

Impact Of Economic Growth on Debt Service in Nigeria

Ajayi Oluwatoyin A.

Department of Statistics, University of Lagos, Lagos, Nigeria

world_ty@yahoo.com

Abstract:

This paper is designed to formulate a Model that best explains Public Debt Servicing using Nigeria as a case study over the period of 30 years (1992-2022). First, we explore the literature of the debt and debt servicing. Second, we develop a model to capture factors (i.e variables) influencing public debt servicing. Then, we estimate it empirically. Unlike the previous studies, we were concerned with the real rather than nominal public debt servicing. Multiple regression was used as the statistical tool for the analysis. The Ordinary least square was the estimation method used. Also the regression assumption was highlighted, tests were carried out to detect violation of the assumption and remedial measures for violation were done. To conclude, it was found that export and public debt are the variables that best explains public debt servicing.

Key words: Economic growth, Debt service.

INTRODUCTION

All over the countries of the world, issue of debt and debt servicing has been a socio-economic problem and Nigeria is not an exemption. From 1978, following the collapse of oil prices in the global market, it exerted considerable pressure on government financial capacity and thus, it became necessary for government to borrow for balance of payments support and project financing. Over the years, there have been increases in the revenue earnings of Nigeria as a country because of its oil wealth. On the contrary this has not trickled down to the citizen of the country.

Nigeria as an oil producing country benefitted from the two oil shocks that occurred in the early 1970s and late 1970s. It led to a hike in the price of crude oil and increased revenue for the government. Nigeria then increased its spending in anticipation of continued higher oil export earnings. Also, Nigeria went borrowing to finance its increased spending leveraged against her present and future oil proceeds. It became known as the 'oil folly'. In other words, the credit rating of the country at that

point in time made it possible for the country to borrow from financial and multilateral institutions. The country used the oil shock profit as collateral to obtain loans. Surprisingly the oil shocks did not last for long, the decline in oil price resulted in rapid accumulation of the country's debt.

However, in between the first and second oil shock, the problem of servicing of the country's debt surfaced and was aggravated after the second oil shock. This brought about Nigeria's debt predicament. It is to this effect that this study investigates the extent to which some macro- economic variables affects debt servicing in Nigeria.

STATEMENT OF THE PROBLEM

Effective debt management is a widely acclaimed policy strategy for macro-economic management of price stability, foreign exchange stability, employment, balance of payment and sustainable increase in economic growth. However, some of the challenges facing the subject matter include the prevalence of contradictory and mixed-results in relation to the assessment of the impact of volume of debt and some macro-economic variable on debt service payment in developing countries (Nigeria inclusive); lack of adequate, comprehensive and accessible information on the nation's debt management policy on domestic and external debt and with inconsistency in debt policy regulation; poor co-ordination, implementation and lack of political will as regards strict adherence and enforcement of debt management policy.

In the same vein, the adverse effect of volatility in international oil price and the discrepancies associated with the administrators; inefficiency, lack of transparency and accountability, and institutional weaknesses of debt management administration. In addition, macro-economic instability, particularly as regard to inflation and foreign exchange rate, and the inappropriate utilization of monetary and fiscal policy instruments; inadequate and inefficient infrastructural facilities, which directly or indirectly reduces debt service capacity, with its adverse consequences on the nation's international debt rating and economic development amongst others constitute both specific and general obstacles facing debt service payment and economic growth in Nigeria.

AIM AND OBJECTIVES OF THE STUDY

The aim of this study is centred on the investigation of the impact of economic growth on debt service in Nigeria.

The specific objectives are:

- (i) to examine the significance of each of the selected macro-economic variables' impact on debt service payment in Nigeria.
- (ii) to ascertain if the macro-economic variables under study jointly exert significant impact on debt service in Nigeria.
- (iii) to determine the proportion of the contribution of the macro-economic variables to debt service in Nigeria.
- (iv) to model debt service payment in Nigeria.
- (v) to identify the degree of association between the debt service in Nigeria and the macro-economic variables under study.

RESEARCH QUESTIONS

In line with the aim and objectives of this study, the following research questions were put forward.

- (i) Does each macro-economic variables impact significantly influence debt service payment in Nigeria?
- (ii) Do the macro-economic variables jointly exert significant impact on debt service in Nigeria?
- (iii) What is the proportion of the contribution of the macro-economic variables to debt service in Nigeria?
- (iv) What is the degree of association between the Nigeria debt service payment and the macro-economic variable under study?

RESEARCH HYPOTHESES

H₀₁: Individual macro-economic variable do not exert significant impact on the debt service payment in Nigeria.

H₀₂: The macro-economic variables do not jointly exert significant impact on debt service in Nigeria.

SIGNIFICANCE OF THE STUDY

The importance of this study is multi-dimensional in nature, but absolutely lies in the possible use of its output as a policy prescription. Since there has been continued clamour for true debt reduction and debt cancellation, as a panacea for stunted growth and development in developing countries, it become pertinent to analyze the factors affecting debt servicing payment in Nigeria.

The output of the research could serve as a guide to the government in bilateral, regional and multilateral debt negotiations, trade policy review and formulation, and in the strengthening of the collaborative role of debt management with the monetary and fiscal policy tools as instruments of macro-economic management.

Furthermore, the study will assist international organizations in their assessment of related-subject matters, particularly as regards to debt rescheduling and debt cancellation usually compiled by IMF and World Bank. In addition, the provision of empirical evidence on the implication of debt service payment on the Nigerian economy could be of invaluable use by certain interested bodies such as the Organized Private Sector (OPS), various bilateral donor associations, NGOs such as Oxfam International, and other researchers and practitioners, particularly in the field of International Economics.

LITERATURE REVIEW

The origin of Nigeria's debt dates back to 1958 when the sum of US \$28 million was contracted for railway construction. Between 1958 and 1977, the level of debt was minimal, as debt contracted during the period were the concessional debts from bilateral and multilateral sources with longer repayment periods and lower interest rates constituting about 78.5 percent of the total debt stock.

