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The long-run effects of fiscal consolidation on economic activity in the CEMAC zone

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This study aims to analyze the long-run effects of fiscal consolidation on economic activity in the Economic and Monetary Community of Central Africa (CEMAC), a grouping of six countries (Cameroon, Congo, Gabon, Equatorial Guinea, the Central African Republic, and Chad) forming a monetary union. The empirical analysis of annual data from the Bank of Central African States (BEAC) over the 1987-2016 period first enabled us to identify 22 episodes of fiscal consolidations in all the CEMAC zone countries during the above-mentioned period. Secondly, by adopting the Fully Modified Ordinary Least Square (FMLOS) and the Dynamic Ordinary Least Square (DOLS) panel methods, our results show that fiscal consolidations have recessionary (Keynesian) effects on the CEMAC zone's economy. Those effects are mainly due to fiscal consolidations that focus on reducing public expenditure.

Keywords: Fiscal consolidations, economic activity, cointegrated panels, DOLS, FMOLS, CEMAC

JEL Classifications: C10, E13, E22 E62

1 Introduction

In the economic literature, opinions on the effectiveness of fiscal policy differ among economists. This policy has been the subject of numerous theoretical and empirical studies, which unfortunately did not lead to a unanimous conclusion. As the main tool of State Intervention, regardless of the approach (short-term or long-term), the fiscal policy aims at providing solutions to the problems of low economic growth, unemployment, current account deficit, and inflation. In short, its purpose is to ensure the objectives defined by Kaldor's magic

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square and to cushion exogenous shocks. This is even more true today because there is real doubt about the ability of monetary policy to deal with specific shocks and stabilize the economy.

In fact, due to the inability of the monetary policy to effectively stabilize the economy during the last economic and financial crisis (Mishkin, 2009), the world economy witnessed fiscal activism of such a magnitude that was last experienced during the "thirty glorious years". This was reflected by counter-cyclical fiscal policies which, in their wake, left huge public deficits and high levels of public debt which, today, are leading to austerity measures in many developed and developing countries. With this massive return to fiscal policy as a stabilization tool, its study has received renewed empirical interest and has been reflected through abundant literature in recent years.

One of the fields of study that emerges from this literature is the analysis of the macroeconomic effects of fiscal consolidations, which are defined as the set of measures used by the government to restore public finances, especially by reducing primary budget deficits. Fiscal consolidations result either from a reduction in public expenditure or an increase in tax revenues or from both measures simultaneously (Alesina and Ardagna, 2010). Many studies have performed an empirical analysis of the macroeconomic effects of these measures, but yet, the results diverge. While some of them argue that fiscal consolidations have expansionary effects (non-Keynesian effects) on the economy (Giavazzi and Pagano, 1990; Alesina and Perotti, 1996; Alesina and Ardagna, 1998 and 2010; Afonso, 2010), others rather stand for the opposite (Guajardo et al., 2014; Alesina et al., 2015; Yang et al., 2015; Carrière et al., 2018; Puig et al., 2021).

However, an in-depth examination of these studies leads to a number of observations: The first major observation is that they have so far been limited essentially to developed countries, especially those of the Organisation for Economic Co-operation and Development (OECD), thus neglecting developing countries, which are nevertheless experiencing problems related to the sustainability of their public finances. Another major finding is that those studies focus mainly on the short-term macroeconomic effects of fiscal consolidations, thus neglecting the long-run effects.

This study therefore proposes to analyze the long-run macroeconomic effects of fiscal consolidations in a small group of developing countries forming a monetary union: the Economic and Monetary Community of Central Africa (CEMAC). There are several reasons why the CEMAC zone would appear to be an ideal setting in which to address this issue. The first is the key role of fiscal policy as a stabilization tool in this subregion. Indeed, the CEMAC countries form a monetary union with fixed exchange rates, which means that in the face of a specific shock, macroeconomic stabilization relies essentially on fiscal policy, as the exchange rate channel - one of the main transmission channels for monetary policy - cannot be functional. This means that there can be no exchange rate adjustment, despite the fact that the various

CEMAC economies are renowned for their high level of external dependence, notably through the export of natural resources.

The second reason is the political relevance of this study. Indeed, the CEMAC zone comprises developing countries with unique economic characteristics and challenges. Focusing on this region enables a more targeted analysis of the effects of budget consolidation in a context that is highly relevant to policymakers. The results can directly inform policy decisions and contribute to sustainable public finance management in similar developing country contexts. In addition, the CEMAC zone faces particular challenges related to fiscal sustainability, such as heavy dependence on commodity exports and limited fiscal reserves. These factors influence the effectiveness and consequences of fiscal consolidation in the region. An analysis of the effects of fiscal consolidation in this region would therefore provide a better understanding of how these contextual factors interact with fiscal policy measures and shape macroeconomic outcomes.

Another methodological reason is the availability of data over a relatively long period, which is essential for a long-term analysis such as the one advocated in this study. Indeed, in order to analyze the long-term macroeconomic effects of fiscal consolidation in the CEMAC zone, we use the cointegrated panel approach, as it enables us to obtain long-term coefficients, after first studying the statistical properties of the various variables.

Indeed, an in-depth examination of the existing literature on the macroeconomic effects of fiscal consolidations enables us to find out not only that the econometric analysis in almost all studies is implemented without prior analysis of the statistical properties (stationarity and cointegration) of the different series, but also that the estimation technique used is the Ordinary Least Squares (OLS) (Alesina and Ardagna, 2012; Guajardo, 2014; Yang et al., 2015). Yet, inappropriate use of this technique can lead to spurious regressions. When, for example, the series are non-stationary, the use of the Ordinary Least Squares technique can provide invalid statistical inferences (Harris and Sollis, 2003). Thus, this paper contributes to the literature on the macroeconomic effects of fiscal consolidation by estimating a cointegrated panel model using the Fully Modified Ordinary Least Square (FMLOS) and Dynamic Ordinary Least Square (DOLS) methods, which have the particularity of being designed to correct the regressors' endogeneity problems, and the serial correlation found in the OLS estimator (Kao and Chen, 1995)

The rest of this paper is organized as follows: The second section reviews the theoretical and empirical literature on the macroeconomic effects of fiscal consolidations; the third section is devoted to the data and the identification of the different episodes of fiscal consolidations in

the CEMAC zone; the fourth section is dedicated to the presentation of the results; the fifth section concludes.

