



Green Bond and sustainability: An empirical Review on Nigerian Economy

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by

Turaki Hamza

Department of Economics, Yusuf maitamasule University, kano.

Abstract: *the main objective of this study is to determine the sustainability of green bond as the source to financing climate friendly project in Nigeria using monthly data of 4 years (March 2013 – March 2017). Auto regressive distributed lag model (ARDL) is designed and used in order to test for the sustainability of the dependent variable upon the independent variables. We employed the use of augmented dickey fuller to determine the stationary of the variables. We also applied ARDL bound test in order to examine if there is any long run relationship between the variable and found out that there is long run relationship between the variable and we also use long run and short run coefficient to determine the elasticity of the of the variable and conclude by determining the (ECR) equation. Finally, we run residual diagnostics where we estimate the serial correlation, hetroskedasticity, normality and stability test where we apply the use of CUSUM and CUSUMSQ and finalize that there is no serial correlation, the variance is homoskedastic, the variables is normally distributed and the variables are stable.*

Keywords: *Green Bond, Augmented-dickey fuller, Autoregressive distributed lag, Green project, Residual Diagnostic, Nigeria.*

INTRODUCTION

Climate change is one of the main hazardous challenges facing globally developed countries due to the high rate of carbon emission and Green House Gases (GHG) that is brought about as a result of our economic activities i.e. through industrial or manufacturing productions, transportations and other technological development or in other word, as a result of rapid economic development and industrialization. The negative effect of the most development is the damages caused to the environment in totality (e.g. Tsunami, flooding etc.). Fossil fuel combustion, livestock management, new technologies etc all contribute to the greenhouse gas (GHG) accumulation and emission. There is also direct pollution that is direct from the natural ecosystem that accumulates and emits

climate unfriendliness gasses. In the present world, new financial instruments have been generated to facilitate the increasing demand for green projects. One of the very promising financial instruments of that kind is green bonds, which are debt instruments with a bonus environmental feature.

Bonds are tradable debt securities with repayment terms contractually set at issuance.

Currently, the bond market is almost twice as large as the equity market: over US\$95,000 billion in bonds outstanding, compared with an equity market capitalization of US\$54,900 billion in 2011. Institutional investors are particularly active on the global bond market, for some reasons which include the appropriateness of risk-return profiles, the transaction volume size, and the very high level of bond standardization that helps to reduce processing costs. These investors were believed to hold over US\$65,000 billion in assets in 2009 (Della Croce, Kaminker, Stewart 2011). The implementation of mitigation and adaptation to climate change actions requires substantial investments. According to the International Energy Agency's *World Energy Outlook* (2011), over US\$25,000 billion will need to be invested in renewable energies and low-carbon technologies between now and 2035, in order to limit the greenhouse gas concentrations in the atmosphere to 450 ppm

In Africa, the African Development Bank (AfDB) comes with more strategies in order to make life better for the Africans. The Bank's Strategy for 2013-2022 aims to improve the quality of Africa's growth and is built around two objectives. The first is to achieve growth that is more inclusive, leading not just to equality of treatment and opportunity but to deep reductions in poverty and a correspondingly large increase in jobs opportunities and creation. The second objective is to ensure that inclusive growth is sustainable, by helping Africa gradually transition to "green growth" that will protect livelihoods, improve water, energy and food security, promote the sustainable use of natural resources and spur innovation, job creation and economic development. Priorities in reaching green growth include building resilience to climate shocks, providing sustainable infrastructure, creating ecosystem services and making efficient and sustainable use of natural resources (particularly water, which is central to growth but most affected by climate change).

