Deficit Financing and Economic Return to Public Expenditure in the CEMAC Member Countries

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Abstract
This paper examines the long-term association between the productivity of public expenditure and sources of deficit financing using panel data covering five CEMAC member countries for the period 1980 to 2018. Addressing issues of cross-sectional correlation and panel heterogeneity associated with panel data analysis alongside panel cointegration, the Fully Modified Ordinary Least Squares and Dynamic Ordinary Least Squares were employed. The findings reveal that each unit of external debt inflow increases the productivity of government recurrent spending but reduces that of government spending on investment although the effect of loans from domestic banking system is salutary. Debts raised via other sources such as special, excess reserves and privatization renders government investments productive. Thus, borrowings from domestic banking system can be more sustainable and consequently the study suggests that both external donors, policy makers and internal stakeholders, instead of dishing out more credit to CEMAC governments, should focus efforts on improving on the monitoring of such loans that are granted to ensure judicious use.

Key words: Deficit financing; Economic return; Public Spending; CEMAC Countries

JEL Classification Codes: C33, H50, H68

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1. Introduction

The nature of the nexus between deficit financing and macroeconomic variables is still a subject of controversies in economic literature and settling on the ideas of classical cum monetarist and Keynesian economists. According to the classical theory, fiscal deficit financed by debt is largely offset by the crowding out effect of deficit financing on private sector investment, and thus, lowers the level of economic growth. According to them, an increase in public investments leads to a reduction in the volume of savings available for private investments and thus, an increase in the cost of capital which relegates the private sector. On the contrary the "crowding-out" assertion was counter by the Keynesian doctrine pioneered by John Maynard Keynes (1883-1946), agreeing to the fact that though crowding out is possible in financial markets, there is a converse effect as well. According to the Keynesian economics, government expenditure is one important component of Aggregate Demand (AD) in the economy. Whenever AD falls short (during recessions), the government can increase expenditure, which in turn will increase AD, and in turn, will stimulate the economy. Bringing in the idea of rather a "crowding in" they contend that government spending will create an increase in aggregate demand. As the economy expands, the private sector has to bump up production and businesses find it profitable to add to their capacity so as to meet the greater consumer demands, thus more production requires that additional capital is invested (Hussain and Mahfuzul Haque, 2017). The Keynesians are of the view that deficit financing represents an important tool to achieve a level of aggregate demand consistent with full employment. They assume that an increase in government spending through the use of borrowed money shifts the aggregate demand curve upward and considered the assumption of full employment by the classical theory as unrealistic.

Based on the above opinions which characterized the empirical scene, there is bound to be no specific directives on how to identify and find ways to address the underlying causes of debt accumulation and vulnerability especially in African heavily indebted poor countries (HIPCs) including countries of the Central African Economic and Monetary Community (CEMAC)[1]: Cameroon, Gabon, the Central African Republic (CAR), Chad, the Republic of Congo and Equatorial Guinea. Since the 2008 global economic crisis, debt sustainability has subsequently deteriorated and risks to debt distress have sharply escalated. In 2014, none of the 30 African HIPCs were assessed to be in debt distress, and only five were at high risk. In 2018, more than one-third are back at, or near, their pre-HIPC starting point. Two countries (Chad and Mozambique) are in debt distress and a further nine (Burundi, Cameroon, and Central African Republic, Ethiopia, The Gambia, Ghana, Mauritania, Sao Tome and Principe and Zambia) are now at high risk of debt distress. Only four of the 30 countries are at low risk (Rustomjee, 2018). With the resumption of risks to debt sustainability, countries and their lenders need to find out ways of breaking out of chronic cycles of debt accumulation and forgiveness.

Thus, Chad, Cameroon, Central African Republic are three countries of the six CEMAC member countries which are now in debt distress. The situation could be further aggravated following that fact that since the mid-2014, the CEMAC sub-region has suffered from a deep economic and financial crisis[2] coupled with the challenging social, political and security problems in the region. The security situation has deteriorated in the Central African Republic and remains precarious in some other areas, such as the Lake Chad region, and Congo's Pool region. Tensions also persist in Cameroon's Anglophone regions. Though CEMAC's economic

[1] CEMAC is a french acronym for Communauté Économique et Monétaire de l'Afrique Centrale.

[2] The deterioration terms of trade in the region is due to prolonged and substantial weakness in the prices of key raw materials it exports, especially oil.

and financial situation has improved in the recent past, it still remains fragile. Economic activity remained well below pre-crisis levels. Non-oil growth slowed down to below 2 percent in 2018, reflecting the effect of fiscal consolidation, the legacy of domestic arrears and a volatile security situation in some regions. Overall regional growth was slightly higher at 2.5 percent, supported by an increase in the oil sector (IMF, 2019).