2 Literature Review

From an empirical point of view, the analysis of the macroeconomic effects of fiscal consolidations has been the subject of vast and divergent literature. Those works are largely motivated by those of Giavazzi and Pagano (1990), where it was found that Denmark and Ireland experienced sustained growth following major fiscal consolidation measures in those countries in the 1980s. This is because their results defied the traditional Keynesian theory, which predicts negative short-term economic effects of fiscal tightening policies via the fiscal multiplier mechanism. However, the different results obtained in those works remain very mixed. While some of them argue that fiscal consolidations have expansionary effects on the economy (Guajardo et al., 2014; Yang et al., 2015), others instead claim that they have recessionary effects (Alesina and Perotti, 1996; Alesina and Ardagna, 1998 and 2010; Burger and Zagler, 2008; Afonso, 2010).

Theoretically, these expansionary effects can be understood either from the supply or from the demand side (Alesina and Perotti, 1997). On the supply side, they are mediated through the labor market via the labor supply and the structure of the labor market (Alesina and Perotti, 1996; Alesina et al., 2002; Alesina and Ardagna, 2012), while on the demand side, they pass through wealth effects (Blanchard, 1990; Bertola and Drazen, 1993; Sutherland, 1997; Alesina and Perotti, 1997) and credibility effects (Alesina et al., 1990; Miller et al., 1990). Moreover, some authors prove that fiscal consolidations focused on reducing government expenditure tend to be less recessionary than those focused on raising taxes (Alesina and Perotti, 1996; Afonso, 2010; Alesina and Ardagna, 2012; Alesina et al., 2012; Yang et al., 2015).

In practice, however, the macroeconomic effects of fiscal consolidations can only be analyzed after their identification. In the literature, this has often been done using two approaches: A first approach, described as "quantitative", which consists of calculating the change in the cyclically-adjusted primary budget balance (CAPB) (Alesina and Ardagna, 2010; Alesina et al., 2012; Yang et al., 2015), and a second approach, described as "qualitative" or "narrative", which consists of using historical documents tracing the evolution of public finances (budget and settlement laws, reports of Central Banks, etc.) (Romer and Romer, 2010; Devries et al., 2011; Alesina et al., 2015; Guajardo et al., 2014; Carriere et al., 2018). Depending on whether these approaches were used individually or in combination (often for comparative purposes), the different results obtained in the literature remain divergent.

Following a quantitative approach, Alesina and Ardagna (1998) analyze the macroeconomic effects of fiscal consolidations in OECD countries over the the1960-1998 period. Their study shows that fiscal consolidations have non-Keynesian effects on the economy. Their results suggest various interpretations on both the demand and the supply sides. On the demand side,

they show that permanent fiscal consolidations increase aggregate demand via wealth effects (Blanchard,1990), and credibility effects (Alesina et al., 1990; Miller et al., 1990). On the supply side, they point out that fiscal consolidations that focus on tax increases are short-lived, and therefore should include reductions in public employment, transfers, and the wage bill to be sustainable. They argue that these measures make the labor market more efficient and increase supply, but only if they are supported by unions.

In the same vein, in a study aimed at finding the most effective combination of the different components of fiscal consolidations that can permanently reduce the debt-to-GDP ratio in 21 OECD countries, Alesina et al. (2012) find that fiscal consolidations that focus on public expenditure cuts lead to a more permanent reduction in the debt-to-GDP ratio and that they lead to smaller recessions than those that focus on tax increases. Moreover, their results show that those fiscal consolidations become expansionary when accompanied by policies to promote economic growth, such as the liberalization of the labor market and the market for goods and services. In another study still focusing on OECD countries, but this time using a narrative approach, Alesina et al. (2015) find that fiscal consolidations focused on public expenditure cuts are less costly in terms of slowing down the economy than those focused on tax increases, thus corroborating the results obtained a few years earlier by, among others, Alesina and Ardagna (2012).

In the same vein, Yang et al. (2015) use both the quantitative and qualitative approaches to examine the short-term effects of fiscal consolidations in 20 OECD countries over the 1970-2010 period, thereby conducting a comparative analysis of the two approaches. Their works show that fiscal adjustments have short-term recessionary effects on the economy and that those consisting of reducing public expenditure generate smaller output losses than those consisting of increasing taxes. Moreover, their results are valid for both approaches used, thus contradicting some studies that argue that the quantitative approach would tend to make fiscal adjustments expansionary, unlike the narrative approach (IMF, 2010; Devries et al., 2011; Afonso and Jalles, 2011).

Following the latter approach, Romer and Romer (2010) study the impact of tax changes on the US economy. Their study finds that tax increases have very recessionary effects on the economy. Specifically, after distinguishing between discretionary and statutory tax changes, they show that a tax increase of 1% of GDP leads to a decline in national output of about 3% over the next three years. Moreover, they point out that these effects are smaller for non-discretionary tax changes. Their results thus contradict those of Burger and Zagler (2008) who, a few years earlier, showed that the high growth rates recorded in the United States during the 1990s were due to the fiscal consolidations that took place during that period.

Similarly, Guajardo et al. (2014) study the effects of fiscal consolidations on the economy in OECD countries. Following a narrative approach, they find that fiscal consolidations have Keynesian effects on private consumption, private investment, and GDP. Furthermore, by

extending the quantitative approach, they find that contrary to their previous results, fiscal consolidations have had expansionary effects on the economy. In the same vein, using a narrative approach, Carriere et al. (2018) found in the case of 14 Latin American countries over the period that fiscal consolidations have contractionary effects on economic activity.

From a completely different angle, David et al. (2022) studied the effects of fiscal consolidation announcements on sovereign spreads in a panel of emerging economies over the period 2000-2008. Their results show on the one hand that sovereign spreads barely decline after executive budget announcements, and on the other hand that spreads decline significantly after the legislature announces approval of austerity measures, particularly in economies with high sovereign spreads, debt levels, and credit risk ratings. On the other hand, they find that consolidation announcements are less binding as sovereign spreads narrow.

These contradictory results show that the debate on the macroeconomic effects of fiscal consolidations is still pending. While some studies argue that they have expansionary effects on the economy, others prove the opposite and sometimes even for the same sample of countries, thus supporting the idea that "we know relatively little about the effect of fiscal policy on growth" (Alesina and Ardagna, 2010).