Green project are projects that has to do with the reduction of climate change. Any project that has the capacity to reduce the climate through mitigation is regarded as "green project". In Nigeria there are several green projects that can be finance or that are eligible to be finance using green bond. Nigeria's confirmed recession and reduction in its main source of income requires creative and directed means to mobilize resources that will fill its funding gap while also ensuring that project implementation achieves the expected outcomes. The expansion of the global market for Green bonds presents an opportunity to join the momentum to provide resources for the NDCs. Nigeria's relatively developed fixed income market provides a platform for a pilot green bond. However, the fixed income market is dominated by FG debt with a limited slice attributed to the private sector. Yet, Nigeria is yet to key in to this important window of opportunity. Green bonds portend excellent tools for promoting sustainable development to market players. As regards issuers in developing countries such as Nigeria, the desire to issue green bonds can lead institutions to step up their Environmental, social and governance (ESG) policies. Also, in the long term,

green bonds can help boost flows of private capital originating in mature markets and used to fund green projects in developing countries. Some international development agencies also use green bonds to fuel the local bond markets.

The federal government issues green bond because of some solid reasons which includes; Raise awareness of economic benefits of the themes in the NDC, Develop framework guidance for subsequent tranches, Increase financial and industry sector confidence in either issuing green bonds or financing green projects, Establish internal capacity to monitor issuer performance and aggregate information to report back to investors and the UNFCCC, Leverage partner programs and funds to direct resources towards providing technical support or participation in green bond issuance Initiatives that will drive implementation, Build institutional base within the capital market for regular green bond issuance, Build capacity within Federal ministry of Environment for oversight, Develop dialogue across relevant MDAs to regularly identify projects and redirect resources to initiate or scale and Periodic interface with Ministry of Budget and National Planning and Finance on the outcomes.

1.1 Empirical and Theoretical review

1.1.1 Capital Structure Theory

A company's goal is to find the capital structure that maximizes the value of the firm. Companies operations can be financed through own capital (equity) or by borrowing money (debt). Investments can be financed through debt by issuing bonds or take loans from financial institutions. Equity investments can be made from money gained from operations and sales or through issuing stocks which effectively means that you are selling a share of the company on the open or private market (Kareem & Saud, 2015).

Classic financial theory bases on the fact that investors choose to maximize their investments by choosing the portfolio that gives the highest expected return at a given level of risk. This means at rational investor are going to invest in that portfolio that gives the highest possible return at their personal risk preference (Markowitz, 1952).

Similar results were also found at the Capital structure area. The earliest famous studies in the subject are the two professors Modigliani and Miller who studied the subject heavily in the 1950s. They came to conclusion that capital structure is irrelevant for the value of a firm, it does not matter how companies finance their operations. They found that the only thing that mattered to the value of the firm was the income from operations and the risk of the underlying asset. However, these findings were based on the assumptions that (Kareem & Saud, 2015).

1.1.1.1 The trade-off theory

The trade-off theory originated as a response to Modigliani and Miller's earlier theories. It was based on symmetric information of the market. In this theory, it is also claimed that the capital structure is not relevant measure on its own. It is the costs and benefits at a certain level of leverage that will determinate the optimal level of debt and equity is. The optimal debt level is therefore a trade-off between the tax shield and reduced agency

costs and the costs of financial distress, increased monitoring and increase contracting costs connected with higher levels of debt (Tong & Green, 2005).

1.1.1.2 The pecking order theory

The pecking order theory is one of the most influential financial theories. It is based on the perception that market information asymmetries exist. This is due to knowledge the senior financial manager's holds about their companies financing structure and firm specific risks. Because of the knowledge gap between investors and the senior management of the company, investors tend to value different sources of financing differently. This leads to what is referred to as the "pecking order". Therefore, companies prefer to finance their investments with internal capital, such as retained earnings, first. The second most valuable way of investing is through debt, such as loans or issuing bonds. At the bottom of the pecking order is new issuance of equity. This signals to investors that the company's debt is overrun at this point (Deeds et al, 2015).

1.1.2 Bond Theory

There are essentially three types of organizations that can issue bonds; governments, municipalities and corporations. Buying bonds effectively mean that you are lending money to the issuer until a specific date. In return, the organization pays interest for the length of the loan. The interest, also called coupon, can be flexible or fixed and is usually higher for long-term bonds. How often interest payments are made varies between bonds. When the bond reaches the maturity date the original amount of the loan is payed back to the owner. There are also bonds, so called no-coupon bonds, that pay no interest rate during the duration and pays the full interest and loaned amount back at the expiration date. Bonds are used to raise money and finance a new project, maintain ongoing operations or for refinancing of an existing debt. Companies may issue bonds directly to investors, as an alternative or as a compliment to obtaining a loan from a bank (Berk & DeMarzo, 2017).

