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Financing the need for infrastructure in WAEMU countries through public debt

Cheikh Tidiane Ndour

Department of Economics, Cheikh Anta Diop University, Dakar, Senegal

E-mail address: ndourse@outlook.com

Phone: 00221775270817

ABSTRACT

This paper proposes an assessment of the non-linear relationship between public deficit and public investment in debt situation. We use an endogenous growth model, with productive public spending, that we test empirically using the interaction model of Brambor and al. (2006), over the period 1980-2017, in WAEMU countries. The results of the estimates show a change in the regime of the relationship between public investment and public deficit for public debt level equal to 75% of GDP. When public debt is below this threshold, any increase in the deficit has an expansive effect on public infrastructure spending. When public debt is above the threshold of 75% of GDP, an increase in the deficit has a recessive effect on public investment.

Keywords: nonlinear, public deficit, public investment, debt

1. INTRODUCTION

The WAEMU countries have for a long time been characterized by persistent public deficits leading to a situation of unsustainable public finances. Since the mid-1980s, the deficit has been around 2.87% of GDP. This chronic deficit is accompanied by a relatively low growth of public investment around 1.9% over the same period. The review of public finances in the UEMOA between 1980 and 2010 shows two phases. During the period 1980-1993, the increase in the deficit (0.37%) was accompanied by an increase in debt (average of

68%) and a low level of investment. The period 1994-2010 is characterized by a public deficit of 4.68% on average.

The WAEMU economies have made a firm commitment to reduce public debt and deficit levels and to increase economic growth, in order to fight poverty and provide the social goods essential to the development process. In 1999, the eight countries of the zone signed the Convergence Pact for Stability and Growth in order to coordinate budgetary policies and provide public authorities with sound public finances. And in recent years many of these countries have developed development plans putting infrastructure at the heart of emergence.

The financing of the public debt deficit is a means by which States can obtain resources to finance public expenditure in general and investment in particular. However, Bertola and Drazen (1993), Sutherland (1997) and Blanchard (1990) postulate that a high deficit today leads to a larger debt tomorrow with a financial burden on public investment. However, the negative impact of the deficit on public investment spending must be acknowledged. It entails a crowding-out effect by raising the level of interest rates and discourages private investment initiatives, but also discourages consumption presence by causing a tax increase in the future.

It is therefore important to juxtapose the widening of the deficit caused by indebtedness and public investment. Beyond what appears to be a correlation, can one empirically assert that the relationship between public investment and deficit is non-linear and depends on the debt's level?

To account for this nonlinear effect of the deficit public investment, it is necessary to use a regime change model (Perotti, 1999), accompanied by an endogenous growth model with productive public spending (Barro, 1990), in which we introduce debt financing.

The change in regime assumes that any increase in deficit causes a future increase in the debt burden causing a fall in public expenditure on consumption and a flow of new resources benefiting investment expenditure. Increasing the deficit allow to substitute public investment expenditure for consumption expenditure by increasing the debt burden.

Nevertheless, such substitution cannot be carried out continuously since there is an incompressible level of public expenditure on consumption. When this threshold is reached, capital expenditure is crowded out by the debt burden and the relationship between the government deficit and investment expenditure becomes negative. The estimates show an optimal level of debt of 75% of GDP.

The rest of the paper is organized as follows. The following section develops the review of the literature. Section 3 develops the methodology. Section 4 gives the source of the data. The section 5 give the results. Section 5 is reserved for conclusion.

2. LITERATURE REVIEW

The theoretical foundations of this study revolve around the proposition that government intervention in economic activity can help to stimulate long-term economic growth by ensuring efficient allocation of resources, regulation of markets and Stabilization of the economy. However, on the strictly theoretical level, it is possible to note three distinct schools of thought: neoclassical, Keynesian and Ricardian equivalence.

The neoclassical school assumes that individuals plan their level of consumption throughout their lifecycle. Public deficits, by transforming taxes to future generations, increase the current level of consumption. Based on the assumption of full employment of

resources, they argue that increasing consumption imply a reduction in savings as interest rates rise to ensure balance in the capital market.

Keynesian economists assume deficit effects that translate into an increase in domestic production making private investment positive. The increase in aggregate demand due to the deficit increases the profitability of private investment and leads to a higher level of investment at a given interest rate.

