WEST AFRICAN INSTITUTE FOR FINANCIAL AND ECONOMIC MANAGEMENT (WAIFEM)

WEST AFRICAN FINANCIAL AND ECONOMIC REVIEW

Volume 13 **December 2015** **Number 2**

FORMULATION OF A CONSISTENT MACROECONOMIC MODEL WITH THE BOND MARKET: SIMPLE ANALYTICS

By Akpan h. Ekpo [1]

Abstract

The paper has discussed the traditional macroeconomic model and provides a simple analysis of the bond market as a proxy for a rudimentary treatment of the financial market. An analysis of the bond market with a simplified assumption still ensures consistency in the formulation of a macroeconomic model in a static context. Consequently, the efforts of economies in the West African sub-region to establish capital market is a step in the right direction.

Keywords: Bond market, West Africa

JEL Classification: C5, C51, D1, D11, D21, D4, D53

I. INTRODUCTION

The keynesian 'revolution' encourages economists to build models that reflect the aggregate economy. The objectives of such models are generally to capture the realities of an economy as it struggles to provide full-employment, price stability, growth and stability in the external sector. The simple macroeconomic model includes the output/product market, money market, labour market, and the external sector to capture the openness of the economy. The money market is often assumed in traditional macroeconomic model to capture the financial market. At best, Walras law is generally invoked to suppress the financial and other relevant markets.`

In the advanced economies, given the sophistication of their financial markets, several macroeconomic models incorporate the complexities of the financial markets. In other words, the models with the financial realities reject the traditional macroeconomic model in assuming away the financial market. It is important to state that even within the traditional and simple analysis, Patinkin (1964) raises the matter of considering the financial market through the bond market if the macroeconomic framework has to be consistent.

There is also a debate as to whether financial stability includes macroeconomic stability or whether the reverse is the case. Nonetheless, the global economic crisis

[1] Akpan H. Ekpo is Professor of Economic and Director General, West African Institute for Financial and Economic Management (WAIFEM). The views expressed in this paper are those of the author and do not represent those of WAIFEM. E-mail: ahekpo@waifem-cbp.org;

of 2008 on account of which the world is still experiencing sluggish growth has re-echoed the importance of making explicit the financial market in macroeconomic analysis.

The West African sub-region's financial market is still emerging. At present, there are stock exchanges in Nigeria, Ghana, Cote'Ivoire, and Senegal. The Gambia and Sierra-Leone have been making preparations towards establishing stock exchanges. The main idea is to raise capital especially within the private sector to finance long-term development.

The objective of this paper is to highlight theoretically the importance of the financial market using the bond market as a proxy in formulating a consistent traditional/conventional macroeconomic model. Following the introduction, section 2 briefly presents the traditional macroeconomic framework. Section 3 examines the bond market. Section 4 concludes the paper. It is expected that the simple analytics would drive home the significance of the bond market in raising capital in the economies of the West African sub-region.

2. TRADITIONAL MACROECONOMIC MODEL

In principles of economics, macroeconomic equilibrium occurs at the level of income and output where $Y = C + I + G$. $Y = C + I + G$ +X-M is a **necessary** but not a **sufficient** condition for commodity market equilibrium. Macroeconomic equilibrium requires that all markets be in equilibrium.

In addition, the $Y = C + I + G + X - M$ condition gives a unique equilibrium income only in the simplest model which ignores prices, interest rate and the effect of wealth on the demand for commodities. The X-M component represents an open economy. However, in this analysis, the paper assumes a closed economy.

Y = income; I = investment spending; G = government spending. In order to provide a framework for understanding macroeconomic model, The paper examines the rudiments of the basic macroeconomic framework:

2.1 The Output Market

The basic assumption underlying the aggregate level of analysis in the paper is that the economy produces only one commodity. This product can be used either for consumption or it can be invested. When invested, it is accumulated as a capital good and combined with the other factors of production (say labour) to produce more output. Assuming a closed economy, equilibrium in the commodity market is shown by:

$$Y = C + I + G \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where Y = real output or national income

C = real private demand for consumption

I = real private demand for investment

G = real government expenditure

Equation (1) must not be confused with the national income identity. Equation (1) is an equilibrium condition which may not be satisfied, if total desired expenditure $(C + I + G)$ is also less than total income (Y), then $(C + I + G)$ is less than output. This cannot be an equilibrium situation, that is, output is less than the demand for commodities. Something must change; either demand to fall or supply to rise or both.

