Public Debt and Economic Growth in Niger: An Autoregressive Distributed Lag Approach

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Abstract

Purpose: The aim of the paper is to examine the existence or not of a long run or a short run relationship between public debt and economic in Niger and investigate the significance of this relationship.

Approach/Methodology/Design: The study first applied time series econometrics tests such as Augmented Dickey-Fuller (ADF) unit root test, Bound cointegration test and Auto Regressive Distributed Lag (ARDL) on annual data obtained from the International monetary fund (IMF) and the West African States Central Bank (BCEAO). The observations cover the period from 1970 to 2019. The study then performed some residual tests including serial correlation, normality and heteroskedasticity for the accuracy of the prediction of the model.

Findings: The empirical results showed no long run relationship between public debt and economic growth in Niger. The short run analysis revealed that public debt and budget balance have short run causal effects on economic growth in Niger. The coefficients are significant at 10% significance level.

Practical Implications: This article gives valuable information to Niger policy makers regarding the effects of public debt on Niger economic growth. The article highlights the effects that public debt has on economic growth in Niger in the short and long run. Therefore helping policy makers decide whether to increase or reduce the borrowing trend.

Originality/value: The results of the paper give valuable information on the relationship that public debt may have with economic growth in Sub Saharan African countries with the similar macroeconomic indicators with Niger.

1. Introduction

Located in the heart of the Sahel, Niger is a vast country with an economy that depends essentially on agriculture which represents 40% of its Gross domestic product (GDP). The economy of Niger has been marked in recent years by economic performances characterized by a growth of almost 5.2% in 2018 and a significant improvement in the business climate (World Bank, 2019). The country's debt as percentage of Gross domestic product (GDP), however continue to increase. In 2018 Niger's debt reached 45% of its GDP. This has led the the International monetary fund to warn Niger government on the increasing trend of Niger's debt ratio (IMF, 2019). The objective of this study is to investigate if these massive debts have an impact on the economic growth of Niger.

In order to reach its objective, the present study applied time series econometrics tests such as Augmented Dickey-Fuller (ADF) unit root test to determine the series integration order, Bound

cointegration test to check the existence of long-run relationship between the research variables and Auto Regressive Distributed Lag (ARDL) estimation. The tests are performed on annual data obtained from the International monetary fund (IMF) and the West African States Central bank (BCEAO). The study also performed some residual tests including serial correlation, normality and heteroskedasticity for the accuracy of the prediction of the model.

2. Literature Review

Dal & Phillip (2020) used Vector Error Correction Model (VECM) on data of Nigeria from the period covering 1980 – 2016. The empirical results revealed that domestic debt has a statistically significant positive relationship with economic growth in the long run while external debt has a negative relationship with economic growth. The coefficients are not statistically significant. Muhammad & Ihtsham (2020) investigated the nonlinear relationships between public debt and economic growth of Pakistan. The article used Autoregressive distributed lag approach on time series data to estimate the short term and long term effects of debt on economic growth in Pakistan. The paper also estimated the growth maximizing level of debt. The empirical results revealed that the optimal level of public debt is 60% of GDP. The results also indicated that a raise in government borrowings will increase economic growth in Pakistan in the long term. But in the short term, an increase of public debt will improve economic growth.

Eneida (2018) investigated the connection between public debt and economic growth in Albania in post-dictatorships used annual data obtained from the Ministry of Finance, the Bank of Albania and the International Monetary Fund. The empirical results showed no significant relationship between public debt and economic growth. The results revealed that shifting the workforce from low productivity to high productivity, prudent fiscal and monetary policies, sustainability of the macroeconomic situation, and steady growth of investment have significant effects on economic growth.

Muhammad et al. (2017) used Autoregressive Distributed lag analysis to investigate the impact of Malaysian Government debt on sustainable growth. The study is conducted over the period 1970 – 2015. The empirical results showed a positive significant short term connection between government debt and sustainable economic growth. The results also indicated a unidirectional causality between government debt and sustainable economic growth. Finally, the article found no evidence of significant impact of government debt on sustainable economic growth.

Ndubuisi (2017) used secondary data of Gross Domestic Product, External debt services, external debt stock, external reserve, and exchange rate to investigate the effects of external debt on economic growth of Nigeria. The paper used some econometrics tests such as the Augmented Dickey-Fuller unit root test, Johansen Cointegration test and error correction mechanism. The empirical results revealed unidirectional causality between external debt and GDP. Mhlaba & Phiri (2017) used Autoregressive distributed lag model to investigate the long term and short-term impacts of public debt on South African economic growth. The paper employed data covering the period 2002 – 2016. The paper split the data in two periods 2002-2007 and 2007-

2016. The empirical results revealed negative long term debt –growth relationship and evidence of a positive short term relationship between the research variables specifically in the period 2007-2016.