Fiscal sustainability has been a subject of intensive discussion among the macro economists in recent years both in the developed and developing countries. The central issue of the theory and empirics of public finance is whether there is a tendency for the fiscal deficits to grow faster than the increase in public debt so that the debtor countries become insolvent. Or instead, are there tendencies for the debt services to get bigger, so that the primary balance surplus tends to tighten over time?

The recent sharp increase in fiscal deficits and public debt in many countries raises a number of important issues regarding their impact on long-term bases. The

foreign financed budget deficit is characterized by persistent exchange rate depreciation, balance of payment distress and high inflation.

Nigeria provides a unique opportunity to examine the nature of fiscal sustainability and debt services payment. Given the significance of huge debt stock accumulated by the past government, whether the state budget can finance all spending in the long term without losing budgetary functions is a key political and economic issue. The main objective of this paper is to reassess the effect of some macro-economic variables and public debt size on public debt servicing. Eventually, the debtor country experiences unstable economic growth.

Many researchers and analysts have attempted to explain the factors responsible for debt service conditions, external debt problems and foreign direct investment experiences of developing countries over time. In the current theoretical literature, debt servicing ability is sometimes referred to as “external sustainability” which may also be referred to ability to pay current and future external debt. We have chosen to use the term “debt servicing ability” instead. Research on measuring debt servicing ability has remained at inadequate amount at this date.

Feder with Just (1977), and later Ross (1981), examined various economic variables that measure economies in terms of capacity to service debts. Feder and Uy (1987) estimated a logit model to measure credit worthiness using various variables. Eaton and Gersovitz (1981) applied a model-based approach to analyze the issue. They used various observable borrower characteristics, such as population, real GNP, nominal GNP, imports/real GNP, real level of debt/public institutions and one dummy variable. Donogh (1982), and Yener and Mambrito (1984) investigated debt capacity from different perspectives. Donogh explained debt capacity and its application to growth models before examining some empirical studies, such as logit, probit, discriminant and principal components analysis. Yener and Mambrito analyzed six ratios and ranked GDP growth rate as the most important variable in their early warning model. Cline (1984), and Karayalcin and Temel (1988) used a logit model to verify the influence of key variables affecting debt rescheduling. Their findings showed that some variables used in the study occupied a notable part in evaluating the developed countries’ capacity to service debts.

Feder and Just (1977) conducted one of the early quantitative analyses of a country’s ability to honour its debt service obligations during a given time period, i.e. its

debt-servicing capacity. They utilized logit analysis to investigate various economic variables that determine the debt-servicing capacity of 41 borrowing countries that represented 85 percent of the total outstanding debt for all developing countries during the 1965-1972 period. The variables they found to be statistically significant are: the debt-service ratio (ratio of debt service to exports); amortization to debt ratio, per capita GNP, ratio of reserves to imports average rate of export growth and the ratio of capital inflows to debt service.

Feder, Just, and Ross (1981) further developed the approach to predict debt-servicing capacity by using more accurate data and adding explanatory variables that allow for medium- and long-run projections. They found that only three of these variables have a significant impact in the second-order approximation, namely, the debt-service ratio, the reserve/import ratio, and the ratio of commercial foreign exchange inflows to debt-service payments. They emphasized that their method is not a substitute for a thorough country analysis that takes into account non-quantifiable (but important) factors such as the internal and external political situation, governmental priorities, and the competence of the economic leadership. They concluded their approach by suggesting that an objective composite index of debt-servicing capacity might be a better method for assessing the proper balance between expected foreign exchange earnings and obligations.

In yet another study showing an insight from cross-country regression analysis by Hasen (2001) on the impact of aid and external debt on growth and investment, the regression results were suggestive of a series of interesting relationships. This is to say as a result of the explanatory regressions there is quite strong evidence of positive impact of aid both on the growth rate in GDP per capita and the investment rate. Empirical analyses reporting negative effects of debt and debt service were also supported while a novelty in the study was the evidence of a complex interplay between the level of external debt and aid flows just as the macroeconomic effectiveness of aid is negatively related to the level of indebtedness which is more severe in highly aid dependent countries.

Amakom (2003) elucidated the effect of economic growth and debt has on poverty in Nigeria using the per capita income approach. The study employed a vector of growth and debt variables like school enrolment rate [secondary], population growth rate, lagged income per capita, fiscal balance amongst others as growth variables while

external debt, domestic debt and debt service were employed as debt variables. The results of the regression estimate shows that the coefficients confirm a priori conditions for the expected effect of debt and growth on poverty applying the per capita income approach in Nigeria. Stephen Kretzmann and Irfan Nooruddin (2004) opine that increasing oil production lead to increasing debt. They conducted a cross-national analysis of some developing countries including Nigeria. They found out that there is a strong and positive relationship between oil production and debt burdens. The more oil a country produces, regardless of oil's share of the country's total economy, the more debt it tends to generate. They used the Generalized Method of Moment for the analysis. Data on all variables were collected for some selected developing countries as possible over the period 1970-2000.

Haryo Kuncoro et.al (2011) studied the cost of public debt services in the case of Indonesia over the period 1999-2009. He used the OLS method to carry out the analysis. It was found that the cost of debt servicing depends on the variables that determine the debt dynamics: primary balance, outstanding debt, inflation and economic growth. And then found out that the unit cost of domestic public debt is more expensive than foreign debt service. Also, according to the finding it was found out that the rate of economic growth tends to induce the cost of debt and the effect is of statistically significance.

METHODOLOGY

Research Design

This research was designed to model debt servicing in Nigeria using some macro-economic variables. To achieve this, a regression model is designed for debt servicing based on significant explanatory variables using the backward elimination variable selection technique of SPSS statistical software (version 29). In addition, E-views 31 and Microsoft Excel 2021 were used to test the validity of the Ordinary Least Square (OLS) Assumption, regression diagnostics and for remedial measure against violation of OLS assumption.

