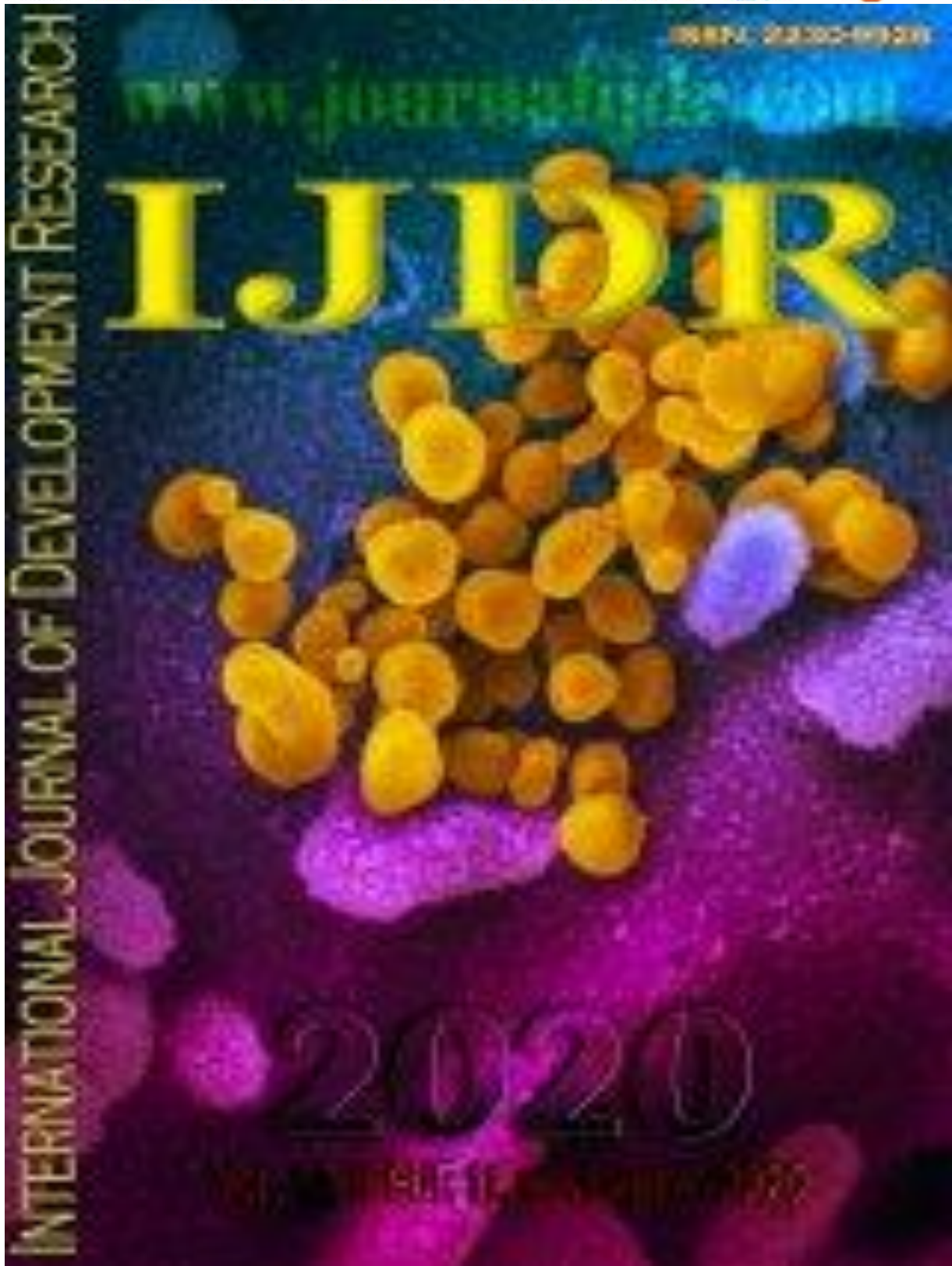


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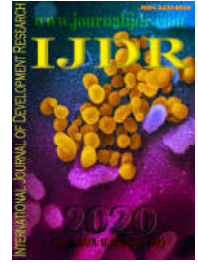
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RESEARCH ARTICLE