There are mainly three reasons why companies choose to issue bonds. The first one is that bonds with fixed interest rate secure the financing costs when the market rates increases. The bond market is usually less restrictive than the banks when it comes to lending. The second one is that bonds usually have a longer maturity than traditional bank loans. And the third benefit is to the opportunity to reach a larger pool of investors, gaining diversification instead of having all their outstanding debt to one or a few banks (Fabozzi, 2009).

Bonds are considered a safe investment for investors since you are ensured to get the money back at the maturity time unless the company goes bankrupt. If you keep the bond until maturity you know exactly what the return of your investment will be when you buy the bond. The interest rate on the bond generally depends on three things. Inflation is how large the general price development is on the market, if the inflation is high the interest rate is higher. If the market rate is high then the interest rate increases. The last factor is the issuer's credit rating. A high credit rating means that the company is likely to be able to pay back the money. Bonds from companies with high

credit rating have lower interest rate. When a bond is issued it is rated by an independent institution marking how capable the company is to pay back the money (Pimco, 2016).

When the bonds are bought by investors directly from the issuers; this is called the primary market. The issuer than gets the money and are bound to pay interest rate according to the contract to the bond holder. The investors can after that trade these contracts at the stock exchange which is referred to as the secondary market. The issuer generated income or debt are unaffected by the trades at the secondary market (Berk & DeMarzo, 2014).

1.2 Empirical review

This paper also relates the literature to other literatures that studies the characteristic of climate friendly projects. Kumar, Managi, and Matsuda 2012; Sadorsky 2012). Climent and Soriano (2011) and Chang, Nelson, and Witte (2012) study the performance of green mutual funds and find that green mutual funds have underperformed on a risk-adjusted basis compared to conventional funds. Others, on the other hand other studies like nabegu et al(2017) have different believe on the sustainability of green financing. They stated clearly in their paper that green bond can't be sustainable in Nigeria.

However, this paper is concern with one main question, is Nigeria going to be a suitable location for issuing climate bonges? To answer this question, we will look examine the possibility of green bond been sustainable in Nigeria

1.3 MODEL SPECIFICATION

The model tries to investigate the sustainability of green bond as an instrument for developing green projects in Nigeria. The models are stated below with the independent variables as consumer price index (CPI), interest rate (INT)and money in circulation (M1), while the dependent variable green bond using the proxy of Federal government bond (FGNB). The model is specified as a functional form as follows:

$$FGNB = f (CPI, INT, M1) \dots\dots\dots (1)$$

Where:

FGNB = federal government bond

CPI = consumer price index (inflation)

INT = Current interest rate

M1 = money in circulation

The model is specified of its stochastic forms:

$$FGNB = \alpha_0 + \alpha_1CPI + \alpha_2INT + \alpha_3M1 + \mu_1 \dots\dots\dots (2)$$

Where:

α_0 = Intercept of relationship in the model or constant.

α_1, α_2 and α_3 = Coefficient of each exogenous variable.

μ_1 = Error term.

The model is specified of its log ln form.

$$\log \text{FGNB} = \alpha_0 + \alpha_1 \ln \text{CPI} + \alpha_2 \ln \text{INT} + \mu_1 \dots \dots \dots (3)$$

1.0 DATA AND METHOD

This paper will try to investigate on the sustainability of green bond as an instrument of financing green projects in Nigeria, employing secondary data from April 2013 to April 2017; implying the use of monthly data, the variables are: federal government bond, Consumer price index and interest rate. The monthly time series was obtain from the Central Bank of Nigeria (CBN), Nigerian Bureau of Statistics (NBS), and Nigeria stock exchange (NSE) data banks. To determine the sustainability we will be estimating using ARDL Bound Test proposed by Perseran and Shin (1999) and co integration technique of analysis.

