

Does economic growth affect poverty in CEMAC and WAEMU zone¹ ? : An empirical comparative analysis with panel data.

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Abstract: In light of increasing interest in the relationship between economic growth and poverty, the present paper uses panel data of CEMAC and WAEMU countries, which use commonly the CFA franc, to determine empirically the impact of growth on poverty for the period 1981–2005. During this period, CEMAC and WAEMU economic progress improved and performance in terms of poverty reduction is slightly satisfactory. Based on random-effects model, we provide estimates for poverty measures at the \$1.25 international poverty line. Regression analysis of panel data shows, that economic growth has a statistically significant impact of reducing poverty only in WAEMU zone.

Key words: Economic growth, Poverty, Inequality, CEMAC, WAEMU, Panel data.

JEL Classification: F43, I3, D63

1. Introduction

Poverty is a serious problem that plagues the CEMAC and WAEMU countries. Reduce poverty³ is the fundamental objective of economic development. In the late 1990s, the bilateral and multilateral development agencies placed

¹ CEMAC: Monetary and Economic Community of Central Africa with six members: Cameroon, Central African Republic, Chad, and Republic of the Congo, Equatorial Guinea, and Gabon. In the study, we exclude Equatorial Guinea, because a lack of data. WAEMU (term in French “UEMOA”): West African Economic and Monetary Union. WAEMU comprises eight countries: Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo. These two zones were established to promote economic integration among countries that share the CFA franc as a common currency.

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³ According to World Bank (2001) : Poverty is a multidimensional phenomenon, encompassing inability to satisfy basic needs, lack of control over resources, lack of education and skills, poor health, malnutrition, lack of shelter, poor access to water and sanitation, vulnerability to shocks, violence and crime, lack of political freedom and voice. Monetary poverty is a dimension of poverty. In this paper, we focus on monetary absolute poverty.

increasing emphasis on poverty reduction in developing countries⁴. The first objective of Millennium Development Goals (MDGs) is to reduce by half the proportion of people in developing countries living in extreme poverty by 2015⁵. This phenomenon is a subject of growing interest in the economic literature. A large number of studies have analyzed the relationship between poverty and economic growth. The main research concern is whether growth has an impact on poverty and to what extent. A number of recent studies suggest that economic growth, in general leads to poverty reduction. Among these studies, Dollar and Kraay's (2002) paper has attracted much consideration. They show that "growth is good for the poor", while income distributions do not change. Similarly, Adams (2003) analyzed the impact of economic growth on poverty for 50 developing countries and he found that growth has an important role to reduce poverty in developing countries.

However, it is difficult to argue that poverty reduction can be achieved without distributional changes. Many studies explore the role of income distribution in the effect of growth on poverty (Ravallion, 1997; Bourguignon, 2003; Adams, 2004; Epaulard, 2003; Adams, 2004; Fosu, 2009, 2010, 2011).

So, does economic growth affect poverty in the CEMAC and WAEMU zone? In other words, does poverty decline or increase in percentage terms with a given percentage in economic growth in CEMAC and WAEMU zone? This paper addresses these important questions providing estimates from panel data regressions, using random effects.

This study is motivated by Fosu (2009, 2011), Adams and Richard (2004), who purpose several empirical results on poverty elasticity, measuring the extent to which economic growth reduces poverty. One of the originalities of this paper is the focus zones, the CEMAC and WAEMU region, which is rarely or not explored in the literature. Indeed, we fill the void in empirical studies of growth and poverty in CEMAC and WAEMU region. Second, results are provided for two poverty measures, the headcount index and the poverty gap index at the \$1.25 standards, to conduct robustness exercise. Third, more generally, the present

⁴ The International Development Targets, set by the Social Summit in 1996, are presented and discussed in Hanmer and Nascond (2000). These were officially adopted by UK Department of International Development. More modest targets were set by USAID (USAID 2001).

⁵Department for International Development (UK). (2000).

paper gives a statistical analysis of economic growth versus poverty performance in the CEMAC and WAEMU region. Finally, the paper also contributes to the literature on economic growth and poverty.

The rest of the paper is organized as follows. Section 2 provides a background on the literature, while section 3 give a statistical analysis of economic growth and poverty in CEMAC and WAEMU countries. Sections 4 and 5 contain data, empirical methodology and regressions results. In section 6, we conclude.

2. Background on the literature

The literature has found that economic growth is strongly associated with poverty reduction across countries and over time. These studies are generally based on linear regressions⁶, where the evolution of some poverty measure is explained by the growth of income or GDP per-capita and a host of other variables, the main issue being the importance of GDP and these other variables in determining poverty reduction. The economists analyze generally the poverty elasticity with respect to economic growth. In fact, the growth elasticity of poverty is the rate of reduction in poverty resulting from a 1% increase in average income or GDP per-capita. If, for example, the growth elasticity of poverty is 2 %, then we would expect an increase in average income of 2% per year to yield a reduction of 4% per year in poverty. Generally, the economists have found different results using different sample and different econometric techniques.

Most of them, consider that economic growth is essential to reduce poverty, provided that the repartition of income distribution unchanged. In this regard, Ravallion and Chen (1997) find that inequality changes uncorrelated with growth rates between 1981 and 1994. They estimated that the elasticity of poverty incidence (at the \$ 1 standard a day) to mean household income was about -3 %. Ravallion (2001) find a lower elasticity -2.1 %. Likewise, a fluently cited paper of Dollar and Kraay (2002) show that “growth is good for the poor”. In a sample of

⁶ Except, the recent paper of Dustin, C. (2011) which is the first to use non –parametric techniques to estimate growth elasticity of poverty.

92 countries, over four decades, the mean income of the poorest 20 % of the population grew on average at the same rate as overall mean incomes. In other words, they estimate that the growth elasticity of poverty is an average, and that growth has no impact on inequality, it leads in practice to favor the goal of accelerating growth and ignoring distribution issues.

However, attention to the importance of inequality in poverty reduction seems to be growing. For example, Ravallion (1997) econometrically tested the growth-elasticity argument that while low inequality helps the poor share in the benefits of growth. Moreover, Adams (2003) emphasized that if the economic growth is measured by survey mean income (consumption), there is a strong statistically significant relation between growth and poverty reduction. In his analysis, a 1 percentage increase in economic growth produced a 2.59 percent decrease in the proportion of people living in poverty (\$1 a person a day). On the other hand, if the economic growth is measured by GDP per-capita, the statistical relationship between growth and poverty reduction is no longer strong but it still exists. Also, he argued that economic growth has little impact on income inequality because economic growth raises incomes for both the rich and the poor proportionally.