Ricardian equivalence stipulates that taxpayers will increase their savings (saving) as a result of increased government borrowing, thereby maintaining interest rates at stable levels. Barro assumes that an increase in deficits due to an increase in indebtedness must be paid today or tomorrow, the total value of revenue being fixed by the present value of the expenditure. Thus, a reduction in current taxes must be offset by an increase in future taxes, leaving interest rates, and therefore private investment, unchanged.

Giavazzi and Pagano (1990) and Blanchard (1990) are the first to speak of the presence of a threshold effect of fiscal policy that is carried out through a signaling effect in a situation of critical debt. This signaling effect is based on the solvency of public finances modifying the formulation of the expectations of private agents. Whether the signal effect is realized through spending or tax in both cases, it puts fiscal policy in relation to threshold effects with an impact on the activity that depends on the level of indebtedness.

In an interpretation similar to this signal effect, Bertola and Drazen (1993) and then Sutherland (1997) based on a model with overlapping generations showed that there could be a psychological threshold of public debt making budgetary adjustment inevitable. A deficit has Keynesian effects when agents are faced with a sustainable level of indebtedness since they will assume that the debt repayment will be based on future generations. On the other hand, in the presence of a debt deemed unsustainable, the agents expect to bear the burden of the debt, in which case a deficit will have non-Keynesian effects.

The Convergence, Stability, Growth and Solidarity Pact (PCSCS), which limits the possibility of State financing, has emerged in a context of low economic growth and the level of investment. Higher deficits could provide sufficient resources to carry out productive expenditures (such as infrastructure investment) to raise the growth path of the Union. It was within the framework that the inclusion of a golden rule emerged in the debates as supervisory mechanisms. This is a rule authorizing debt financing of public investment expenditure provided that the criteria in the Pact do not restrict too much public investment.

In the past, Musgrave (1939) had envisaged such a rule as a mechanism for limiting the public indebtedness of States, reserving only budget deficit financing to capital expenditure. It has been applied informally in Germany and more formally in Great Britain with the development of a law on this rule (Buiter, 2001; Kell, 2001). However, its application in Great Britain has greatly increased capital expenditure (Poterba, 1996). It is therefore seen as an effective means of effectively financing public investment.

In this same line of justification for the golden rule of public finance, Porée and Valila (2003) have shown that fiscal rules that do not differentiate the nature of public spending can create a bias against investment spending. The political cost is probably less to postpone investment projects than to compress wage and transfer expenditure. In a similar approach to that of Porée and Valila (2003), the negative impact of fiscal adjustments on public investment was well supported by Oxley and Martin (1991) and Ballassou and Franco (2000) confirming that public investment is the more volatile state budget with adverse effects on growth.

Minea and Villieu (2008) using a panel model with threshold effects, for 22 countries in OECD, find a nonlinear relation of the public deficit on public investment for a threshold of debt of 120% of GDP. They showed that when the debt ratio is low, the impact of the deficit is positive because the debt burden can be absorbed by a decrease in consumer spending. When the debt is very high, on the other hand, it is no longer possible to reduce consumer spending and the adjustment is made by capital expenditure, so that the relationship between deficit and capital expenditure becomes negative.

Ndour (2017) in a study for Senegal shows that the debt ratio is 80 percent of GDP. It uses an endogenous growth model over the period 1980-2015. When public debt is below this threshold, any increase in the deficit has an expansive effect on public infrastructure spending. When public debt is above the threshold of 80% of GDP, an increase in the deficit has a recessive effect on public investment.