Also, if $C + I + G+> Y$, then people desire to spend more than total income and output. This is possible only by borrowing, drawing on savings or printing money) consequently, output must rise or demand must fall or both.

Therefore, Y = $C + I + G$ **is a necessary condition for equilibrium in the commodity or product market.** There are many different income levels for which $Y = C + I + G$, one for each interest rate and price level.

Note that equation (1) is written in real terms. It will not alter the analysis if nominal values are used. Real terms have been used to capture the essence of inflation. Though in some markets, it is controversial whether to use real or nominal values due to the notion of **"money illusion"**

It is important to ascertain the determinants of (C, I, G). The simplest theory postulates the consumption function as:

$C = C\,(Y)$…….(2)

$O < \frac{\partial C}{ry} < 1$ ……..(3)

With I and G remaining constant $(I = I_o,\ G = G_o)$

Equation (2) says that consumption depends upon income while investment and government expenditure are both determinant exogenously.

Substituting these relationship into equation (1) the paper has:

$Y = C\,(Y) + I_O + G_O$ ……..…..(4)

So that Y can be solved uniquely in terms of the exogenous values of investment and government expenditures.

Let consumption be a function of disposable income: That is:

$\mathrm{C} = \mathrm{C}\ (\mathrm{yd});\ \mathrm{o} < \frac{\partial \mathrm{c}}{\mathrm{ry}\,\partial} <$ ……(5)

Where $\mathrm{Yd} = \mathrm{Y} - \mathrm{T}$

Yd = real disposable income;

$\mathrm{T} =$ taxes;

T can be endogenous: $T_o = \mathrm{T_o} + \mathrm{tY}$

If we assume T to be constant (T_O) then we have a Keynesian short-run consumption function:

C = c(Y-T)

However, after Keynes, there has emerged sophisticated postulations of the consumption function, namely;

- Shifting income hypothesis.
- Relative income hypothesis.
- Permanent income hypothesis, and
- Life cycle income hypothesis.

Most of these postulations have been derived from utility maximization. The outcome of these studies has modified the typical Keynesian SR consumption function.

The paper cannot reconcile the on-going controversies as regards the appropriate consumption function. However, the up-shot of these contributions is that consumption is, however, made to depend on wealth, disposable income and interest rate.

The latter is not completely accepted by most authors. The Paper can thus state a consumption function as:

$C = C\left(yd, r,\ {}^{Z}/_{P}\right)$ ……(6)

$o < \frac{\delta c}{\delta Y} < 1;\ \frac{\delta c}{\delta {}^{Z}/_{P}} >_O;\ \frac{\delta C}{\delta r} \gtrless o$

Where r = rate of interest.

$^{Z}/_{P}$ = real wealth of the private sector.

For now, drop r in order to have:

$C = C\left(Yd, {}^{Z}/_{P}\right)$ .....(7)

Equations (6) or (7) can be described as a long-run consumption function incorporating wealth as a proxy for all the other determinants of consumption. The investment function can be postulated in its simplest form as:
$I = I(r) \qquad I' < o$ .....(8)

Equation (8) holds based on the discounted present value criterion. A profit maximizing firm should invest on those projects yielding a positive discounted present value.

As the interest rate rises, the number of projects having this property will fall so that the amount of investment undertaken by the firm will fall, thus justifying equation (8)

The investment function can also be written as:

$I = I\ (r, Y, K)$ .....(9)

$$\frac{\partial I}{\partial r} < o\ , \frac{\partial I}{\partial y} > o; \frac{\partial I}{\partial k} < o$$

Equation (8) shows that investment depends positively on the level of income; negatively on the interest rate and level of existing capital stock K.