The estimated total public debt-to GDP ratio for the region though moved upwards to above 50 percent of GDP at end-2016, up from 28 percent at end-2014 (IMF, 2017), is expected to decline further to 47 percent of GDP in 2020 and to less than 40 percent by 2023 (IMF, 2019). No doubt, this is an indication that CEMAC member countries still need to borrow substantial amounts to finance their development. When the government decides to have a deficit budget, there is the need to provide funds for the excess expenditure, since a deficit budget means that the overall government expenditure is greater than its anticipated revenue accumulated through taxes. The government necessarily have to look for money from alternative sources (mostly through borrowing) to bridge the gap between its expenditure and revenue.

Therefore, the source of deficit financing can have an important effect on the sustainability of a country's debt. A rising public-debt burden means higher interest costs, which could divert resources from education, health care, and infrastructure. However, there is possibility that addressing the rising government debt and composition of debt can have implications on the sustainability of these debts. There is need to confront the issue of deficit-financing and growth with fresh empirical facts. We infer if borrowed funds factored in the budget can render spending productive. Productivity of public expenditure can be estimated by comparing growth in the total amount of output with growth in the total amount of input of spending used. Inferring from the traditional literature laid by Aschauer (1989), this relates to the economic return to public spending, where productivity will increase when more output is being produced for each unit of input compared with the previous year. Our analyses assume that the latter would depend on which source of financing enables government spending more productive.

The paper sought to investigate the implications of budget deficit financing on public expenditure productivity. The study employs panel data covering five CEMAC member countries for the period 1980 to 2018. Specifically, the paper evaluates the marginal effect (contributions) on the productivity of public consumption and investment expenditures of the basic external and domestic deficit financing with the former considered as a first derivative of public expenditure with respect to GDP. Results from the study indicate that deficits financed from external loans and the domestic banking system have significant positive influence on the productivity of government recurrent spending with a better effect from domestic financing while deficits financed from other sources such as special and trust fund, excess reserves and privatization proceeds renders government investments productive.

The remainder of the paper is organized as follows. Section 2 reviews the literature, while section 3 describes data, model, variables and descriptive statistics. The empirical methods are discussed in the fourth section. The empirical results are presented in the fifth section and we conclude the paper in Section 6.

2. An overview of theoretical and empirical literature

2.1 Theoretical highlights

Three main theories characterize the macroeconomic effects of budget deficit namely the Neoclassical, Keynesian, and Ricardian theories respectively.

The classical theory dwells on the economic doctrine of Adam Smith and his followers, and developed following the works of David Ricardo, John Stuart Mill and the Reverend Thomas Malthus. The idea underpinning the classical theory is that fiscal deficit financed by debt may cause interest rate to rise and this in turn discourages the issue of private bonds and private investments (i.e., crowding out effect) and this may lower the level of economic growth. The theory presupposes a situation of full employment where any extra expenditure financed by debt or by creation of money is bound to create inflationary rise in prices. Thus, increased budget deficit financing may lead to a rise in interest rates, which and therefore results to a rise in the level of inflation, and adversely affecting the level of economic growth due to crowding out of resources. Furthermore, budget deficit creates and increase in debt leaving a huge tax burden on future generation because borrowed funds will need to be repaid.

Contrary to the neoclassical perception of an inversely relationship between budget deficit and macroeconomic variables, the Keynesians see deficit financing as policy a tool that can be used to achieve a level of aggregate demand consistent with full employment. The idea rests with the British economist John Maynard Keynes which states that there is a positive relationship between budget deficits and macroeconomic variables and that increasing budget deficit will lead to an increase in aggregate demand and improve investor's confidence on the economy's potential, thereby fostering investments and aggregate savings which results in economic growth in the long run. Based on the Keynesians doctrine then, when a rise in budget deficits creates an increase in domestic production which makes investors optimistic about the future prospects and thus, invest more one can refer to it as "crowding in" effect. The idea of full employment assumed in the classical theory becomes unrealistic meaning deficit financing according to the Keynesian theory can be used to create additional employment when the economy is suffering from a deficiency of effective demand.

However, the Ricardian Equivalence theory ascribed to David Ricardo (1772-1823) and coined by Barro (1989) comes in with a different view; that budget deficits do not have any impact on macroeconomic variables. The Ricardian argument is based on the premise that an increase in government budget deficit is equivalent to a future increase in tax liabilities which will be will be repaid either now or in future because a cut in taxes today must be matched by future increase in taxes thereby leaving real rate of interest, private investment, exchange rate and domestic production unaffected (Awolaja and Esefo, 2019). The Ricardian equivalence theory rests its underpinning on two assumptions, namely; rational expectations and household taxation which posit rising budget deficit due to a fall in taxes and financed by borrowing, may incite the government to increase future taxes to repay the interests and debts. Holding this fact true, then individuals' lifetime income remains unchanged and so consumer spending remains unchanged. Thus, any increase in government expenditure that increases the budget deficit would lead to a corresponding decrease in consumption expenditure, as households save more in anticipation of their future tax liability. The net effect on aggregate demand then is zero and fiscal policy is entirely ineffective. Feldstein criticised the Ricardian equivalence theory arguing in 1976 that Barro ignored economic and population growth and demonstrated that the creation of public debt depresses savings in a growing economy.