Similarly, Adams and Richard (2004) use 60 developing countries to analyse the growth elasticity of poverty. He uses two measures of Economic growth: growth as measured by the changes in the survey mean, and growth as measure by change in GDP-per capita, in analyzing the effect of growth on poverty. He shows that while economic growth does reduce poverty, the rate of poverty reduction depends very much on how economic growth is defined. When it measure by changes in survey mean income (consumption), the growth elasticity of poverty is -2.79 %, that is, a 10% increase in changes in survey mean income will reduce poverty by 27.9%. But when growth is measured by changes in GDP per-capita, the growth elasticity of poverty is a statistically insignificant - 2.27 %. Moreover, Adams (2004) also finds that the growth elasticity of poverty is larger for the group with the smaller value of the Gini coefficient (less inequality), its means that the value of the growth elasticity is lower in countries

with higher inequality. This means also, that policies which reduce inequality will increase the amount of poverty reduction associated with economic growth. More recently, Fosu (2009, 2010, and 2011) finds that inequality adversely affects the growth elasticity of poverty. For example, Fosu (2009) explored the extent to which inequality influences the impact of growth on poverty reduction, based on a global sample of 1977-2004 panel data for Sub Saharan Africa (SSA) and non-Sub Saharan Africa countries. Several models are estimated, with growths of the headcount gap and squared gap poverty ratios as respective dependent variables, and growth of the Gini coefficient as explanatory variable. For both SSA and non-SSA samples and for all three poverty measure, headcount index, poverty gap index and squared poverty gap index, the paper finds that, the impact of GDP growth on poverty reduction as a decreasing function of initial inequality. The study additionally observes that higher rates of increases in inequality tend to exacerbate poverty

3. Statistical analysis of economic Growth and poverty in CEMAC and WAEMU countries

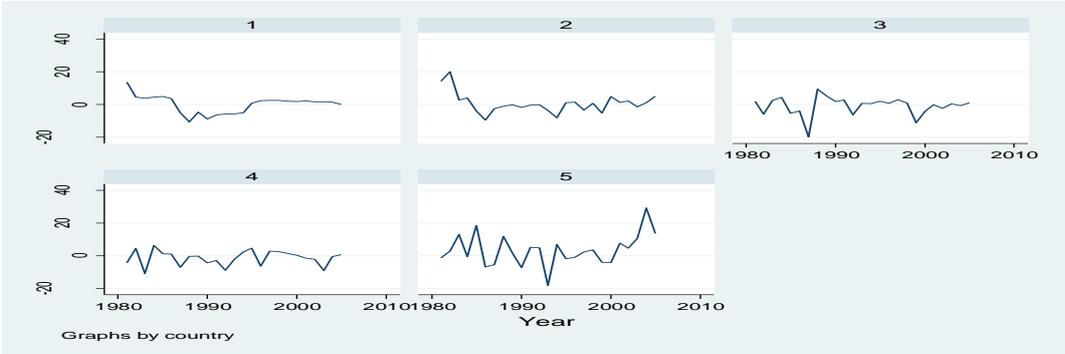
In this section, we provide a statistical analysis of the performance against economic growth, poverty and inequality in CEMAC and WAEMU countries during 1981-2005.

3.1 The state of economic growth performances in CEMAC and WAEMU countries

Here, we give a comparison of the CEMAC and WAEMU economic growth performances. Figure 1 and figure 2 presents the trends of CEMAC and WAEMU economies. For the CEMAC countries, we note generally, a satisfactory and good progress on GDP per-capita. The Chad economy is distinguished with the highest GDP per-capita growth during the latter period. Gabon and Central African Republic economic per capita GDP growth are not satisfactory during the period. Only, the Republic of Congo presents a moderate trend in economic growth compared to other. Concerning the WAEMU region, we note a good progress on GDP per-capita in Burkina Faso, Benin, Mali, Senegal and Togo,

especially, during the latter period. For Guinea-Bissau, Côte d'Ivoire and Niger, the tendance is not satisfactory, especially during the latter period, while GDP per-capita decline.

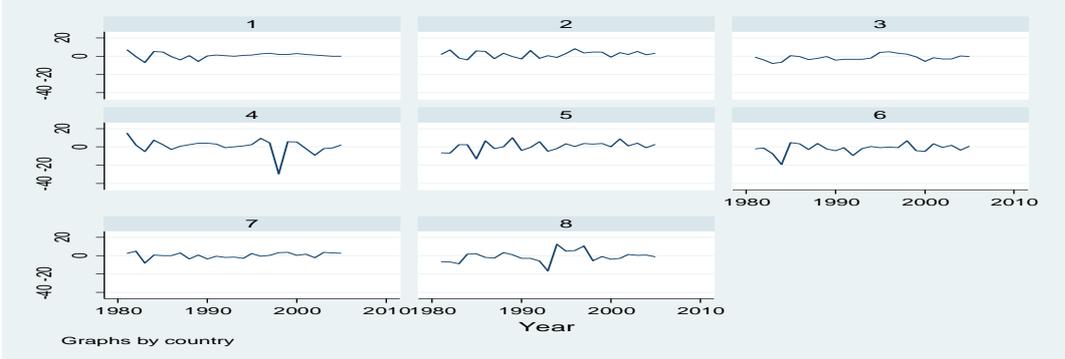
Figure 1: Per-capita GDP growth in individual CEMAC economies 1981-2005



Notes: The meaning of the numbers are respectively: 1 = Cameroon, 2= Republic of Congo, 3=Gabon, 4= Central African Republic, 5= Chad.

Source: World Bank database 2011 and author presentation.

Figure 2: Per-capita GDP growth in individual WAEMU economies 1981-2005



Notes: The meaning of the numbers are respectively: 1 = Benin, 2= Burkina Faso, 3=Côte d'Ivoire, 4= Guinea-Bissau, 5= Mali, 6= Niger, 7= Senegal, 8= Togo.

Source: World Development Indicators 2011 and author presentation.

