergence regardless of the growth-span specification. Openness and FDI remain relevant, but capital deepening does not seem to be a major factor anymore. Price instability exhibits a positive and significant coefficient across all models. In other words, inflation is associated with convergence towards the average per-capita GDP. However, the reason is that year fixed effects are excluded from the estimation.

There are virtually no differences between the annual and 3-year specifications in Table 6 except for the 1994–2010 period dummy. As in Table 5, the dummy has a negative and significant coefficient in the annual growth model, whereas it is insignificant in the 3-year growth model.

4 Concluding remarks

Explaining the impact of economic and political institutions (e.g., ownership, election systems, market and regulatory mechanisms) on long-term development in Africa is not only of theoretical importance (Acemoglu and Robinson 2010; Fosu 2012a; Fosu 2012b), but it also offers guidance on economic policy. Fittingly, Nubukpo et al. (2016) in their latest book on the future of the CFA explore extensively the theoretical and logical arguments for sustaining the mechanisms of the CFA area. In this study, we focused on the current state of income convergence between countries belonging to the CFA zone, an area encompassing 14 countries with 70 years of experience in a currency union with a fixed exchange rate. Besides the fact that convergence in itself is examined within this unique institutional monetary regime, we also included certain institutional variables among the factors explaining economic development. Our results can be summarized as follows.

First, the analysis of the convergence shows a clear trend towards the formation of two clubs on both sides of the distribution. The distribution becomes bimodal with clearly pronounced "poor" and "rich" club. Over time, and especially after the 1994 devaluation, the middle mode shifts downwards towards the lower levels of per-capita income. Furthermore, the probability that a given country would converge to the club

of poor countries increases. Accordingly, the main conclusion is that there is no expected convergence in the CFA area and relative growth dynamics exhibit a tendency to lower growth rates and lower relative per-capita income levels. The strengthening of this trend after the devaluation of 1994 questions the effectiveness of this policy measure for area-wide convergence. According to the stylized factors of development presented in Rodrik (2014), convergence is the exception rather than the rule, and our results appear to support this observation.

Second, a number of factors we presumed to be behind the relative income dynamics proved to be statistically insignificant (e.g., institutional factors, corruption, human capital), which, of course, does not mean that they, in fact, do not affect growth. Other commonly accepted growth factors, such as gross capital formation, openness, and FDI, seem to promote convergence. Government spending is not correlated with convergence, while financial development seems to have a positive effect only over longer periods of time. This leads us to suppose that we need a critical approach to the primary statistics, preliminary data reconstruction, and clearly a more subtle definition of growth factors specific to the African continent.

In general, our findings draw attention to the lack of structural reforms in the CFA area, which represents a major stumbling block for achieving real convergence in the near future. Furthermore, the very nature of the central banks in the zone, which function almost like currency boards where the monetary base is fully backed up, create constraints for the development of the financial sector and for investment that, in turn, have an adverse effect on growth. Accordingly, if this monetary regime remains in place in the future, more radical structural reforms are needed to free up the development of the financial sector and of investment policies. Alternatively, the monetary regime of the CFA area would need more flexibility, however this needs to be carefully weighed up.

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