OPEN ACCESS

ALGEBRAIC ANALYSIS OF BENIN PUBLIC DEBT SUSTAINABILITY

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ABSTRACT

The outstanding public debt of Benin on June 30, 2020 was FCFA 4,251.44 billion compared to FCFA 3, 857.97 billion on March 31, 2020 (CAA, 2020). The corresponding indebtedness ratios are 43.9% (1st term of 2020) and 48.4% (2nd term of 2020). Such indebtedness progress deserves an analysis of Benin public debt sustainability. The aim of this study is to carry on the algebraic analysis of Benin public debt sustainability. This approach is based on the control of indebtedness ratio through intertemporal budgetary constraint. The algebraic estimate in the programming software R showed that Benin can reduce its indebtedness ratio by 40% in the medium term with considerable budgetary efforts.

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INTRODUCTION

Debt sustainability expresses the capability of a State to pay off its loans, and thus its creditworthiness (Maillot, 2012; Mankiw, 2003). It depends especially on the difference between the growth rate of economy and the interest paid on the debt. It is impossible to determine a threshold from which «the unsustainability» appears. It is related to the foreseeable proceeds which will enable to pay interests, even to pay off a part of the debt. There is no absolute criteria to judge the sustainability because this depends on the capability of the government to levy new taxes or reduce its expenses, thus on the socio political context which varies from a country to another. Debt sustainability remains a timely issue, because debt burden continues to constrain developing countries despite several initiatives such as the one in favor of heavily indebted poor countries (HIPC) in 2003 and the initiative towards multilateral debt relief (IADM) in 2006. The analysis of debt sustainability by the International Monetary Fund (IMF, 2018) shows that the majority of African countries are likely to experience over-indebtedness. So, only 8 African countries over the 53 (Uganda, Morocco, Libya, Botswana, Lesotho, Rwanda, Senegal and Tanzania) experience a low risk of debt crisis. The current debt service (repayment of interests and capital) concerns more than 20% of governments annual budgets.

The statistical bulletin of Benin public debt made by the Autonomous Amortization Fund (CAA, 2020), indicates that the outstanding public debt as at June 30, 2020 was FCFA 251.44 billion compared to FCFA 3, 857.97 billion as at March 31, 2020. Furthermore, the public indebtedness ratios (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 ratios changed 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, as was the case in the 90s. Indeed, the convergence agreement between the member States of WAEMU provides in its article 18, Chapter II on convergence criteria, that no country should exceed a ratio of 70% for the outstanding internal and external debt recorded in the normal GDP. It also requires in second level criteria, a primary deficit limited to 3% of GDP. So, to estimate the budgetary effort necessary for Benin in order to reduce its indebtedness ratio, it is important to focus on the definition of debt sustainability as a basis. Such definition sets out that a public debt is considered to be sustainable if the current outstanding debt can be paid off at a given time in the

future. In other words, the future updated budgetary surplus must cover the debt stock at a given time. This study carries out the algebraic estimate of Benin public debt sustainability. It focusses on the intertemporal budgetary constraint of the State and the budgetary sustainability during the achievement of public debt sustainability. According to this approach, the budgetary policy is sustainable when the indebtedness ratio is stable on average. The control of the indebtedness ratio is therefore crucial for the achievement of sustainability (Hénin, 1996). The sustainability of public debt may be considered to be ensured when a country is able to fulfil all these current and future obligations for its debt service, without any debt relief, any rescheduling, any accumulation of arrears. It is defined based on some mathematical tools. The latter enabled some authors (Fisher and Easterly 1990, Adjanooun et Aguessy-Vognon, 2020) to explain the dynamics of public debt in studying the relationship of interdependence between the primary balance and public debt progress. In general, a budgetary policy is considered to be unsustainable when it constantly leads to an increase of Debt/GDP ratio. On the contrary, such policy is considered to be sustainable when it enables to make the ratio stable and better, to bring it under its initial value.