Table 1 presents the 1981-1996 and 1996-2005 regional averages of per-capita GDP growth for CEMAC and WAEMU zone. For CEMAC region, we first note a spectacular per-capita GDP growth in the Chad (6.28 %) and a strong per-capita GDP growth in the Cameroun (1.85 %) during the latter period. Second, Gabon and Central African Republic registered the worst record of per-capita GDP growth during the two sub-periods (respectively -1.24 %, -1.15 %). Only, the

Republic of Congo registered an appreciable GDP per-capita growth over both sub-periods (0.79 % and 0.67 %).

Concerning the WAEMU region, Burkina Faso is distinguished with the highest level of per capita GDP growth (1.47 % and 3.45%) followed by Benin (0.36 % and 1.52 %), over both sub-periods. The Mali and the Senegal registered a substantial per-capita GDP growth followed by Togo in the region during the latter period (respectively 2.73 % and 1.70 %). In the case of Guinea-Bissau, we note a decline in per-capita GDP during the latter period (-1.59 %). Furthermore, Côte d'Ivoire and Niger registered the worst record of per-capita GDP in both sub-periods (respectively -2.14 % and -2.43 % during the first period; -0.46 % and -0.07 % during the second period).

Table 1: Per-capita GDP growth by zone, 1981-2005

		P.C.GDP growth (%)	
		1981-96	1996-05
CEMAC			
Cameroon		-0.86	1.85
Rep.Congo		0.79	0.67
Gabon		-0.57	-1.24
Central African Republic		-1.70	-1.15
Chad		1.42	6.28
WAEMU		1981-1996	1996-05
Benin		0.36	1.52
Burkina Faso		1.47	3.45
Côte d'Ivoire		-2.14	-0.46
Guinea- Bissau		0.44	-1.59
Mali		-0.44	2.73
Niger		-2.43	-0.07
Senegal		-0.48	1.70
Togo		-1.40	0.48

Notes: Per-capita GDP growth rates are calculated as averages of annual values in each country, in the CEMAC and WAEMU zone. Per capita GDP growth rates data are available for other years over 1981-2005 as well, but we have opted to divide the period in two sub-periods 1981-1996 and 1996-2005, to see the per capita GDP growth record after 10 years and to compare per capita GDP growth rates. This strategy is used by Fosu (2011).

Source: World Bank database 2011 and author's calculations.

3.2 The challenge of reducing poverty in CEMAC and WAEMU countries: historical record

3.2.1 Poverty trends in CEMAC and WAEMU economies

Here, we give a comparison of trends in poverty, in the CEMAC and WAEMU countries. Table 2 presents trends in poverty by countries in the CEMAC and WAEMU zone, based on the international poverty line of \$ 1.25/per person/per day⁷. In fact, for the each zone, the table presents the incidence of poverty⁸ for 1981, 1996, and 2005, these year cover the 1981-2005 period for which country data are sufficiently reliable⁹. The poverty record is generally satisfactory in all countries for each zone. The observation of the incidence of poverty shows a slight decline in poverty in the WAEMU and CEMAC countries. All these decreases were reflecting the effects of strategies for reducing poverty whose implantation began early 1990. For each region, analyze of incidence of poverty by countries reveals modest progressions, but different from one country to another.

Among all the countries in the CEMAC zone, Central African Republic registered the highest level of incidence of poverty followed by Chad, Republic of Congo and Cameroon and Gabon in 1981 an in 2005. Of the eight WAEMU countries, four saw their poverty rate declined between 1981 and 2005 (Benin, Burkina Faso, Mali, Senegal). Meanwhile, the four other knew an increase in their incidence of poverty. In 1981, Mali and Burkina Faso recorded the highest poverty rate in the WAEMU zone (respectively 81.52% and 73.02%). On the contrary, in the same year, Cote d'Ivoire and Guinea-Bissau were the least poor (respectively 6.66% and 31.15%). So, comparing the two regions, we note that, in 2005, WAEMU countries have the highest level of poverty than the CEMAC countries. Figures 3 and 4 reported in appendix, confirm these trends.

⁷ The \$1.25 poverty line which is equivalent to \$32.74 per month at purchasing power parity (PPP) in terms of household consumption in 2005, is the equivalent to the \$ 1 per person per day poverty line.

⁸ The incidence of poverty(headcount index) measures the percent of the population leaving below the poverty line

⁹ Poverty data are available for other years over 1981-2005 as well, but we assume to select these years for the growth rates, in order to provide comparable countries analysis. This method is used recently by Fosu (2011).

Table 2: Historical poverty record (headcount index in %) in CEMAC and WAEMU economies 1981-2005

	P0_1.25 (%)		
CEMAC	1981	1996	2005
Cameroon	42.99	51.46	27.51
Rep.Congo	61.91	77.85	54.1
Gabon	3.59	9.81	4.84
Central African Republic	79.91	80.26	64.43
Chad	61.09	67.05	58.67
	P0_1.25 (%)		
WAEMU	1981	1996	2005
Benin	53.47	61.75	49.99
Burkina Faso	73.02	66.96	55.04
Côte d'Ivoire	6.66	23.65	20.38
Guinea- Bissau	31.15	46.38	42.46
Mali	81.52	78.91	51.43
Niger	57.44	80.39	65.88
Senegal	68.26	52.85	33.5
Togo	35.2	27.84	38.68

Note: To provide comparability across countries, the same poverty line, \$ 1.25 per day is applied to all countries.

Source: World Bank PovcalNet database 2011.

3.2.2 Poverty reduction in CEMAC and WAEMU economies

Here, we give a comparison of changes in poverty in the CEMAC and WAEMU economies by calculating the mean annual log-difference of all countries for the whole period 1981-2005 (Table 3).

However, in order to analyze the poverty reduction during the whole period, we calculated the mean annual change of the incidence of poverty (in logarithm form) for the CEMAC and WAEMU countries (Table 3). For the CEMAC countries, Cameroon registered the largest poverty reduction (-1.86 %) during the period 1981 -2005, followed by Central African Republic (-0.90 %), Congo (-0.56 %) and Chad (-0.17 %). Conversely, Gabon registered an increase in incidence of poverty, at 1.24 percentages during the same period. And, concerning the WAEMU countries, Senegal is the country that experienced the largest decline in the incidence of poverty with a- 2.97 percentage, followed by Mali (-1.92 %), Burkina (-1.18 %) and Benin (-0.28 %).