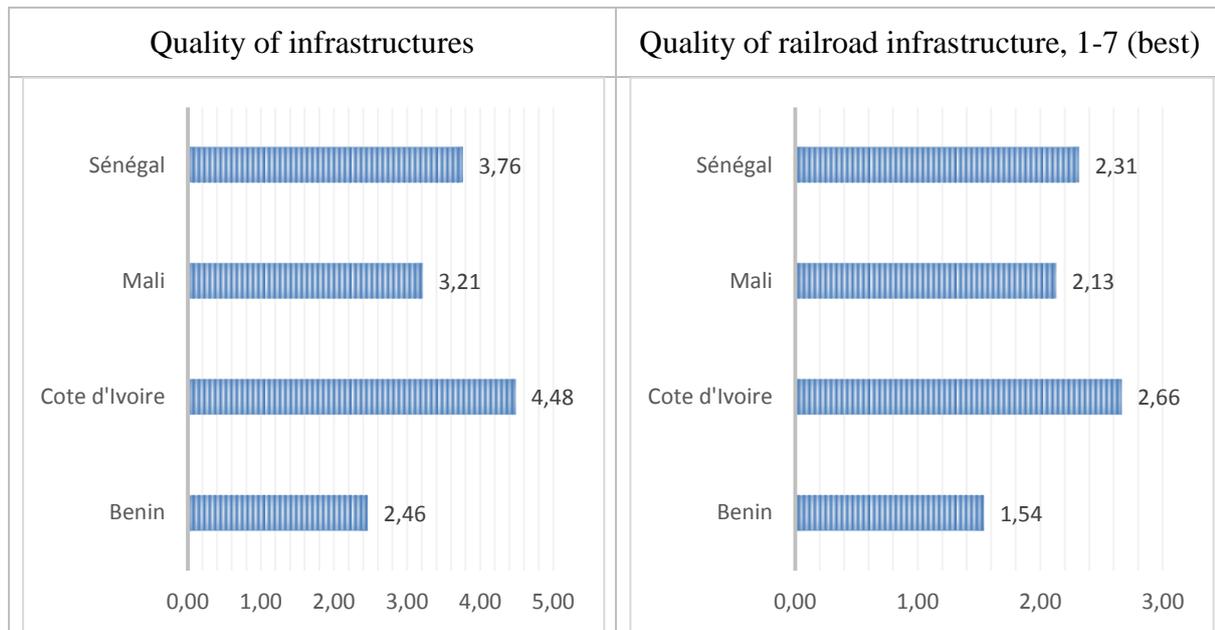
Nevertheless, Kellermann (2007) finds some arguments against the golden rule of public finances. Such a rule is likely to lead to a bias in favor of public investment to the detriment of human capital or research (education and health), which in national accounts are not considered investment expenditure.

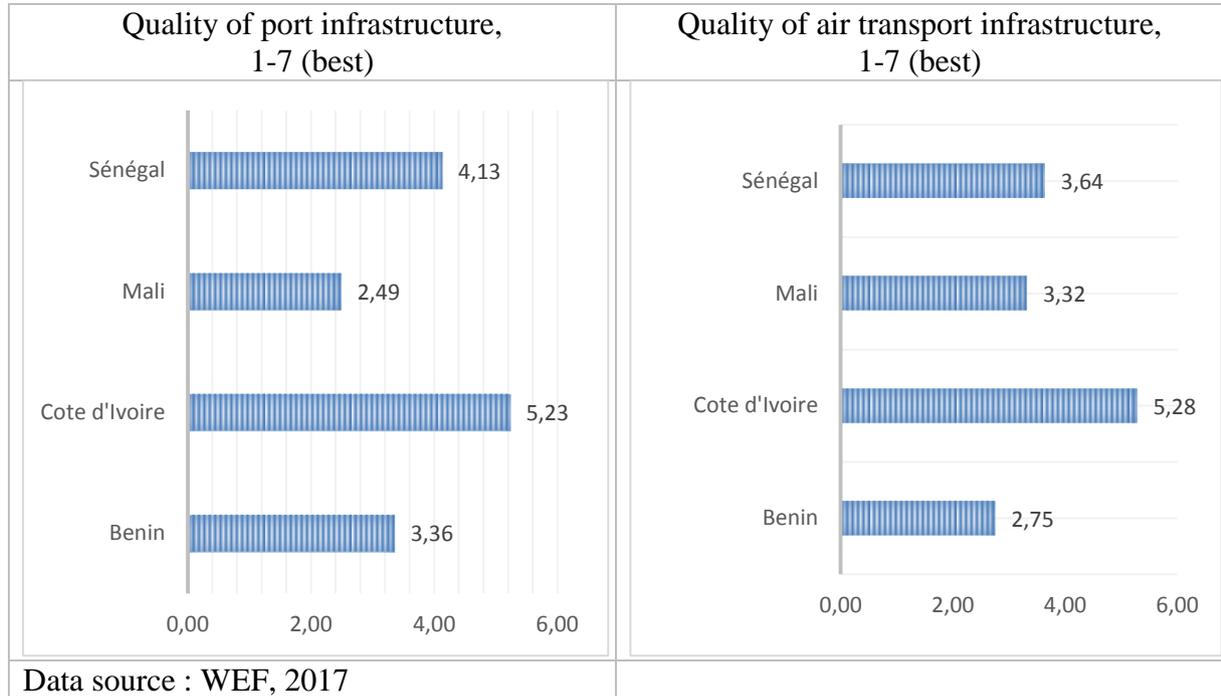
3. WEAKNESS OF PUBLIC INFRASTRUCTURE LEVEL

Infrastructure generally refers to the basic structures that facilitate and support economic activity. They are essential to the functioning of the economy because they provide fundamental services and connect markets. Thus, inadequate infrastructure represents bottlenecks to the competitiveness of the economy.