As far as the CEMAC zone in particular is concerned, to our knowledge there are no studies analyzing the effects of budget consolidation on economic activity within an exclusive framework. However, in recent years, numerous studies have been carried out to assess the effectiveness of fiscal policy in this zone. These studies have focused primarily on the cyclicality of budgetary policy and the size of fiscal multipliers. Overall, these studies show that fiscal policy is procyclical in the CEMAC zone (Adedejii and Williams, 2007; Guillaumont and Tapsoba, 2011; Mpatswe et al., 2011; Bikai, 2015), and that the size of fiscal multipliers is less than unity (Bikai et al. 2017; Wabo Nokam and Gankou, 2020), reflecting the ineffectiveness of fiscal policies for macroeconomic stabilization in this monetary union.

3 Methodology

3.1 Data and identification of fiscal consolidation episodes in the CEMAC zone

In this study, we use annual data over the 1987-2016 period. The choice of this period was dictated by the availability of fiscal data, including primary expenditure and primary revenues for all CEMAC countries. These fiscal data serve as a basis for identifying episodes of fiscal consolidations, i.e., years in which the government took effective action to reduce the public deficit, either by substantially reducing public expenditure or by raising taxes. All these data come from the Bank of Central African States (BEAC).

Of the two above-mentioned approaches to budget consolidation identification, we opt for a quantitative approach in this study. This choice is mainly justified by difficulties in accessing historical archives over a long period for all CEMAC countries, which would have allowed us

to also consider the narrative approach. However, although both approaches may in some contexts provide different episodes of fiscal consolidations (Kleis and Moessinger, 2016), they usually lead to almost similar conclusions in terms of their magnitude (Guajardo et al., 2014).

As in most empirical studies that make use of the quantitative approach, (Alesina and Perotti, 1995; Alesina and Ardagna, 1998, 2010, 2012; Afonso, 2010; Yang et al., 2015; Alberola and Sousa, 2017.), the cyclical correction in the calculation of the CAPB is done in this study following the methodology proposed by Blanchard (1993). It consists of regressing primary revenues *(R_t)* and primary expenditure (*G_t)* on a time trend *(trend) and* the output gap *(GAP_t)* in order to eliminate effects related to economic fluctuations such as inflation or changes in real interest rates.

For the cyclical correction of primary expenditure, for example, this can be formally presented as follows:

$$G_t = \alpha_0 + \alpha_1 Trend + \alpha_2 GAP_t + \varepsilon_t \quad (1)$$

Using the estimated coefficients $\alpha_0\, \alpha_1$, the next step is to calculate the value of primary expenditures adjusted for changes in the output gap based on the one-period lagged output gap GAP_{t-1}:

$$G_t^*(GAP_{t-1}) = \hat{\alpha}_0 + \hat{\alpha}_1 Trend + \hat{\alpha}_2 GAP_{t-1} \quad (2)$$

Thus, the change in cyclically adjusted primary expenditure is given by$G_t^*(GAP_{t-1}) - G_{t-1}$. The same procedure is followed to calculate the change in cyclically adjusted primary revenue $R_t^*(GAP_{t-1}) - R_{t-1}$ to derive the change in the cyclically adjusted primary balance (CAPB)given by:

$$\Delta CAPB = [R_t^* - R_{t-1}] - [G_t^* - G_{t-1}] \quad (3)$$

3.2 Definition of fiscal consolidation episodes

The definition of fiscal consolidation episodes is based on observed changes in the cyclically adjusted primary balance (*CAPB)*. In other words, a given period will be considered a fiscal consolidation episode if there is a significant change in the *CAPB* as a percentage of the GDP. Various arbitrary thresholds are used in the literature to assess the significance of the change in the *CAPB*, and thus define fiscal consolidation episodes. Table 1 below provides an overview of the different definitions given to fiscal consolidation episodes in some empirical studies.

Table 1: Definitions of fiscal consolidation episodes according to some empirical studies

Studies	**Criteria for defining fiscal adjustment episodes based on changes in the CAPB**
Alesina and Perotti (1995) Alesina and Ardagna (2010)	The change in CAPB is of at least one percentage point of annual GDP.
Alesina and Ardagna (1998)	The change in CAPB is of at least two percentage points of annual GDP or at least one and a half percentage points on average over the past two years.
Giavazzi et al. (2000)	The change in CAPB is at least one and a half percentage points of the annual GDP over two consecutive years.
Afonso (2010)	The change in CAPB is of at least one and a half standard deviations (in the panel) in one year, or at least one standard deviation on average over the past two years.
Alesina and Ardagna (2012)	Cumulative changes in CAPB are of at least two percentage points of GDP in two consecutive years and at least three percentage points of GDP in three or more years, with improvement in each year.
Yang et al. (2015)	An improvement in the *CAPB* of at least the standard deviation(σ_i) + the average $(\mu_i)$of the year under consideration for a single-year budget adjustment, and an improvement in the *CAPB* of at least$\mu_i + 1/3\sigma_i$ in the first year accompanied by a cumulative change of at least $\mu_i + 4/3\sigma_i$over two years or $\mu_i + 2\sigma_i$over three years or more for multi-year fiscal adjustments.

Source: The authors

The criteria summarized in the table above, while not exhaustive, can be considered standards for defining fiscal consolidation episodes following the quantitative approach (Yang et al., 2015). However, the choice of one or the other criterion remains optional and depends on the context. In this study, for each country, we consider that fiscal consolidation has taken place in a given year if the change in the cyclically adjusted primary balance in that year represents at least 1% of the GDP. The choice of this criterion was based on both the empirical literature (Alesina and Perotti, 1995; Alesina and Ardagna, 2010) and some historical facts specific to each CEMAC country, and thus on a semi-narrative approach. Indeed, after several simulations carried out using the various thresholds identified in the literature, the 1% threshold proved to be the most satisfactory, as beyond this threshold, certain episodes of budget consolidation

found in reports by international organizations (IMF, World Bank, BEAC, Bank of France), among others, are not taken into account.

Based on the above definition, we have identified 22 episodes of fiscal consolidations across the CEMAC countries. Table 2 below summarizes the different episodes of fiscal consolidations identified within the CEMAC zone.

Table 2: Summary of fiscal consolidation episodes in the CEMAC zone

Country	Fiscal consolidation episodes	Total number of episodes	Number of years
Cameroon	1987-1994, 2011-2016	2	14
Congo	1987-1990, 1992-1995, 2003, 2013-2016	4	13
Gabon	1987-1990, 1993-1994,1999, 2011-2016	4	13
E. Guinea	1987-1994, 2010-2016	2	15
RCA	1992-1996, 1999-2000, 2006, 2014-2016	4	10
Chad	1987-1988, 1990-1991, 1995, 2001-2005, 2010-2011, 2013-2015	6	15
CEMAC		22	80

Source: Authors' calculations based on BEAC data

This table shows that the number of years of fiscal consolidations varies from one country to another (except between Congo and Equatorial Guinea) and that the duration of consolidation episodes has not always been stable over time.