Method of Data Analysis

The essence of statistical analysis is to transform raw material data into a meaningful form for easy understanding as a basis for drawing inferences. This study utilizes among others; regression analysis, correlation coefficient, student t-test for

correlation significance, coefficient of determination, test for heteroscedasticity, test for auto-correlation, and test for non-normality.

- **Multiple linear regression model**

The general multiple linear regression model (also called the *multiple regression model*) can be written in the population as

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \dots + \beta_k x_k + e \quad \text{---(1)}$$

Where β_0 is the intercept, β_1 is the parameter associated with x_1 , β_2 is the parameter associated with x_2 , and so on. Since there are k independent variables and an intercept, equation---(1) contains $k + 1$ (unknown) population parameters. The parameters $(\beta_1, \beta_2, \dots, \beta_k)$ other than the intercept (β_0) are referred to as the slope parameters. The variable e is the error term or disturbance. It contains factors other than x_1, x_2, \dots, x_k that affect y . No matter how many explanatory variables we include in our model, there will always be factors we cannot include, and these are collectively contained in e .

Equation (1) can be written more compactly in matrix notation

$$Y = X \beta + e \quad \text{---(2)}$$

Where $Y = \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ \vdots \\ Y_n \end{bmatrix}$, $X = \begin{bmatrix} 1 & X_{11} & X_{21} & X_{31} & \dots & X_{k1} \\ 1 & X_{12} & X_{22} & X_{32} & \dots & X_{k2} \\ 1 & X_{13} & X_{23} & X_{33} & \dots & X_{k3} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & X_{1n} & X_{2n} & X_{3n} & \dots & X_{kn} \end{bmatrix}$, $\beta = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \vdots \\ \beta_n \end{bmatrix}$, and $e = \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ \vdots \\ e_n \end{bmatrix}$

As in the two and three variables models, the k -variable case of the OLS estimates are obtained by minimizing

$$\sum \hat{e}_i^2 = \sum [Y_i - \beta_0 - \beta_1 X_{1i} - \dots - \beta_k X_{ki}]^2 \quad \text{---(3)}$$

Where $\sum \hat{e}_i^2$ is the residual sum of squares (RSS)

In scalar notation, the method of OLS is used to estimate $\beta_0, \beta_1, \beta_2, \dots, \beta_k$ making the $\sum \hat{e}_i^2$ as small as possible. This is done by differentiating Eq.(3) partially with respect to $\beta_0, \beta_1, \beta_2, \dots, \beta_k$ and setting the resulting expressions zero. This process yields n simultaneous equations in k unknowns; the normal equations of the least square theory are as follows:

$$\begin{aligned} n\beta_0 + \beta_1 \sum X_{1i} + \beta_2 \sum X_{2i} + \dots + \beta_k \sum X_{ki} &= \sum Y_i \\ \beta_0 \sum X_{1i} + \beta_1 \sum X_{1i}^2 + \beta_2 \sum X_{1i} X_{2i} + \dots + \beta_k \sum X_{1i} X_{ki} &= \sum X_{1i} Y_i \end{aligned}$$

$$\beta_0 \sum X_{2i} + \beta_1 \sum X_{1i} X_{2i} + \beta_2 \sum X_{2i}^2 + \dots + \beta_k \sum X_{2i} X_{ki} = \sum X_{2i} Y_i$$

:

:

$$\beta_0 \sum X_{ki} + \beta_1 \sum X_{ki} X_{1i} + \beta_2 \sum X_{ki} X_{2i} + \dots + \beta_k \sum X_{ki}^2 = \sum X_{ki} Y_i \quad \text{---(4)}$$

Equation (4) can be represented in matrix form as

$$X'X \beta = X'Y \quad \text{---(5)}$$

Or more compactly as

$$[X' X] \beta = X' Y \quad \text{---(6)}$$

• **Correlation coefficient**

Correlation analysis is concerned with the strength of the relationship between two variables (i.e the degree of closeness of relationship between two variables). When we compute measures of correlation from a set of bivariate data, our interest focuses on the degree of the correlation between the variables.

One of the methods of measuring the co-efficient for correlation is the product moment or Pearsonian coefficient, the first following the method of calculation and the second the name of its discoverer, Karl Pearson. It is a measure of the strength of the linear relationship between variables, say, X and Y. It is denoted by *r* and computed as:

$$r = \frac{[n \sum xy - \sum x \sum y]}{\sqrt{[n \sum x^2 - (\sum x)^2] * [n \sum y^2 - (\sum y)^2]}} \quad \text{---(7)}$$

It should be noted that the correlation coefficient *r* assumes a value between -1 and +1, regardless of the units of X and Y.

Moreover, a value of *r* near or equal to zero implies little or no linear relationship between X and Y. In contrast, the closer *r* comes to +1 or -1, the stronger the linear relationship between X and Y, and if *r* is +1 or -1, all the sample points fall exactly on the least square line. Positive value of *r* implies a positive linear relationship between X and Y; that is, Y increases as X increases. Negative value of *r* implies a negative linear relationship between X and Y; that is, Y decreases as X increases.

• **Coefficient of determination**

The coefficient of determination produces an objective measure of the goodness of fit. It has been developed to assist researchers to know how well the

regression line fits the data. This is because there could be vast differences in how well a regression line fits a set of data. It is denoted by R^2 , and computed by squaring the Pearson's correlation coefficient r .

- **Test of individual beta significance**

It is necessary to test if $\hat{\beta}$ are significantly different from zero. Formally, we test the hypothesis:

$H_0: \beta_k = 0$ against the alternative hypothesis

$H_1: \beta_k \neq 0$

The test statistics is

$$t = \frac{\hat{\beta}_k - 0}{\sqrt{\text{Var}\hat{\beta}_k}} \quad \text{---(8)}$$

Where β_k is any of the β 's ($\beta_1, \beta_2, \beta_3, \dots$)

This t-value is compared with the t - distribution value with $n-p$ degrees of freedom for each of the beta tested.

