ISSN: 2658-8455
Volume 1, Issue 3 (November, 2020), pp.58-72.
www.ijafame.org

An Investigation of Debt Sustainability issue in Gabon

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Disclosure statement: The authors are not aware of any funding, that might be perceived as affecting the objectivity of this study.

Conflicts of interest: The authors reports no conflicts of interest.

Cite this article Ekouala Makala , U., & Nait Bouzid, K. (2020). An Investigation of Debt Sustainability issue in Gabon. International Journal of Accounting, Finance, Auditing, Management and Economics, 1(3), 58-72. https://doi.org/10.5281/zenodo.4281440

DOI: 10.5281/zenodo.4281440
Published online: November 20, 2020.

ISSN: 2658-8455
Volume 1, Issue 3 (November, 2020), pp.58-72.
www.ijafame.org

IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

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Abstract

The literature dealing with the issue of fiscal deficit sustainability (government's solvency) starts first with the great contribution of Hamilton and Flavin (1986), and further development by Wilcox (1989), Trehan and Walsh (1991), Hakkio and Rush (1991), Buiter and Patel (1992), Tanner and Liu (1994), Bohn (1995), Wu (1998), Makrydakis et.al., (1999). The issue of debt sustainability analysis (DSA) highlights principally three main theoretical approaches in the literature: 1) Debt Ratio analysis; 2) the Present Value Constraint (PVC); and 3) the Accounting Approach. Using the present value constraint framework (PVC), our research follows the studies developed by Trehan and Walsh (1991), Hakkio and Rush (1991), and Bohn (1995) which have gained significant devotion in the macroeconomics literature. Hence, using yearly tax series data of Gabon over the period from 1980 to 2020, our study uses the stationarity and co-integration approach to investigate the issue of public debt sustainability in Gabon. We first apply the stationarity tests on the following fiscal series: government debt, fiscal balance, government revenue, expenditure, and as well as the ratio to GDP of the mentioned series before using the co-integration tests on government revenue and expenditure. The empirical findings highlight globally the non-stationarity of fiscal series while the Johansen co-integration tests don't show any long-run correlation between the government revenue and expenditure indicating the non-sustainability of Gabonese public debt.

Keywords: Debt Sustainability, Budget Deficit, IBC[1], Stationarity, Co-integration.
JEL Classification: E6
Paper type: Empirical research

[1] Intertemporal Budget Constraint

1. Introduction

The recent pandemic situation started in Wuhan (China) brought several developing countries to accumulate external debt in order to try to control the spread of the COVID-19. This situation highlights the issue of indebtedness in the Economic and Monetary Community of Central Africa (CEMAC) and particularly in Gabon. Since a huge part of the revenue resources generated from the exports is dedicated to paying the debt service either than being used to build up some infrastructure.

Before the pandemic, Gabon's debt situation was already alarming as well as for the whole CEMAC zone. Thus, in one year the CEMAC area's budget deficit (Cameroon, Central African Rep, Chad, Congo Rep, E. Guinea, and Gabon) has been doubled, from 3.5% of GDP in 2015 to 7.9% of GDP in 2016, bringing up a particular interest in the fiscal policy of the region. This increase in the budget deficit can be explained by the changing operating in the macroeconomics environment; such as the fall of tax revenue and more particularly the persistent decreasing effect of the oil prices resource which represents between 20% - 75% of the total revenue of 5 countries over the 6 member states of the community.

Besides, the austerity program established by governments seems to have contradictory results since, on the one hand, it tried to correct the public deficit for almost all countries except for Gabon (-0.4% of GDP in 2018) and Cameroon (-1.2% of GDP in 2018), and on the other hand, the level of debt keeps increasing and getting even close to the limit in terms of debt to GDP ratio (70% of GDP, in CEMAC zone). This contradictory situation in which the government aims to reduce its public expenditure but at the same time the level of public debt keeps growing (Gabon's external debt increased by 9.4% in 2018) could be a starting point to try to figure out what kind of fiscal policy is applied in Gabon.

The theory dealing with fiscal and debt sustainability highlights the government intertemporal budget constraint and the flow-budget constraint, the idea behind this is to see whether the fiscal policy currently active can be conducted without any trouble of government solvency. While following empirical policy scrutiny, fiscal sustainability rests extremely ambiguous, at the point that every single study tries to derive its own approach separately and conclusions consequently. The literature retains principally three different reasons for refunding the government debt, which is "Insolvency; illiquidity" and unwillingness-to-pay, see (Eaton, 1989; Dreher and al., 2006).

From the perspective of empirical study, the insolvency approach is generally considered following two main paths. The first path is related to the country risk models, a couple of economic indicators are used to assess the country's possibility of debt reimbursement, generally in the form of the following fiscal series: debt/GDP, primary surplus/GDP, debt service/exports and debt/exports (Blanchard, 1990; Cuddington, 1997; Croce and Juan-Ramon, 2003).