Figure 1 below shows that of the 22 fiscal consolidation episodes identified in the CEMAC zone, the majority (i.e., exactly 13 episodes) lasted three years or more, with a maximum of eight years observed between 1987 and 1994 in Cameroon and Equatorial Guinea, a period during which almost all CEMAC countries were under Structural Adjustment Programs (SAPs). Episodes lasting between one and two years were mostly observed in the Central African Republic, which had four of the nine recorded episodes, followed by Chad (two episodes), Gabon (two episodes), and Congo (one episode).

When fiscal consolidations are assessed not in episodes but rather in years, it becomes clear that fiscal consolidations in CEMAC have been concentrated mainly in three sub-periods: 1987-1991, 1992-1996, and 2012-2016.

Figure 1: Distribution of fiscal consolidation episodes in CEMAC according to their duration

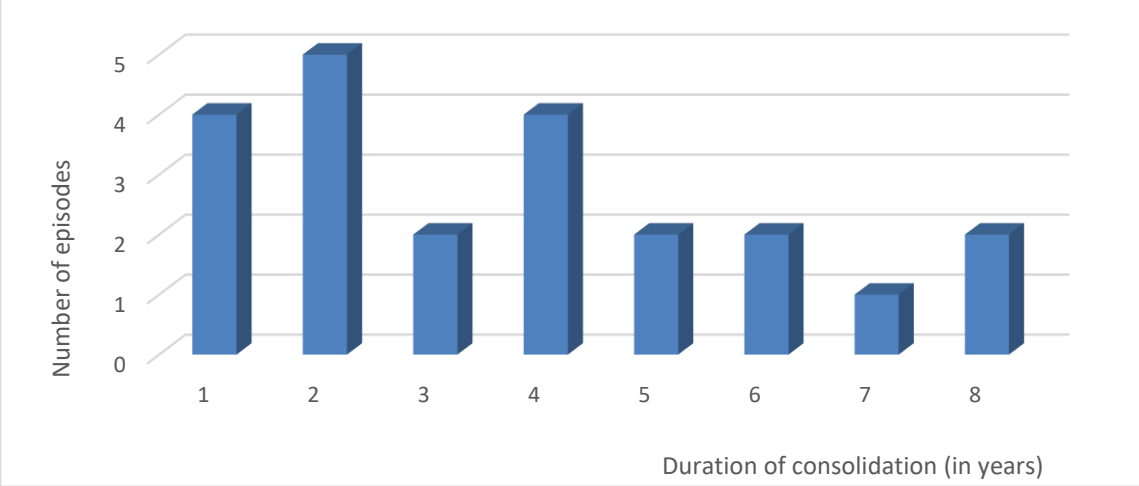
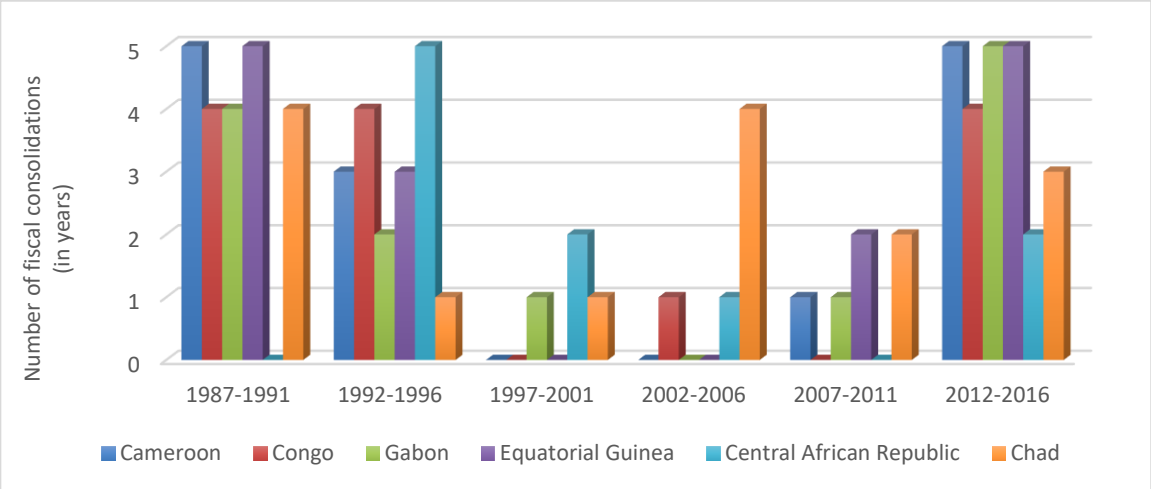


Figure 2: Distribution of budget consolidations (in years) by sub-periods in CEMAC



The fiscal consolidations observed during the 1987-1991 period can be attributed to the economic crisis that hit the zone in the mid-1980s and to the Structural Adjustment Programs (SAPs) prescribed by donors (the World Bank and the IMF), one of the key measures of which was to reduce the State's expenditure. Those observed during the 1992-1996 period are the continuity of the previous ones, with the only difference being that from 1994, in addition to budgetary adjustments, there was a monetary adjustment, which was the devaluation of the CFA franc.

When fiscal consolidations are assessed not in episodes but rather in years, it becomes clear that fiscal consolidations in CEMAC have been concentrated mainly in three sub-periods: 1987-1991, 1992-1996, and 2012-2016. The budget consolidations observed during the 1987-1991 period can be attributed to the economic crisis that hit the zone in the mid-1980s and to the Structural Adjustment Programs (SAPs) prescribed by donors (the World Bank and the IMF), one of the key measures of which was to reduce the State's expenditure. Those observed during the 1992-1996 period are the continuity of the previous ones, with the only difference being that from 1994, in addition to budgetary adjustments, there was a monetary adjustment, which was the devaluation of the CFA franc.

The fiscal consolidations observed during the 2012-2013 period can be attributed to the repeated declines in raw material prices, particularly oil prices on the international market. However, it is also true that, in addition to the above-mentioned periods, other years of fiscal consolidations were recorded in some CEMAC countries. This was for example the case in Gabon, in 1999, a year during which the country was consolidating its public finances, and in Chad between 2001 and 2005, the period during which the country implemented the third structural adjustment program (SAP III).