2.2 Macroeconomic effects of budget deficit-financing

A majority of empirical evidence on the relationship between deficit financing and selected macroeconomic variables have been studied in Nigeria (Ifeanyi and Umeh, 2019; Nwaeke and Korgbeelo, 2016) found that deficits financed from external loans have insignificant negative influence on economic growth while deficits financed from domestic sources (e.g. domestic

banking system and non-bank financial system) stimulate economic growth in Nigeria; that irrespective of the source, deficit financing have no significant influence on inflation opposing Oyejide (1972) that used the Fisher's kind of equation to study the effects of deficit financing on inflation and capital revealing a direct correlation between inflation and measures of deficit financing while further analysis indicate that domestic sources of financing deficits aggravate unemployment in Nigeria (Nwaeke and Korgbeelo, 2016).

Further analyses in Nigeria revealed that explanatory variables such as budget deficit, money supply and external debt have positive effect on economic growth with budget deficit being insignificant (Ojong and Owui, 2013; Solawon and Adekunle, 2018) but others echoed a negative effect on growth (Olawunmi and Ayinla, 2007)

Similarly, some studies focused on the effect of deficit financing on other macroeconomic variables. Akinnifesi (1984) studied the influence of deficit financing on inflation in Nigeria using measures of fiscal deficit financing such as change in money supply, change in credit to the government by the banking system, government deficit expenditure, and industrial production and food price indices. The major finding from the study was that inflationary tendencies in Nigeria were jointly explained by these variables representing fiscal deficit financing. Onwe (2014) sought to investigate the implications of deficit financing on economic stability in Nigeria revealing that external source of deficit financing, non-banking public source of deficit financing and exchange rate has significant and positive implications on economic stability proxy for GDP, while ways and means source of deficit financing, banking system source of deficit financing and interest rate has negative implications on economic stability in Nigeria. The implication is that government deficit financing through external source of deficit financing and non-banking public source of deficit financing will maintain economic stability while government deficit financing through banking system and ways and means source of deficit financing will reduce economic growth thereby causing instability in the economy.

Hamad and Marwan (2019) examine the effect of deficit financing on economic stability in Jordan and provide empirical evidence that external borrowing and domestic bank financing negatively affect economic stability. The bank effect is due to crowding out of the private sector. The negative impact of external borrowing is driven by the current high level of outstanding public debt, 98 percent of GDP. Public debt is mainly channeled to finance current expenditures at the expense of capital expenditures, which has a minimal impact on growth. Nonbank financing although not statistically significant, exhibits the right sign as it has a positive effect. Lastly, an analysis of the effect of Ghana's budget deficit financing and economic growth deficit financing had a negative impact on Ghana's economic growth (Akoto, 2020).

This paper steps in with a novelty on the nexus between deficit financing and the economy, iterating the need for borrowed funds to be repaid easily or in other words making a country's debt sustainable. In line with idea of Musgrave (1939) golden rule, there should be a possibility of government debts to generate greater output (i.e., borrowed money factored in government expenditures should render the latter productive). Our study slightly relates with Dalmagas (1998) who adopted the endogenous growth modelling strategy of Barro, and analysed the relation between the output elasticity of government investment and a variety of variables for a large sample of countries determining that several of variables influence the productivity of public services through various channels, but not in a robust way except fiscal deficits. He concluded that even though government services are shown to be essential for the growth

process through the provision of infrastructure, self-sustaining growth can be undermined by excessive deficit financing that adversely affects the productivity of public capital.

A number of studies in the past have investigated the macroeconomic effects of deficit-financed fiscal policy, including the golden rule[3] and its variations with more recent ones like (Tamai, 2014, 2016; Ueshina, 2018; Akira and Tamai, 2019). Most of the studies dwelled on the impacts on economic growth of fiscal deficit, fiscal rules, and the sustainability of public debt adopting the extended models of Barro (1990) and Futagami et al. (1993) while basing their analyses on theoretical and analytical demonstrations.

In particular, Tamai (2014) examined the relationship between deficit-financed fiscal policy and economic growth in the stochastic economy with disturbances attributable to private and public investment volatility. Results indicate that a higher tax rate on income eliminates fluctuations in the growth rate and increases (decreases) the mean growth rate when the income tax rate is sufficiently low (high). The implication emanating from the study is that deficit-financed fiscal policy affects economic growth and its stability through not only investment in private capital and disposal income of households but also the portfolio changes of households.

Tamai (2016) developed a stochastic growth model with private and public capital to show that the golden rule of public finance can actualize the first-best equilibrium. Based on its theoretical and numerical analysis, estimated values show that the model can give a good value for the difference between two marginal products in the UK economy, and might be applicable to Germany and Japan if the golden rule was active.