Following the second path, the econometric approach for fiscal and debt sustainability, analyze the issue of debt sustainability in the long run. Thus, the solvency condition requires that the present value of the future cash-flow of the primary surplus should not be less than the level of the actual debt. More specifically, analyzing fiscal series stationarity provides helpful tools to have an accurate perception of the implications of a government intertemporal solvency in the long-run. By testing the solvency of the intertemporal budget constraint, the unit root tests conclude whether the budget or external deficit of a given government doesn't lead to debt sustainability issues. The first studies found in the literature concerning the issue of fiscal deficit sustainability (government's solvency), start with the contribution of Hamilton and Flavin (1986), and further development by Wilcox (1989), Trehan and Walsh (1991), Hakkio and Rush (1991),

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Volume 1, Issue 3 (November, 2020), pp.58-72.
www.ijafame.org

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International Journal of Accounting, Finance, Auditing, Management & Economics

Buiter and Patel (1992), Tanner and Liu (1994), Bohn (1995), Wu (1998), Makrydakis et.al., (1999). The issue of public debt sustainability highlights generally three main theoretical approaches in the literature, that is: 1) Debt Ratio analysis; 2) the Present Value Constraint (PVC); and 3) the Accounting Approach. Using the present value constraint framework (PVC), our research follows the studies developed by Trehan and Walsh (1991), Hakkio and Rush (1991), and Bohn (1995) which have gained significant devotion in the macroeconomics literature.

Thus, the main question leading the study is formulated as follows: is the current Gabonese debt sustainable?

To support this research questions our paper, first of all, examines fiscal policy and debt sustainability issues in the economy of Gabon using the stationarity and cointegration approach, a technique that helps to investigate more accurately the current debt situation of the country. Moreover, our period of study is including the data of the covid19 period, a situation that might affect the budget constraint solvency according to the increasing trend of the public debt lately. Thus, the study aims to contribute to the literature examining the sustainability of fiscal deficits and public debt, and our findings may reinforce the linearity or non-linearity between fiscal series in our data sample following previous studies (Martin, 2000; Payne et al., 2008; Fincke and Greiner 2011).

The interest of this research is justified first by the recent increase of both public deficit and public debt in Gabon pointing out the question of fiscal policy and public debt sustainability but also to investigate if the government's answer to that situation is relevant: « the Gabonese debt is sustainable there is no reason to worry, declared the government». Fiscal policy is regarded as sustainable when, if held in the indefinite future, it does not violate the solvency constraint; and a government is said to be solvent if the present-value budget constraint, i.e., its intertemporal budget constraint (IBC) holds. In other words, the public deficit can be sustainable if the government can borrow. When debt sustainability is defined as the ability of a state to meet its debt obligation without requiring debt relief or accumulation arrears.

Our next section presents literature related to debt sustainability, section3 presents the Methodology while section4 highlights the results and discussion, and finally, section5 presents the conclusion.

2. Literature review related to debt sustainability analysis

Literature related to the debt sustainability analysis (DSA) has investigated the probability that a given government violates the intertemporal budget constraint by assessing if the time series of fiscal data comply with the hypothesis that the expected present value of primary balance equalizes the initial level of debt. Our paper analyzes the issue of debt sustainability following this literature. Therefore, testing the fiscal sustainability of debt policies using the non-stationary time series was firstly analyzed by Hamilton and Flavin (1986). They tested the No-Ponzi-Game condition focusing on the stochastic properties of the deficit. Their study aimed to see whether the US government deficit and debt series are stationary which was the case for the sample covering the period 1962-1984. Wilcox (1989), on the convergence to zero requirements of the government intertemporal budget constraint, highlights the role played by the interest rate in terms of discounting the draft of the public debt. While Trehan and Walsh (1991) proposed as conditions for debt sustainability, the existence of cointegration between primary deficit and debt just after testing the stationarity of the series.

In more recent literature, Bohn (2007) showed that sustainability matches with the integration of the series no matter the order of integration. And further tests suggested by Bohn (1995, 1998) argue that a given public debt can be considered sustainable if the primary fiscal balance (surplus) to GDP ratio reacts positively to the debt-GDP ratio. The economic intuition behind this is that a rise of government debt today should be compensated by an increase of primary surplus to help the public debt to stay sustainable. Statistically, an increase in primary surpluses in response to a higher government debt involves that the series of public debt to GDP ratio comes to be mean-reverting i.e. if a higher debt to GDP ratio is followed by a rise in the primary surplus relative to GDP, the debt to GDP ratio will decline and return to its mean. However, the mean-reversion holds only if the reaction coefficient, determining how strongly the primary surplus reacts as public debt rises, is sufficiently large. Bohn (1998) suggested that analyzing fiscal policy reliability should not be limited to the stationarity of the debt-to-GDP ratio, therefore, he provides a new sustainability test which does not require interest rate rules. To see whether governments react to the change of debt by correcting primary balances consequently, the intuition focuses on the reaction functions of fiscal policy for the assessment of fiscal deficit sustainability.