Siew & Yan (2015) used time series analysis and correlation test on annual data from Malaysia to investigate if public debt contributes to economic growth in Malaysia. They used data over the period 1991 to 2013. The study results revealed that public debt has a negative impact on Gross Domestic Product in the long run. The results also indicate that budget deficit, government consumption and external debt service are a decreasing function of GDP. Stella (2015) used a combination of time-series and cross-section data from the period 1981-2014 to investigate the common impact of government debt on GDP growth in the Europe union countries. The empirical results revealed a positive and statistically significant effect of debt on economic growth.

3. Methodology and Procedures

3.1 Research data

The current study used time series annual data obtained from the International monetary fund (IMF) and the West African States Central Bank (BCEAO). The observations cover the period from 1970 to 2019. The logarithm of Gross domestic product (GDP) is used as proxy for economic growth. Whereas, public debt in percentage of GDP, budget balance in percentage of GDP, Government consumption in percent of GDP and logarithm of the external debt service are respectively used as proxy for Public Debt (PD), Budget Balance (BB), Government Consumption (GC) and External Debt Service (EDS). Table 1 shows the research variables descriptive statistics.

Table 1: Research Variables Descriptive Statistics

Variables	Obs	Mean	Median	Maximum	Minimum	Std. Dev.
EG (economic growth)	50	21.6425	21.4983	22.9682	20.29235	0.7110
PD (public debt)	50	46.9316	44.2450	109.250	8.11000	27.829
BB (budget balance)	50	-3.5891	-3.61541	1.5828	-10.6400	2.7009
GC (gov. consumption)	50	13.5398	14.2081	17.8887	8.168108	2.6783
EDS (external debt service)	50	17.6209	17.8956	19.3172	14.6000	1.2420

Source: Author's calculation based on data from the IMF and BCEAO

Table 1 indicates that during the study period the national budget of Niger is mostly in deficit with an average of -3.59 as percentage of Niger Gross Domestic Product. The table also indicates that, on average the mean of public debt to GDP is 46.9316 and the budget balance to GDP is -3.5891. The data also revealed about 13.5% of government consumption to GDP. The indicators of external debt service display a moderate fluctuation in variability. The range of external debt service in the sample is going from 14.6% to 19.3%.

3.2 Methodology

The current paper adopts a three-step econometrics approach to examine the significance of the relationship between public debt and economic growth in Niger. The study begins by checking the correlation among the research variables. After the correlation test, the Augmented Dickey-Fuller (ADF) unit root test is applied to verify the integration order of the research variables. Having established the integration order of the research variables, the appropriate cointegration test is applied in second step for testing the presence of cointegration relationship between the research variables. If the variables are cointegrated, there is a long run relationship among the variables. In third step, based on the findings of the second step, the appropriate short run and long run models are estimated. Finally, further residual tests including serial correlation, normality and heteroskedasticity tests were performed for the accuracy of the prediction of the model. The study used a basic debt-growth model on annual data to investigate the significance of the relationship between public debt and economic growth in Niger. The model consists of a set of indicators of debt burden with a proven impact on economic growth. The equation of the model used is given below:

$$EG_t = \alpha + \beta_1 PD_t + \beta_2 BB_t + \beta_3 GC_t + \beta_4 EDS_t + \mu_t \quad (1)$$

Where: EG represents economic growth, PD stands for public debt, BB stands for budget balance, GC stands for government consumption, EDS stands for external debt service and alpha and are respectively the intercept and error term. For the model specification and the number of lags to use in the model, information criteria are used to determine the optimal number. Table 2 provides the information criterion selection result.

Table 2: Information Criterion Selection Result

VAR system estimates	value
Determinant resid covariance (dof adj.)	1.313187
Determinant resid covariance	0.357379
Log likelihood	-315.8502
Akaike information criterion	15.45209
Schwarz information criterion	17.59618

Source: Author's calculation

Table 2 shows that the value of the Akaike information criterion (AIC) (15.45209) is lower than the value of the Schwarz information criterion (SIC) (17.59618), hence the number of lags to be considered for the model is selected according to the results provided by the Akaike Information Criterion (AIC) and designed by k. The information criteria suggest a model with a constant without trend for the variables. Since we are using annual data, in order to avoid spurious regression, we started the lag length selection by including a maximum of 4 lags. The Akaike Information Criterion suggests a lag length of k=4 for the model. Table 3 gives the optimal lag selected for the model by the information criteria.