The acceptance of $H_0: \beta_k = 0$ implies that the independent variable X does not in fact influence the dependent variable Y. In other words, acceptance of H_0 implies that there is no significant relationship between X and Y.

In general, to test

$H_0: \beta = \beta^*$ against

$H_1: \beta \neq \beta^*$

The test statistics is

$$t = \frac{\hat{\beta} - \beta^*}{\sqrt{\text{Var}\hat{\beta}}} \quad \text{---(9)}$$

- **Test for heteroscedasticity**

This is a test for the presence of non- constancy of error variance. Heteroscedasticity means that the error variance is non-constant. The (White) test statistic is calculated by multiplying sample size, n by the models R^2 value. The result gotten is assumed to follow chi square distribution, denoted χ^2_{cal} . We know the chi square table value using, n as its degree of freedom at a significant level denoted as $\chi^2_{tab(\alpha,n)}$ the decision rule is if χ^2_{cal} greater than $\chi^2_{tab(\alpha,n)}$, we reject the null hypothesis and hence accept the alternative hypothesis. Also in the case where the p -value of the

white test statistic is given, we reject the null hypothesis if p -value is less than given α significant level and hence accept the alternative hypothesis.

Test Hypothesis:

H_0 : The error term have constant variances

H_1 : The error term does not have constant variance

- **Test for auto-correlation**

This is a test for the presence of autocorrelation in error terms. Autocorrelation means that adjacent observations are correlated. If they are correlated, then least squares regression underestimates the standard error of the coefficients; our predictors may appear to be significant when they may not be. For example, the residuals from a regression on daily stock price data may depend on the preceding observation because one day's stock price affects the next day's price.

The Durbin-Watson (test for auto-correlation) statistic is conditioned on the order of the observations (rows). The statistical software assumes that the observations are in a meaningful order, such as time order. The Durbin-Watson statistic determines whether or not the correlation between adjacent error terms is zero. To reach a conclusion from the test, there is need to compare the displayed statistic with lower and upper bounds in a table. If $D > \text{upper bound } (d_U)$, no correlation exists; if $D < \text{lower bound } (d_L)$, positive correlation exists; if D is in between the two bounds, the test is inconclusive.

Test Hypothesis

H_0 : The residuals are not auto-correlated

H_1 : The residuals are auto-correlated

- **Test for non-normality**

Jarque-Bera (test for non-normality) statistic measures how well the data follow a particular distribution using the histogram plot. The better the distribution fits the data, the smaller this statistic will be. The Jarque-Bera statistic compares the fit of several distributions to see which one is best or to test whether a sample of data comes from a population with a specified distribution. The hypotheses for the Jarque-Bera test are:

H_0 : The data (residuals) follow a normal distribution

H_1 : The data (residuals) does not follow a normal distribution

If the p -value (when available) for the Jarque-Bera test is lower than the chosen significance level (usually 0.05 or 0.01), we conclude that the data do not follow the normal distribution. If we are trying to determine which distribution the data follow and we have multiple Jarque-Bera statistics, it is generally correct to compare them. The distribution with the smallest Jarque-Bera statistic has the closest fit to the data. If distributions have similar Jarque-Bera statistics, choose one based on practical knowledge.

- **Variance Inflation Factor**

Variance inflation factor is a test that indicates the extent to which multicollinearity (correlation among predictors) is present in a regression analysis. Multicollinearity is problematic because it can increase the variance of the regression coefficients, making them unstable and difficult to interpret.

Variance inflation factors (VIF) measure how much the variance of the estimated regression coefficients are inflated as compared to when the predictor variables are not linearly related. The quantity below is what is deemed the variance inflation factor for the k^{th} predictor. That is:

$$VIF_k = \frac{1}{1-R_k^2} \quad \text{---(10)}$$

Where R_k^2 is the coefficient of determination value obtained by regressing the k^{th} predictor on the remaining predictors.

As a rule of thumb:

$VIF = 1$	implies	<i>Not Correlated</i>
$1 < VIF \leq 5$	implies	<i>Moderately Correlated</i>
$5 < VIF \leq 10$	implies	<i>Highly Correlated</i>

VIF values greater than 10 may indicate multicollinearity is unduly influencing the regression results. In this case, we may want to reduce multicollinearity by removing unimportant predictors from our model.

DATA ANALYSIS

Table 1.1: Regression model of all predictors

Predictor	Coef	SE Coef	T	P	VIF
Constant	-1201	32464	-0.04	0.971	
frr	-0.1321	0.2081	-0.63	0.534	387.151
exc	-370	1266	-0.29	0.774	66.399
gdpr	-4.72	90.03	-0.05	0.959	1.138

pint	-258	3121	-0.08	0.935	4.636
savs	810	4906	0.17	0.871	8.059
m1	0.0256	0.5139	0.05	0.961	4519.672
m2	-0.0364	0.2423	-0.15	0.882	3437.725
oil	32.30	44.83	0.72	0.481	236.232
inf	116.0	585.5	0.20	0.845	1.833
exp	0.04769	0.05582	0.85	0.405	346.187
res	0.02593	0.04236	0.61	0.549	111.767
pub	0.03109	0.02115	1.47	0.160	23.419
S = 45368.0		R-Sq = 95.2%		R-Sq (adj) = 91.7%	

- Where *frr* = federal retained revenue
exc = foreign exchange rate
gdpr = real GDP growth rate
pint = prime interest rate
savs = savings interest rate
m1 = narrow money
m2 = broad money
oil = oil price per barrel in naira
inf = inflation rate
exp = total export in millions of naira
res = total foreign reserve in millions of naira
pub = total public debt in millions of naira

The deduced debt service payment (*dsp*) model is:

$$dsp = -1201 - 0.1321frr - 370exc - 4.72gdpr - 258pint + 810savs + 0.0256m1 - 0.0364m2 + 32.30oil + 116.0inf + 0.04769exp + 0.02593res + 0.03109pub \quad \text{---(11)}$$

The beta coefficients of all the predictors are insignificant at 0.05 significance level. This indicates that all the predictors independently does not have significant impact on debt service payment.

