Econometric Analysis of Benin Public Debt Sustainability

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ARTICLE INFO	ABSTRACT
Publication Online: 16 December 2020 Corresponding Author: **Alfred B. K. DOSSA**	Public indebtedness rates (outstanding debt recorded in the GDP) of Benin are respectively from 41.2% (4th term 2019), 43.9% (1st term 2020) and 48.4% (2nd term 2020). Previously, these rates have increased from 56.2% on December 31, 2018, compared to 54.3% in 2017 (Autonomous Amortization Fund - CAA, 2020). The progress of these indebtedness rates deserves an analysis of Benin public debt sustainability. This study thus aims at carrying out the econometric analysis of Benin public debt sustainability. The outcomes of data processing in the programming software R reveal that estimated β ($\hat{\beta}$ = 0,7318), is comprised between 0 and 1; we can deduce, according to QUINTOS (1995) that the revenues and expenditures partially adjust and that Benin public has a low sustainability.

1- Introduction

The management of public debt has been subject to a plentiful literature and has benefitted from a revival of interest from policy makers and university community since the outbreak of the crisis related to Greek public debt in 2009. To define it, authors generally refer to its objectives which focus on the control of indebtedness costs and risks and also to the control of public debt impacts on the economy (Adjanohoun and Aguessy-Vognon, 2020). Public debt management is therefore considered to be efficient when it enables to comply with the requirements of indebtedness or refund based on a strategy combining optimally costs and risks of the State funding. So, according to Tobin (1963), the aim of public debt management is to contribute to the macroeconomic stabilization and indebtedness costs minimization on the one hand, and to guarantee debt sustainability on the other hand. Debt sustainability thus remains an issue related to debt management, because debt burden continues to influence developing countries, despite several initiatives such as the initiative in favour of highly indebted poor countries (HIPC) in 2003 and the initiative of multilateral debt relief (IADM)

in 2006 (Samizafy, 2013). The analysis of debt sustainability by the international monetary fund (IMF, 2018) shows that the majority of African countries are likely to experience over-leverage. So, only 8 African countries out of 53 (Uganda, Morocco, Libya, Botswana, Lesotho, Rwanda, Senegal and Tanzania) have a low risk of debt crisis. The current debt service (interests and capital refund) covers 20% of governments annual budgets.

The statistical bulletin of Benin public debt carried out by the Autonomous Amortization Fund (CAA, 2020), indicates that Benin outstanding public debt on June 30 , 2020 was FCFA 4, 251.44 billions compared to FCFA 3, 857.97 billions on March 31, 2020. Moreover, the rates of public indebtedness (outstanding debt recorded in the GDP) are respectively 41.2% (4th term 2019), 43.92% (1st term 2020) and 48.40% (2nd term 2020). Previously, these rates increased from 56.2% on December 31, 2018, compared to 54.3% in 2017. Despite the fact that these indebtedness ratios are under the community threshold of 70% set for the member countries of the West African Economic and Monetary Union (WAEMU), this calls for Benin public debt sustainability to be analyzed

in medium and long term to avoid to come back to the vicious circle of chronic indebtedness as a result of an economic crisis in the 90s (Adjanohoun and Aguessy-Vognon, 2020).

The econometric evaluations of stationarity and cointegration of debt sustainability step from the first researches carried out by some economists, especially when the indebtedness crisis increased in developing countries. The first econometric analysis were carried out in 1986 by Hamilton and Flavin. These two economists addressed the sustainability of the American budgetary policy through a stochastic perspective. They have been the first ones to carry out an empiric evaluation of the compliance with the intertemporal budgetary constraint of the American State referring to stationarity evaluations (ADF), series of debt and primary balance over the period (1960-1984). They considered that sustainability of budgetary policy meant the stability thereof. Their evaluation thus focused on the stationarity of debt and primary deficit. At the end of their research works, they concluded that American budgetary policy was sustainable. Moreover, the works carried out by Hamilton and Flavin (1986) were criticized by Kremers (1988) because their regression did not include any overdue and did not eliminate the self-correlation of residues. He also questioned the choice of the discount rate which was based on a real rate.

Other empiric studies were developed by Trehan and Walsh (1988). They introduced the evaluations on cointegration of series. They applied these evaluations on the series of debt and primary deficits in the United States from 1964 to 1984, and ended up concluding that the American budgetary policy was non sustainable. Hakkio and Rush (1991) asserted that the existence of a relationship of cointegration between total revenues and expenses is a necessary and sufficient condition for sustainability. Despite this, they ended up joining Kremers (1988) and Trehan and Walsh (1988) asserting that American budgetary policy was non sustainable between 1960 and 1984. These evaluations of cointegration are a kind of generalization of stationarity evaluations for series of debt and primary balance. The cointegration of total revenues and expenses implies the existence of a stationary linear combination between these two variables. Otherwise, the long term relationship between revenues and expenses is stable on average.