Unlike in an endogenous growth model that assume a balanced budget rule implying no public debt in the model (Barro, 1990; Futagami et al., 1993), Ueshina (2018) using same model examined the effects of public debt on the economic situation and social welfare. The assumption is that in reality such productive expenditure is financed mainly by fiscal deficit and not tax revenue and thus, introducing public debt into Futagami et al. (1993) under the Golden Rule of Public Finance, where the government issues bonds only to finance public investment, such a model is compared with the balanced budget model. The following results were obtained: Two steady states exist: one is unstable with zero growth and the other is saddle-path stable with positive growth. The economy may not converge to the stable steady state if the public capital relative to public debt is not sufficient at the initial point. Second, the model shows that the growth maximizing tax rate exceeds the welfare-maximizing tax rate in considering transitional dynamics, but the short-term effect can differ from that of a model with a balanced budget rule (Ueshina (2018).

Akira and Tamai (2019) provided a comprehensive analysis of the effects of debt-financing public investment on intergenerational welfare in terms of their properties by examining the growth and welfare effects under the golden rule of public finance and population aging through the former effect. The following results were obtained: First, the growth-maximizing tax rate is lower than the output elasticity of public capital. Second, the growth-maximizing tax rate is not equivalent to the welfare-maximizing one. Third, growth- and utility-maximizing

[3] The concept of the golden rule of public finance (Musgrave, 1939) has been presented as one way to execute capital investment along with the pay-as-you-use principle. Referring to Akira and Tamai (2019), the golden rule can be considered as the possibility of borrowing to finance productive public investment that has potential to pay for itself over the long-term together with a balanced current budget. Furthermore, the golden rule stipulates that public debt must be less than public capital and the golden rule includes a debt rule that sets a limit for the ratio of public debt to GDP as well as for the ratio of fiscal deficit to GDP (Akira and Tamai, 2019).

tax rates are positively associated with longevity. Based on this relationship, population aging increases the equilibrium tax rate by majority voting and ratio of public debt to GDP.

3. Data, descriptive statistics and model specification

The study aims to determine the relationship between budget deficit financing and public expenditure elasticity of output growth (considered as the public expenditure productivity) in five CEMAC Member Countries (Cameroon, Gabon, Central African Republic, Chad and Republic of Congo). The five countries have been chosen on the basis of availability of data. The macro panel data for the five CEMAC member countries[4] (N=5) from 1980 to 2018 (T=39), has been extracted from the World Bank Development Indicator (World Bank, 2019). We used an interpolation technique to fill up missing observations noticed in the sample especially for debts raised via the non-bank financial system and debts incurred from other sources (i.e., special and trust fund, excess reserves).

The definition and summary statistics of variables are presented in Table 1. All variables are expressed in natural logarithms. The transformation to natural logarithms reduces the spread (range) in the data and stabilises the variances of the series (Dar and Asif, 2019). More so, Lütkepohl & Xu (2012) found that substantial estimation improvements are achieved by taking the log transformation of macro-economic variables. Therefore, for the two dependent variables, we use natural logs as coefficients and directly interpreted them as elasticities.

Table 1: Definition and Descriptive of variables

Variable	Description	N	T	NT	Overall mean	Std. Dev.
LGOCEXP	Productivity of recurrent government spending	5	38	190	-2.614	48.805
LPUIEXP	Productivity of public investment spending	5	38	190	-0.146	1.957
LEXT	Budget deficits from foreign loans (External Debts)	5	39	195	30.983	3.042
LDBS	Debts raised via the domestic banking system	5	39	195	29.824	2.998
LNBP	Debts raised via the non-bank financial system	5	39	195	28.184	3.608
LOS	Other sources (special and trust fund, excess reserves and privatization proceeds)	5	39	195	30.983	2.479

Source: Calculated by authors

Productivity of recurrent government spending (***LGOCEXP***) is the ratio of the first difference of the log of gross domestic product (GDP) with respect to the first difference of log of recurrent government expenditure while productivity of productivity of public investment spending (***LPUIEXP***) is represents the ratio of the first difference of log of GDP to the first difference of log of public investment spending.