$R^2 = 0.952$, implies that approximately 95.2% of the variation in debt service payment is being explained by all the predictors under study. In other words, all the predictors under study contributed about 95.2% to the nation's debt service payment.

Looking at the VIF value column of the predictors. "inflation rate", "real GDP growth rate", "prime interest rate" have VIF between 1 to 5 which indicates moderate multicollinearity. "savings interest rate" has VIF between 5 to 10 which indicates high multicollinearity. While "total public debt", "total foreign reserve", "total export", "oil price per barrel", "broad money", "narrow money", "foreign exchange rate" and "federal retained revenue" have VIF value greater than 10 which indicates very high multicollinearity.

Table 1.2: Test of joint significant impact of all predictors

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	12	6.87030E+11	57252487644	27.82	0.000
Residual Error	17	34990313792	2058253752		
Total	29	7.22020E+11			

The ANOVA table has a p -value of 0.000 which is less than the conventional 0.05 significance level. This means that the regression is well fitted. In other words, all the predictors jointly exert significant impact on the debt service payment.

Table 1.3: Test for auto-correlation

Durbin-Watson statistic (DW) = 2.19712 $d_L = 1.07$, $d_U = 1.83$

$DW > d_U$. This indicates that there is no first order positive auto-correlation about the residuals. Since $4 - DW = 4 - 2.19712 = 1.80288$, then $d_L < 4 - DW < d_U$. This implies that the test is inconclusive.

Table 1.4: Test for Heteroscedasticity

White Heteroskedasticity Test:

F-statistic	37.64145	Probability	0.000375
Obs*R-squared	29.83487	Probability	0.190285

The probability value for the white test is 0.190285, which is greater than the significance level of 0.05. Therefore the null hypothesis of homoscedasticity is not rejected. This means the null hypothesis is accepted that there is homoscedasticity.

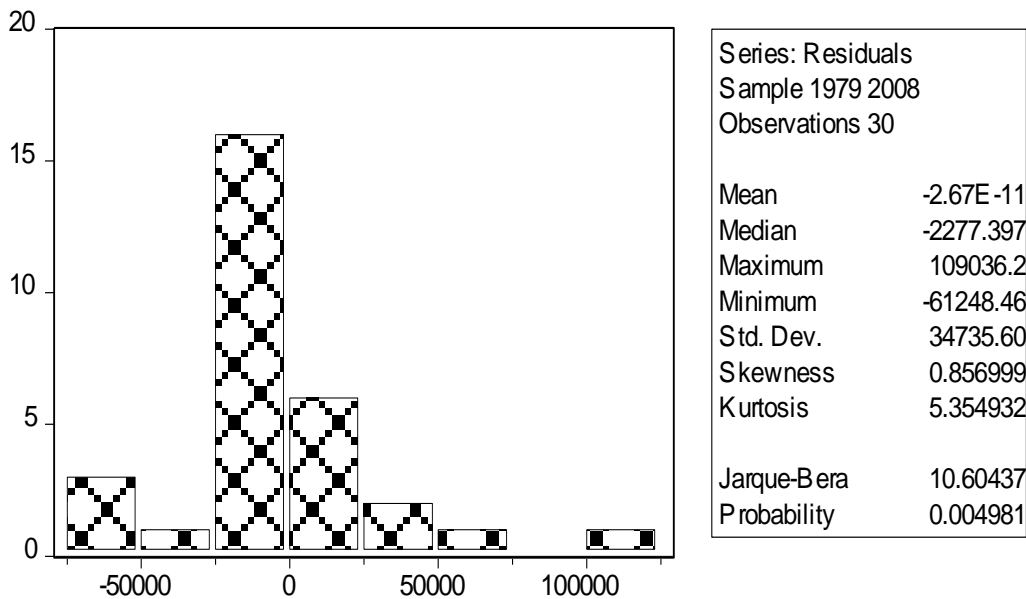
Table 1.5: Ramsey Reset (Correct Specification) test for all predictors

Ramsey RESET Test:

F-statistic	29.54941	Probability	0.000055
Log likelihood ratio	31.38627	Probability	0.00000
			0

The probability value for the Ramsey reset test is 0.000055. Since the probability value of the Ramsey Reset test is less than the significant level at 0.05, therefore the null hypothesis is rejected. It means that model is not correctly specified.

Table 1.6: Test for Normality (Jarque-Bera) of all predictors



The probability value for the Jarque-Bera test is 0.004981. Since the probability value of the Jarque-Bera test is lesser than the significant level at 0.05, therefore the null hypothesis is rejected. It means the residual of the model is non-normally distributed.

Table 2.1: Backward Elimination Method for the regression model (Eq. 11)

Predictor	Coef	SE Coef	T	P	VIF
Constant	1454.244	9621.575	0.151	0.881	
pub	0.027	0.005	5.638	0.000	1.632
exp	0.082	0.015	5.657	0.000	31.264
frr	-0.145	0.053	-2.745	0.011	33.233
S = 43786.6		R-Sq = 94.4%		R-Sq(adj) = 93.8%	

The **retained predictors** are: public debt (pub), export (exp) and federal retained revenue (frr).

The deduced **Multicollinearity corrected** debt service payment model is thus:

$$dsp_{mc} = 1454.244 + 0.027pub + 0.082exp - 0.145frr \quad \text{---(12)}$$

A unit increase in public debt (pub) will lead to 0.027 unit increase in debt service while export and federal retained revenue remain constant. Similarly, a unit increase in export (exp) will lead to 0.082 unit increase in debt service while public debt and federal retained revenue remain constant. Contrarily, a unit increase in federal retained revenue (frr) will lead to 0.145 unit decrease in debt service while public debt and export remain constant.

The beta coefficients of the retained predictors are significant at 0.05 significance level.