Regarding the quality of infrastructure, the level remains low when compared to that of developed countries.

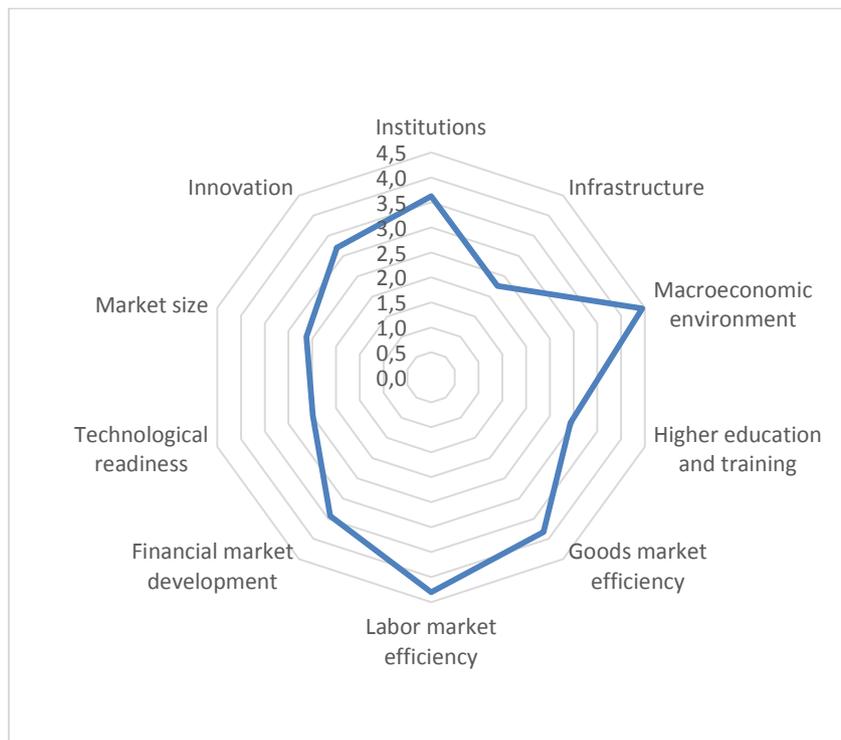
Graph 1. Quality of infrastructures



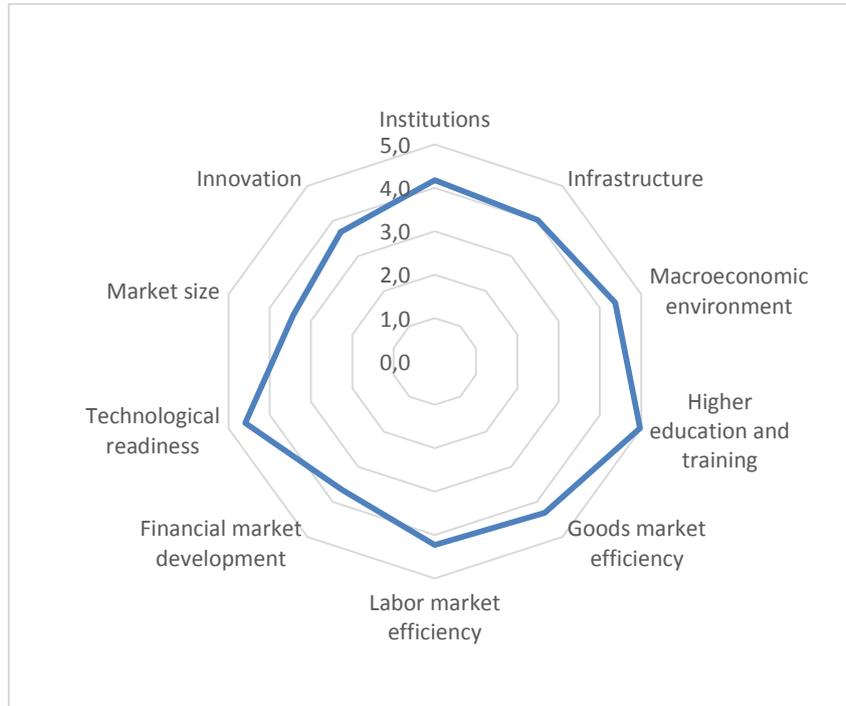


Infrastructure among the weaknesses of the economy

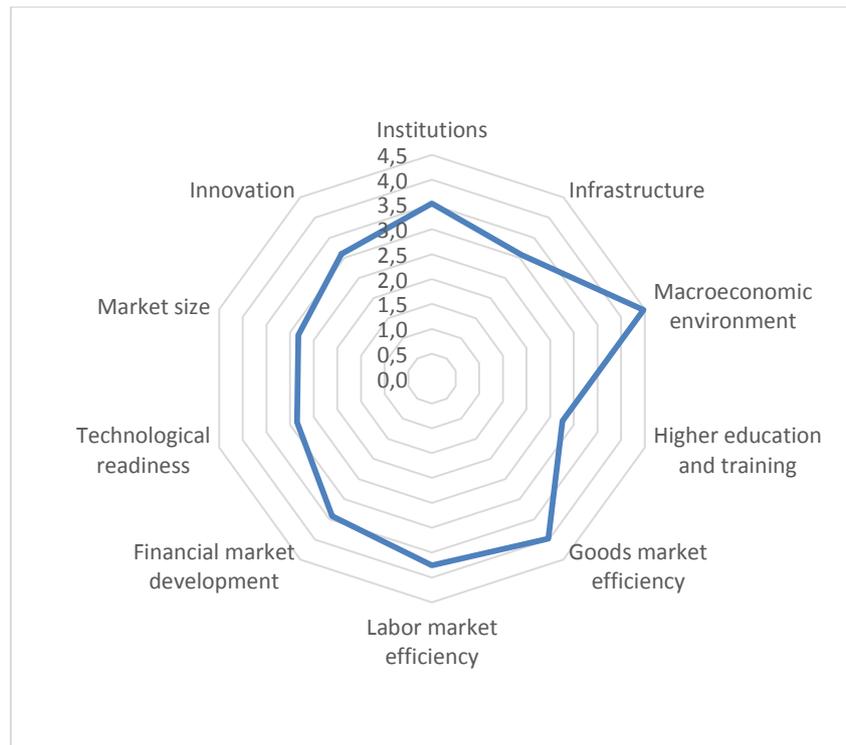
Graph 2(A-D). Weaknesses of the economy



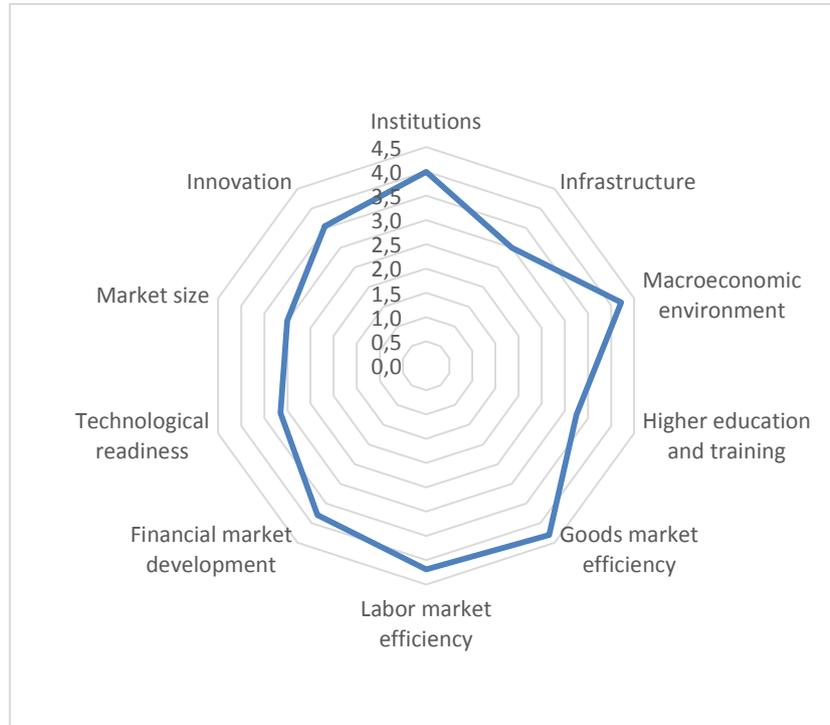
A. Benin



B. Cote d'Ivoire



C. Mali



D. Senegal

Infrastructure is the second constraint to the overall competitiveness of the economy after institutions. In terms of their level of development, WAEMU countries are performing in telecommunications infrastructure (telecommunication density, internet density) and in electrical energy infrastructure (electricity generation capacity)

4. METHODOLOGY

We use the theoretical model of endogenous growth (Barro, 1990) in which we introduce the debt financing of productive public spending.