Substituting equations (6) and (8) into the product market equilibrium (equation 1) yields the **IS** curve

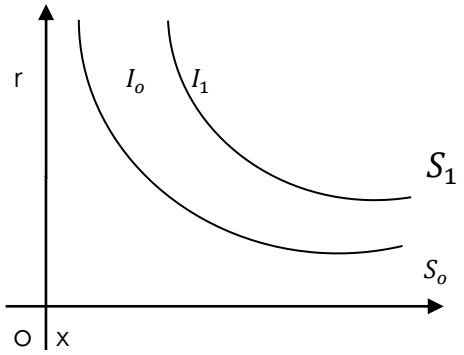
$Y = C\ (Y - T) + I(r)$ + G .....(10)

The IS curve gives the combination of Y and r which keep the product or commodity market in equilibrium. Differentiating both sides of (9) with respect to Y, the paper has:

$\left.\frac{dr}{dy}\right|_{IS} = \frac{I - C^1}{I^1} < o$.....(11)

Implying a downward slopping IS curve

Fig. 1: The IS Curve



The IS curve is downward slopping because as income rises, consumption rises but less than income. Invariably, the only way the excess output can be absorbed is by additional investment and for this to occur, the interest rate must fall.

It should be clear that the position of the IS curve depends on the position of the investment function, consumption function and government expenditure. An increase in government expenditure, or an outward shift in either C or I function will push the IS curve downward as IS_O (see the appendix for an algebraic derivation of the IS equation).

2.2 The Money Market

Combining the quantity theory of exchange, the micro-foundations of monetary theory as well as the Keynesian liquidity preference theory, the paper can state the demand for money thus:

L/P = L (Y, r)……..(12)

Where Y'>0; r'<0

The real money supply is determined exogenously through the Central Bank:

M/P = M0/p……..(13)

It should be noted that the money supply can be determined endogenously through the commercial banking system and the open market operations of the Central Bank.

Setting equation (12) equal to equation (13) will yield equilibrium in the money market in a static model. Solving the equilibrium for either r or Y will result in an LM

equation. The LM equation gives the combinations of r and Y that clears the money market in a static model. An algebraic derivation of the LM equation is shown in the appendix.

2.3 Equlibrium In The Product/Output and Money Markets

The equilibrium levels of income and interest rate is arrived at by combining the IS and LM curves/equations. Rewriting the two equations:

$Y - C\,(Y - T) - I(r) - G = o$ .....(14)

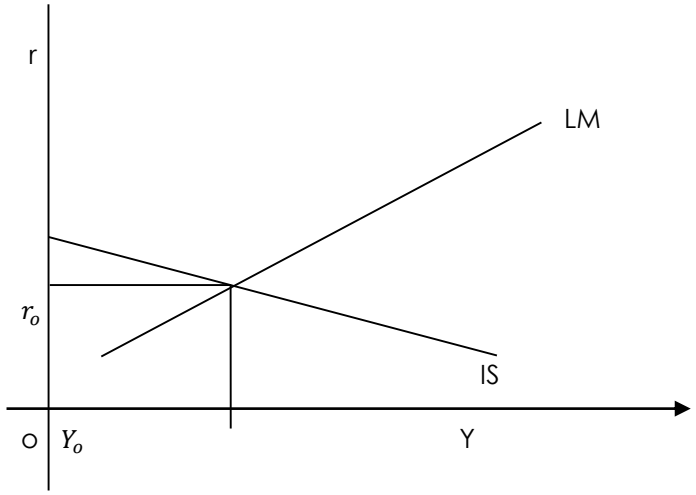
$^{m}/_{p} - L\,(Y, r) = o$ .....(15)

*Note that taxes T is exogenously determined.

It is straight forward that based on our assumptions, equations (14) and (15) can be solved uniquely for Y, r in terms of P, G, M. T.

The graphical solution is given below

Figure 2: Determination of Equilibrium in the Output and Money markets



The solution:

$Y = Y(P;\ G, M, T)$ …….. (16)

Which relates equilibrium income as determined by demand to price. It can thus be seen as an aggregate demand function.