2.1 Unit Root Test

This is a pre co-integration test; it is used to determine the order of integration of a variable that is how many times it has to be differenced or not to become stationery. It is to check for the presence of a unit root in the variable i.e whether the variable is stationary or not. The null hypothesis stated that there is no unit root. This test is carried out using the augmented dickey fuller ADF technique of estimation. The rule is that if the ADF test statistics is greater than the 5% probability value we accept the null hypothesis i.e the variable is non stationery but if the ADF test statistics is less than 5% probability value i.e the variable does not become stationery if the variable does not become stationery at first difference twice. However, it is expected that the variable becomes stationery at first difference.

2.2 Autoregressive distributed lag ARDL Bound Test.

This study employed the ARDL bound testing method in analyzing the long run relationship involving Federal government bond, consumer prices index, interest rate and money in circulation. The ARDL bound test modeling procedure is proposed by Pesaran and Shin (1999) and subsequently extended by Pasaran , Shin and Smill (2011) . The ARDL bounds co integration approach has many advantages while compared to other techniques of co-integration. For instance, the ARDL bound test does not set assumption restricting all the variables to be integrated in the same order, which was contrary to other techniques of co-integration. Thus, the ARDL method can be employed

without regarding whether the variables are integrated to order zero or order one. Secondly, the ARDL test is appropriate with even small size of the samples, where as other techniques of co-integration are responsive to high sample size. Thirdly, the ARDL method offers unbiased estimates of the long run model at valid t statistics even when some of the variables are endogenous (Harris and Salis 2003). The ARDL model used in this study can be formulated in equations as follows.

$$\Delta \ln FGNB_t = \alpha_0 + \sum_{i=1}^n \alpha_1 \Delta \ln FGNB_{t-i} + \sum_{i=1}^n \alpha_2 \Delta \ln CPI_{t-i} + \sum_{i=1}^n \alpha_3 \Delta \ln INT_{t-i} + \alpha_1 FGNB_{t-i} + \alpha_2 CPI_{t-i} + \alpha_3 INT_{t-i} + \varepsilon_t$$

$$\Delta \ln CPI_t = \beta_0 + \sum_{i=1}^n \beta_1 \Delta \ln CPI_{t-i} + \sum_{i=1}^n \beta_2 \Delta \ln FGNB_{t-i} + \sum_{i=1}^n \beta_3 \Delta \ln INT_{t-i} + \beta_1 \ln FGNB_{t-i} + \beta_2 \ln CPI_{t-i} + \beta_3 \ln INT_{t-i} + \varepsilon_t$$

$$\Delta \ln INT_t = \theta_0 + \sum_{i=1}^n \theta_1 \Delta \ln INT_{t-i} + \sum_{i=1}^n \theta_2 \Delta \ln FGNB_{t-i} + \sum_{i=1}^n \theta_3 \Delta \ln CPI_{t-i} + \theta_1 \ln FGNB_{t-i} + \theta_2 \ln CPI_{t-i} + \theta_3 \ln INT_{t-i} + \varepsilon_t$$

Where:

FGNB is federal government bond

CPI Is the inflation

INT Is interest rate

θ , β , δ and α are the parameters of the model

Δ Is the first difference operator

t is the time period

ε_1 is the error term.

If the calculated statistics is greater than the upper critical bounds value, then the null hypothesis is rejected. Alternately, if the f statistics falls within the bounds, the co-integration result becomes inconclusive. Lastly, if the f statistics is below the value of lower bounds then we failed to reject the null hypothesis of no co-integration.

3.1 PRESENTAION OF RESULT AND INTERPRETATION

Table 1: Unit Root Test Result

	Test Critical Values			ADF Test	MacKinnon(1996)	Remarks	Order
	1%	5%	10%	Statistics	P-Values		
logFGNB	-4.192337	-3.520787	-3.191277	-5.360055	0.0004***	Stationary	I(1)
CPI	-3.310324	-2.925169	-2.600658	-3.310324	0.0200**	Stationary	I(0)
INT	-4.165756	-3.508508	-3.184230	-7.336875	0.0000***	Stationary	I(1)
M1	-4.161144	-3.506374	-3.183002	-5.625079	0.0001***	Stationary	I(0)

Note: *, **, *** signifies level of significance at 1%, 5% and 10% respectively. The figure below signifies there stationarity.