Table 3: Poverty reduction CEMAC versus WAEMU 1981-2005.

	Poverty reduction (Mean annual log- difference 1981- 2005 (Headcount index, %)
CEMAC	
Cameroon	-1.86
Rep.Congo	-0.56
Gabon	1.24
Central African Republic	-0.90
Chad	-0.17
WAEMU	
Benin	-0.28
Burkina Faso	-1.18
Côte d'Ivoire	4.66
Guinea- Bissau	1.29
Mali	-1.92
Niger	0.57
Senegal	-2.97
Togo	0.39

Notes: The mean annual log-difference is calculated as the logarithmic difference (dlog) of ending-year value and beginning-year value, divided by the number of years between the two years x 100 percent.

3.3 Economic growth and poverty in CEMAC and WAEMU economies

Discussions in sections 3.1 and 3.2 have profiled separately trends in economic growth, poverty in the CEMAC and WAEMU countries, this section gives the statistical analyze of the relationship between them during the whole period 1981-2005, and over both sub-periods 1981-1996 and 1996-2005 (Tables 4 and 5). Fosu (2011) gives a similar statistical analyze on the developing world in 1981-2005. We start by analyzing the observations presented in Table 4.

First, among the CEMAC countries, only the Chad registered a strong GDP growth (3.46 %) accompanied by modest poverty reduction (-0.17 %) during the period. More, the moderate poverty reduction in Congo (0.10%), appear to have translated by moderate poverty reduction (-0.56 %). We note also, the particular case of Gabon which registered a modeste GDP Growth, associated with an increase in the poverty rate (1.24 %), during the period. Cases of Cameroon and Central African Republic required attention, while the decline of per-capita GDP during the whole period, appears to have resulted from poverty reduction.

Second, among the WAEMU countries, only four countries registered GDP growth which seems to have resulted in poverty reduction (Burkina Faso, Mali, Benin, and Senegal). For Côte d'Ivoire, Niger and Togo, the per-capita GDP decline during the period seems to account for increase in poverty. In this regard, we relieve, particularly, of these observations, the substantial increase in incidence of poverty in Côte d'Ivoire during the period. However, we note also the particular case of Guinea-Bissau, which registered a moderate GDP growth accompanied by an increase in poverty, during the period.

Table 4: Economic Growth and poverty in CEMAC and WAEMU countries 1981-2005 (%)

	P.C. GDP growth	\$1.25 P0 growth
CEMAC		
Cameroon	-1.30	-1.86
Rep.Congo	0.10	-0.56
Gabon	0.72	1.24
Central African Republic	-0.89	-0.90
Chad	3.46	-0.17
WAEMU		
Benin	0.74	-0.28
Burkina Faso	2.00	-1.18
Côte d'Ivoire	-1.75	4.66
Guinea- Bissau	0.81	1.29
Mali	0.79	-1.92
Niger	-1.58	0.57
Senegal	0.40	-2.97
Togo	-0.93	0.39

Notes: Per-capita GDP growth rates are 1981-2005 means of annual values from World Bank database (2011). P0 is the headcount index. Growth rates of P0 are calculated as the log-differences using latest year and star-year values, divides by the number of years between the two periods, x 100 percent.

Source: World Bank database 2011 and author calculations.

It is important to analyze also, the observations shown in table 5, because, they gives us the progress against economic growth and poverty in both sub-periods, 1981-1996 and 1996-2005, and permit us to provide comparable countries analysis. For the CEMAC countries, only Chad and Republic of Congo registered GDP growth per-capita resulting, an increase in poverty in the first period, and poverty reduction during the latter period. For Central African Republic and Gabon, the per-capita GDP decline over both sub-periods seems to

account, for considerable increase in poverty in Gabon and modest increase in poverty in Central African Republic, during the first period, and substantial poverty reduction during the latter period. In the case of Cameroon, the moderate per-capita GDP decline during the first period accompanied by an increase in poverty, conversely, the appreciable GDP growth during the latter period appear to have been translated to substantial poverty reduction.

Concerning the WAEMU countries, only Burkina Faso was clearly the most efficient in terms of GDP growth per-capita and poverty reduction over both sub-periods. Benin registered the same trend in progress against GDP per-capita in both sub-periods, but, with an increase in incidence of poverty during the first period. For Senegal, Mali and Togo, the appreciable GDP growths during the latter period, seems to have been resulted to substantial poverty reduction, except in Togo. For Côte d'Ivoire and Niger, we note a per-capita GDP decline in both sub-periods, associated with an increase in incidence of poverty during the first period and poverty reduction during the second period. The case of Guinea-Bissau require also attention, it registered a modest GDP growth during the first period, accompanied by an increase in poverty rate, and a decline in GDP per capita during the latter period. So, these observations reflect considerable differences across time, and considerable regional differences (especially countries differences), in the relation between economic growth, and poverty. The finding of our statistical analysis is consistent with the results of the study of Fosu (2011)¹⁰.

Table 5: Economic Growth and Poverty in CEMAC and WAEMU countries over both sub-periods 1981-1996 and 1996-2005.

	P.C GDP		\$1.25 P0 growth (%)	
	growth (%)		1981-1996	1996-2005
CEMAC	1981-1996	1996-2005	1981-1996	1996-2005
Cameroon	-0.86	1.85	1.2	-6.96
Rep.Congo	0.79	0.67	1.53	-4.04
Gabon	-0.57	-1.24	6.7	-7.85
Central African Republic	-1.7	-1.15	0.03	-2.44
Chad	1.42	6.28	0.62	-1.48
WAEMU	1981-1981-96	1996-05	1981-1996	1996-2005

¹⁰ Fosu (2011) finds substantial regional and country differences in the relation between economic growth and poverty, in his statistical analysis for developing countries.

Benin	0.36	1.52	0.96	-2.35
Burkina Faso	1.47	3.45	-0.58	-2.18
Côte d'Ivoire	-2.14	-0.46	8.45	-1.65
Guinea- Bissau	0.44	-1.59	2.65	-0.98
Mali	-0.44	2.73	-0.22	-4.76
Niger	-2.43	-0.07	2.24	-2.21
Senegal	-0.48	1.7	-1.71	-5.07
Togo	-1.4	0.48	-1.56	3.65

Notes: Per-capita GDP growth rates are the annual averages values from World Bank database (2011). P0 is the headcount index. Growth rates of P0 are calculated as the log-differences using latest year and star-year values, divides by the number of years between the two periods, x 100 percent.