The first one to have taken advantage of the works of Hakkio and Rush (1991) is Quintos (1995). She came back to their works in introducing the distinction between strong sustainability and low sustainability. She describes the relationship of cointegration between proceeds and expenses of strong sustainability when the ratio between both variables is a unit one. Otherwise, a strong sustainability means proceeds and expenses completely ajust. In this case, there is a strong presumption of stationarity of deficits series. However, Quintos (1995) describes such relationship of low sustainability when the coefficient of cointegration is comprised between 0 and 1. In other words, the proceeds increase in the same order as the expenses but with a lower

range. In such situation, the series of deficits is no longer necessarily static. The works of Hakkio and Rush (1991) and Quintos (1995) have been highly criticised respectively by Wickens and Uctum (1993) and by Hénin (1996). These authors are against the idea that the tests of cointégration be a more flexible generalization of the global balance stationarity test. They say that the principal interest of cointegration tests is to provide an estimation of the coverage coefficient for expenses and proceeds. In his article « Sustainability of deficits and budgetary adjustments » Hénin (1996) declares that: « ...cointégration is neither necessary for gross sustainability, nor is it sufficient for net sustainability. His aim is thus mostly to establish a convergent estimation of the coverage ratio of expenses over proceeds when these variables are themselves non stationary. ». He also has in common with Wickens and Uctum (1993) the fact that stationarity does not mean a direct coverage of expenses by proceeds, but rather a sufficient coverage of the debt burden by the primary balance. Moreover, the notions of strong and low sustainability are also questionable in so far as they do not prevent the debt to GDP ratio from reaching very high levels. Finally Bohn (1995), also shared these criticisms and suggests a test of cointegration different from the previous ones. His strategy consisted in testing sustainability in studying the relationship of cointegration between primary balance and debt stock.

2- Materials and Method
2.1- Sources of data and processing tools
The quantitative data of the study have been collected on the sites of the general Directorate of Revenue Fund and Public Accounting (DGTCP), World Bank (WB), International Monetary Fund (IMF), National Institute of Statistics and Economic Analysis (INSAE), Autonomous Amortization Fund (CAA), Debt Accounting Agency (ACD) and the general Directorate of Economic Analysis (DGAE).

These data have been processed by the methods of estimation in the programming software R. Indeed, R is a software which represents a free alternative to SPSS and SAS softwares meant for the statistical and econometric analysis. It is in command line. To use it, type some commands in a browser window. It finally has very good capabilities of graphic representations.

2.2- Methodology
The econometric method of debt sustainability is made based on tests of stationarity or cointegration. The tests imply that sustainability requires proceeds and expenses to be cointegrated, that is to say there is a linear combination of these two variables that is stationary. This long term relationship is based on this:

$$T_t = \alpha + \beta.G_t + \varepsilon_t \qquad (1)$$

T_t : total proceeds
G_t : budgetary expenses + debt burden

ε_t : random term
α : constant

The test of stationarity ADF (Augmented Dickey-Fuller) will be used to assess the debt stationarity and the test of cointegration between the total proceeds and the total expenses. The aim of the test of stationarity ADF is to appreciate the long term properties of the debt. The unit root test of Dickey-Fuller augmented (ADF) has, as a null hypothesis, the non stationarity of the series, that is to say the presence of a unit root in the studied series and as alternative hypothesis the stationarity of the series.

The test of cointégration between the proceeds and the expenses according to him, is often used to complete the tests of stationarity. This test carried out in case of non stationarity of the debt. Indeed, the aim is to find out if some variables with a unit root have a common stochastic trend. Should this be the case, there is then a relationship of long term balance between the variables. In other words, the linear combination of both variables from non-stationary series is, according to her, a stationary one. The types of sustainability in accordance with the properties are supmmarized in the table 1.