A different approach based on the general equilibrium framework requires that sustainable fiscal policies match with the general equilibrium conditions which link the public and private sectors, in respect to this logic, Chalk (2000) incorporates permanent fiscal deficits into an overlapping generation's model study arguing that if the GDP growth rate is greater than the interest rate of the steady-state, then these permanent deficits are considered as sustainable. Mendoza and Ostry (2008) analyze the fiscal solvency following the same framework, and the positive response of primary balance to fluctuations in public debt in their study shows evidence of fiscal solvency for the sample of emerging and developed economies used. Additionally, some scholars have measured the risks of dampening economic activity and the issue of government with limited fiscal space that is facing the risk-neutral lenders (Ghosh et al., 2013), it is the case particularly when durable fiscal consolidation is needed to ensure the sustainability of fiscal policy and public debt (Eichengreen and Panizza, 2016).

Empirical studies have recently devoted considerable attention to the fiscal sustainability issue, two empirical frameworks are dedicated to the fiscal sustainability tests, the first consists of testing the stationarity of the fiscal series, while the second recourse to the used of cointegration to investigate the long-term relationship between fiscal variables of interest. Following the first framework, if the deficit is non-stationary then the series is growing without any limit, consequently, the debt will also grow without boundaries leading to an unsustainable fiscal policy. As a result, the budget constraint or the so-called Bohn's No-Ponzi-Game constraint will be violated. Since a stationary deficit ensures that fiscal policy is efficient and the debt is under control, so no need to worry about the sustainability of the public debt. Under the second framework, the main objective remains on investigating the long-run relationship between government total revenues and expenditures through the cointegration tests. In the case of a long-run relationship between the two series then the government of the sample used takes to account the revenues to plan its expenses so the debt will not grow without bound, therefore, it will be sustainable.

Under the same framework, Smith and Zin (19991) found that the Canadian public debt was not sustainable for the monthly data covering the period 1946-1984. The same result was found in the case of Italy for the period from 1979 to 1991 by Baglioni and Cherubini (1993) using monthly data. In the case of India, using yearly data covering the sample period from 1970 to

ISSN: 2658-8455
Volume 1, Issue 3 (November, 2020), pp.58-72.
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International Journal of Accounting, Finance, Auditing, Management & Economics

1988, Buiter and Patel (1992) conclude that the Indian government debt was not sustainable. Similarly, based on an annual data sample of some EU countries, Caporal (1995) found that the German, Italian, Danish and Greek debts were not sustainable over the period 1960-1991.

Under the second framework, the debt sustainability analyses (DSA) focus on using the co-integration tests to explore the long-run relationship between government revenues and expenditures. If such a relationship is found, then it can be concluded that government debt is sustainable. That is the case for the US, where Haug (1995) found that the US government debt is sustainable. This result was also confirmed by Quintos (1995), who concluded the sustainability of the US government debt until 1980 for a sample covering from 1947 to 1992.

Furthermore, in the case of some selected G7 countries, Payne's research (1997) concludes the sustainability of the German public debt. Following the same findings, Athanasios and Sidiropoulos (1999) assert the sustainability of Belgium, Greek, Portugal, Italy, and Spain's government debt. Using a new set of data covering the period 1977-2013 of some selected EU countries, Naime's (2015) unit root tests, conclude that only Germany has a sustainable budget deficit, and the co-integration tests confirm the sustainability of the German fiscal policy and revealed as well that France fiscal policy is sustainable, however, Ireland, Italy, Spain, and Portugal fiscal policies appeared to be sustainable only during the 70s and 80s. But the government revenues and expenditures series started to be unsustainable after the 2008 financial crisis.

2.1. Theoretical Background

When the insolvency issue rises in a given economy that means the debt is unsustainable, i.e. the concerned government cannot pay back its debt. It also means that the present value of the sum of future revenues minus expenditures is larger than the initial level of indebtedness.

In this context, the PVC's empirical tests should not be interpreted as a test of government insolvency, but rather as tests of whether its conduct of fiscal policy is unsustainable. That is, could the past dynamic behavior of government revenues, expenditures, and budget deficits, as captured by their time-series properties, be continued indefinitely without leading to an insolvency situation where the government can no longer service its debt and subsequently default on it. Since meeting the Present Value Constraint is regarded as a no-violation of the No-Ponzi-Game constraint, the government cannot borrow and spend without bound. Empirical studies dealing with these issues start with the financing constraint of the public sector.