Differentiating equations (14) and (15) wrt P we have:

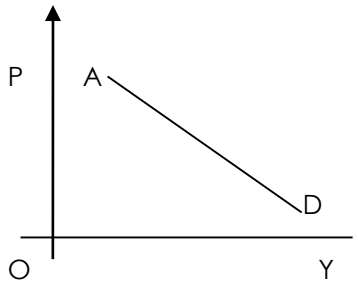
$$\begin{pmatrix} I - \frac{\partial <}{\partial y} & -\frac{\partial I}{\partial r} \\ -\frac{\partial L/p}{\partial y} & -\frac{\partial L/p}{\partial r} \end{pmatrix} \begin{pmatrix} \frac{\partial Y}{\partial p} \\ \frac{\partial r}{\partial p} \end{pmatrix} = \begin{pmatrix} 0 \\ \frac{m}{p^2} \end{pmatrix}$$

and solving for $\partial y/\partial p$ via scalar expansion

$$\frac{\partial y}{\partial p} = \frac{\frac{(\partial I)}{\partial r}\, m/P^2}{-\frac{\partial L/P}{\partial r}\left(\frac{1-\partial I}{\partial Y}\right) - \left(\frac{\partial L/P}{\partial Y}\right)\left(\frac{\partial I}{\partial r}\right)} < o \quad \text{.....(17}$$

Thus, the AD Curve is downward sloping:

Fig. 3: THE AGGREGATE DEMAND CURVE



In the traditional model, the eclectic aggregate supply curve can be derived through the labour market (see Miller, 1995).

The money market in the traditional model subsumes the financial wealth. The discussion of the long-run consumption function which incorporates the wealth

effect does not explicitly consider the financial market. The paper next provide a simple analysis of the bond/financial market for some consistency within the basic model.

3.0 THE BOND MARKET

Traditionally, the bond market is often assumed away in the macro-model. This is often allowed by invoking Walras' law. According to this law, if all markets are in equilibrium but one market then that one market is indeed in equilibrium. As part of building a consistent macro-model, it is necessary to consider the bond market because if it is not in equilibrium, the system may in theory and practice exhibit some problems.

What is presented below is an introduction and simplified version to ensure consistency with the traditional macro-model. The paper notes that the issue of formulating a consistent macro-model is much more involved; it concerns analysing the budget constraints of all economic agents and that of the entire economy as well as the underling various behaviourial relationships. A consistent framework makes explicit the several implicit assumptions of the traditional IS – LM framework.

In the macro-model, a bond is a general type of nonmonetary financial asset issued by firms to finance investment and by the government to help finance government spending. It will be generally assumed that each bond pays 1₦ in interest each period and has no maturity date. In addition, both firms and government supply bonds, households (which hold the bonds) do not distinguish between government and private bonds. Let us state the following equations:

3.1 Demand for Bonds:

$$\bar{\beta}^d = \frac{\frac{1}{r}\beta^d}{p} = \beta_o^d + ey + qr + h\frac{m}{p} \quad \text{.....(18)}$$

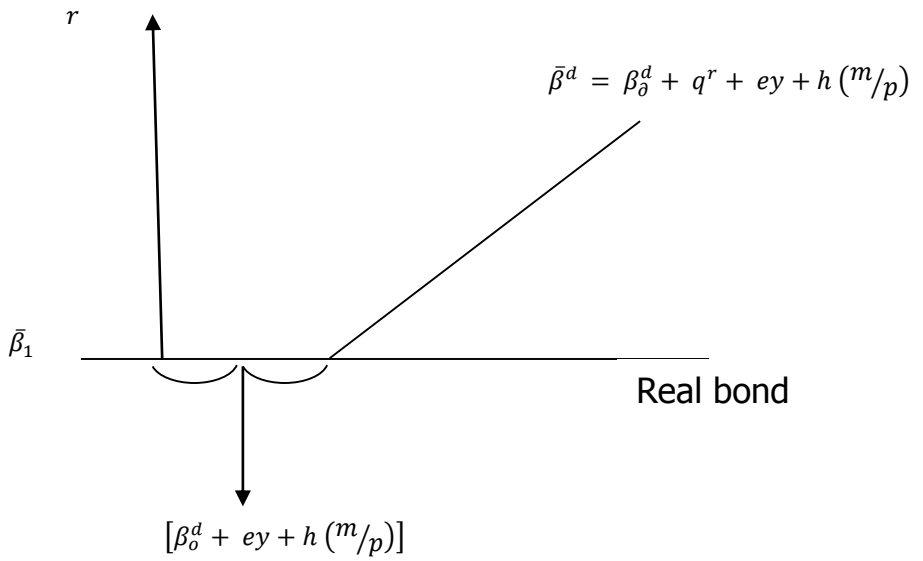
$$\beta^d = \beta\left(y,\ r, {}^{m}/_{p}\right) \text{ (general form)}$$