Let G be the productive public expenditure, G^c public expenditure on consumption, B the stock of public debt, Y the GDP, $t \in [0,1]$ the proportional tax rate, D the public deficit and r the rate interest.

In the Barro model, productive public expenditure (public investment) is given by:

$$G = tY \text{ where } Y = AL^{1-\alpha}K^\alpha \quad (1)$$

With K the physical stock and L the level of work in the economy.

Unlike the Barro model, we assume that productive public spending can be financed by debt. The budget constraint of the government can be written as follows:

$$D = rB + G^c + G - tY \quad (2)$$

The ratio of the budget deficit to GDP is considered to be constant in the long term, which corresponds even to the idea of a zero base budget deficit ratio imposed by the PCSCS:

$$\delta = \frac{D}{Y}$$

In the long run, the budget constraint of the government is rewritten as follows:

$$(\delta + t)Y = (rB + G^c) + G \quad (3)$$

In this relation, productive public expenditure (investment) is separated from unproductive public expenditure (consumption expenditure and debt burden). We assume that unproductive expenditures represent a fraction $(1 - \alpha)$ of total government revenues. The government spends a fraction of revenue on productive public spending. We assume that there is an incompressible component of consumer spending \bar{G}^c . When this threshold is reached, the government can no longer reduce consumer spending.

Under these conditions, the equations of investment and consumption expenditure are given by:

$$G = \alpha(\delta + t)Y \leftrightarrow g = \alpha(\delta + t) \quad (4)$$

With $g = \frac{G}{Y}$ representing the ratio of public investment to GDP

$$G^c + rB = (1 - \alpha)(\delta + t)Y \leftrightarrow g^c + rb = (1 - \alpha)(\delta + t) \quad (5)$$

With $g^c = \frac{G^c}{Y}$ and $b = \frac{B}{Y}$

When public consumption reaches the threshold of minimum ratio \bar{g}^c , the budget constraint of the government is written as follows:

$$g^c = \bar{g}^c \\ g = (\delta + t) - (rb + \bar{g}^c) \quad (6)$$

Public consumption expenditure is given in equation (6), while expenditure on public investment is obtained from the budgetary constraint of the State. The necessary condition for a balanced growth path is that all variables change at the same rate γ which represents the growth rate of GDP. In this case, we can deduce the ratio of public debt to GDP:

$$b = \frac{B}{Y} = \frac{B}{D} * \frac{D}{Y} = \frac{\delta}{\gamma} \quad (7)$$

In the long run, the model generates two regimes. In the first economic policy regime, public expenditure on consumption exceeds the threshold limit \bar{g}^c . In other words, the threshold \bar{g}^c not being reached, the model is thus written:

$$g^c = (1 - \alpha)t + \left(1 - \alpha - \frac{r}{\gamma}\right) \delta > \bar{g}^c \tag{8}$$

$$g = \alpha(\delta + t)$$

An increase in the deficit ratio (δ) increases the ratio of productive public expenditure in 8. It also leads to a decrease in public consumption expenditure. Indeed, the growth rate of the long-term public debt that is equal to γ must be lower than the real interest rate $\gamma < r$ in order to respect the solvency condition and avoid the Ponzi games. Consequently, a rise in the deficit causes a fall in the public expenditure ratio.

In the second economic policy regime, the minimum threshold for the public consumption ratio is reached while the ratio of productive public expenditure comes from the budget constraint. In this case the consumption and investment expenditure equations are written as follows:

$$g^c = \bar{g}^c \tag{9}$$

$$g = t - \left(1 - \frac{r}{\gamma}\right) \delta \tag{10}$$

This ratio g is derived from the government's intertemporal budget constraint. An increase in the deficit reduces productive public spending in 10.

Under the first system, consumption expenditure adjusts to the debt burden, so that an increase in the deficit benefits investment expenditure, which is a substitute for consumer spending. In the latter, on the contrary, consumer spending has reached its minimum threshold, so that the adjustment to the permanent increase in the debt burden (net of the permanent resources provided by the deficit) is based on public expenditure Investment. The economy will be in the first regime when the ratio of public expenditure on consumption is high, that is to say when the burden of the debt burden is not too great. This regime will therefore appear for a low public debt stock as a percentage of GDP, while the second regime will emerge for a high stock of public debt, with a strong interest draw, bringing public consumption expenditure to their uncompetitive threshold.