This indicates that the retained predictors (“pub”, “exp”, and “frr”) independently has

significant impact on debt service payment. Though, federal retained revenue (frr) has inverse impact while public debt and export have a positive impact on debt service payment.

$R^2 = 0.944$, implies that approximately 94.4% of the variation in debt service payment is being explained by pub”, “exp”, and “frr. In other words, pub”, “exp”, and “frr contributed about 94.4% to the nation’s debt service payment.

Looking at the VIF value of the retained variables. “pub” VIF value is 1.632 which indicates moderate multicollinearity. While “exp” and “frr” have VIF value greater than 10 which indicates very high multicollinearity.

Table 2.2: Test of joint significant impact of the retained predictors

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	6.8E+11	2.273E+11	147.243	0.000
Residual Error	26	4.0E+10	1543669024		
Total	29	7.2E+11			

The ANOVA table has a p -value of 0.000 which is less than the conventional 0.05 significance level. This means that the regression is well fitted. In other words, all the predictors jointly exert significant impact on the debt service payment.

Table 2.3: Test for auto-correlation of the retained predictors

Durbin-Watson statistic (DW) = 2.085, $d_L = 1.21$, $d_U = 1.65$

Since $DW > d_U$. Therefore, it means there is no first order positive auto-correlation about the residuals. Since $4 - DW = 4 - 2.085 = 1.915$, then $4 - DW > d_U$. It means there is no first order negative auto-correlation about the residuals.

Table 2.4: Test for Heteroscedasticity of the retained predictors

White Heteroskedasticity Test:

F-statistic	2.835678	Probability	0.032399
Obs*R-squared	12.75606	Probability	0.047077

The probability value of the white test is 0.047077. Since the probability value of the white test is less than the significant level at 0.05, therefore the null hypothesis of homoscedasticity is rejected. It means the alternative hypothesis that says there is heteroscedasticity is accepted.

Table 2.5: Ramsey Reset (Correct Specification) test for the retained predictors

Received: 23 March 2023

227

Revised: 2 April 2023

Final Accepted for publication: 10 April 2023

Copyright © authors 2023

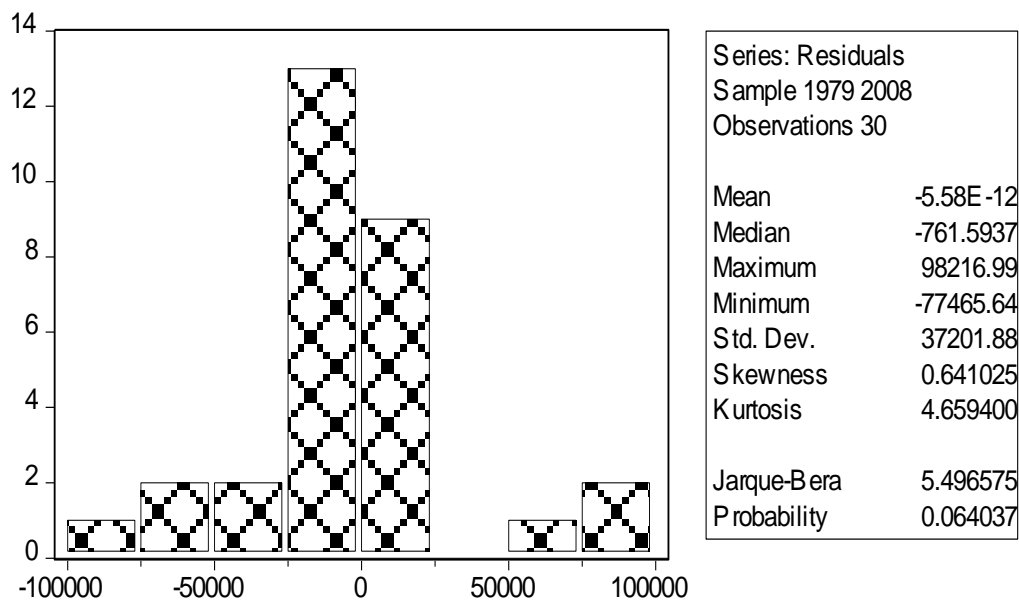
DOI: <https://doi.org/10.5281/zenodo.7881735>

Ramsey RESET Test:

F-statistic	0.367903	Probability	0.549618
Log likelihood ratio	0.438267	Probability	0.507960

The probability value of the Ramsey Reset test is 0.549618. Since the probability value of the Ramsey Reset test is greater than the significant level at 0.05, therefore the null hypothesis is not rejected. It means that model is correctly specified.

Table 2.6: Test for Normality (Jarque-Bera) of the retained predictors



The probability value of the Jarque-Bera test is 0.064037. Since the probability value of the Jarque-Bera test is greater than the significant level at 0.05, therefore the null hypothesis of normality is not rejected. It means the residual of the model is normally distributed.

Table 3.1 Backward Elimination Method for the 1st Multicollinearity Corrected Regression Model (Eq. 12)

Predictor	Coef	SE Coef	T	P	VIF
Constant	-1014	10676	-0.09	0.925	
PUB	0.023413	0.005157	4.54	0.000	1.495
EXP	0.043271	0.003540	12.22	0.000	1.495
S = 43786.6		R-Sq = 92.8%		R-Sq(adj) = 92.3%	

The newly retained predictors are: public debt (pub) and export (exp).

Received: 23 March 2023

Revised: 2 April 2023

Final Accepted for publication: 10 April 2023

Copyright © authors 2023

DOI: <https://doi.org/10.5281/zenodo.7881735>

The deduced 2nd **Multicollinearity corrected** debt service payment model is thus:

$$dsp_{mc}^2 = -1014 + 0.023413pub + 0.043271exp \quad \text{---(13)}$$

A unit increase in public debt (pub) will lead to 0.023413 unit increase in debt service while export remains constant. Similarly, a unit increase in export (exp) will lead to 0.043271 unit increase in debt service while public debt remains constant.