This constraint relates the primary deficit plus the nominal debt service to the changes in the outstanding debt. The following equation link the stock of debt in period t, B_t to the previous debt B_{t-1} associated with the debt service rB_{t-1} and the primary surplus or deficit (Z). Z_t will be considered as a surplus if it has a positive sign and as a deficit in case of a negative sign.

$$B_t = (1 + r)B_{t-1} - Z_t \quad (1)$$

Where, B_t is the total outstanding debt at the end of period t, and r is the ex-post return on central government debt, and it is assumed to be constant. Given the time paths for r and Z_t, the government financing constraint in equation (1) describes the time path of the stock of debt, i.e. the dynamics of debt build-up or diminishment. Reorganizing equation (1) frontward n periods and summing up, we get:

$$B_{t-1} = \sum_{j=0}^{n} \frac{R_{t+j}}{(1+r)^{j+1}} - \sum_{j=0}^{n} \frac{G_{t+j}}{(1+r)^{j+1}} + \frac{B_{n+1}}{(1+r)^{n+1}} \quad (2)$$

Where G is central government expenditures defined to exclude interest payments, and R is central government tax revenues. If the last term in equation (2) approaches zero as the number of periods increases, then the No-Ponzi-Game Constraint (NPG) will be satisfied, i.e.,

$$\lim_{n\to\infty} \frac{B_{n+1}}{(1+r)^{n+1}} = 0 \qquad (3)$$

The No-Ponzi-Game Constraint in equation (3), also known in literature as the intertemporal budget constraint or solvency condition states that the present value of the government's debt in the indefinite future converges to zero. For this to occur, debt B in the numerator must grow more slowly than the rate of interest r. The government cannot finance interest payments on the debt by continuously issuing new debt. This will happen when equation (3) is not violated.
If we assume that public debt is growing over time at a constant rate δ to have $B_{t+j} = (1+\delta)B_{t+j-1}, \forall j$, we can rewrite equation (3) as follows:

$$\lim_{n\to\infty} (\frac{1+\delta}{1+r})^n B_0 = 0 \qquad (4)$$

For equation (4) to converge to zero, δ should be less than r, i.e., the rate of growth of the debt should be less than the real interest rate. On the other hand, the literature relates the PVC to the accounting approach to assess fiscal sustainability by focusing on debt ratios to GDP.

From the above expressions we derive this equation:

$$Z_t = (r-g)b_{t-1} \qquad (5)$$

For the Gabonese's debt to stop growing overtime equation (5) must hold. Hence, debt depends on the spread between the real interest rate r and the growth rate of GDP g. If g > r, then debt stabilizes even with a budget deficit (i.e., z is negative). If r = g, then debt stabilizes since the budget is balanced. If r > g, then the debt will keep on growing over time even in the presence of a budget surplus (i.e., z is positive), rising a debt sustainability issue in the country.

Thus, the main hypothesis of this study is to test the sustainability of Gabonese government debt. Therefore, the following sub hypotheses are derived to conduct our research:
H0: there is a unit root in the fiscal series
H1: the series is stationary (alternative hypothesis)
H2: the government revenues and expenditures are cointegrated
H3: there is no long-run cointegration between the two series (alternative hypothesis).

3. Methodology

The econometric tests supporting our research are the two frameworks advanced in the literature, which are stationarity and cointegration tests. If the budget deficit is stationary, i.e., integrated of order zero, I(0) then according to Trehan and Walsh (1988, 1991), this constitutes a sufficient condition to conclude that fiscal policy is sustainable. That is, the government deficit will not grow without bound, and the actual deficit will asymptotically converge to zero over time. The convergence to zero of the government deficit means that the PVC or the intertemporal solvency condition in equation (4) is satisfied. Therefore, an equivalent empirical test would be to test for the existence of unit roots in government expenditures (inclusive of debt service: $(G_t + r_t B_{t-1})$ and revenue series. If the two series do not contain a unit root, then the budget

ISSN: 2658-8455
Volume 1, Issue 3 (November, 2020), pp.58-72.
www.ijafame.org

deficit will be integrated of order zero and the intertemporal solvency condition in equation (4) will be satisfied pointing to the sustainability of fiscal policy.

According to Hakkio and Rush (1991), if the two series contain a unit root (i.e., are integrated of order 1) then one must search for a long-run equilibrium relationship between them. If such a relationship does not exist, debt would be unsustainable. We establish stationarity or non-stationarity of the individual fiscal series by applying both the Phillips–Perron (PP) and Augmented Dickey-Fuller (ADF) unit root tests. Furthermore, the co-integration tests used in this paper are based on maximum likelihood estimation which proposes two distinct tests for determining likelihood ratios, including the trace and maximum eigenvalue statistics. The trace test determines *r* co-integrating vectors' null hypothesis along with the substitute *n* co-integrating vectors' hypothesis. If the value of *r* is 0, then one can conclude that a long-run relationship does not exist between the non-stationary variables, hence no co-integration exists (Osterwald-Lenum, 1992). The maximum eigenvalue test determines *r* co-integrating vectors' null hypothesis combined with the alternative hypothesis of (*r*+1) co-integrating vectors.