The threshold value of the debt ratio below (top) of which the economy is in the first (second) regime is obtained by equality between (6a) and (7a)

$$b^* = \frac{((1 - \alpha) \delta - \bar{g}^c)}{r}$$

This threshold is decreasing according to the resources allocated to productive public expenditure, the incompressible level of consumer spending g^c and the real interest rate.

The model predicts a change in the regime of the relationship between public deficit and productive public spending in relation to the debt ratio. This relationship is positive when the public debt ratio is sufficiently low, lower (b) so that the debt burden is also low. An increase in the deficit accompanied by a fall in public expenditure on consumption increases productive public expenditure. On the contrary, a high public debt (greater than b), so that the eviction effect by the burden of the debt is consistent, leads to a decrease in productive expenditure.

The simplest way to test the basic theoretical model is to specify an equation with interaction variable (Brambor and al., 2006) to measure the effect of the deficit (d) as a function of past debt (b-1) on public investment (g).

$$g_{it} = \mu_i + \alpha_1 d_{it} + \alpha_2 b_{it-1} + \alpha_3 (d_{it} * b_{it-1}) + \alpha_4 tgdp_{it} + \alpha_5 aide_{it} + \alpha_6 rf_{it} + \mu_{it} \quad (11)$$

where:

g_{it} : represents the gross capital formation of State i at period t

d_{it} : represents the public deficit of State i at period t

b_{it-1} : represents the public debt of State i in period $t-1$

$tgdp_{it}$: represents the GDP growth rate of State i

$aide_{it}$: represents the State's official development assistance

rf_{it} : represents the tax revenue of the state i

μ_{it} : represents residues

One specifies the debt in delayed value of a period, because it is that which enters the definition of the debt load. Modeling with this polynomial form in bit-1 makes it possible to envisage the existence of a polynomial of order one in the deficit on the investment.

Data

We used annual data for the period 1980-2017 of the WAEMU economies. This statistical information comes from several international organizations and institutions. First, information related to public debt, official development assistance, public investment comes from the World Bank database. Next, the statistical information related to the public deficit comes from EMU. Finally, we used national statistics for the tax revenue variable.

We are working on a panel of 7 countries over the period 1980-2017. We therefore did not take Guinea Bissau in our study due to its late entry (1997) into the area. In this estimation step, the dependent variable is the state gross fixed capital formation ratio as a percentage of real GDP in 2008, the explanatory variables are: the government deficit ratio, the public debt ratio, the official development assistance ratio, the GDP growth rate, the tax revenue ratio. All these variables except the GDP growth rate are expressed as a percentage of GDP.

5. RESULTS

The model confirms the significance of the non-linear relationship between public deficit and public investment conditional on public debt. The coefficient of the interaction variable is significantly different from zero at the 1% threshold.

The results of the estimated model confirm the significance of the non-linear relation between public deficit and public investment for an optimal debt level. The coefficient assigned to the interaction variable between the public debt and the public deficit is significantly different from zero for an error threshold of 1%.

The growth rate has a positive effect on public investment at the 1% threshold. This means that an increase in economic growth within the UEMOA zone leads to an increase in public investment. Similarly, the official development assistance variable is significant at the

1% threshold and positive. Any increase in official development assistance leads to an increase in public investment.

The tax receipt variable is positive and significantly different from zero at the 1% threshold. An increase in tax revenues leads to an increase in public investment. This result is in line with that found by Barro (1990) in his model of endogenous growth theory.

The coefficient of the deficit variable is positive and significantly different from zero, which means that the public deficit has a significant positive effect on public investment when the public debt is zero. But that does not make sense because the public debt cannot be zero. With the table above we cannot know the impact of the deficit on investment when the public debt is significantly different from zero. Recognizing this we present the following figure which illustrates the marginal effect of the deficit on public investment.