Source: World Bank database 2011 and author calculations.

4. Empirical Methodology

4.1 Data

The data are drawn from World Bank PovcalNet¹¹ and the World Development Indicators 2011. Data from PovcalNet are widely used in international Panel studies. Recent studies, including Adams (2004) and Fosu (2009, 2010, 2011), used poverty data from the same source.

The data consist of:

- The Headcount index (P0) which is the useful measure of poverty. It is defined as the proportion of households whose income (or consumption depending on the underlying survey design) is less than the per-capita \$1.25 a day threshold which is equivalent to \$32.74 per month at 2005-PPP exchange rates.
- The poverty gap index (P1) which measures the extent to which individuals fall below the poverty line as a proportion of the poverty line. In others words, it measures the average gap (in percent of the poverty line) that separates the poor from the income poverty line.
- The economic growth which is measured by GDP per capita (in purchasing power parity constant (2000) international US \$) represented by GDPPC in our estimations.

¹¹ PovcalNet is an online Poverty Analysis tool. See <http://iresearch.worldbank.org/povcalnet>.

- The Gini index of income inequality¹² (GINI) is commonly used in the literature to measure inequality and to assess the impact of growth on poverty.
- Openness (OPEN) which is the sum of exports plus imports as a share of GDP. This measure is introduced into the model to take into account the influence of a policy of trade integration on poverty. In empirical literature, exist contradicting results regarding impact of international trade on poverty. Generally, some studies showed that, trade as important policy options to reduce poverty in developing countries through economic growth¹³.
- Population Growth (GPOP): Generally there is a positive relation between population growth and poverty. But, this links is complex¹⁴, evidence suggests that high fertility is as much a symptom of poverty as a cause.

Note that, just like Adams (2004) and Fosu (2009, 2011), we include in our regression the logarithm changes of all variables. Details of all variables and sources are also reported in appendix table 9.

Table 6 presents the summary statistics for CEMAC and WAEMU samples in both levels and growth rates. According to these data, 45.94 percent of the CEMAC population was poor, and 50.21 percent of the WAEMU population was poor, during the whole period. Moreover, the level of inequality income, measuring by the Gini index, is only slightly larger for CEMAC. We note that these summary statistics data mask important differences between the CEMAC region and WAEMU zone, reflecting the heterogeneity across region. The appendix table 10 presents the summary statistics for all variables, including openness and population growth measures.

¹² The measured Gini coefficient is a standard measure of inequality which is scaled to lie between zero (perfect equality) and 100 (perfect inequality).

¹³ See for instance Dollar and Kraay (2001, 2002).

¹⁴ See, for instance, World Bank. (2001). The International Development Goals: Strengthening Commitments and Measuring Progress. Background note prepared by the World Bank Group for the Westminster Conference on Child Poverty, London, 26 February, pp.12.

Table 6: Growth, poverty and inequality: summary statistics**A. Variables in Levels, CEMAC versus WAEMU (in parentheses)**

Variables	Min		Max		Mean	
P0_1.25	1,030	(6,660)	83,150	(86,230)	45,948	(50,21)
P1_1.25	0,200	(1,020)	57,410	(53,310)	23,148	(22,82)
GDPPC	144,288	(154,106)	5399,984	(900,069)	1369,400	(315,878)
GINI	39,780	(34,410)	61,330	(54,14)	46,040	(42,231)

B. Growth (log-differenced) rates , CEMAC versus WAEMU (in parentheses)

Variables	Min		Max		Mean	
DLNP0_125	-1.860	(-1.919)	1,245	(4,660)	-0,449	(0,514)
DLNP1_125	-2,463	(-3,826)	1,356	(7,191)	-0,942	(0,388)
DLNGDPPC	-1,282	(-1,845)	3,165	(1,931)	0,023	(-0,368)
DLNGINI	-1,425	(-2,481)	0,000	(0,814)	-0,326	(-0,275)

4.2 The Model

Here, we use panel data to analyze how economic growth affects poverty in CEMAC and WAEMU zone. In fact, we use a linear parametric regression of poverty. It is important to note that, generally, all models in the literature use linear parametric model to estimate the growth elasticity of poverty. Except, a new form of model developed recently by Chambers (2011) who proposed a non-parametric approach to estimate the growth elasticity of poverty.

To arrive at the estimating model, we purpose an expanded model, adapting that proposed by Ravallion and Chen (1997)¹⁵ and used by several economists as Bourguignon (2003) and Adams (2004).

$$\ln P_{it} = \alpha_i + \beta_1 \ln GDPPC_{it} + \beta_2 \ln GINI_{it} + \beta_3 \ln OPEN_{it} + \beta_4 \ln GPOP_{it} + \delta t + \varepsilon_{it} \quad (1)$$

¹⁵ The Ravallion and Chen Model (1997) is expanded here by adding three variables: the measure of inequality, openness and population growth. In fact, there model exclude the changes in inequality.

Where $\ln P_{it}$, is the logarithm of headcount index measured as the proportion of the population below the poverty line in region i during time period t , $\ln GDPPC_{it}$ is the logarithm of GDP per capita level , $\ln GINI_{it}$ is the logarithm of the Gini index, $\ln OPEN_{it}$ represent the logarithm of openness measured as the sum of exports plus imports as a share of GDP and $\ln GPOP_{it}$ the logarithm of population growth. α_i is the fixed effect term, δ a trend rate of change over time t and ε_{it} a white-noise error term that include errors in the poverty measure.

Taking the first differences in Equation (1), α_i , the fixed effect term, can be eliminated in order to obtain :

$$\Delta \ln P_{it} = \delta + \beta_1 \Delta \ln GDPPC_{it} + \beta_2 \Delta \ln GINI_{it} + \beta_3 \Delta \ln OPEN_{it} + \beta_4 \Delta \ln GPOP_{it} + \Delta \varepsilon_{it} \quad (2)$$

Where $\Delta \ln P_{it} = \ln P_{it} - \ln P_{i(t-1)}$. Equation (2) is the main model of interest.