The results present the stationarity test using Augumentated Dickey Fuller test for stationarity. The result shows that only CPI (consumer price index) and M1 (money in circulation) is integrated of order I(0) at 5% level of significance, meaning that it is stationary at level. While the remaining variables logFGNB (federal government bond) and INT (interest rate) becomes stationary at the first difference, implying that they are integrated of order I(1). Because of the mixture of I(0) and I(1) series this therefore, encourages usto use ARDL bound test. Similarly, the null hypothesis of stationarity test is that variable has unit root. When the probability value is less than 5% we are going to reject the null hypothesis and conclude the variable is stationary while above 5% we are going to accept the null hypothesis and conclude the variable is non-stationary.

Table 2: ARDL Bound test result

Variables	F-Statistic	Co-integration
F(cpi, int, m1)	9.604976***	Co-integration
Critical value	Lower Bound	Upper Bound
1%	4.29	5.61
5%	3.23	4.89
10%	2.72	3.77

Notes: *** Statistical significance at 1% level; ** Statistical significance at 5% level; * Statistical significance at 10% level. The lag length k=1 was selected based on the Schwarz criterion (SC).

Therefore, the empirical findings lead to the conclusion that there is long run relationship between federal government bond which is the dependent variable and the independent variables which is inflation (cpi), interest rate (int) and money in circulation (M1) because we fail to accept the null hypothesis. This is because the F-statistics is higher than the upper bound at 5% level of significance and also the condition is that, if F-statistics is higher than the upper bound at 1%, and 5%, we reject the null hypothesis and conclude the presence of long run relationship between the variables.

Table 3: Long Run Coefficients. Dependent variable: $\Delta\text{LOGFGNB}$ ARDL(3,0,0,0)

Variables	Coefficient	Std. Error	t-statistics	Prob.
CPI	-0.003022	0.003096	-0.976226	0.3391
INT	0.006392	0.002217	2.883454	0.0084***
M1	0.000001	0.000000	7.559417	0.0000***
C	2.524372	0.113999	22.143797	0.0000***

From table 3 above, we can see that both cpi which is consumer price index is insignificant and negatively related to the dependent variable. We interpreted the result by saying a 1% increase in consumer price index (CPI) leads to 0.003% decrease in federal government bond. Interest rate (int) and money in circulation (M1) are found to be positively related to the dependent variable and are both significant at 1%. From the result above, we can interpret the result on the basis that a 1% increase in interest rate leads to 0.0064% increase in the dependent variable. Also, 1% increase in money in circulation leads to 0.000% increase in federal government bond.

Table 4: Short-run coefficient. Dependent variable: ΔLOGSPI ARDL(3,0,0,0)

Variables	Coefficient	Std. Error	t-statistics	Prob.
D(CPI(-1))	0.133151	0.049819	2.672685	0.0136**
D(INT)	0.002190	0.000689	3.179970	0.0042***
D(M1(-1))	-0.000000	0.000000	-3.827093	0.0009***
CoinEq(-1)	-0.274915	0.049355	-5.570158	0.0000***

The table above shows the short run coefficient or Error Correlation Representation (ECR). In the short run the CPI, and INT maintained the positive relationship with respect to federal government bond and also all the variables are found to be significant at 5% and 1% level of significance respectively. And money in circulation in the short run is also significant at 1% but negatively related to the dependent variable. In the short run, 1% change in money in circulation leads to 0.000% decrease in conventional bond. Lastly, when the coefficient of ECM is negative and is statistically significant it means a fairly high speed of adjustment to equilibrium. The speed of adjustment to equilibrium from the result above is about 27.49%.