To explore the relationship between budget deficit financing and public expenditure productivity in five CEMAC Member Countries, we consider a linear heterogeneous panel regression model specified as follows;

$$y_{it} = \alpha_i + \beta_i^{'} x_{it} + \varepsilon_{it}, \quad i = 1,2,...,N \text{ and } t = 1,2,...,T; \text{ with } Cov(\varepsilon_{it}, \varepsilon_{ij}) \neq 0 \qquad (1)$$

[4]Equatorial Guinea was excluded because of missing observation for variables used.

where y_{it} are the independent variables of country i in year t, x_{it} is a $k-$vector of regressors of independent variables. α_i is a country specific intercept, and ε_{it} is the error term. The baseline model equation can be written as follows:

$$Ly_{it} = \alpha_i + \beta_{1t} LEXT_{it} + \beta_{2i} LDBS_{it} + \beta_{3i} LNBP_{it} + \beta_{4i} LOS_{it} + \varepsilon_{it} \quad (2)$$

The two dependent variables represented by Ly_{it} are; productivity of recurrent government spending (***LGOCEXP***) and productivity of productivity of public investment spending (***LPUIEXP***). These could also be referred to as public expenditure elasticity of output growth which helps to identify whether public expenditures are productive once borrowings are factored into the budget. The independent variables are as described in Table 1. The coefficients of various sources of financing or borrowings representing the independent variables should be positive for productive spending or judicious use of borrowed funds.

4. Econometric analysis techniques

4.1. Testing for integration

The application of cointegration techniques necessitates identification of the order of integration, as cointegration requires that variables to be integrated in order one. According to (Baltagi and Pesaran, 2007) and (Biørn, 2016), six first generation panel stationary tests can be used to check the order of integration of the selected variables.

Starting with Dickey and Fuller (1979) which uses the p^{th} order augmented Dickey Fuller regression method, Levin, Lin and Chu, (2002) extends the test and assumes a common unit root process across panels. Im, Pesaran and Shin (2003) extends Levin et al. (2002) test by allowing unit root process to vary across panels. Dickey and Fuller (1979), Levin et al. (2002) and Im et al. (2003) assume an individual unit root process across the panels. Using Levin et al. (2002) and Im et al. (2003) studies, a bias is generated when the number of cross sections is larger than number of periods. Breitung and Das (2005) correct the bias generated in the application of these two tests. All the tests above assume the null hypothesis of unit root against the alternative hypothesis of no unit root. Hadri (2000) unit root test is based on Lagragian multiplier and assumes the null hypothesis of no unit root against the alternative hypothesis of the presence of a unit root.

However, the application of first-generation unit root tests necessitates the non-existence of cross-sectional dependency. If cross-sectional dependency exists in the panel data, the second-generation unit root tests like panel Seemingly Unrelated Regressions Augmented Dickey–Fuller (SURADF), Covariate Augmented Dickey-Fuller (CADF) and cross-sectionally augmented IPS (CIPS) are applied. In econometrics, cross-sectional dependency is explained as a situation where units forming panel are related to error terms in panel data model (Baltagi and Pesaran, 2007), as indicated in equation 1. According to Senturk, Akbas and Ozkan (2014), it is explained as a situation where unit forming panel are affected by shocks, and consequently affecting other units of the panel. Various tests exist to analyze cross-sectional dependency in panel data. The various tests are CD_{LM1} (Breusch and Pagan, 1980), CD_{LM2} and CD_{LM} (Pesaran, 2004), and $CD_{LM\ adj^*}$ (Pesaran, 2007). While the CD_{LM1} test is applied when N is constant and $T \to \infty$, the CD_{LM2} is applied when N and T are asymptotically and normally distributed $(N \to \infty\ and\ T \to \infty)$. The CD_{LM} and $CD_{LM\ adj^*}$ which use an asymptotically standard normal distribution are applied when $T > N$.

4.2. Testing for cointegration and estimating the long-run relationship

4.2.1 Panel cointegration tests

Among the several cointegration tests that are available (see Barbieri (2008)), we employ Pedroni (2004) panel cointegration test for detecting the existence of cointegration relationship among the variables. Pedroni (2004) allows for heterogeneity (heterogeneous intercept and trend coefficient across cross country). More so, Pedroni (2004) provided a total of eleven statistics that are used in panel cointegration test. The eleven statistics are divided in two groups; panel statistic (within dimension) and group statistic (between dimensions). The following hypothesis is tested against the alternatives:

$H_0 : \rho_i = 0$ (No Cointegration)

Homogeneous Alternative, $H_1 : (\rho_i = \rho) < 1 \; \forall_i$

Heterogeneous Alternative, $H_1 : \rho_i < 1 \; \forall_i$

Based on the test hypothesis, the panel statistics is concerned with homogeneous alternative while group statistics is concerned with heterogeneous alternative. All the statistics follow an asymptotically normal distribution. The statistics from the test are enough to be robust against heterogeneity and cross section dependence. The advantage of panel cointegration is that it allows examining the long-term relationship among variables while letting the short-term dynamic change between variables.

4.2.2 Estimation of the long-run cointegrating relationship

In estimating the long run relationship between the dependent and independent variables, we use the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS). Based on studies by Levin et al. (2002), endogeneity and heterogeneity are major issues that should be addressed while estimating the long-run coefficients in a dynamic panel. Therefore, endogeneity bias and serial correlations are corrected by FMOLS and DOLS techniques and the estimators allow for standard normal inference (Pegkas, 2015).