3.3 The model to consider

In the literature, two main approaches are used to analyze the macroeconomic effects of fiscal consolidations: a statistical approach, which consists of conducting a descriptive analysis of the different fiscal components and selected macroeconomic variables before, during, and after fiscal consolidation episodes (McDermott and Wescott, 1996; Alesina and Perotti, 1997; Giudice et Turini, 2007; Alesina and Ardagna, 2012), and an econometric approach, which relies on a pre-specified model. The authors (IMF, 2010; Alesina and Ardagna, 2010; Guajardo et al., 2014; Yang et al., 2015) chose the latter approach, and their method most often consisted of specifying and then estimating a dynamic panel model relating the proxy variable for the economy, and the proxy variable for the fiscal consolidation.

Drawing on these authors, the basic equation used to analyze the macroeconomic effects of fiscal consolidations in this study is as follows:

$$Y_{it} = \alpha + \beta CAPB_{it}^{fc} + \varepsilon_{it} \quad (4)$$

Where Y_{it} represents the logarithm of real economic activity for country i in year t. In this study, this variable is represented in turn by the logarithm of real GDP (*GDP*), the logarithm of private consumption (*PRIVCONS*), and the logarithm of private investment (*PRINV*). $CAPB_{it}^{fc}$ is the estimated size of fiscal consolidations (measured by the change in the cyclically adjusted primary balance as a percentage of GDP). ε_{it} represents an error term.

Moreover, given that the empirical literature reports that fiscal consolidations focused on government expenditure cuts are more likely to be expansionary than those focused on a tax increase, we refine our analysis by taking their composition into account. Therefore, in compliance with the literature (Guajardo et al., 2014; Yang et al., 2015), we split consolidations into two types: "expenditure-oriented" consolidations and "revenue-oriented" consolidations. The former corresponds to fiscal consolidations in which the reduction in government expenditure is proportionally greater than the increase in revenue, while the latter corresponds to fiscal consolidations in which the increase in revenue is proportionally greater than the reduction in expenditure. This distinction leads us to the following equation (5):

$$Y_{it} = \lambda_0 + \lambda_1 CAPB_{it}^{fc,G} + \lambda_2 CAPB_{it}^{fc,R} + \nu_{it} \quad (5)$$

Where $CAPB_{it}^{fc,G}$ and $CAPB_{it}^{fc,R}$ represent, respectively, the estimated size of fiscal consolidations focused on increasing government expenditure, and the estimated size of fiscal consolidations focused on increasing taxes.

3.4 Estimation procedure

The estimation procedure commonly used in the literature to analyze the macroeconomic effects of fiscal consolidations is to first estimate the pre-specified model using Ordinary Least Squares (OLS), and then to infer the cumulative effects over a given period (typically three years) using the *delta method*[1] (IMF, 2010; Guajardo et al., 2014; Yang et al., 2015). Yet, using OLS with non-stationary series can lead to spurious regressions involving invalid statistical inferences (Harris and Sollis, 2003). To avoid this, the estimation procedure adopted in this study focuses on a three-step approach: The first step consists of testing the stationarity of the different series used; The second step consists of analyzing the long-run equilibrium relationship between these different series; In the third step, the methods deemed appropriate are used to proceed with the empirical estimates.

3.4.1 Panel unit root tests

In the literature, there is a multitude of panel unit root tests, ranging from "first generation " tests (Maddala and Wu, 1999; Hadri, 2000; Levin et al., 2002; Im et al., 2003), to "second generation" tests (Pesaran, 2003; Bai and Ng, 2004; Moon and Perron, 2005). The former is based on the hypothesis of independence between individuals, while the latter is rather based

[1] In statistics, the delta method is a method for deriving an approximate probability distribution for a function from a normal asymptotic statistical estimator (Oehlert, 1992).

on the opposite hypothesis (existence of dependence between individuals). Given the economic structure and characteristics of the various CEMAC economies[2], in this study, we opt for a first-generation unit root test, namely that of Im et al. (2003) (IPS). The particularity of this test is that it is based on a double heterogeneity hypothesis: that of the autoregressive root, and that of the presence of a unit root in the panel. Indeed, if we consider the following autoregressive model:

$$Y_{it} = \rho_i Y_{it-1} + \delta_i X_{it} + \varepsilon_{it} \quad (6)$$

where: $i = 1,2,\ldots,N$ represent the countries observed over the period $t = 1,2,\ldots,T$; X_{it}exogenous variables with individual and time-fixed effects; $\rho_i$autoregressive coefficients, and ε_{it}stationary error terms.

If$\rho_i \prec 1$, the seriesY_{it} is considered weakly stationary. Meanwhile, if$\rho_i = 1$, then the seriesY_{it} contains a unit root. Most first-generation unit root tests (Levin et al., 2002; Hadri, 2000; Breitung, 2000) assume thatε_{it} is normally distributed (iid) and that$\rho_i = \rho$ for all i. This implies that the autoregressive rootρ_i is homogeneous for all the individuals in the panel and that the individual processes are transversely independent. However, Pesaran and Smith (1995) point out that potentially large biases can result from the inclusion of homogeneous parameters in the autoregressive process, hence the importance of parameter heterogeneity in dynamic panel data models.

The panel unit root test of Im et al. (2003) that we adopt in this study allows us to obtain heterogeneous autoregressive coefficients (ρ_i). This seems more reasonable to us, given the socio-economic conditions of each CEMAC country. The IPS test averages the unit root tests of Augmented Dickey-Fuller (ADF) while considering different orders of correlation between the series, i.e.,$\varepsilon_{it} = \sum_{j=1}^{p_i} \varphi_{ij}\, \varepsilon_{it-j} + u_{it}$ Substituting this expression into equation (6), we get:

$$Y_{it} = \rho_i Y_{it-1} + \sum_{j=1}^{p_i} \varphi_{ij}\, \varepsilon_{it-j} + \delta_i X_{it} + u_{it} \quad (7)$$

Where p_i is the number of lags in the ADF regression. The null hypothesis of the test is that each series in the panel contains a unit root (i.e., $H_0: \rho_i = 1$), while the alternative hypothesis is that at least one of the individual series in the panel is stationary (i.e., $H_1: \rho_i \prec 1$). Im et al. (2003) define a *t-bar* statistic as the average of the individual Augmented Dickey-Fuller (ADF) statistic ($t - bar = \frac{1}{N}\sum_{i=1}^{N} t_{\rho_i}$). This statistic is normally distributed under the null hypothesis with the critical values provided by Im et al. (2003).

[2] The CEMAC countries form a monetary union that is quite heterogeneous in terms of their productive structures, as shown by the economic description of these countries in the appendix.