Therefore, a State should necessarily make sure that the ratio does not get out of control and always has a reasonable value and should focus on the primary public balance (SP), which provides the difference in value between public expenditures (exclusive of interest) and tax revenue. If this difference is positive, thus there is a budgetary deficit and therefore the State will have to fill such funding gap through a recourse to other funding means (loan). If such difference is negative, the State thus shows a primary surplus which enables it to pay off a part of its debt and to adjust its Debt/GDP ratio. Furthermore, it is also important to note that in some cases, primary deficit does not necessarily mean that the ratio is going to increase. And conversely, a budgetary surplus does not necessarily imply that the State will be able to reduce its Debt/GDP ratio. Knowing that the Public Balance reflects the good or bad management of the State as far as public finance is concerned, it represents a strong signal to investors who, by confidence or fear for default pass their sensitivity to the latter on risk premium required for loans. As a consequence, the value of the primary public balance is crucial considering the fact that it conducts the Debt/GDP ratio to the good or bad direction. The progress of public debt is therefore flexible enough to the changes of public expenditures and revenue.

In absolute terms, a budgetary policy becomes unsustainable when it implies a level of indebtedness significantly over the level authorized by capital markets and lenders generally speaking (Samizafy, 2013). A method enabling to estimate the required budgetary effort in order to stabilize or reduce the indebtedness ratio is the one based on intertemporal budgetary constraint. This shows that the outstanding public debt recorded at a time (t) is equal to the outstanding public debt recorded at a time (t-1) plus the interests paid on this outstanding public debt minus the primary budgetary surplus or plus the primary budgetary deficit. So, to have a control of the progress of Debt/GDP ratio, it is necessary to control the difference between the rate of interest and the rate of growth. When the rate of interest is higher than the rate of growth, there is a need for minimizing the difference to the maximum in order to expect that a possible budgetary surplus could stabilize the ratio. Otherwise, if the difference goes up, it

would become almost impossible to stabilize the ratio given the fact that this would require a quite important budgetary surplus and tremendous budgetary efforts.

MATERIELS AND METHOD

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) (Confer databases attached). 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.

Methodology

The algebraic method of debt sustainability is made based on intertemporal budgetary constraint of the State and the budgetary sustainability in the achievement of public debt sustainability. According to this approach, the budgetary policy is sustainable when the ratio of indebtedness is stable on average. It is thus important to control the ratio of indebtedness for the achievement of sustainability through the intertemporal budgetary constraint which is defined as follows:

$$G_t + iB_{t-1} - T_t = B_t - B_{t-1} \quad (1)$$

with :

B_t : Outstanding public debt ;

G_t : Public expenditures exclusive of interest of the year t ;

T_t : The amount of tax revenues;

i : The rate of nominal interest supposed to be constant.

Every year, the State collects some resources in the form of tax, contributions and fees (T_t) and uses them in the form of current public expenditures and transfer reports (G_t) as well as to pay the debt interest charges (iB_{t-1}). The increase of the debt represented by : $B_t - B_{t-1} > 0$ is well and truly the budgetary deficit (D_t). The equation (1) can thus be written as follows:

$$G_t - T_t + iB_{t-1} = D_t \quad (2)$$

This public deficit comprises two elements: the primary deficit ($G_t - T_t$) and the interests paid over the debt (iB_t). According to Peretti and Watel (1997): «*The budgetary deficit constitutes a kind of « resource » which adds to tax and non-tax resources of the States*». The State will thus use the loan to finance its budgetary deficit. In cumulating the annual budget balance of $t = 1$ to $t = z$, we have :

$$B_0 = \sum_{t=1}^z \frac{T_t - G_t}{(1+i)^t} + \frac{B_z}{(1+i)^z} \quad (3)$$

The intertemporal budget constraint of the State thus imposes the following condition of transversality:

$$\lim_{z \rightarrow \infty} \frac{B_z}{(1+i)^z} = 0 \quad (4)$$

or in an equivalent way :

$$B_0 = \sum_{t=1}^{+\infty} \frac{T_t - G_t}{(1+i)^t} \quad (5)$$

The condition (4) means that the nominal outstanding public debt must increase asymptotically at an annual rate not exceeding the nominal interest rate. In other words, the State may indefinitely resort to the loan provided the interest charges from it be soon or later covered by budgetary surpluses before interest (5). The total budgetary balance may be constantly negative, but not the budgetary balance before interests. As for the condition of sustainability, it goes from the same principle as the condition of transversality, but is much more close to the importance of difference between the rates of interest and the rate of growth.