Three reasons have been advanced for using the FMOLS over the OLS in cointegrated panel data (See Christopoulos and Tsionas (2004)). First, the FMOLS allows consistency of the long-run relation with the short run adjustments. Second, it deals with the endogeneity of regressors problem, and third, it respects the time-series properties of the data and explicitly considers the integration and cointegration properties of the variables. The DOLS is a parametric model where lagged first-differenced coefficients are estimated explicitly. Thus, it adjusts the errors by augmenting the static regression with leads, lags and contemporaneous values of the regressors in first differences (Kao and Chiang, 2005). Therefore, for the robustness of results, this study applies both the FMOLS and the DOLS techniques to estimate the long-run parameters.

4.3. Estimating panel causality

Having estimated the long run relationship, the study applies the panel causality technique to detect the causality properties between the economic variables specified in the model. Dumitrescu and Hurlin (2012) developed the Granger causality test for panel modelling by adding cross-sectional units. The simple equations of the Granger causality test with two stationary variables – M_t and N_t – observed over T periods and N entities are presented as follows:

$$M_t = \alpha_1 + \sum_{i=1}^{n} \beta_{1i} N_{t-i} + \sum_{i=1}^{n} \beta_{2i} M_{t-i} + e_{1t} \qquad (3)$$

$$N_t = \alpha_2 + \sum_{i=1}^{n} \beta_{3i} N_{t-i} + \sum_{i=1}^{n} \beta_{4i} M_{t-i} + e_{2t} \quad (4)$$

Where n denotes the number of lags, $\alpha_1, \alpha_2, \beta_1, \beta_2, \beta_3,$ and β_4 are parameters to be estimated while e_{1t} and e_{2t} are error terms. If variable *M* does not cause variable *N*, the parameters of *N* over the lagged *M* are mutually zero.

5. Empirical results and discussions

This study follows the conventional step of panel cointegration approach. We begin the analysis by stationary testing and then go for cointegration testing followed by estimation of long-run parameters. The short run causality testing is performed using the pairwise panel causality test of Dumitrescu and Hurlin (2012).

5.1 Cross-Sectional dependency and Stationary tests

Cross-sectional dependence of the variables is a fact that should be detected for the variables to decide which panel unit root test would be applied. The *CD* tests were applied to the data prior to panel unit root test, in order to detect the existence or non-existence of cross-sectional dependency among variables. The results are presented in Table 2.

Table 2: Cross Section Dependence Test Results of the Variables

	CD test		CD_{LM1}		CD_{LM2}		$CD_{LM\ adj*}$	
Variable	**stat**	**p-value**	**stat**	**p-value**	**stat**	**p-value**	**stat**	**p-value**
LGOCEXP	0.020	0.987	2.555	0.990	0.045	0.964	-6.125	0.000
LPUIEXP	0.070	0.947	10.28	0.416	0.389	0.696	-2.213	0.013
LEXT	15.97	0.000	192.2	0.000	12.93	0.000	141.0	0.000
LDBS	18.48	0.000	143.6	0.000	10.17	0.000	103.3	0.000
LNBP	10.36	0.000	18.05	0.054	0.529	0.597	5.828	0.000
LOS	15.91	0.000	169.1	0.000	12.46	0.000	123.1	0.000

Source: Authors' calculation

Using the $CD_{LM\ adj*}$ test (since $T > N$), the results for Cross Sectional Dependence of different variables in Table 2 show that the p-values are statistically significant. This suggests that the null hypothesis of the absence of cross sectional dependence is rejected for all variables at 1% level of significance. Therefore, the residuals from the standard panel regression would be contemporaneously correlated and this should be addressed while panel stationarity would be tested. Hence, the second-generation panel unit root tests were applied in order to analyze the stationarity characteristics of the variables

For robustness checks, we apply the first-generation unit tests (Fisher-Type, IPS and Breitung tests) as shown in Table 3. All the tests are concerned with the null hypothesis of "panels contain individual unit root." The tests are performed with a test regression specification of constant and trend. Panel A of the table reports results of the variables at levels, while panel B shows the results of the variables at first difference. The Fisher-Type test results reveal that all variables contain unit root at levels. However, when these variables are converted into first difference, they become stationary. The same conclusion applies when the Im et al. (2003) and Breitung and Das (2005) statistics for panel unit root test are carried out. We can thus conclude that the variables are nonstationary at levels and stationary at first difference.

Table 3: First generation unit root tests

Number of lags = 3			
	Fisher-type	**IPS**	**Breitung**
Panel A: Variables at levels			
LGOCEXP	-0.022	-0.679	-0.686
LPUIEXP	-0.566	-0.259	-1.569*
LEXT	0.279	0.074	-0.600
LDBS	0.438	0.186	-0.735
LNBP	1.156	1.678*	0.107
LOS	-1.677*	-1.642*	-1.379
Panel B: Variables at first difference			
DLGOCEXP	-3.040***	-2.835***	-7.026***
DLPUIEXP	-7.853***	-7.412***	-4.285***
DLEXT	-3.115***	-2.877***	-2.225**
DLDBS	-2.023**	-1.902**	-1.492*
DLNBP	-4.471***	-4.139***	-4.267***
DLOS	-3.328***	-3.058***	-3.645***

Note: ***, ** and * denote 1%, 5% and 10% significance levels, correspondingly.