3.4.2 Panel co-integration tests

Cointegration tests enable us to establish a possible long-run relationship between the different series when unit root tests reveal that they are non-stationary at the level. In this study, we use the panel cointegration test of Pedroni (1999, 2004). This choice is justified by the fact that it takes into account the heterogeneity between the different individuals in the panel. Given this heterogeneity, Pedroni's (1999, 2004) cointegration test, which also provides cross-sectional interdependence with the different individual effects, is specified in this study as follows:

$$Y_{it} = \alpha_i + \delta_t + \beta CAPB_{it}^{cf} + \varepsilon_{it} \quad (8)$$

whereY_{it} and$CAPB_{it}^{cf}$ are the log of real economic activity and the estimated size of fiscal consolidations, respectively; α_i andδ_t are country and time fixed effects, respectively. $\varepsilon_{it}$are the estimated residuals, representing the deviations from the long-run relationship.

To test the null hypothesis of no cointegration ($\rho_i = 1$), a unit root test is applied to the residuals as follows:

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + \omega_{it} \quad (9)$$

Pedroni (1999, 2004) proposes two categories of cointegration tests, one based on the “within” intradimensional approach, and the other based on the “between” interdimensional approach. The latter category is more general in the sense that it allows heterogeneity between individuals under the alternative hypothesis. The test based on the "within" approach includes four statistics while the one based on the "between" approach includes three. These two categories of tests are distinguished by the specification of the alternative hypothesis: For the first category, it is the following$H_1: \rho_i = \rho < 1, \forall i:$; and for the second category, it is written: $H_1: \rho_i < 1, \forall i$.

3.4.3 Estimation method

Although cointegration tests make it possible to establish whether or not there is a long-run relationship between a set of macroeconomic variables, they do not provide any information about the value of the estimated parameters. For a panel model, when a cointegration relationship is established between the different variables, an efficient estimator must be used. In this study, we use two estimators: the Fully Modified Ordinary Least Square (FMOLS) estimator and the Dynamic Ordinary Least Square (DOLS) estimator, because they appear to be more efficient in the context of cointegrated panel models, even though the FMOLS estimator has a small sampling bias, unlike the DOLS estimator, which is more efficient (Kao and Chiang, 2001).

4 Empirical results

4.1 Results of the unit root and cointegration tests

Table 3 below presents the results of the Im et al. (2003) unit root test applied to the main variables.

Table 3: Results of the Im et al. unit root test (2003)

Variables	IPS statistics in levels	Critical chance	IPS statistics in 1st difference	Critical chance	Order of integration
GDP	0.20196	0.5800	-2.95914	0.0015	I (1)
CAPB	-0.19933	0.4210	-8.21019	0.0000	I (1)
PRIVCONS	2.00055	0.9773	-7.53112	0.0000	I (1)
PRIVINV	-0.02219	0.4912	-5.26435	0.0000	I (1)

Notes: I (1) indicates that the series studied is integrated of order 1, thus stationary in the first difference. Source: Authors' calculations

As these results indicate, all the series used are integrated of order 1, hence the need to carry out a cointegration test to see whether or not there is a long-run equilibrium relationship between the different variables.

Table 4 below presents the results of the Pedroni (1999, 2004) cointegration test applied to the baseline model.

Table 4: Results of Pedroni's (1999, 2004) cointegration tests

Variables	*GDP, CAPB*		*PRIVCONS, CAPB*		*PRIVINV, CAPB*	
Test statistics	value	Critical chance	value	Critical chance	value	Critical chance
Panel v-Statistic	6.1633	0.0000	-1.0752	0.8589	0.7474	0.2274
Panel rho-Statistic	-2.087	0.0184	-2.6488	0.0040	-5.1733	0.0000
Panel PP-Statistic	-2.6768	0.0037	-3.6919	0.0001	-5.9511	0.0000
Panel ADF-Statistic	-2.5454	0.0055	-3.5491	0.0002	-0.9128	0.1807
Group rho-Statistic	0.8409	0.7998	-0.8005	0.2117	-1.7318	0.0416
Group PP-Statistic	-0.3597	0.3595	-4.2284	0.0000	-4.5206	0.0000
Group ADF-Statistic	-0.2411	0.4047	-3.7373	0.0001	-2.5451	0.0055

Source: Authors' calculations

From the results in this table, we can conclude that there is a long-run equilibrium relationship between the different variables used in the basic model. Indeed, for each variant of this model, at least four out of seven statistics in the Pedroni (1999, 2004) test reject the null hypothesis of no cointegration.

4.2 The long-run effects of fiscal consolidation on economic activity in the CEMAC zone

Given the results of the unit root and cointegration tests, the analysis of the macroeconomic effects of fiscal consolidations in this study is carried out using estimation techniques specific to cointegrated panels, notably the DOLS and FMOLS methods. Table 5 below presents the estimated coefficients of the macroeconomic effects of fiscal consolidations in the CEMAC zone, obtained from the basic model provided by equation (4).

Table 5: Macroeconomic effects of fiscal consolidations in the CEMAC zone

	Estimation method					
	FMOLS			DOLS		
Variables	Real GDP	Private consumption	Private investment	Real GDP	Private consumption	Private investment
Fiscal consolidation	-1.113** (0.5404)	-0.063** (0.025)	-0.094** (0.039)	-1.835*** (0.466)	-0.069 (0.029)	-0.089** (0.044)
R-Squared	0.137	0.590	0.475	0.495	0.666	0.557
Adjusted R-Squared	0.105	0.574	0.456	0.427	0.632	0.501
Number of countries	6	6	6	6	6	6

Notes: Values in parentheses represent standard deviations. ** and *** indicate the level of significance of the coefficients estimated at the 5% and 1% thresholds respectively.
Source: Authors' calculations

The results reported in this table reveal that fiscal consolidations have negative effects on the CEMAC zone's economy, corroborating, among others, those of Guajardo et al. (2014) and Yang et al. (2015), and those recently obtained by Woldu and Kano (2023) in the short term in the case of a sample of Sub-Saharan African countries over the period 2000-.2019. These effects are more pronounced on economic growth than on the components of aggregate demand which are private consumption and private investment. These results thus confirm the Keynesian presumption that fiscal consolidations would have recessionary effects on the economy. Thus, an improvement in the cyclically-adjusted primary balance would lead to a decline in economic growth, private consumption, and private investment in the CEMAC zone.