The beta coefficients of the retained predictors are positive and significant at 0.05 significance level. This indicates that the retained predictors (“pub” and “exp”) independently has positive significant impact on debt service payment.

$R^2 = 0.928$, implies that approximately 92.8% of the variation in debt service payment is being explained by pub” and “exp”. In other words, pub” and “exp” contributed about 92.8% to the nation’s debt service payment.

Looking at the VIF value of the retained variables. “pub” and “exp” have VIF value that is between 1 to 5 which indicates moderate multicollinearity. This means the 2nd Multicollinearity corrected regression model does not have a multicollinearity problem.

Table 3.2: Test of joint significant impact of the retained predictors

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	6.70254E+11	3.35127E+11	174.79	0.000
Residual Error	27	51766122509	1917263797		
Total	29	7.22020E+11			

The ANOVA table has a p -value of 0.000 which is less than the conventional 0.05 significance level. This means that the regression is well fitted. In other words, both predictors jointly exert significant impact on the debt service payment.

Table 3.3: Test for auto-correlation of the retained predictors

Durbin-Watson statistic (DW) = 1.75038, $d_L = 1.28$, $d_U = 1.57$

Since $DW > d_U$. Therefore, it means there is no first order positive auto-correlation about the residuals. Since $4 - DW = 4 - 1.75038 = 2.24962$, then $4 - DW > d_U$. It means there is no first order negative auto-correlation about the residuals.

Table 3.4: Test for Heteroscedasticity of the retained predictors

White Heteroskedasticity Test:

F-statistic	9.377265	Probability	0.000090
Obs*R-squared	18.00174	Probability	0.001233

The probability value for the white test is 0.001233. Since the probability value of the white test is lesser than the significant level at 0.05, therefore the null hypothesis of homoscedasticity is rejected. It means the alternative hypothesis that there is heteroscedasticity is accepted.

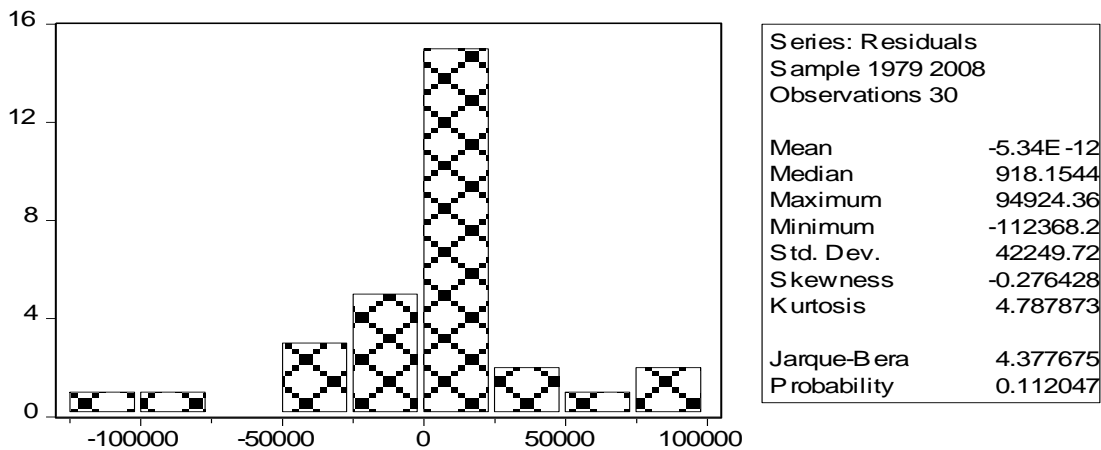
Table 3.5: Ramsey Reset (Correct Specification) test for the retained predictors

Ramsey RESET Test:

F-statistic	0.357755	Probability	0.554931
Log likelihood ratio	0.409980	Probability	0.521980

The probability value for Ramsey Reset test is 0.554931. Since the probability value of the Ramsey Reset test is greater than the significant level at 0.05, therefore the null hypothesis is not rejected. It means that model is correctly specified.

Table 3.6: Test for Normality (Jarque-Bera) of the retained predictors



The probability value of the Jarque-Bera test is 0.112047. Since the probability value of the Jarque-Bera test is greater than the significant level at 0.05, therefore the null hypothesis of normality is not rejected. It means the residual of the model is normally distributed.

Table 4: Robusting the 2nd Multicollinearity corrected Regression

Number of obs = 30
F(2,27) = 83.99
Prob > F = 0.0000
R-squared = 0.9283
Root MSE = 43787

	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]
Debtser					

Received: 23 March 2023

Revised: 2 April 2023

Final Accepted for publication: 10 April 2023

Copyright © authors 2023

DOI: <https://doi.org/10.5281/zenodo.7881735>

Export		0.0432707	0.0072158	6.00	0.000	0.028465	0.0580763
Publicdebt		0.0234133	0.0077418	3.02	0.005	0.0075285	0.0392981
_cons		-1013.757	4588.675	-0.22	0.827	-10428.94	8401.427

This makes the residuals robust and the residual variances constant.

DISCUSSION OF FINDINGS

- **Regression including all predictors**

The model using all the data has a R^2 value of 0.952. It means that 95.2% of the variation in the dependent variable (debt service) is explained by the independent variables. The VIF reveals most of the predictors having high or very high multicollinearity. The anova table shows that the model has good fit. The White test for heteroscedasticity shows that the residuals variances are homoscedastic. The Durbin-Watson for auto-correlation shows that the residuals are not positively auto-correlated but the test for negative auto-correlation is inconclusive. The Ramsey Reset test shows that the model is incorrectly specified. The Jarque-Bera test shows that the residuals are not normally distributed.

- **1st Multicollinearity Corrected Regression Model**

The model is gotten using the backward elimination method of model selection. It has a R^2 value of 0.944. It means that 94.4% of the variation in the dependent variable (debt service) is explained by the retained independent variables. The VIF reveals most of the predictors having very high multicollinearity. The anova table shows that the model has a good fit. The White test for heteroscedasticity shows that the residuals variances are heteroscedastic. The Durbin-Watson for auto-correlation shows that the residuals are not auto-correlated. The Ramsey Reset test shows that the model is correctly specified. The Jarque-Bera test shows that the residuals are normally distributed.