Equation (18) is the demand for bond equation, $\bar{\beta}^d$ is the number of bonds demanded. Each bond pays 1₦ per period in interest thus ${}^{1}/_{r}$ is the price of bond. All households demand an amount of real bonds $\left(\frac{{}^{1}/_{r}\beta_d}{p}\right)$. Equation (18)

assumes that real bonds demanded: (1) rises with income $\frac{\partial\bar{\beta}^d}{\partial y} = e > o$; (2) increases as the rate of interest rises $\left[\frac{\partial\bar{\beta}^d}{\partial r} = g > o\right]$; and (3) rises as real cash

balances grow $\left[\frac{\partial \bar{\beta}^d}{\partial \mu y p} = h > o\right]$. The demand for real bonds has a positive slope $\left[\partial \bar{\beta}^d / \partial_r > o\right]$. Its horizontal intercept is found by setting $r = o$. The curve shifts as income or real cash balances or the constant term changes.

Fig. 4: DEMAND FOR BONDS



$$\overline{\beta_g} = \frac{{}^1/_{r\beta g}}{p} = \left({}^1/_r\right)\frac{\beta g}{p} \Rightarrow \text{govt. bonds}$$

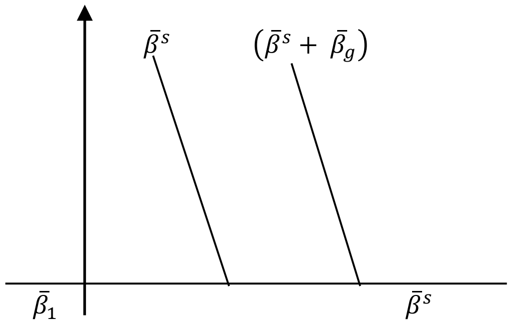
3.2 Bond Supply

$$\bar{\beta}^s = \frac{{}^1/_{r\beta^s}}{P} = \beta^s_{o-\,j_r+\,sy} \quad \ldots\ldots\ldots\ldots\ldots(19)$$

$\bar{\beta}^s = \beta^s\,(r, y)$ (general form)

Equation (19) is the bond supply equation. It depends on a constant term, on the interest rate and on income. Firms desire to invest more if the interest rate falls and to finance such investment by selling more bonds. Increases in income shift $\overline{\beta_s}$ to the right; low values of income shift $\overline{\beta_s}$ to the left.