Table 1: Low or strong sustainability of public debt through expenses and proceeds

Coefficient	Cointegration	Type of sustainability
$\beta = 1$	Yes (proceeds and expenses completely)adjust	Strong sustainability
$0 < \beta < 1$	Yes (proceeds and expenses partially adjust)	Low sustainability

Source: QUINTOS (1995)

The procedure of sustainability test takes place in two steps. The 1st step consists in applying stationarity tests on the debt/DGP series. The 2nd step consists in checking and confirming the previous results. We carry out the tests of cointegration between the total proceeds and expenses. First of all, we carry out a test of stationarity for total proceeds and expenses separately. If they are non-stationary in level (and stationary in difference), the hypothesis is tested to have no relationship of cointegration between these two variables. In case of cointegration between proceeds and expenses, we would conclude a public debt sustainability (strong or low one as the case may be).

Step-by-step procédure of ADF stationarity test
Lest's consider the following models:
- Model (1) : $\Delta T_t = \beta T_{t-1} + \varepsilon_t$ (ii)
- Model (2) : $\Delta T_t = \beta T_{t-1} + \alpha + \varepsilon_t$ (iii)
- Model (3) : $\Delta T_t = \beta T_{t-1} + \alpha + \delta_t + \varepsilon_t$ (iv)

With : α = constant and δt = trend
For the studied series, we will adopt the step-to-step strategy in 3 steps.
Step 1: We estimate the model (3) and we start checking the significance of the trend. 2 possible cases:
1) The trend is non-significant: $t_{trend} < t_{theoretical}$ (or p-value > 5%). We moves to step 2.
2) The trend is significant: $t_{trend} > t_{theoretical}$ (or p-value < 5%). Then we test H_0 : $\beta = 0$ (Non stationarity) : 2 possible cases:
H_0 is true: the series is non stationary.
H_0 is wrong: the series is stationary.
Step 2: This step is applied only if the trend in the model (3) is non-significant. We estimate the model (2) and we start checking the significance of the constant.
2 possible cases:
1) The constant is not-significant $t_{constant} < t_{theoretical}$ (or p-value > 5%). We move to step 3

2) The constant is significant $t_{constant} > t_{theoretical}$ (or p-value < 5%). The we test H_0 : $\beta = 0$ (Non stationarity) : 2 possible cases.
H_0 is true: the series is non stationary
H_0 is wrong: the series is stationary
Step 3: This step is only applied if the constant in the model (2) is non-significant. We estimate the model (1) and we directly test H_0: $\beta = 0$ (Non stationarity). 2 possible cases:
H_0 is true: the series is non stationary
H_0 is wrong: the series is stationary

Procedure of cointégration test
If we have: $T_t \leadsto I(1)$ and $G_t \leadsto I(1)$
$I(1)$: 1st level intégration, we estamate by OLS the long term relationship: $T_t = \beta G_t + \alpha + \varepsilon_t$
In order to have a cointegration, the residue ε_t of the linear regression has to be stationary:
$\varepsilon_t = T_t - \beta G_t - \alpha \leadsto I(0)$.
The stationarity of the residue is tested with the test of Dickey-Fuller (simple or augmented one).

2.3-   Definition of variables
GDP: this is the economic indicator which enables to quantify the total value of production of the annual wealth made by the economic agents residing inside a territory.
Public debts: it is the set of financial liabilities taken in the form of loans by a State, its local authorities and bodies which are directly under its supervision.
Total proceeds: it is the set of resources, tax and non-tax revenues, collected by the State during the financial year.
Total expenses: they are made up of programmes expenses and interests on debt. They include current, net expenses on goods and services, subsidies and social benefits.

3- Results and Discussion

The critical threshold considered for all our tests is 5%. The estimations of tests outputs in the software R enabled to to present the following various results.

3.1- Test of stationarity ADF for debt/GDP ratio

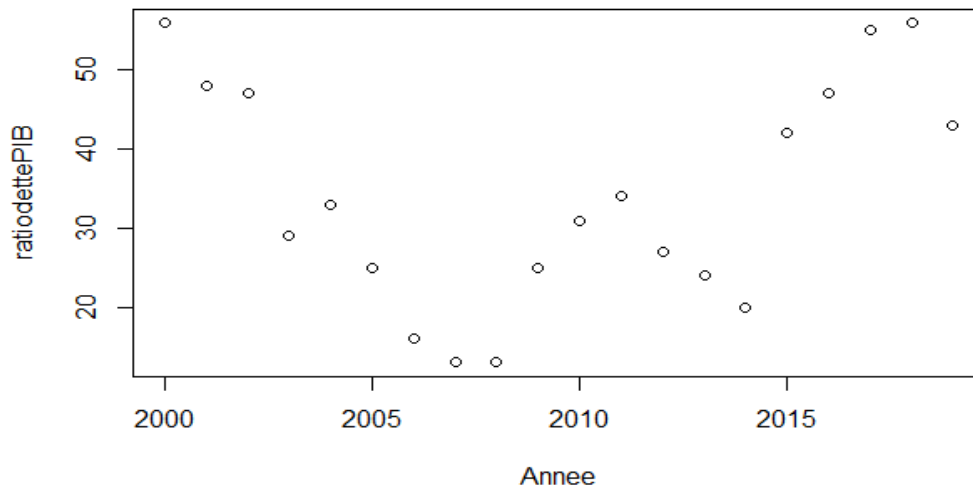The following chart shows the progress of Benin endebtedness rqtio over the period 2000 to 2019.