Table 3 Model Optimal Lag Selection

Lag	LogL	FPE	AIC	SC	HQ
0	-503.2459	2719.755	22.09765	22.29641	22.17211
1	-317.1427	2.487431*	15.09316	16.28575*	15.53991*
2	-301.6710	3.916748	15.50744	17.69385	16.32648
3	-279.2150	4.855360	15.61804	18.79829	16.80938
4	-238.9260	3.088815	14.95331*	19.12738	16.51694

Source: Author's calculation

Table 3 shows that the selected information criterion AIC suggests using 4 lags in the model, hence $k=4$. The variables integration order is determined using the Augmented Dickey-Fuller (ADF) unit root test.

4. Results and Discussion

4.1 Correlation test

Table 4: Research Variables Correlation Matrix

	EG	PD	BB	GC	EDS
EG	1	0.015736	-0.31751	0.687452	0.545183
PD	0.015736	1	-0.357218	0.289060	0.358343
BB	-0.31751	-0.357218	1	-0.334127	-0.701044
GC	0.687452	0.289060	-0.334127	1	0.450053
EDS	0.545183	0.358343	-0.701044	0.450053	1

Source: Author's calculation

Table 4 shows the correlation coefficients of the research variables. The economic growth is negatively correlated with budget deficit. Thus, it suggests that budget deficit impedes economic growth. High correlations are found between economic growth and government consumption and between budget balance and external debt service with respectively the correlation coefficients of 0.687452 and -0.701044 indicating a strong relationship between economic growth and government consumption and between budget balance and external debt service. The lowest correlation is between economic growth and public debt.

4.2 Augmented Dickey-Fuller (ADF) unit root test results

Table 5: Augmented Dickey-Fuller (ADF) Test At Series Level

Variables	Number of lag	5% Critical value	ADF test statistic	p_value
EG (economic growth)	4	-2.928142	-0.482070	0.8852
PD (public debt)	4	-2.928142	-2.011019	0.2812
BB (budget balance)	4	-2.928142	-2.205240	0.2073

GC (government consumption)	4	-2.928142	-2.461834	0.1314
EDS (external debt service)	4	-2.928142	-3.603920*	0.0095

Source: Author's calculation

Table 5 shows the ADF unit root test on series level. The null hypothesis of unit root in the series is rejected for the variable EDS at 5% significance level as the ADF test statistic (-3.603920) is less than the 5% critical value (-2.928142) and the p_value (p=0.0095) is lower than 0.05, that is $p < 0.05$. Hence the variable EDS is stationary at series level. EDS is therefore $I(0)$ integrated of order zero. Table 5 also indicates that the same null hypothesis can't be rejected for all the remaining research variables because their ADF test statistics are greater than the 5% critical value and their respective probability values are higher than 0.05. Hence all the remaining 4 variables are nonstationary at their level.

Table 6: Augmented Dickey-Fuller (ADF) Test At Series First Differences

Variables	Number of lag	5% Critical value	ADF test statistic	p_value
EG (economic growth)	4	-2.929734	-3.160082	0.0293
PD (public debt)	4	-2.929734	-3.323846	0.0197
BB (budget balance)	4	-2.929734	-3.332286	0.0193
GC (government consumption)	4	-2.929734	-3.154809	0.0297

Source: Author's calculation

Table 6 shows the ADF unit root test results on series first differences. The 5% significance level critical value is -2.929734. The ADF test statistics for all the variables (EG, PD, BB and GC) are lower than the 5% critical value and the p_values are less than 0.05 which indicates rejection of the null hypothesis. Hence all the series are stationary they do not have unit root.

According to the ADF unit root tests results, the null hypothesis is rejected at 5% significance level for the variable EDS but it can't be rejected for the remaining research variables at series level. The same null hypothesis is rejected at 5% significance level for the remaining variables EG, PD, BB and GC at series' first differences. Therefore EDS is integrated of order zero $I(0)$ and the remaining research variables EG, PD, BB and GC are integrated of order one $I(1)$.

4.3 Bounds Cointegration Test Result

Having established that the research variables are integrated of different order $I(0)$ and $I(1)$, the appropriate cointegration test is the Bounds test for cointegration proposed by Pesaran, Shin and Smith (2001). The test is conducted at 5% significance level. Table 7 gives the bounds cointegration test results.