However, the logarithm form is commonly applied in several recent studies as those of Adams (2004) and Fosu (2010, 2011). In fact, this form permits to present the elasticities after estimations. In equation (2), the rate of poverty reduction (P) is regressed on the rate of changes in GDP per-capita, the rate of changes in inequality with the rate of changes of others control variables (openness and population growth). Equation (2) represents the model in which the partial growth elasticity of poverty equal β_1 and the inequality elasticity of poverty is called β_2 are estimated. For the others control variables, β_3 and β_4 are respectively, the elasticity of poverty with respect to openness and population growth.

However, in the empirical exercise, we apply three estimations for each sample, named as “the naïve model”, “the standard model” and “the improved standard model”. These terms are specified by Bourguignon (2003). First, we can estimate in a “naïve model¹⁶”, the total growth elasticity of poverty, by regressing only observed changes in the poverty rate on observed changes in GDP per-capita. Second, the “standard model” includes the observed change in income inequality, as an additional explanatory variable. Third, in the last model, which

¹⁶ This term of naïve model is presented by Bourguignon (2003). This model was used previously by Ravallion and Chen (1997). Moreover, analyze of this form of model is also presented by Bresson (2007).

is termed “the improved standard model” contain two additional variables: the measures of population growth and openness.

5. Empirical Results and discussion

This section presents the estimation results for CEMAC and WAEMU samples.

5.1 Estimation results

Equation (2) is estimated using random effects specification¹⁷, with the incidence of poverty P_0 , as measure of poverty, for CEMAC and WAEMU samples. For each specification, we apply the three models: “the naive model”, “the standard model” and “the standard improved model”. These three different models are compared with each other. The estimation results are reported in tables 7 and 8. After, we compare the results for CEMAC sample, with the results for WAEMU sample. To ensure validity of the statistical results, we give the heteroscedastic robust t-statistics in parentheses. Based on the Hausman test reported in tables 7 and 8, the random effects estimates seems statistically superior to the fixed effects¹⁸. Results confirm heterogeneity of results between CEMAC region and WAEMU zone.

First, , the naïve model suggests a insignificant positive elasticity of poverty with respect to growth at 0.85 %, in the CEMAC zone, and a significant negative growth elasticity of poverty, respectively at -1.23 % in the random effects approach, in the WAEMU region. The positive trend of growth elasticity on poverty for CEMAC sample don’t surprises us, when we regard the statistical relation between growth and poverty in individual CEMAC countries ; and the finding for WAEMU sample imply that growth reduce poverty, a 10 percent rise in economic growth should be translated to a reduction in rate of poverty growth by 12.3 percent.

Second, concern “the standard model”, the regression results show, a positive insignificant growth elasticity of poverty at 0.88 %, with a high positive

¹⁷ The Random effect model is also used by Fosu (2009, 2010). Note that the results reported by Adams (2003, 2004), for instance, are based on Ordinary Least Squares (OLS).

¹⁸ Fosu (2009) find a similar result, based on the Hausman test.

significant inequality elasticity of poverty for the CEMAC sample at 4.58 % ; and a negative significant elasticity of poverty with respect to growth at -1.18 % with a positive insignificant inequality elasticity of poverty at 1.5 % for the WAEMU sample. This means that, a 1 % increase in income inequality will increase poverty by 4.58 %., in the CEMAC zone; and a 10 % increase in economic growth can be expected to produce a 11.8 % decrease in the proportion of the poor.

Third, concern “the improved standard model”, the econometric results suggest a positive insignificant growth elasticity of poverty at 0.89 %, with a high positive significant inequality elasticity of poverty for the CEMAC sample at 5.07 %; and a negative significant elasticity of poverty with respect to growth at -1.20%, with a positive insignificant inequality elasticity of poverty at 1.47 %, for the WAEMU sample. In addition, the others control variables, as the measure of openness and the measure of population growth, present, insignificant coefficients of poverty elasticity in all regressions.

So, to conclude, the results between CEMAC and WAEMU samples appear to differ considerably by the significance of the coefficients of the poverty elasticities : the growth elasticity of poverty is significant only for the WAEMU sample, and the inequality elasticity of poverty is significant only for the CEMAC sample. Furthermore, the results of our empirical analysis are consistent with the economic literature¹⁹.

¹⁹ See for instance, Richard and Adams (2004), Fosu (2009).

Table 7: Economic growth and poverty: Random effects regression results 1981-2005

Panel CEMAC sample, Dependent variable = Difference in the Log of headcount index 1.25 \$ / person/day.

VARIABLES	Naïve model (1)	Standard model (2)	Improved standard model (3)
	dlnp0_125	dlnp0_125	dlnp0_125
dlngdppc	0.855 (1.017)	0.888 (1.018)	0.898 (1.050)
dlngini		4.580*** (1.071)	5.072** (2.112)
dlnopen			-0.0892 (0.504)
dlngpop			-0.416 (0.931)
Constant	-0.469 (0.850)	1.024 (1.609)	0.854 (1.585)
Observations	40	40	40
Number of country	5	5	5
H	0.14 [0.70]	1.55 [0.46]	1.30 [0.86]

Notes: Estimates obtained using random effects specification on the CEMAC panel sample. H is the Hausman specification test statistic with the respective p values in squares brackets. All variables expressed in log difference. Robust standard errors in parentheses (***) p<0.01, ** p<0.05, * p<0.1).

Table 8: Economic growth and poverty: Random effects regression results 1981-2005

Panel WAEMU sample, Dependent variable = Difference in the Log of headcount index 1.25 \$ / person/day.

VARIABLES	Naïve model (1)	Standard model (2)	Improved standard model (3)
	dlnp0_125	dlnp0_125	dlnp0_125
dlngdppc	-1.200*** (0.409)	-1.184*** (0.446)	-1.205** (0.482)
dlngini		1.500 (1.894)	1.475 (1.795)
dlnopen			0.0210 (0.348)
dlngpop			0.0125 (0.469)
Constant	0.0718 (0.642)	-0.700 (1.126)	-1.257 (1.227)
Observations	64	59	58
Number of country	8	8	8
H	0.01 [0.92]	0.68 [0.71]	1.12 [0.89]

Notes: Estimates obtained using random effects specification on the WAEMU panel sample. H is the Hausman specification test statistic with the respective p values in squares brackets. All variables expressed in log difference. Robust standard errors in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

5.2 Robustness exercise: Testing the effect of growth on poverty with the poverty gap index

As a robustness test, we re-estimated equation (2), with poverty gap index; results are reported in annex (tables 10 and 11). This exercise is supplementary panel estimation in CEMAC and WAEMU samples. We also use the three models, naïve, standard, and improved standard. In almost all cases, the general trends for the poverty gap index, in CEMAC and WAEMU samples, are similar for those obtain with the headcount index. However, the openness and population growth variables are significant only, for the regression using poverty gap index.