Figure 1: Progress of debt/GDP ratio
Source: Estimations in the software R, 2020

Table 2: Test of stationarity ADF of debt/GDP

Variable analyzed	Test	Null Hypothesis tested	Trend	Constant	Unit root test	Conclusion
Debt/GDP ratio	ADF	Non stationarity	Non significant	Non significant	-0,7646 > -1.95	Non stationarity

Source : Estimations dans le logiciel R, 2020

It follows from this table the non stationarity of the endebtedness ratio. We can keep in mind at this level that Benin public debt does not have a long term strong sustainability. In order to refine our analysis, let's focus on the study of total proceeds and expenses through the test of cointegration. We thus have to check whether there is a long term balance relationship between Benin total proceeds and expenses over the period 2000 to 2019. We thus had to test first of all the stationarities of proceeds/GDP ratio and expenses/GDP ratio, and then to carry out the test of cointegration between proceeds and expense

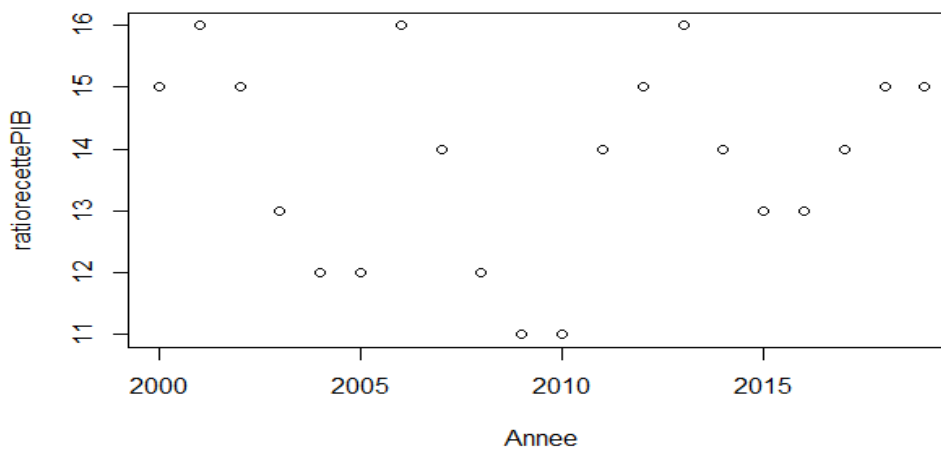### 3.2- Test of stationarityé ADF on the proceeds/GDP ratio

Figure 2: Progress of proceeds/GDP ratio for 2000 – 2019
Source: Estimations in the software R, 2020

Table 3: Test of stationarity ADF of proceeds/GDP ratio

Variable analyzed	Null hypothesis tested	Trend	Constant	Unit root test	Level stationarity	Integration
Proceeds/GDP ratio	Non stationarity	Non significant	Significant	-2,4576 > -3,00	Non stationary	Order 1

Source: Estimations in the software R, 2020

From these results, we can observe that the series proceeds/GDP is not stationary in level. However, it is stationary on the series in first difference. This enables us to conclude that the series is an order 1 integrated series, this means that we have to differentiate the series once in order to make it stationary.

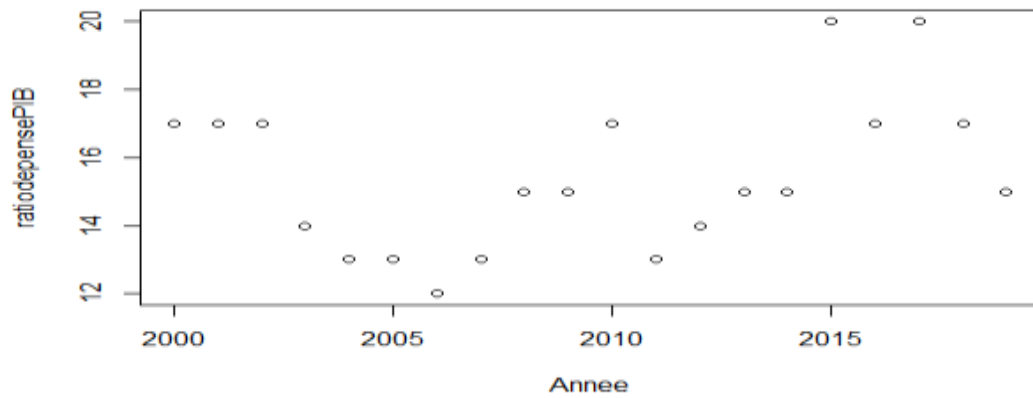### 3.3- Test of stationarity ADF on the expenses/GDP series