Using both the second generation and first-generation tests, all the variables have been found to be integrated of order one, i.e. I (1). Therefore, we can establish the existence of a long run relationship among them by estimating the panel cointegration test.

5.2 Testing cointegration

The outcome of the Pedroni (2004) tests with linear trend and constant are summarized in Table 4. Except for the panel v-statistics, all the statistics are significant at the 1% level. This suggests that the null hypothesis of no cointegration is rejected for all models. Hence, the results confirm the existence of a long-run cointegration relation between the dependent and independent variables.

Table 4: Pedroni (2004) Cointegration Tests

	LGOCEXP	***LPUIEXP***
Intra Dimension (Common AR coefficients)		
panel - v statistics	-0.6077	-0.4709
panel - rho statistics	-3.696***	-4.763***
panel - t statistics	-9.657***	-11.07***
panel - adf statistic	-7.133***	-4.807***
Between Dimension (Individual AR coefficients)		
group - rho statistics	-3.042***	-4.224***
group - t statistics	-10.36***	-12.16***
group - adf statistics	-4.933***	-4.501***

Note: ***, ** denote 1% and 5% significance levels, correspondingly.

5.3 Long run cointegrating vector

In order to obtain robust results, two methods (FMOLS and DOLS) are applied as earlier mentioned to estimate the cointegrating vector. Table 5 contains the estimation results of the long-run link between variables.

Table 5: Panel FMOLS and DOLS results

	LGOCEXP		***LPUIEXP***	
Variable	**FMOLS**	**DOLS**	**FMOLS**	**DOLS**
LEXT	0.059**	3.321***	-2.222***	-2.222***
	(2.336)	(3.279)	(-9.628)	(-9.628)
LDBS	0.130***	1.973**	-0.966***	-0.966***
	(5.558)	(2.600)	(-5.351)	(-5.351)
LNBP	-0.053	1.395	-0.067	-0.067
	(-1.119)	(0.014)	(-0.807)	(-0.807)
LOS	-0.036	-1.953*	2.278***	2.278***
	(-0.577)	(-2.081)	(7.780)	(7.780)

Note: ***, ** and * denote 1%, 5% and 10% significance levels, correspondingly. (…) denotes the t-statistics. The FMOLS and DOLS results are the same for second dependent variable.

As observed in Table 5, both FMOLS and DOLS techniques portrayed generally consistent findings regarding long term association among series and the findings are almost the same for FMOLS and DOLS. However, since FMOLS require less assumptions and lead to consistent results, focus is made on FMOLS while interpreting the results.

The findings indicate that productivity of recurrent government spending has a positive and significant relationship with foreign borrowings and borrowings from the domestic banking system but a negative relationship with debts raised via the non-bank financial sector and other sources though is insignificant in the CEMAC sub region. However, the results also show that a one-unit rise in foreign borrowing raises the productivity of recurrent spending by 0.059 as opposed to 0.13 for debts raised via the domestic banking system in a long-run. This could mean that borrowed funds mobilized from the domestic banking system is more productive than if raised from foreign sources and used as current spending. On the other hand, the productivity of government spending on investment has a negative relationship with foreign borrowings and borrowings from the domestic banking system but a positive relationship with debts raised via other sources such as special and trust fund, excess reserves and privatization proceeds which are all significant in the CEMAC sub region.

Indications are that that a 1-unit rise in foreign borrowing reduces the productivity of recurrent spending by 2.2 as opposed to 0.96 for debts raised via the domestic banking system in a long-run. This could mean that borrowed funds mobilized neither from the domestic banking system nor from foreign sources are not productively used but such debts are relatively better if they are raised in the domestic economy. Nevertheless, other sources such as special and trust fund, excess reserves and privatization proceeds are considered productive and relevant for government investment purposes. The results of this study may lend credence to the fact that foreign borrowings are more of a luxury than a necessity as opposed to domestic borrowings in such a way that the strings attached to the former maybe more stringent.

5.4 Dumitrescu-Hurlin panel causality tests

Having estimated the FMOLS and DOLS, the study further performs the Dumitrescu-Hurlin causality test to detect whether there is a short run relation between the economic variables as shown in Table 6. Taking into account the panel of 5 CEMAC member countries, this test provides consistent standardized panel statistics for a small sample, even in the presence of cross-sectional dependence (see: Dumitrescu and Hurlin, 2012). The test statistic is based on the individual Wald statistics of Granger non-causality averaged across the cross-section units, and hence assumes all the coefficients to be different across the cross-sections. It is also important to note that this test requires variables to be stationary at level. Based on the unit root the test was applied on first difference of the series, and hence, the results are considered as the short run causalities.