Table 7: Bounds Cointegration Test Results

Variables	Lag length	F-statistic	5% significance level Critical Value	
			Lower bound I(0)	Upper bound I(1)
EG (economic growth)	4	1.407117	2.56	3.49
PD (public debt)	4			
BB (budget balance)	4			
GC(gov. consumption)	4			
EDS (ext. debt service)	4			

Source: Author's calculation

Table 7 shows that the obtained F-statistic of 1.407117 is below the critical values of the lower bounds I(0) for all the 4 levels of significance (10%, 5%, 2.5% and 1%) which indicates that there is no cointegration among the research variables, hence, no long-run relationship. Therefore only short run model, the Auto regressive Distributed Lag Model will be considered.

4.4 ARDL Estimation Result

The appropriate short run model is the autoregressive distributed lag (ARDL). For the model specification, the Akaike Information criterion selected an ARDL (4, 1, 3, 0, 0). The study will therefore estimate the following equation:

$$\Delta EG_t = \beta_0 + \sum_{i=1}^4 \beta_i EG_{t-i} + \gamma PD_{t-1} + \sum_{j=1}^3 \delta_j BB_{t-j} + \theta GC_t + \rho EDS_t \quad (2)$$

Table 8: ARDL Estimation Results

Variable	Coefficient	t-Statistic	Prob.
EG (-1)	0.998431	5.769240	0.0000
EG (-2)	-0.223659	-0.879535	0.3855
EG (-3)	0.014587	0.058995	0.9533
EG (-4)	0.240901	1.410529	0.1677
PD	-0.004087	-1.525370	0.1367
PD (-1)	0.004388	1.741871	0.0908
BB	0.003513	0.260989	0.7957
BB (-1)	0.012595	1.128023	0.2674
BB (-2)	0.006135	0.575795	0.5687
BB (-3)	0.022099	2.238941	0.0320
GC	-0.007810	-0.666440	0.5098
EDS	0.030692	0.834113	0.4102
C	-0.866858	-0.894903	0.3773

Source: Author's calculation

Table 8 provides the auto-regressive distributed lag estimation results. Table 8 shows no short run causal effect between public debt and economic growth at 5% significance level. The same table reveals a run causal effects between public debt and economic growth at 10% significance level as the probability value (p) of the t-statistic of the first lag of public debt (PD(-1)) is less than 0.1 ($p=0.09<0.1$) but the coefficient is not statistically significant. Table 8 also reveals a short run causal effect between budget balance and economic growth at 5% level but the coefficient is not significant.

4.5 Diagnostic Tests on Residuals Results

In order to check the reliability of the estimates, some diagnostic tests are conducted on the residuals. Table 9, Table 10 and Table 11 give respectively the tests on residuals which include respectively the autocorrelation, the normality and heteroskedasticity test.

Table 9 Residuals Serial Correlation LM Tests

LM Statistic	Test statistic	Probability value
lag 1	27.21109	0.0354
lag 2	32.35400	0.0148
lag 3	37.24891	0.0447
lag 4	19.75268	0.0375

Source: Author's calculation

Table 9 shows that the LM statistic for lag 1, lag 2, lag 3 and lag 4. The tests probability values for the 4 lags are less than 0.05. This indicates that the null hypothesis that states that there is no serial correlation among residuals can't be rejected. Hence the residuals are not correlated.

Table 10 Residual Normality Test Result

Variables	Jarque-Bera statistics	Probability value
EG	6.786503	0.0336
PD	130.2701	0.0000
BB	0.379482	0.0382
GC	1.497336	0.0447
EDS	0.637874	0.0472

Source: Author's calculation

Table 10 also shows the residuals normality test result. Looking at Jarque-Bera normality test result, the evidence of normality in the 5 series can't be rejected. Hence the residuals are normally distributed.

Table 11 Residuals Heteroskedasticity Test Result

LM Statistic	Chi-square	Probability value

Residual	233.0490	0.0421
Heteroskedasticity Test		

Source: Author's calculation

Table 11 shows the residual heteroskedasticity test result. The null hypothesis of no heteroskedasticity in the residuals can't be rejected. The residuals are therefore homoskedastics. The diagnostic tests on the residuals showed that the estimates are reliable.

5. Conclusion and Suggestion

The present study analyzed the relationship between public debt and economic growth in Niger using annual data for the period 1970-2019. For this analysis, the study used various time series econometric techniques such as unit root test, Bounds cointegration test, auto-regressive distributed lag and some diagnostics tests on residuals. The empirical results showed no long run relationship between public debt and economic growth in Niger. The study also revealed that public debt and budget balance have short run causal effects on economic growth in Niger. The coefficients are significant at 10% significance level.

Conflict of Interest

The author of the article declares no conflict of interest.

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