FIGURE 5: SUPPLY OF BONDS

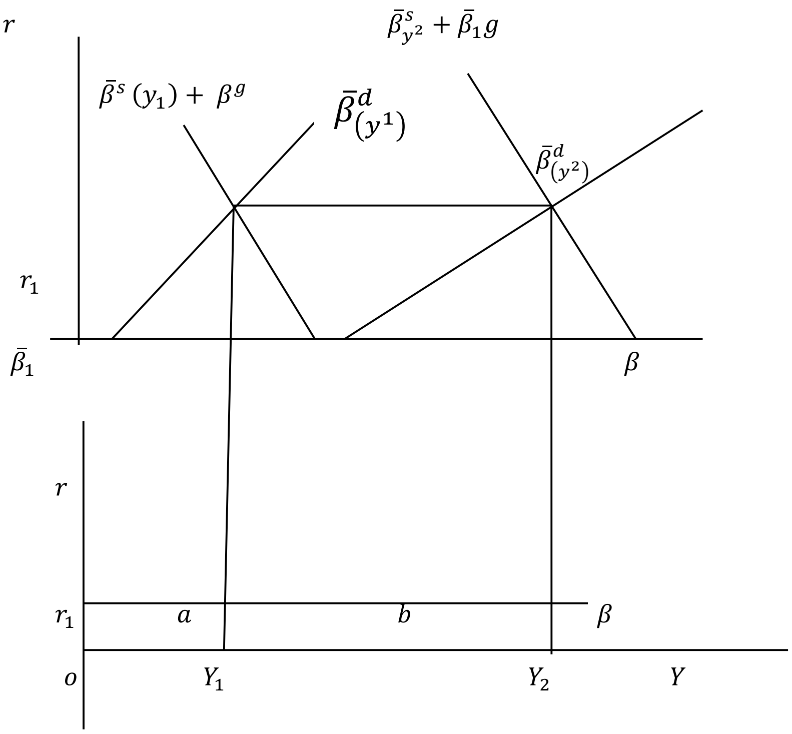


The total supply of bonds is the sum of bonds from firms and government bonds. An increase in any will shift the shift the supply of bonds to the right.

Bond Market Equilibrium

$$\bar{\beta}^d = \bar{\beta}^s + \bar{\beta}_g \quad \text{...} \quad (20)$$

Fig. 6: Graphical Derivation of the $\beta\beta$ Curve

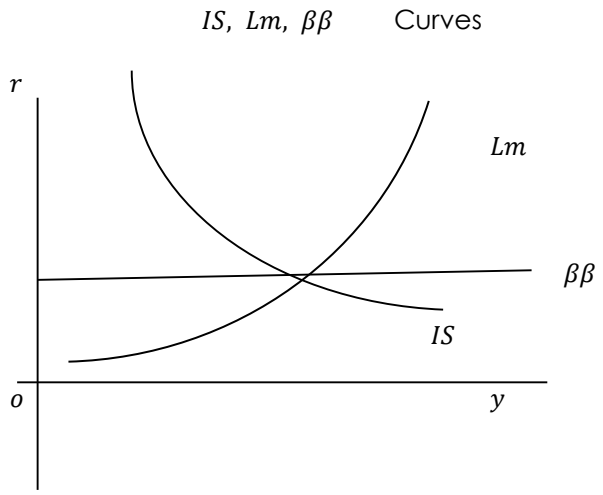


Bond market equilibrium is found at the point where $\bar{\beta}^d = \bar{\beta}^s + \bar{\beta}_g$. The initial interest rate needed to clear the bond market is r_1. If the Walrasian auctioneer calls out a higher income (Y_2), the increase will be both bond demand and bond supply. $\bar{\beta}^d$ and $\bar{\beta}^s$ shift to the right by the same amount when income rises. This assumption of equal slopes is made just for simplicity.

$$\left[\frac{\partial \bar{\beta}^d}{\partial y} = e;\ \frac{\partial \bar{\beta}^s}{\partial y} = s.\ Hence\ e = s\right]$$

Plotting points a and b on to the lower graph results in an horizontal $\beta\beta$ curve which shows the combinations of r and y that clear the bond market. It is anticipated that if the bond market is incorporated into the traditional IS-LM, the system can be graphed thus:

Fig. 7: OUTPUT, MONEY AND BOND MARKET IN EQUILIBRIUM



Note that if the $\beta\beta$ curve does not clear the traditional model, there will be several equilibrium points. Note also that the horizontal $\beta\beta$ curve is due to our simplified assumption (see the appendix for algebraic derivation of the BB curve.

4. CONCLUSION

The paper has summarized the traditional macroeconomic model with an analysis of a simple bond market as a proxy for the financial market. If the bond market is not considered explicitly, there could be several equilibrium points in a static model. Under such a scenario, it would be difficult to ascertain which combination of income and the rate of interest that clears both the output and money market. A consideration of the bond market with a simplified assumption still ensures macroeconomic stability within a static partial equilibrium analysis.