However, some researchers show that the effects of fiscal consolidations on the economy depend on their composition, and point out, by the way, that fiscal consolidations focused on

reducing public expenditure would tend to be expansionary, while those focused on increasing taxes would tend to be recessionary. Do those findings apply to CEMAC?

4.3 Compositional effects of consolidations in the CEMAC zone

This subsection focuses on the empirical analysis of the compositional effects of fiscal consolidations on the CEMAC zone's economy. This analysis enables us not only to isolate the effects of public expenditure cuts and tax increases on the economy but also to confirm or reject the hypothesis that fiscal consolidations focused on public expenditure cuts tend to be expansionary at the expense of those focused on revenue increases. The results of the estimation of equation (5) specified above by the FMOLS and DOLS methods are summarized in Table 6 below:

Table 6: Compositional effects of fiscal consolidations on the CEMAC zone's economy

	Estimation method					
	FMOLS			DOLS		
Variables	Real GDP	Private consumption	Private investment	Real GDP	Private consumption	Private investment
Expense-driven consolidations	-0.080*** (0.0265)	-0.071*** (0.027)	-0.122*** (0.042)	-0.099*** (0.029)	-0.087*** (0.033)	-0.133** (0.052)
Revenue-driven consolidations	0.0218 (0.049)	0.003 (0.051)	0.068 (0.079)	0.052 (0.080)	0.015 (0.084)	0.138 (0.139)
R-Squared	0.5800	0.592	0.485	0.702	0.680	0.607
Adjusted R-Squared	0.5616	0.574	0.463	0.637	0.617	0.497
Number of countries	6	6	6	6	6	6

Notes: Values in parentheses represent standard deviations. ** and *** indicate the level of significance of the coefficients estimated at the 5% and 1% thresholds respectively.
Source: Authors' calculations

These results indicate that fiscal consolidations based on public expenditure cuts have recessionary effects on the CEMAC zone's economy, while those based on tax increases have rather neutral effects. Thus, the Keynesian effects of fiscal consolidations on the economy, as observed above, are mainly due to the reduction in public expenditure. The neutral effects of tax-increasing-based fiscal consolidations can be explained by, among other things, the predominance of the informal sector in CEMAC countries, and the relatively low weight of tax revenues in total revenues, which are mainly made up of revenues linked to raw material exports, particularly oil, whose prices fluctuate widely.

5 Conclusion

This paper aimed at analysing the macroeconomic effects of fiscal consolidations in the CEMAC zone. After identifying the different episodes of the said consolidations, the empirical analysis revealed that fiscal consolidations have Keynesian effects on the said zone's economy. After taking the composition of these fiscal consolidations into account, our results showed that the observed Keynesian effects would emanate mainly from fiscal consolidations focused on public expenditure reduction, as those focused on tax increases tend to have neutral effects on the economy, contrary to what is observed in developed countries. This result is problematic for CEMAC countries insofar as fiscal revenues are mainly derived from the export of raw materials, the prices of which fluctuate greatly. Indeed, in the face of a decline in raw material prices, as has been the case in recent years, the risk of fiscal policy procyclicality is very high in CEMAC. A possible procyclicality implies, among other things, a decrease in public expenditure during economic downturns, which, according to our results, will accentuate recessions. It would therefore be interesting, for example, for the CEMAC zone's country to create a common stabilization fund for the exploitation of revenues from the export of raw material (particularly oil), in order to protect themselves against potential declines in the price of these materials on the international market.

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Appendices: Economic description of CEMAC countries

Appendix 1: Productive and export structure of CEMAC countries

- **Cameroon**

	Crude oil	Cocoa	Coffee	Cotton	Raw wood	Aluminum	Bananas	Rubber
1987-2000	51.1%	10%	9.1%	5.7%	11.1%	7%	3.2%	2.5%
2001-2016	63%	14.3%	2.7%	5%	3.9%	5.4%	3%	2.4%

- **Congo**

	Crude oil	Gas, propane and butane	Petroleum products	Tropical woods	Eucalyptus logs	Sugar
1987-2000	81.91%	0%	1.5%	7.6%	1.65%	0.76%
2001-2016	88.74%	1.4%	1.9%	5%	0.13%	0.30%

- **Gabon**

	Crude oil	Manganese	Uranium	Wood
1987-2000	76.1%	7%	2.1%	12%
2001-2016	81.4%	8.1%	0%	8%

- **Equatorial Guinea**

	Crude oil	Methanol and Other Gases	Wood	Cocoa	Coffee
1987-2000	41.2%	0%	28.7%	10%	0.4%
2001-2016	74%	21%	0.80%	0.02%	0.002%

- **Central African Republic**

RCA	Cotton	Diamonds	Coffee	Tobacco	Wood	Gold
1987-2000	10.5%	46.4%	9.2%	1.1%	20.4%	0.11%
2001-2016	2.7%	28.6%	1.9%	0.12%	44.4%	0.37%

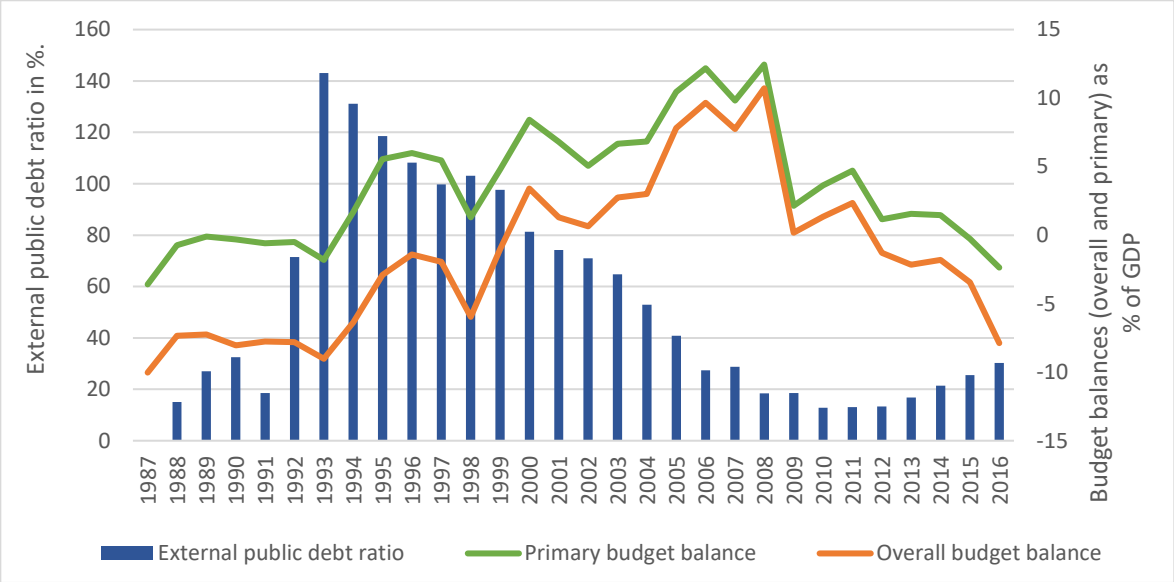
- **Chad**

	Cotton fiber	Cattle	Crude oil	Gum arabic
1987-2000	44.1%	30.9%	0%	1.8%
2000-2016	9.5%	16.6%	69.5%	2.6%