3.2 RESIDUAL DIAGNOSTICS

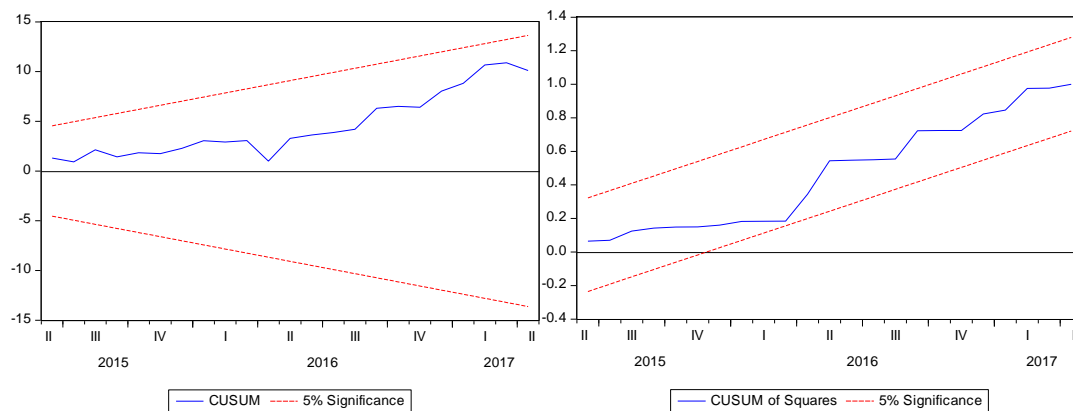
Table 5; Serial correlation LM, Hetrokedasticity Test & Normality Test Result

DIAGNOSTICS	F-Statistics	Probability. Chi(2)
Serial correlation(B.P LM test)	0.240360	0.6392
Hetroskedasticity(ARCH)	1.179103	0.2723
Normality test	1.693810	0.428740

From residual tests, we can see the serial correlation LM test, Hetrokedasticity test and normality test result. From the result above, the chi(2) probability is found to be insignificant. The condition for every post estimation is that, we want the chi(2) or probability of each and every post estimation to be insignificant and as such we accept the null hypothesis. From the result above we accept the null hypothesis by concluding that there is no serial correlation between the variables, the variance of the variable is homoscedastic and the variables are normally distributed.

3.3 Stability Tests

Here we are trying examined the stability of the long-run parameters together with the short-run movements for the equations. For test, we relied on cumulative sum (CUSUM) and cumulative sum squares (CUSUMSQ) tests proposed by Borensztein *et al.* (1998). This same procedure has been utilized by Pesaran and Pesaran (1997), Mohsen *et al.* (2002) and Suleiman (2005) to test the stability of the long-run coefficients. The tests applied to the residuals of the ECM model



Figures 1 and 2 plots is the CUSUM and CUSUM of squares statistics. It can be seen from Figure 1 that the plot of CUSUM stays within the critical 5% bounds that confirms the long-run relationships among variables and thus shows the stability of coefficient. However, CUSUMSQ statistics also stays within the 5% critical bounds of parameter stability. Thus indicates stability of the coefficients.

4.0 Conclusion and Recommendation

This paper tries to access if there is any risk associated with financing climate finance project using green bond or the sustainability of using such instrument. In the long run and short run, there is a positive relationship between federal government bond (green bond proxy), CPI, INT and M1 and are all found to be insignificant. Also, the empirical analysis carried out using ARDL bound test signifies that the long-run relationship between FGNB, CPI, INT and M1 exist. We also found out that the variables are not serially correlated, there variance is homoscedastic and the variables are normally distributed. And finally we found out the variables are stable using CUSUM and CUSUMSQ test. However, we conclude that there no risk associated with financing climate friendly project using green bond. And there is a very high probability of sustainability for using Green bond.

Some of the policies that this paper suggests include; providing well sound policy maker on the issue of mitigation policies. Policies that will encourage more investment carbon market because carbon market is the fastest growing capital market in the world. Also, the authorities responsible for issuing this green bond should go extra mile in order to encourage investors to invest more on green projects. Finally, our paper only discuss on the sustainability of green finance in Nigeria. Other interested researchers might go extra mile to discuss on issues associated with the risks associated with financing climate or green project using green bond.

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