$$\frac{B_{t+1}}{PIB_{t+1}} = \frac{B_t(1+i) + D_{t+1}}{PIB_t(1+g)} \text{ where; } PIB = GDP \quad (6)$$

- If $i > g$: then the Debt/GDP ratio permanently increases even if the primary deficit is null. Then appears the usefulness of the condition of sustainability which imposes the release of a primary surplus. We are going from a condition of transversality to a condition of sustainability. The government will no longer be able to fulfil its obligations at a given time in the future.
- If $i < g$, then we have a rate of growth higher than the rate of interest which entirely modifies the model of the public debt. In such case, there is no problem related to sustainability. Indeed, there is no more any obligation to necessarily have budgetary surpluses, some deficits may be authorized and compensated by the superiority of the rate of growth compared to the rate of interest. So, to ensure a sustainability of public debt by the State in the long term, the State has to make some budgetary efforts necessary for the reduction of the debt/GDP ratio.

A public debt is considered to be sustainable if the outstanding debt today may be paid off at a given time in the future ($D_{t+n} = 0$). In other words, the future updated budgetary surpluses must cover the debt stock at a given time. Thus we can write as follows:

$$D_t = \frac{SP_{t+1}}{(1+i)} + \frac{SP_{t+2}}{(1+i)^2} + \frac{SP_{t+3}}{(1+i)^3} + \dots + \frac{SP_{t+n}}{(1+i)^n} \quad (7)$$

Which equals:

$$D_t = \frac{\sum_{j=1}^n (1+i)^{n-j} SP_{t+j}}{(1+i)^n} \quad (8)$$

with SP as public balance

Let \overline{SP} be the constant of the public balance (surplus or deficit) enabling the creditworthiness of the State in the long term :

$$\overline{SP} = \frac{D_t(1+i)^n}{\sum_{j=1}^n (1+i)^{n-j}} \quad (9)$$

Given the fact that $D_{t+n} = 0$ and based on the equation (8) we have :

$$(1+i)^n \times D_t - \sum_{j=1}^n (1+i)^{n-j} SP_{t+j} = 0 \quad (10)$$

As a consequence, we have the condition of creditworthiness:

$$D_{t+n} = D_t(1+i)^n - \sum_{j=1}^n (1+i)^{n-j} SP_{t+j} = 0, \quad (11)$$

$$\frac{D_{t+n}}{PIB_{t+n}} = \frac{D_t(1+i)^n - \sum_{j=1}^n (1+i)^{n-j} SP_{t+j}}{PIB_{t+n}} \text{ Yet, So}$$

$$\frac{PIB_{t+n}}{PIB_t} = (1+g)^n \frac{PIB_t}{PIB_t} \quad (12)$$

$$\frac{D_{t+n}}{PIB_{t+n}} = \frac{D_t(1+i)^n - \sum_{j=1}^n (1+i)^{n-j} SP_{t+j}}{(1+g)^n PIB_t}$$

Let's suppose that the ratio D_{t+n}/PIB_{t+n} is a proportion β of the indebtedness rate on the date t :

$$\frac{D_{t+n}}{PIB_{t+n}} = \beta \times \frac{D_t}{PIB_t} \text{ with } 0 \leq \beta \leq 1 \quad (13)$$

In replacing in the equation (5*), we have:

$$\beta \times \frac{D_t}{PIB_t} = \frac{D_t(1+i)^n - \sum_{j=1}^n (1+i)^{n-j} SP_{t+j}}{(1+g)^n PIB_t} \quad (14)$$