3.1. Research Model

The following equations are estimated:

$$\Delta X_t = \alpha_1 + \alpha_2 X_{t-1+} \sum_{i=1}^{k} \delta_i \Delta X_{t-i} + \varepsilon_t \quad (6)$$

Where Δ represents the first-difference; and (X_t) stands respectively for the following fiscal time series: G (government spending), R (government revenues), (BB) budget balance, and Debt, as well as the ratio of these variables to GDP; α_i and δ_i are constant parameters; and ε_t is a stationary stochastic process. K represents the number of lags determined based on the Akaike Information Criterion (AIC) for the ADF tests and the Newey-West Information Criterion for the PP tests. To determine the order of integration of our series, equation (6) is modified to include second differences in lagged first and k lags of second differences. That is,

$$\Delta^2 X_t = \lambda_1 \Delta X_{t-1} + \sum_{i=1}^{k} \mu_i \Delta^2 X_{t-i} + \varepsilon_{1t} \quad (7)$$

Where, $\Delta^2 X_t = \Delta X_t - \Delta X_{t-1}$, λ_i, μ_i are constant parameters; and ε_{1t} is a stationary stochastic process. The k lagged difference terms are included so that the error terms ε_t and ε_{1t} in both equations are serially independent. Equations (6) and (7) are also estimated with a time trend.
According to Walsh and Trehan (1988, 1991), the non-stationarity of fiscal policy and debt series constitutes a sufficient condition to conclude that the fiscal policy investigated is unsustainable. Consequently, the government deficit will grow without boundaries and the current deficit will not converge to zero over time. The non-convergence to zero implies that the Present Value Constraint (PVC) i.e. the intertemporal solvency condition of our equation (4) will be violated.
The co-integration tests to be used in this paper are based on maximum likelihood estimation that proposes two distinct tests for determining likelihood ratios, including the trace and maximum eigenvalue statistics. The Johansen test starts with a vector auto-regression (VAR) of the order *p* represented as:

$$X_t = \mu + B_1 X_{t-1} + \cdots + B_p X_{t-p} + \varepsilon_t \quad (8)$$

Where *xt* represents (*n* ×1) integrated variables' vector generally represented as *I*(1) during ε_t represents an (*n* ×1) innovations vector. The two likelihood ratio tests include the trace test and the maximum eigenvalue statistics and are defined in Equations (9) and (10) respectively (Lüutkepohl et ali., 2002).

$$J_{Trace.Stat} = -S \sum_{t-r+1}^{n} ln\,(1 - \widehat{\beta_l}) \quad (9)$$

$$J_{Max.Stat} = -Sln\,(1 - \widehat{\beta_{r+1}}) \quad (10)$$

In Equations (9) and (10), S determines the sample size, while $\widehat{\beta}_i$ shows the ith biggest canonical correlation. The advantage associated with this model is that it can be used in the estimation of several cointegration relationships (Lai & Lai, 1991).

3.2. Data

The data used in this study are time-series data covering a period over 40 years (1980-2020) and targeting principally government revenues, government expenditures, budget balance, and government total debt, as well as the ratio of the above variables to GDP. The choice of this period is due to the availability of data and also a need of starting the analysis with a set of data beginning 20 years after the Gabonese independence to avoid any bias related to the weight of the colonial period. Our data are extracted from the World Development Indicators (World Bank) and AFDB Socio-Economic Database (African Development Bank).

All 8 tax series will be used for the unit root tests (ADF & PP), while the Johansen cointegration tests involve only the government revenue and expenditure series. However, the causality test of our VAR Model will consider the variables simply taken at levels, that is government revenue; government expenditure; budget balance; and government total debt.

Table1: *Summary statistics*

Variables	Obs	Mean	Std. Dev.	Min	Max
Total debt(%GDP)	41	45.6871	22.08999	13.77843	90.13537
Fiscal balance(%GDP)	41	0.747859	6.416671	-13.7808	11.67325
Fiscal balance	41	1.48e+08	5.36e+08	-6.91e+0	1.71e+09
Total debt	41	3.58e+09	1.74e+09	7.96e+08	7.34e+09
Total expenditure	41	2.24e+09	1.09e+09	1.10e+09	6.10e+09
Total expenditure(%GDP)	41	26.31694	7.100813	17.57663	49.16142
Total revenue	41	2.38e+09	1.26e+09	8.53e+08	5.56e+09
Total revenue(%GDP)	41	27.03478	5.579171	17.86891	36.46946