Table 1. Results of the fixed effect model estimates

Variables	Coefficients	Prob
Public deficit	0.632 ^{***}	(0.000)
Public debt	- 0.0415 ^{***}	(0.001)
Public deficit*Public debt	-0.961 ^{***}	(0.001)
GDP growth rate	0.323 ^{***}	(0.001)
Official development assistance	0.424 ^{***}	(0.000)
Tax revenues	0.562 ^{***}	(0.008)
Number of observations	259	
R ²	0.76	

Note: the dependent variable is public investment. Probabilities are shown in parentheses. Significance levels of 1% and 5% are respectively represented by *** and **. The probabilities are shown in parentheses.

The 95% confidence interval around the curve representing the marginal effect allows us to determine the conditions under which the fiscal deficit has a significant impact on public investment. The fiscal deficit has a statistically significant effect when the upper and lower limits of the confidence interval are all together below or above the zero line. The public deficit has a significant positive impact when debt is low. This effect diminishes as public debt becomes more and more important. Once the debt reaches 75% of GDP the deficit no longer has a significant positive effect.

Examination of the derivative $\partial g / \partial d$ reveals two regimes of economic policies. Under the first regime, the increase in the fiscal deficit has a positive impact on public investment spending for a relatively low level of debt. The graph shows that this level of public debt is 75% of GDP. Beyond this public debt threshold, an increase in the deficit has an adverse

effect on public investment. The relevance of these results could be measured in terms of its compliance with the observation of an increase in public investment from the second half of the 1990s. Thus, since the 1994 fiscal consolidation campaign has resulted in a significant increase in public investment.

Our results are consistent with the statistical analysis of the data. As we saw in the 1990s, when the public debt of the UEMOA countries approached the threshold of 75% of GDP, the correlation between the deficit and the investments which was positive became more difficult to identify. This threshold of 75% of GDP was rarely reached in three countries of the zone (Côte d'Ivoire, Mali and Togo).

This identification of the fundamental factors underpinning public investment decisions can serve as a frame of reference for the development of policies for a significant revival of public sector activities. In light of the results of our econometric modeling exercise, we believe that the following policies can help stimulate public investment.

In an economic system favorable to environmental degradation, the introduction of excise taxes (taxes on pollution) makes it possible to increase tax revenues and trigger an increase in public investment. The channeling of the informal sector, which generates hundreds of millions of CFA francs, which are beyond the control of the public treasury, generates tax revenues that can encourage an increase in investment funding.

We recommend improving the framework and functioning of the legal system and fighting corruption, which is the main obstacle to official development assistance, which is a significant determinant of the financing of public investment in all countries of the WAEMU zone. Regarding the discussion on the golden rule of public finances in the WAEMU zone, our results can be interpreted as follows: no country has reached this threshold of 75% of GDP, any public deficit oriented towards investment may seem to be effective. In the WAEMU zone, debt reduction of up to 70% of GDP can be redefined to 75% provided that this increase in debt is concentrated in the financing of public investment expenditure, which can increase the Growth of the area.

6. CONCLUSIONS

In this paper, we attempt to empirically assess the non-linear effect of the public deficit on public investment expenditures as a function of the level of indebtedness. A review of the literature on the concept of non-linearity of the public deficit on public investment by level of indebtedness was prepared. Two main mechanisms are generally implemented within the theoretical literature. The first postulate is that a high deficit in the current period leads to a bigger debt tomorrow. And, the increase in the debt burden induces leads to a crowding out effect on public investments. The second postulate is that a public deficit is likely to provide public resources for the financing of public infrastructures and public investment expenditure. This is commonly called the golden rule of public finances. With regard to empirical checks, a preliminary statistical analysis suggests the presence of a non-linear relationship between the public deficit and public investment for a given level of indebtedness. In a much more robust way, the econometric analysis based on a treatment of the budget constraint of the State confirms the existence of this non-linear effect.

The results of the panel regressions show a public debt threshold around a debt-to-GDP ratio of 75%, which would lead to a change in the sign of the relationship between public

deficit and public investment. In our estimates, official development assistance, tax revenues, and the GDP growth rate have significant positive effects on public investment spending. Our estimation results justify the adoption of the golden rule of public finances in the WAEMU zone since all the countries in the WAEMU zone have not yet reached this debt level of 75% of GDP, but this raises a problem because the constraints on the deficit financing is tighter than those affecting the debt ratio.

An important contribution of this study is to show that the Growth and Solidarity Stability Pact implemented in the UEMOA zone cannot be registered only in a nominal sense at inking with the euro. The fiscal rules set out in the Stability Pact should be studied in depth. The study should benefit from further study. One of the extensions of this study would be to determine the impact of this debt threshold of 75% on long-term economic growth in the WAEMU zone.

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