It is a truism that although macroeconomic management in developing countries has received increased attention the analytical framework for the study of macroeconomic issues seems to have given scant attention to the role of bond markets. Instead there is a proliferation of models with different and often conflicting assumptions about degree of capital mobility, the functioning of exchange rate regime, expectations, degree of wage – price flexibility, role of dynamic responses to policy and exogenous shocks, etc. The new generation of macroeconomic models that stresses those assumptions are a case in point. This study is an attempt to extend the theoretical frontiers of textbook rendition of the traditional macroeconomic model of a developing economy by incorporating the bond market. Thus consistency is achieved for the macroeconomic framework. It has underpinned the wisdom in developing capital markets by developing countries including the ECOWAS sub-region.

Even so, the effort does not necessarily represent the last word. Model building is an evolutionary process that will continue to reflect new developments in economic theory, better understanding of the structure of developing countries etc.

REFERENCES

Agenor, Paul and P.J. Montiel (2008), *Development Macroeconomics*, Princeton University Press

Branson (2008), *Macroeconomic Theory and Policy*, Harper and Row,

Blanchard and Fischer (2003), *Lectures on Macroeconomics*, MIT Press, (Compulsory Text)

Levacic and Rebman (1982), *Macroeconomics: an Introduction to Keynesian-Neoclassical controversies*, Macmillan,

Turnovsky (1979), *Macroeconomic Analysis and Stabilization*: Cambridge University Press

Patinkin, Don (1964), *Money, Interest rates and Prices, Harper and Row*, New York.

Romer, David (2012), *Advanced Macroeconomics*, McGraw-Hill, New York

Soludo, Charles C. (1998), *Macroeconomic Policy Modeling of African Economies*, Acena, Enugu, Nigeria

Ekpo, A.H. et al (2004), *Macroeconomic Model of the Nigeria Economy*, Vintage, Ibadan

APPENDIX

Algebraically an IS curve which incorporates wealth (Z) can be derived thus:

Assume:

$C = a + b_1\,(Y - T)\; x\; b_2\; \left({}^{Z}/_{p}\right)$ .....(A1)

$I = I_{O-Vr}$ .....(A2)

$G = G_o$ .....(A3)

${}^{Z}/_{P} =$ the real value of wealth

a, b, c, I, and V are parameters, all of which > o

Substituting (13'), (13'') and 13''') into equation (5) we have

$Y = a + b_1(Y - T) + b_2\; C\left({}^{Z}/_{P}\right) + I_o - V_r + G_o$

$r = \frac{a+I=G_o-b_1T+\,b_2\,{}^{Z}/_{P}}{v}$ - Y $\frac{(I-b)}{V}$ .....(A4)

Equation (14) is the IS curve and it incorporates the wealth variable

This IS curve slopes downwards:

$\left.\frac{dr}{dy}\right|_{IS} = -\frac{(1-b_1)}{V}$

Deriving the LM equation in a closed system.

${}^{L}/_{P} = Lo + ky - qr$ ..... (B1)

$\frac{M^s}{p} = \frac{m}{p}$ (Money supply) (B2)

L = demand for liquidity preference

P = price level

r = interest rate

Y = income

M^s = money supply

At equilibrium: $Lo + Ky - qr = \frac{m}{p}$ (B3)

Solve for r:

$r = \frac{(Lo - {}^{m}/_{p})}{q} + \frac{K}{q}y$ LM equation .....(B4)

The term on the rhs gives the value for r that clears the money market when income is o. The term (Lo – mP)/q is the vertical intercept of the Lm curve. This intercept could be positive or negative depending on the magnitude of Lo relative to ${}^{m}/_{p}$. The intercept will increase and LM will shift up and to the left for any increase in Lo or decrease in $({}^{m}/_{p\ or\ q})$.

The shape of the LM curve is the coefficient of Y in the LM equation since

$\left.\frac{dr}{dy}\right|_{LM} = \frac{K}{q} > o$

Any movement along an LM requires r and y to change in a way that will keep ${}^{L}/_{P}$ constant since ${}^{m}/_{P}$ is fixed and ${}^{L}/_{P}$ must equal ${}^{m}/_{P}$.