Hence the formula of indebtedness ratio at a given time:

$$\frac{D_t}{PIB_t} = \frac{D_t(1+i)^n - \sum_{j=1}^n (1+i)^{n-j} SP_{t+j}}{\beta(1+g)^n PIB_t}$$

$$\frac{D_t}{PIB_t} - \frac{D_t(1+i)^n}{\beta(1+g)^n PIB_t} = \frac{-\sum_{j=1}^n (1+i)^{n-j} SP_{t+j}}{\beta(1+g)^n PIB_t}$$

$$D_t \left[\frac{1}{PIB_t} - \frac{(1+i)^n}{\beta(1+g)^n PIB_t} \right] = D_t \times \frac{\beta(1+g)^n PIB_t - PIB_t(1+i)^n}{\beta(1+g)^n PIB_t^2}$$

$$= D_t \times \frac{\beta(1+g)^n - (1+i)^n}{\beta(1+g)^n PIB_t}$$

So, from (7) and (8) we have:

$$-\frac{\sum_{j=1}^n (1+i)^{n-j} SP_{t+j}}{\beta(1+g)^n PIB_t} = D_t \frac{\beta(1+g)^n - (1+i)^n}{\beta(1+g)^n PIB_t}$$

Thus D_t is equal to:

$$D_t = \frac{-\sum_{j=1}^n (1+i)^{n-j} SP_{t+j}}{\beta(1+g)^n PIB_t} \times \frac{\beta(1+g)^n PIB_t}{\beta(1+g)^n - (1+i)^n}$$

In dividing D_t by the +GDP at a given time, we have:

$$\frac{D_t}{PIB_t} = \frac{-\sum_{j=1}^n (1+i)^{n-j} SP_{t+j}}{[\beta(1+g)^n - (1+i)^n] PIB_t}$$

From this report between the initial debt and the GDP, we have the following equation:

$$-\sum_{j=1}^n (1+i)^{n-j} \overline{SP} \times PIB_t = D_t [\beta(1+g)^n - (1+i)^n] PIB_t$$

$$\overline{SP} = \frac{D_t [\beta(1+g)^n - (1+i)^n]}{-\sum_{j=1}^n (1+i)^{n-j}} = \frac{D_t [(1+i)^n - (1+g)^n \beta]}{\sum_{j=1}^n (1+i)^{n-j}}$$

\overline{SP} being the proportion of the national revenue which enables to fulfil the condition of sustainability, we have as a consequence:

$$\frac{\overline{SP}}{PIB_t} = \frac{D_t}{PIB_t} \times \frac{(1+i)^n - (1+g)^n \beta}{\sum_{j=1}^n (1+i)^{n-j}} \text{ . Soit :}$$

$sp = \overline{SP}/PIB_t$: the level of the public balance compared to the GDP which guarantees the sustainability of the debt at a given period (n).

n: the number of years authorized to reach the required the Debt/GDP ratio (β)

$\mu = D_t / PIB_t$: the level of initial debt compared to the GDP

β being the required debt/GDP ratio (70%). So:

$$sp = \mu \times \frac{(1+i)^n - (1+g)^n \beta}{\sum_{j=1}^n (1+i)^{n-j}}$$

From this relation, we can estimate the constant of the required primary balance every year in order to reduce the ratio of public debt compared to the GDP.

RESULTS AND DISCUSSION

Based on the formula of the primary public balance necessary for the reduction of the ratio of indebtedness in the long term and thus for the smooth running of the State budgetary policy, we could estimate the budgetary effort to be made by the State to ensure the creditworthiness of public debt. We were focused on the budgetary and economic information of the financial year 2019. These informations are in the table below:

Tableau 1. Economic and budgetary data for 2019

Economic data	Values
Rate of interest in 2019 (i)	4.5%
Rate of growth in 2019 (g)	6.9%
Rate of indebtedness in 2019 (μ)	41.2%

Source : *banquemonddiale.org, www.tresorbenin.bj etcaa.bj*

From these informations, we quantified the primary public balance of the State in order to reduce its ratio of indebtedness to a threshold of 40% maximum going from the public debt stock in 2019. Our estimates can be summarized in two levels. First level, the required public balance is estimated in complying with the economic informations. Second level, an increase of 2% of the rate of growth has been carried out, the rate of interest not being changed. The outcomes are as follows:

Table 2. Estimation of the primary public balance of the State

\overline{SP} (in % GDP)	Case for data observed in 2019	Case for an increase of 2% of the rate of growth
2 ans	13.07	12.44
5 ans	5.18	4.77
7 ans	3.71	3.26
10 ans	2.59	2.06

Source : *Our estimates, 2020*

The values found represent the budgetary surpluses in %of the GDP. We notice that the more the period is long, the more the required primary surplus is low. So, in taking the real economic informations in 2019, Benin will have to secure a budgetary surplus of 13.07% of the GDP, in order to reduce its outstanding public debt to 40% within 2 years. Also within 10 years it will be able to reduce its outstanding debt to 40% with a budgetary effort of 2.59% of the GDP. Furthermore, with an increase of 2% of the rate of growth, we can observe that the budgetary effort to be made by Benin State is low compared to the first case. Let's note that in both cases, the rate of growth is higher than the rate of interest. So, it is important to note that the more the difference between the rate of interest and the rate of growth is high (the rate of growth to be necessarily higher than the rate of interest), the more it will be easier for the State to reduce its rate of indebtedness as fast as possible. We can therefore conclude that Benin State will be able to reduce its ratio of indebtedness to 40% in the medium term, with a little considerable budgetary effort. However, it could succeed in achieving such objective within a shorter period, either in increasing its ratio of growth, or in reducing its ratio of interest, or both at the same time. Also, the State must thus find the good combination between public expenditures and public revenues to be able to release important budgetary surpluses.

Conclusion

The objectives of debt management have not recorded a progress since 2015 in Benin. They are governed by the decree n° 2015-581 of November 18, 2015 related to indebtedness policy and public debt management of Benin and clearly defined in its article 3. However, at the end of this research, it appears that the economic model of Benin debt management is facing the problem of public debt sustainability. Analysis show that the more the difference between the rate of interest and the rate of growth is higher, (the rate of growth higher than the rate of interest), the more the State will be able to reduce its ratio of indebtedness, in achieving budgetary surpluses. 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 revenues and the total expenditures to release budgetary surpluses; finally (iii) boost the rate of economic growth, to increase the budgetary surpluses in order to reduce its rate of indebtedness. The State thus has to be careful in its indebtedness policy.

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Annex

Database

Year	GDP	Public debt	Total revenue	Total expenses
2000	1,9396E+12	1,4353E+12	2,901E+11	3,223E+11
2001	2,0236E+12	7,5076E+11	3,203E+11	3,532E+11
2002	2,3064E+12	1,0872E+12	3,509E+11	3,82E+11
2003	2,9484E+12	8,3984E+11	3,806E+11	4,263E+11
2004	3,397E+12	8,3072E+11	4,0251E+11	4,295E+11
2005	3,6268E+12	9,2291E+11	4,2975E+11	4,555E+11
2006	3,8826E+12	2,6653E+11	6,2121E+11	4,839E+11
2007	4,5068E+12	5,4369E+11	6,4369E+11	5,856E+11
2008	5,3852E+12	7,135E+11	6,6152E+11	6,847E+11
2009	5,3587E+12	8,3264E+11	5,758E+11	8,054E+11
2010	5,2675E+12	1,6066E+12	6,03E+11	8,9594E+11
2011	5,9073E+12	1,9848E+12	8,4396E+11	7,5945E+11
2012	6,1548E+12	1,9203E+12	9,048E+11	8,8742E+11
2013	6,9155E+12	1,144E+12	1,0847E+12	1,0446E+12
2014	7,3392E+12	1,4618E+12	9,9489E+11	1,1248E+12
2015	6,2912E+12	2,0805E+12	8,244E+11	1,2644E+12
2016	6,5304E+12	2,5131E+12	8,3195E+11	1,1266E+12
2017	7,0171E+12	2,9274E+12	1,0026E+12	1,3973E+12
2018	7,8729E+12	3,2518E+12	1,1536E+12	1,3164E+12
2019	7,9502E+12	3,4766E+12	1,2216E+12	1,221E+12

Source : BENIN/DGAE, CAA, DGTCP, 2020