In fact, these measures seem to have significant effects on poverty in CEMAC region (respectively at 0.69 %, and -0.97%). On the contrary, only the change of population growth has negative significant effects on poverty in WAEMU region, at -0.41 %. Furthermore, results for the poverty gap index do not alter our conclusions.

6. Concluding Remarks

Using the panel data of CEMAC and WAEMU countries, for the period 1981-2005, the paper aims to examine empirically, the degree to which economic growth affect poverty in these economics. Moreover, we give a statistical analysis of economic growth and poverty in CEMAC and WAEMU individual countries. First, the paper finds that, except for Gabon, Côte d'Ivoire, Guinea Bissau, Niger and Togo, poverty measured at the \$1.25 per day, decrease slightly for all countries during the whole period. In this regard, we suggest that it will be difficult for these countries to attain the objective of reducing poverty by half by 2015 of MDGs. The CEMAC and WAEMU zone have an enormous challenge to reach this goal. Second, the paper finds also, there are considerable differences across time, and considerable regional differences (especially country differences), in the relation between economic growth and poverty. More interestingly, the nature of relationship between economic growth and poverty is not simple for all countries. For some countries the statistical relationship is consistent with the literature (Chad in CEMAC zone, and Benin, Côte d'Ivoire in WAEMU region) and in contrast to others, the relationship is reversed. (Eg, a GDP growth per-capita accompanied by increase in poverty or inversely)

However, for empirical analysis, we provide estimates for both headcount index and poverty gap index, at the \$1.25 poverty level, for CEMAC and WAEMU samples, with random effects specification. In this regard, our estimates are show to be robust to changes in poverty measure. As Adams (2004), Epaulard (2003), and Fosu (2009, 2010, 2011), our econometric results show that economic growth plays a vital role on poverty reduction.

We find substantial differences in poverty elasticities between the two regions. The regression results shows, that economic growth has a statistically significant impact of reducing poverty in WAEMU zone, and has no significant effect on poverty in CEMAC region. In addition, we find a statically impact of income inequality on poverty in CEMAC region and an insignificant impact of income inequality in WAEMU zone.

Furthermore, the others control variables, as the measures of openness and population growth are not significant in all regressions, except for the supplementary estimation (using poverty gap index). In this regard, this finding suggest to search others explanations. For this, first, the role of quality of institution is very important for explaining the CEMAC and WAEMU countries growth and poverty experience. In general, the growth loss associated with bad policies²⁰. In this regard, we suggest, there is need for deeper empirical work on “*impact of institutional quality in the growth-poverty nexus for CEMAC and WAEMU region*”. Second, we suggest, “*a country specific approach of economic growth and poverty in CEMAC and WAEMU countries*”. Then will we have a firm basis for defining specific policies for most effectively achieving poverty reduction.

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²⁰ Economic Commission for Africa (2006).

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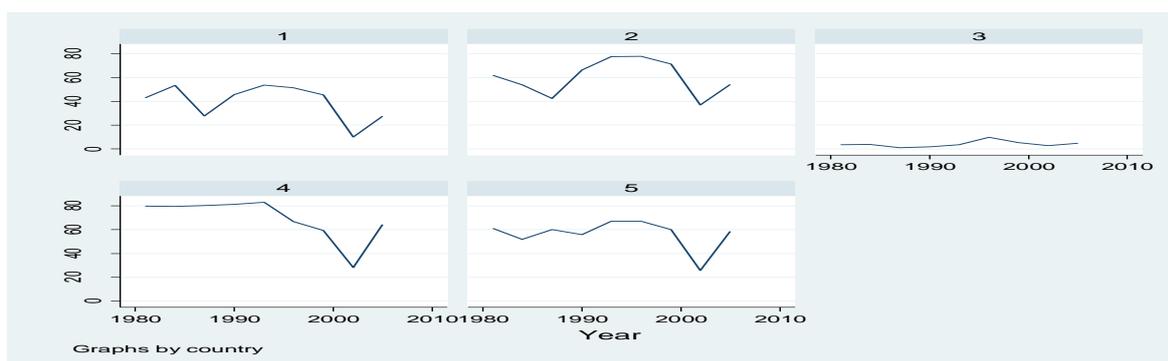
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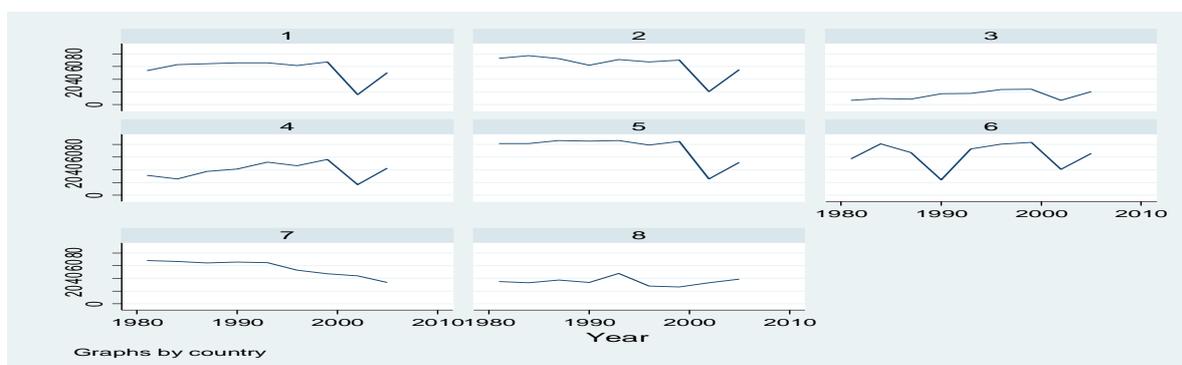
Figure 3: Poverty trends for CEMAC economies 1981-2005



Notes: The meaning of the numbers are respectively: 1 = Cameroon, 2= Republic of Congo, 3=Gabon, 4= Central African Republic, 5= Chad.