- **2nd Multicollinearity Corrected Regression Model**

The model is gotten after correcting for multicollinearity the first time. It has a R^2 value of 0.928. It means that 92.8% of the variation in the dependent variable (debt service) is explained by the newly retained independent variables. The VIF reveals that both newly retained predictors exhibit moderate multicollinearity. This means the 2nd multicollinearity corrected regression model does not have a multicollinearity problem. The anova table shows that the model has a good fit. The White test for heteroscedasticity shows that the residuals variances are heteroscedastic. It was remedied by applying robust standard errors to make the residuals variances constant (homoscedastic). The Durbin-Watson for auto-correlation shows that the residuals are

not auto-correlated. The Ramsey Reset test shows that the model is correctly specified. The Jarque-Bera test shows that the residuals are normally distributed.

CONCLUSION

Empirical analysis of the economic factors influencing the debt service payment in real terms was the focus of this study. As earlier discussed, Nigeria is indebted to several creditors and this does not augur well for the overall well being of the economy.

In other to achieve the objective of this work; thirty year period of debt payment to creditors were considered from annual data, spanning 1992 to 2022. This is because it is believed that thirty years is long enough to smoothen fluctuations in the data collected. The data collected were used to generate the regression result to reflect the cause and effect relationship between the dependent and the independent variables on which this study is based.

The essence of this study is to develop a parsimonious model (i.e a model that is economical, simple and with good fit). This study shows that debt servicing to Nigerian creditors is affected by some macro-economic variables. In this study, it was found that export and public debt not only influenced debt service payment significantly but also positively.

RECOMMENDATIONS

Based on the findings in this study, I wish to recommend the followings:

- Governments should try minimize expected debt servicing costs and cost of holding liquid assets, subject to an acceptable level of risk.
- Governments should strengthen her export capacity to enhance her debt service payment.
- Debt servicing needs to be linked to a clear macroeconomic framework, under which governments seek to ensure that the level and growth in public debt are sustainable.
- Debt servicing should be audited annually by external auditors.

REFERENCES

Received: 23 March 2023

Revised: 2 April 2023

Final Accepted for publication: 10 April 2023

Copyright © authors 2023

DOI: <https://doi.org/10.5281/zenodo.7881735>

Adesola W.A., (Received 30, January 2009; Revision Accepted 20, April 2009). "Debt Servicing and Economic Growth in Nigeria". An Empirical Investigation Global Journal of Social Sciences Vol 8, No. 2, 2009: 1-11

Adofu .I and Abula M., (Submitted December 17, 2009, accepted January 10,2010). "Domestic Debt and the Nigerian Economy". Current research journal of economic theory 2(1):22-26, 2010

Amakom U.S (2003), "Nigeria Public Debt and Economic Growth: An Empirical Assessment of Effects on Poverty", African Institute for Applied Economics Enugu Nigeria

Apotekere, T. and Barthelemy .S (2001), "*Genetic Algorithms and Financial Crises in Emerging Markets*", 18th International Conference in Finance, Namur (Belgium), June.<http://www.tac-financial.com/publ/affi-namur-2001.pdf>

Cline, R.W.(1984), "*International Debt; Systematic Risk and policy Response*", Washington; The MIT Press.

Donogh C.M (1982). "Debt Capacity and Developing Country Borrowing; A Survey of the Literature." IMF Staff Papers 29 (4)

Eaton .J. and Gersovitz M.(1981). "Debt with Potential Reputation; Theoretical and Empirical Analysis." Review of Economic Studies 48; 289-309.

Feder. G. and Just R.E., (1977), "*A Study of Debt Servicing Capacity Applying Logit Analysis*" Journal of Development Economics 4.

Feder. G., Just R.E. and Ross.K (1981), "*Projecting Debt Servicing of Developing Countries*" Journal of financial and Quantitative Analysis 16.

Hansen, H. 2001, "The Impact of Aid and External Debt on Growth and Investment Insights from Cross-Country Regression Analysis" *WIDER Development Conference on Debt Relief, Helsinki, 17-18 August*

Haryo Kuncoro et al (2011). "The Cost of Public Debt Services : The Case of Indonesia", International Journal of Advanced Economics and Business Management, Vol, No. 1, Issue No. 1, 014 - 024

IMF(2001), " Executive Summary: The State of the Nigerian Economy"

John Neter et.al(2004), " 5th Edition Applied Linear Statistical Models" ,Mc Graw-Hill Irwin series

Karayalcin, A. and Temel .T(1988), "*Debt Services Capacity of Developing Countries and The Case of Turkey*", The Central Bank of the Republic of Turkey Research, Planning, and Training Department, Discussion Papers No: 8810. <http://www.tcmb.gov.tr/research/discus/8810eng.pdf>

Ngassam Chris (1992), "Factors Affecting the External Debt-Servicing Capacity of African Nations : An Empirical Investigation", Center for Economic Research on Africa.

Received: 23 March 2023

Revised: 2 April 2023

Final Accepted for publication: 10 April 2023

Copyright © authors 2023

DOI: <https://doi.org/10.5281/zenodo.7881735>

Osuala .E. C (1987), “Introduction to Research Methodology”, Africana-Fep Publishers, Onitsha.

Seber .G.A.F (1977), “Linear Regression Analysis”, John Wiley, New York

Stephen Kretzmann and Irfan Nooruddin. (2004). “Drilling into Debt: An Investigation into the Relationship Between Oil and Debt”, Washington D.C: Oil Change International, Jubilee USA Network.

Weisberg. S (1985), Applied Linear Regression, 2nd ed., John Wiley, New York, 324 pp.

Yener D. and Mambrito F. (1984), “An Early Warning Model for International Debt Servicing Problems”, METU Studies in Development 11.