Notes: The figures in the tables represent the share of production exported as a percentage of total exports. Source: Authors' calculations based on BEAC data

As the tables above show, the CEMAC economies are dominated by the natural resources sector, particularly oil, which is the main source of export revenue for most member countries, making the region vulnerable to fluctuations in commodity prices.

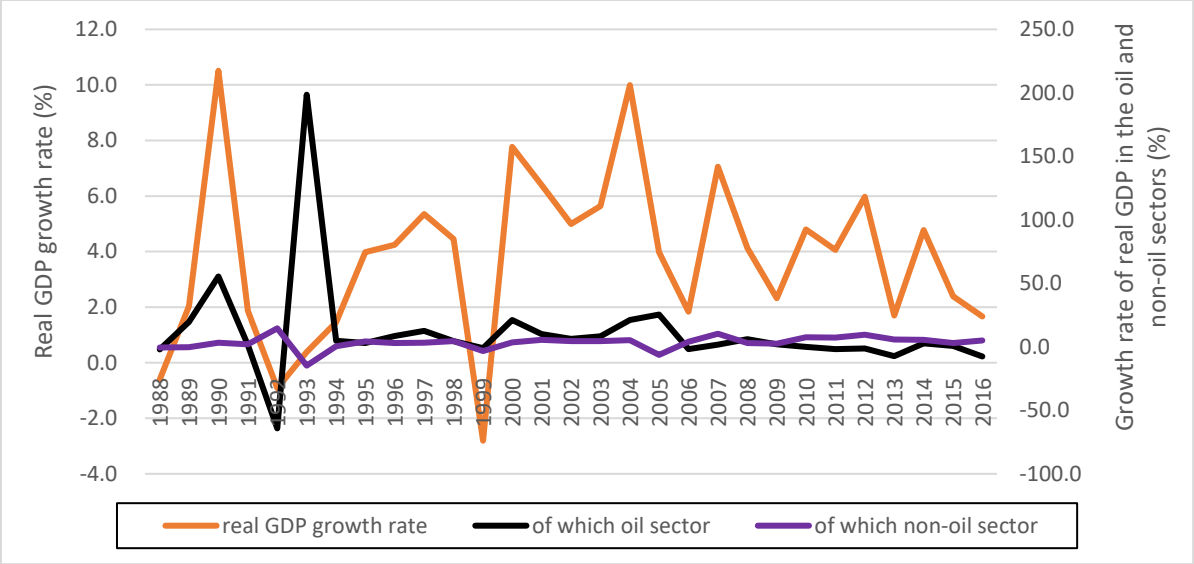
Appendix 2: Evolution of budgetary balances (in % of GDP) and the external public debt rate in the CEMAC zone



Source: Authors based on BEAC data

Budget deficits are common in the CEMAC zone due to the volatility of revenues from natural resources and the sometimes-inefficient management of public finances. Faced with these permanent budget deficits, some CEMAC countries are obliged to go into debt in order to compensate for the fall in oil revenues. Faced with this, budget adjustments are often imposed by international donors, notably the IMF, to restore balance to public finances.

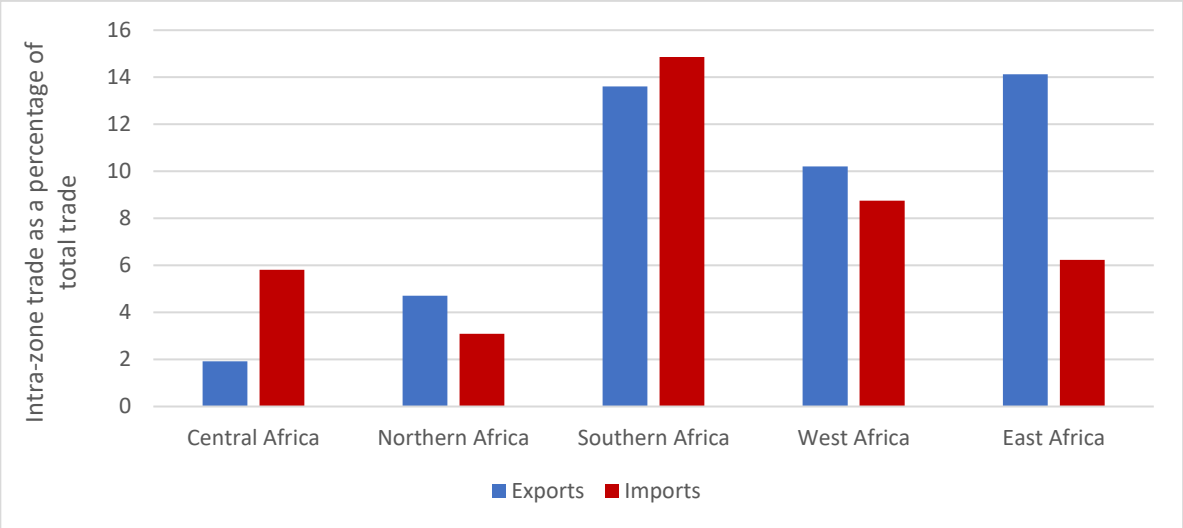
Appendix 3: Evolution of the real GDP growth rate in the CEMAC zone



Source: Authors based on BEAC data

As shown in the figure above, economic growth in CEMAC is mainly driven by the oil sector.

Appendix 4: Intensity of intra-regional trade in Central Africa compared with other Economic and Regional Communities (RECs) in 2017



Source: Authors based on UNCTAD data

As the graph above shows, Central Africa is the least commercially integrated of all the RECs in Africa. In 2017, intra-regional trade accounted for an average of 3.8% of total trade in Central Africa, compared with 14.2% in Southern Africa and 10.8% in East Africa. This low level of regional integration is often attributed to poor transport infrastructure and non-tariff barriers.