Source: Authors' computation from WDI and AFDB databases

4. Results and discussion

4.1. Regression results

Following our econometrics analysis, and based on ADF & PP unit root tests, Table2 shows the non-stationarity of the variable public debt (Dt) at the level and as well as a % of GDP for the Gabonese Republic, While for the Government expenditure (G), it is showing the existence of unit root at the level for both tests (ADF&PP) and as a % of GDP, both tests (ADF&PP) highlight the stationarity of the government expenditure(%GDP) with constant and trend and with no constant and trend both tests (ADF&PP) confirm the non-stationarity of the series expenditure as found at the level i.e., G(1) following the stationarity of its first difference. The government revenue (R) shows for both tests (ADF &PP) a non-stationarity of the series as well as at the level than as a ratio to GDP, thus, the government revenue is considered as integrated of order 1 since taking the first difference of the series the stationarity is found at the level and as a % of GDP. And finally, the fiscal balance (FB) display relatively two main results, on the one hand, we have stationarity at the level for PP test, and for ADF one we consider the variable with no constant and trend. And on the other hand, the series is no stationary at the level for the ADF test with constant and trend and as a ratio to GDP, the same result is confirmed by both tests

ISSN: 2658-8455
Volume 1, Issue 3 (November, 2020), pp.58-72.
www.ijafame.org

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ADF&PP except for PP where the variable is no longer stationary with constant and trend (cst.&t). However, the variable fiscal balance seems to be the one that presents the less alarming situation among all the series of our study. Globally, all our series are integrated of order 1, so the non-stationarity of the fiscal series suggest looking for the long-run relationship between the government revenue and expenditure according to Hakkio and Rush (1991), if the two series contain a unit root (i.e., are integrated of order 1) then one must search for a long-run equilibrium relationship between them.

Table2: *Unit Root Tests*

	G	G/GDP	R	R/GDP	FB	FB/GDP	Dt	Dt/GDP	Mackison's Critical Value	
									5%	10%
Cst.&TT										
ADF	-2.391	-4.25**	-2.889	-2.366	-2.474	-2.98	-1.383	-1.749	-3.54	-3.204
ADF FD	-5.04**		-4.33**	-5.28**	-6.51**	-6.44**	-4.32**	-3.81**	-3.544	-3.206
No.Cst.										
ADF	-0.083	-0.774	-0.305	-1.015	-2.16**	-2.66**	0.977	-0.432	-1.95	-1.606
ADF FD	-5.11**	-7.04**	-4.39**	-5.33**			-4.12**	-3.83**	-1.95	-1.606
Cst.&TT										
PP	-12.6	-23.9**	-9.972	-11.922	-23.1**	-14.835	-8.307	-5.884	-19.116	-16.36
PP FD	-41.4**		-26.8**	-38.5**		-42.7**	-51.8**	-48.0**	-19.04	-16.32
No.Cst.										
PP	-0.072	-0.747	-0.117	-0.615	-19.1**	-13.7**	0.932	-0.746	-7.556	-5.428
PP FD	-41.5**	-40.6**	-26.7**	38.8**			-51.5**	-48.0**	-7.54	-5.42

Source: Authors' tests.

Notes: ADF is the Augmented Dickey-Fuller unit root test and PP is the Phillips–Perron unit root test. FD is the First Difference; R is government revenues; G is the government spending; FB is the Fiscal Balance; The unit root tests are performed assuming the suppression of the Constant (Cst.), or the presence of Constant and Time Trend (Cst.&TT) in the series. The numbers of lags are the proper lag intervals based on the Akaike Information Criterion (AIC). ∗ denotes rejection of the null hypothesis of non-stationarity at the 10% level of significance, while a ∗∗ denotes a stronger rejection at the 5% level.

Table 3 above presents the results of the Johansen co-integration tests. The empirical findings highlight the absence of co-integration between the government revenue and expenditure, which implies that the Gabonese government debt is unsustainable according to the Johansen co-integration tests. Both trace statistics and Max Eigen statistics highlight that there is no cointegration in the long-run, and this result is significant at 5%.

The VAR model in this research is used to investigate the causality between the central Government debt and our variables of interest, namely: fiscal balance, Government expenditures, and Government revenues.

We first test the impact of Government debt on fiscal balance, Government expenditure, and Government revenue before testing the impact of those three variables on Government debt.

Table3: *Johansen tests for cointegration*

Hypothesis:R&G		Trace statistic	Critical value	Max Eigen statistic	Critical value
Null	Alternative		5%		5%
r=0	r≥1	**14.6948***	15.41	**10.2333**	14.07
r<1	r=2	4.4614	3.76	4.4614	3.76
Hypothesis:R&G(%GDP)		Trace statistic	Critical value	Max Eigen statistic	Critical value
Null	Alternative		5%		5%
r=0	r≥1	**2.6266***	15.41	**2.6266**	14.07
r<1	r=2	0	3.76	0	3.76

Source: Authors' tests.

Notes: Note that, the Johansen co-integration likelihood ratio test is based on the trace of the stochastic matrix and the λ value of the Max-Eigen Statistic. The prior test considers a constant in the data rather than a linear trend, in which r represents the number of cointegrating vectors with a maximum lag 2 years in VAR and the asymptotic critical value is from Osterwald-Lenum(1992), where ∗denotes the significance at 5% level. Our data covers the period from 1980-2020.