Table 6: Dumitrescu and Hurlin panel causality test results

Dependent Variable: DLGOCEXP		
Null Hypothesis:	Zbar - Stat	Prob.
DLEXT does not homogeneously cause DLGOCEXP	-2.102**	0.0189
DLGOCEXP does not homogeneously cause DLEXT	1.611*	0.0908
DLDBS does not homogeneously cause DLGOCEXP	2.460**	0.0315
DLGOCEXP does not homogeneously cause DLDBS	-0.946	0.3596
DLNPB does not homogeneously cause DLGOCEXP	1.680*	0.0921
DLGOCEXP does not homogeneously cause DLNPB	0.415	0.4623
DLOS does not homogeneously cause DLGOCEXP	1.901*	0.0573
DLGOCEXP does not homogeneously cause DLOS	1.371	0.1702
Dependent Variable: DLPUIEXP		
DLEXT does not homogeneously cause DLPUIEXP	-0.102	0.9189
DLPUIEXP does not homogeneously cause DLEXT	1.511	0.1308
DLDBS does not homogeneously cause DLPUIEXP	0.641	0.5213
DLPUIEXP does not homogeneously cause DLDBS	-1.663*	0.0963
DLNPB does not homogeneously cause DLPUIEXP	0.203	0.8392
DLPUIEXP does not homogeneously cause DLNPB	0.981	0.3264
DLOS does not homogeneously cause DLPUIEXP	2.638**	0.0337
DLPUIEXP does not homogeneously cause DLOS	1.442	0.2071

Note: *, ** denote 5%, and 10% significance levels, correspondingly.

The result shows that short-run causality is bidirectional between the productivity of government recurrent spending and external borrowings in the CEMAC countries. This reveals that in the short run, increasing external debts significantly results to falling productivity of recurrent government consumption and vice versa. The study also finds a unidirectional causality running from internal borrowings (domestic banking and non-bank financial systems and other sources) to the elasticity of recurrent government expenditure with respect to output growth. As concerns government investments, the results show that the short run causality is unidirectional from the productivity of government investments to borrowings from the domestic banking system in a negative manner and from other sources of borrowings to productivity of government investments in a positive sense. However, the study does not find any unidirectional and bidirectional external loans nor loans from the non-bank financial system and productivity of government investments respectively. Hence, the panel causality

tests reveal that the null hypotheses of LEXT and LNPB do not cause LPUIEXP cannot be rejected at the 5% level.

6. Summary and conclusions

This study investigates the effect of deficit financing on the productivity of government recurrent and investment expenditures in a panel of 5 CEMAC member countries from 1980 to 2018 using a panel cointegration technique highly capable to determine the long run relationship amongst domestic and external financing and returns to public expenditure. Data was obtained from the World Bank Development Indicator. To test for the presence of long-run associations between domestic and external financing and returns to public expenditure, we first control for Cross-sectional dependence to decide on the type of panel unit root tests to be adopted in order to detect the existence or non-existence of cross-sectional dependency among variables. With the application of the second-generation panel unit root tests and later a robustness checks, by applying the first-generation unit tests we conclude that all variables are nonstationary at levels and stationary at first difference.

The study tested for the existence of cointegration employing the Pedroni (2004) cointegration technique and the results confirmed that there was a presence of long run relations among variables in the CEMAC member countries. In order to estimate the long-term link between variables and to determine the effectiveness of deficit financing in raising the productivity of public spending, this study used FMOLS and DOLS. The findings showed that productivity of recurrent government spending has a positive and significant relationship with foreign borrowings and borrowings from the domestic banking system but a negative relationship with debts raised via the non-bank financial sector and other sources though is insignificant in the CEMAC sub region. The findings also revealed that the productivity of government spending on investment has a significant negative relationship with foreign borrowings and borrowings from the domestic banking system but a positive and significant relationship with debts raised via other sources such as special and trust fund, excess reserves and privatization proceeds in the CEMAC sub region.

There are indications that borrowed funds mobilized neither from the domestic banking system nor from foreign sources are not productively used but such debts are relatively better if they are raised in the domestic economy. Other internal sources of deficit financing such as special and trust fund, excess reserves and privatization proceeds are considered productive and relevant for government investment purposes. The results may lend credence to the fact that foreign borrowings are more of a luxury than a necessity as opposed to domestic borrowings in such a way that the strings attached to the former maybe more stringent. The policy recommendations from the results are that, both external donors, policy makers and internal stakeholders, instead of dishing out more credit to CEMAC governments, they should put in place a monitoring system that to ensure that loans that are granted are used for the relevant purpose.

Disclosure statement

No potential conflict of interest was reported by the authors.

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