Source: PovcalNet database 2011.

Figure 4: Poverty trends for WAEMU economies 1981-2005



Notes: The meaning of the numbers are respectively: 1 = Benin, 2= Burkina Faso, 3=Côte d'Ivoire, 4= Guinea-Bissau, 5= Mali, 6= Niger, 7= Senegal, 8= Togo.

Source: PovcalNet database 2011.

Appendix Table 9: Details of all variables and sources

Variables	Abbreviations	Comments	Sources
Headcount index	Lnp0	Logarithm of headcount index	World Bank Povcalnet 2011
Poverty gap index	lnp1	Logarithm of poverty gap index	World Bank Povcalnet 2011
GDP per capita	lngdppc	Logarithm of per capita GDP	World Developpement Indicators 2011
Inequality (Gini index)	lngini	Logarithm of gini coefficient	World Bank Povcalnet 2011
Openness	lnopen	Logarithm of openness, defined as exports plus imports in GDP	World Developpement Indicators 2011

Growth of the Headcount index	dlnP0	Average annual growth of headcount index, computed as log difference between the last and first observation, divided by number of years (Adams , 2004; Fosu,2009, 2011)	World Bank Povcalnet 2011
Growth of the poverty gap index	dlnp1	Average annual growth of poverty gap index, computed as log difference between the last and first observation, divided by number of years (Adams, 2004; Fosu, 2009, 2011)	World Bank Povcalnet 2011
Growth of GDP per capita	dlngdppc	The growth rate is calculated as the log difference between the last and the first available observations, divided by the number of years (Adams, 2004; Fosu,2009, 2011)	World Developpement Indicators 2011
Growth of the Gini coefficient	dlngini	The growth rate is calculated as the log difference between the last and the first available observations, divided by the number of years (Adams, 2004 ; Fosu,2009, 2011)	World Bank Povcalnet 2011
Growth of openess	dlnopen	The growth rate is calculated as the log difference between the last and the first available observations, divided by the number of years	World Developpement Indicators 2011
Growth of population growth	dlngpop	The growth rate is calculated as the log difference between	World Developpement Indicators 2011

		the last and the first available observations, divided by the number of years (Fosu, 2011)	
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Appendix Table 10: Summary statistics of all variables

A. Variables in Levels, CEMAC versus WAEMU (in parentheses)

Variable	Min		Max		Mean	
P0_1.25	1,030	(6,660)	83,150	(86,230)	45,948	(50,21)
P1_1.25	0,200	(1,020)	57,410	(53,310)	23,148	(22,82)
GDPPC	144,288	(154,106)	5399,984	(900,069)	1369,400	(315,878)
GINI	39,780	(34,410)	61,330	(54,14)	46,040	(42,231)
OPEN	25,710	(29,625)	138,664	(104,589)	70,633	(57,072)
GPOP	1,637	(1,459)	3,612	(4,428)	2,677	(2,735)

B. Growth (log-differenced) rates, CEMAC versus WAEMU (in parentheses)

Variable	Min		Max		Mean	
DLNP0_125	-1.860	(-1.919)	1,245	(4,660)	-0,449	(0,514)
DLNP1_125	-2,463	(-3,826)	1,356	(7,191)	-0,942	(0,388)
DLNGDPPC	-1,282	(-1,845)	3,165	(1,931)	0,023	(-0,368)
DLNGINI	-1,425	(-2,481)	0,000	(0,814)	-0,326	(-0,275)
DLNOPEN	-2,256	(-1,793)	4,255	(2,603)	0,178	(-0,113)
DLNGPOP	-2,306	(-4,192)	1,562	(1,770)	-0,834	(-0,196)

Appendix Tables 11 and 12: Robustness exercise, the use of poverty gap index as dependent variable (dlnp1), \$1.25 poverty standard.

Appendix Table 11: Economic growth and poverty: Random effects regression results 1981-2005.

Panel CEMAC sample, Dependent variable = Difference in the Log of poverty gap index 1.25 \$ / person/day.

VARIABLES	Naïve model (1) dlnp1_125	Standard model (2) dlnp1_125	Improved standard model (3) dlnp1_125
dlngdppc	0.248 (1.084)	0.264 (1.107)	0.246 (1.124)
dlngini		2.168*** (0.459)	3.540*** (0.795)
dlnopen			0.690** (0.320)
dlngpop			-0.947** (0.411)
Constant	-0.948 (0.695)	-0.241 (0.674)	-0.705 (1.091)
Observations	40	40	40
Number of country	5	5	5
H	0 [0.96]	0.09 [0.95]	0.61 [0.96]

Notes: Estimates obtained using random effects on the CEMAC panel sample. H is the Hausman specification test statistic with the respective p values in squares brackets. Robust standard errors in parentheses (***) p<0.01, ** p<0.05, * p<0.1)

Appendix Table 12: Economic growth and poverty: Random effects regression results 1981-2005.

Panel WAEMU sample, Dependent variable = Difference in the Log of poverty gap index 1.25 \$ / person/day.

VARIABLES	Naïve model (1)	Standard model (2)	Improved standard model (3)
	dlnp1_125	dlnp1_125	dlnp1_125
dlngdppc	-1.826*** (0.249)	-1.870*** (0.217)	-1.708*** (0.279)
dlngini		0.972* (0.583)	0.855 (0.772)
dlnopen			0.0299 (0.160)
dlngpop			-0.411* (0.240)
Constant	-0.285 (0.725)	-0.372 (0.895)	-0.222 (0.696)
Observations	64	59	58
Number of country	8	8	8
H	0.01 [0.92]	0.94 [0.62]	1.97 [0.74]

Notes: Estimates obtained using random effects on the WAEMU panel sample. H is the Hausman specification test statistic with the respective p values in squares brackets. Robust standard errors in parentheses (***) p<0.01, ** p<0.05, * p<0.1)

List of countries

CEMAC countries: Cameroon, Republic of Congo, Gabon, Central African Republic, Chad.

WAEMU countries: Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, Togo.