The test results of the impact of government debt on fiscal balance, government expenditure, and revenue in Table 4, show that the Government debt has a negative impact on the first lags and a positive impact on the second lags of Government expenditure and revenue and a positive impact on both lags of fiscal balance, however, all the results are statistically insignificant.

Besides, the test results for the impact of fiscal balance, Government expenditure, and revenue on Government debt indicate a positive impact on fiscal balance and expenditure and a negative impact of revenue on Government debt, but, all are statistically insignificant for our study case. The only significant results in our VAR tests are the impact of fiscal balance and expenditure on the revenue. For the first lags of both series, we have a negative effect on fiscal balance and expenditure on government revenue.

Table4: *VAR results*

	Total debt		Fiscal Balance		Expenditure		Revenue	
Total debt	0.64976	0.20579	0.05883	0.00107	-0.1045	0.11507	-0.0538	0.12170
	{0.000}	{0.253}	{0.542}	{0.991}	{0.369}	{0.322}	{0.587}	{0.219}
Fiscal Balance	1.97802	1.27702	-1.46195	-0.6813	-2.03011	1.08720	**-3.0070**	0.64537
	{0.363}	{0.534}	{0.209}	{0.536}	{0.148}	{0.413}	**{0.012}**	{0.568}
Expenditure	2.46542	1.80484	-1.68674	-1.2361	-1.60897	1.04631	**-2.7765**	0.07480
	{0.258}	{0.395}	{0.148}	{0.277}	{0.253}	{0.446}	**{0.020}**	{0.949}
Revenue	-2.20505	-1.7903	2.04031	0.84831	2.60133	-1.1865	4.12223	-0.5995
	{0.318}	{0.417}	{0.085}	{0.473}	{0.068}	{0.406}	{0.001}	{0.622}
Constant	1.63E+	{0.618}	-1.05E+	{0.548}	2.98E+	{0.158}	1.94E+	{0.281}
R2	0.8227		0.5065		0.822		0.9048	

Source: Author's computing,

Notes: This Table presents the VAR results of GABON, where {} represents the probability and values in **bold** imply statistically significant results. The targeting variables are namely: Central government total debt (Gov.Debt), Central Government Fiscal Balance (which indicates a surplus (+) or a deficit(-)), Central government total expenditure (Expenditure), and Central Government total revenue (Revenue).

4.2 Discussion

The ADF&PP stationarity tests applied on our fiscal series are showing globally the existence of unit root. Thus, the government debt, government revenue, and expenditure are said to be integrated of order 1 since their first differences are stationary i.e. I(0). Only the fiscal balance series comes out with balanced results: the ADF test shows a non-stationarity whereas the PP

ISSN: 2658-8455
Volume 1, Issue 3 (November, 2020), pp.58-72.
www.ijafame.org

IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

states the existence of stationarity. According to Trehan and Walsh (1988, 1991), since our fiscal series are not integrated of order 0, I(0); then we cannot conclude that fiscal policy in Gabon is sustainable. As a result, we can say that the Gabonese government debt grows without boundaries, and the government reaction function does not respond accordingly since the expenditure keeps on growing, exposing a weak fiscal policy. This result is contrary to the study conducted by Hamilton and Flavin (1986), where the No-Ponzi-Game condition test for the US showed stationarity of the US government deficit and debt series, results in line with Mendoza and Ostry (2008) where a positive response of primary balance to fluctuations in public debt was found showing evidence of fiscal solvency in their study for the sample of emerging and developed economies based on an overlapping generation's model study. The main reason for the swelling of the indebtedness is the drop of the oil barrel price since the country has a strong dependence on the oil revenue. Consequently face to low tax revenue, the need in terms of public deficit funding leads to an accumulation of public debt. Such a situation highlighting an issue that faces an economy that is based exclusively on the exports of natural resources. The government should take urgent resolutions consequently by exploring other sources of revenues such as the agricultural sectors, tourism or industry in order to break with the dependence on the natural resources revenues, which expose the entire economy to any negative external shock on the oil price.