Figure 3: Progress of expense/GDP ratio
Source: Estimations in the software R, 2020

The following table summarizes the results obtained from our tests on this series:

Table 4: Test of stationarity ADF of proceeds/GDP ratio

Variable analyzed	Null hypothesis tested	Trend	Constant	Unit root test	Level stationarity	Integration
Expenses /GDP ratio	Non stationary	Significative	-	-3,25 > -3,60	Non stationary	Order 1

Source: Estimations in the software R, 2020

We thus conclude that the expenses/GDP series is stationary in first differentiation, and is consequently order 1 integrated. From the relationship of tests results about the proceeds/GDP and expenses/GDP series, we notice that both series are order 1 integrated. It is thus possible to check the cointegration between proceeds and expenses.

3.4- Test of cointegration between total proceeds and expenses
The estimation of the long term relationship between proceeds and expenses by ordinary least squares method (OLS) gave the following results:

Reminder on the model estilated: $T_t = \alpha + \beta\, G_t + \varepsilon_t$

Results of the estimation: $\widehat{\beta} = 0,7318$

$\widehat{\alpha} = 122900000000$

We notice that the β estimated is comprised between 0 and 1. We can conclude according to QUINTOS (1995) (Table 1), that Benin public debt has a low sustainability. Proceeds and expensses partially adjust. A test of stationarity ADF has been applied on the estimated residues. The results are included in the following table:

Table 5: Test of stationarity ADF of estimated residues

Variable analyzed	Hypothesis tested	Trend	Constant	Unit root test	Conclusion
Residues	Non stationarity	Non significant	Significant	-3,23 < -3	Stationary

Source: Estimations in the software R, 2020

We thus notice the stationarity of the estimated residues. As a consequent, both procceds expenses variables are cointegrated and the long term relationship estimated is really valid. Also, all the tests carried out in the software R to check the assumptions of normality, autocorrelation and homoscedasticity of residues show that the residues follow a normal rule and are non-correlated among themselves. In the light of the results of our tests on the Benin State data, we can observe that Benin public debt sustainability is a reality, but is low. Indeed, the implementation of an expansive budgetary policy by the State some times over the ten previous years, in deteriorating the public balance through the increase of expenses had some multiplier effects on the progress of public debt despite the GDP growth. It is thus important to find a mechanism to comply with the cash position plans forecasts. The State should therefore avoid to conduct an expansive budgetary policy, thus avoiding the deterioration of the public balance which has to be a positive one, in order to guarantee the stability of the country's economy. Also, political decisions must at least have some impact on the State cash position. It has to find a way to achieve budgetary surpluses from the difference between its proceeds and its expenses over financial years. Therefore, it has to adjust its proceeds and expenses in order to avoid deficits. The budget has to be permanently balanced. A rigorous management of expenses to be made and a discipline in the allocation of resources are therefore required. The State could either increase the growth rate, or decrease the interest rate, or even both in order to reduce the budgetary efforts it has made with a view to reducing its indebtedness rate. The State must therefore be careful as far as its indebtedness policy is concerned.

4- Conclusion

The objectives of debt management have not progressed since 2015 in Benin. They are governed by the decree n° 2015-581 dated November 18, 2015 on the policy related to the indebtedness and management of Benin public debt and clearly defined in its article 3. However, it emerges, at the end of this research, that the economic model of Benin debt management is facing the problem of public debt sustainability. The analysis showed that public debt sustainability is real but is low ($\widehat{\beta} = 0{,}7318$; is comprised between 0 and 1). So, the State will have to : (i) improve its budgetary policy in order to avoid a deterioration of the public balance, (ii) have a correct adjustment between the total proceeds and expenses to achieve budgetary surpluses, finally (iii) boost the economic growth rate to increase the budgetary surpluses in order to reduce its indebtedness rate. The State thus has to be careful in its indebtedness policy.

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