Furthermore, the non-stationarity of the Gabonese public debt series is confirmed by the Johansen co-integration tests, since the empirical findings conclude the absence of co-integration between government revenue and expenditure in the long-run. This implies that the Gabonese public debt is not sustainable. Our findings are consistent with the study of Smith and Zin (1991) who explored the Canadian public debt using monthly data covering the period from 1946 to 1984, as well as the study of Baglioni and Cherubini (1993) who examined the case of Italy using monthly data all concluded the non-sustainability of public debt. In the same line as our results, the study developed by Buiter and Patel (1992) found the unsustainability of public debt for the case of India using yearly data covering the period from 1970 to 1988. However, our empirical findings are not consistent with the results found by Haug (1995) and Quintos (1995) for the US case where the US government debt was found to be sustainable. Similarly, Paynes's research (1997) concluded the sustainability of the German public debt for the case study of selected G7 countries. Then, later on, Athanasios and Sidiropoulos (1999) found the sustainability of Belgium, Greek, Portugal, and Italy's public debt. The non-sustainability of the Gabonese public debt in this study addresses a strong signal to the government who believes that there is no worry about the sustainability of the public debt in Gabon. Our empirical findings should be regarded as an alarming signal addressed to the IMF who concluded in their country report of Gabon in 2018 that the Gabonese public debt will stay in a sustainable path; here is a great reason to revise their report. Besides, the VAR results indicate a positive impact of fiscal balance (deficit) and government expenditure on the accumulation of public debt. An increase of one unit in the fiscal deficit increases the indebtedness by 1.98 for the first lag and 1.28 for the second lag while an increase of one unit in the expenditure leads to a rise of the debt by 2.46 for the first lag and 1.8 for the second lag. The government has to control their expenditure and deficit by reducing spending and also increasing the tax revenue as the effect of the revenue to reduce the government debt is quite close to the increasing effect of the expenditure (respectively around (-2.2) for the first lag and (-1.8) for the second lag).

5. Conclusion

This study investigates the issue of public debt sustainability in Gabon using yearly data covering the period from 1980 to 2020. The data used in the research are collected from the World Development Indicators (WDI), and the African Development Bank (AFDB). The theoretical framework applied in this research is the Present Value Constraint (PVC) following the stationarity and co-integration approach. The empirical findings highlight globally the non-stationarity of the fiscal series namely: government debt, fiscal balance, government revenue, and expenditure. Even if the fiscal balance presents somehow balanced results i.e. non-stationary according to ADF tests with constant and time trend and stationary for the PP tests. Furthermore, the Johansen cointegration tests confirm the nonexistence of cointegration between government revenue and expenditure. This suggests that the government debt of Gabon is unsustainable while politicians believe that there is no worry in the actual level of public debt our results based on the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests emphasize a prevalent sovereign debt crisis in the country if appropriate measurements are not applied accordingly. According to the limit fixed in terms of debt to GDP ratio in the CEMAC Zone, the member states should keep the level of public debt under 70% of the GDP ratio; the intuition behind this limit is for the government debt to remain under control avoiding the violation of the intertemporal budget constraint (IBC) or the threshold rule of government indebtedness. However, at a level less than the limit of 70% of GDP ratio, precisely around 39.25% for the last 5 years, the Gabonese government debt appears to be unsustainable according to our empirical findings based on Johansen co-integration tests. As a consequence, there is no long-run relationship between our two series (Central government revenue & government expenditure). These results highlight an issue in terms of fiscal space since the threshold fixed at 70% of GDP by the Economic and Monetary Community of Central Africa (CEMAC) does not prevent them from potential debt distress while respecting the threshold. The results address, on the one hand, the Gabonese government to have a rigorous look at their debt management rather than just saying there is no worry for the Gabonese debt sustainability, and on the other hand, the IMF (2018) to review their report of Gabonese economy in which it is indicated that the debt will stay in a sustainable path. This is as well an address to the Economic and Monetary Community of Central Africa (CEMAC) to reconsider the threshold to a lower level i.e. 60% of GDP ratio as suggested by scholars for developing countries even less if we consider an interval of 50% to 60%. The main reasons that could explain the actual debt issue in Gabon are the fall of the oil price experienced lately. Thus, the country has a dependence on the oil revenue such that any negative external shock deteriorates the entire economy, the increase of government spending is also one of the reasons since the country has been engaged in huge public investments these last 15 years such as building football stadiums and also holding sports competitions and plenty of social investment projects that did not get finalized. The reason is that those projects came with a wave of new government agencies in which colossal funds were injected and because of lack of control the management of funds was so weak and even become worse since the president's health issue and more recently the Covid-19 is another reason of the Gabonese indebtedness showing an inefficiency of government in the management of public debt.

The Gabonese debt issue seems to be shared by almost all the six CEMAC countries according to the IMF (2016) report on the Central African Economic and Monetary Union (CEMAC). It seems to be evident that there is a risk of a debt crisis in the region. More specifically rather than using colossal funds in some useless personal investment, the governments of the region should instore some structural reforms such as the adoption of

ISSN: 2658-8455
Volume 1, Issue 3 (November, 2020), pp.58-72.
www.ijafame.org

consolidation policies, reduce the government expenditure trend, reform the tax policy, and more importantly adopt some public investments in terms of infrastructure namely: roads and railways, electricity in some countryside, healthcare system, and education. Such investments are known to stimulate both private and public investments, necessary to upward the growth of the real GDP rate and consequently stabilize government debt. In order to understand the debt situation of the whole region, our next study will investigate the sustainability of fiscal and public debt in the CEMAC region.

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