The change in ${}^{L}/_{P}$ as we move up LM is composed of two different effects. First, as the interest rate rises, ${}^{L}/_{P}$ declines by $(-q)\ x\ (dr)$.

Second, as income rises, ${}^{L}/_{P}$ increases by the amount (K) times $(dy) \Rightarrow [k\ x\ dy]$. Since the next change in ${}^{L}/_{P}$ must be zero, it follows that $(-q)\ dr + (k)\ dy = o$ …….. (B5)

$\left.\frac{dr}{dy}\right|_{LM} = \frac{k}{q}$ = slope of the LM equation.

The magnitude of "q" affects the slope of the LM. As "q" gets smaller, the shape $\frac{k}{q}$ grows larger, **In the limit, as q approaches zero, the term $\frac{k}{q}$ approaches infinity**. This leads to a vertical LM curve on the usual **classical case.**

On the other hand, if ${}^{L}/_{p}$ responds to interest rate changes very strongly then "q" is very large and the slope of LM $({}^{k}/_{q})$ becomes small. In the limit, as "q"

approaches infinity, the slope of LM approaches zero. That is, $^{dr}/_{dy=o}$ which corresponds to a horizontal LM curve. For many years. Keynesian economists thought that the LM curve looked like this during the great depression period of the 1930s.

Algebraic Derivation of the $\beta\beta$ Curve

Setting equation (18) equals (19) we have:

$$\beta_o^d + ey + qr + h\left({}^{m}/_{p}\right) = (\beta_o^s - jr + sy) + \bar{\beta}_g \quad \text{(C1)}$$

Solving for r:

$$r = \left[\frac{\beta_o^d + h\left({}^{m}/_{p}\right) - \beta_o^s - \bar{\beta}_g}{g+j}\right] - \frac{[(e-s)]Y}{g+j} \quad \text{.....(C2)}$$

Equation (4) is the $\beta\beta$ curve. If $y = o$, then

$$r = -\frac{\beta_o^d - h\left({}^{m}/_{p}\right) + \beta_o^s + \beta^g}{g+j} \quad \text{.....(C3)}$$

which is the intercept of the $\beta\beta$ curve. Since we assumed that $(e = s)$, the coefficient of the y term in the equilibrium equation becomes zero. The $\beta\beta$ curve has a zero slope $\frac{\partial r}{\partial y} = -\frac{(e-s)}{g+j} = o$.

This reduces the $\beta\beta$ equation to:

$$r = \left[\frac{\beta_o^d + h\left({}^{m}/_{p}\right)}{g+j}\right] - \frac{\beta_{o-}^s \bar{\beta}_g}{g+j} \quad \text{.....(C4)}$$

Since $(g + j) > o$, we get a positive equilibrium interest rate (r) only if the numerator of the bracketed term on the rhs of equation (C4) is negative .

Shifts in the $\beta\beta$ Curve

The r which clears the bond market will increase and $\beta\beta$ will shift upward if $\beta_o^s + \beta^g$ increases, β_o^d falls and ${}^{m}/_{p}$ falls either via a higher p or lower m.

An exogenous increase in bond supply $\left(\beta_o^s + \beta_1^g\right)$ would shift the original bond supply curve to the right and give a higher equilibrium r.

FINANCIAL DEVELOPMENT, INCOME IN EQUALITY AND ECONOMIC GROWTH IN ECOWAS COUNTRIES: AN ECONOMETRIC ANALYSIS

By Patricia A. Adamu[2]

Abstract

This paper seeks to explicate the relationship among financial development, income inequality and economic growth in ECOWAS countries. A two-equation simultaneous equation model is specified and estimated using three alternative techniques, viz., two-stage least squares estimator employing pooled data; two-stage least squares methodology employing the fixed effects model; and dynamic panel model methodology. The period of analysis is 2001 through 2012. From the empirical results, financial development, the modern sector and real GDP per capita, are found to be positively and significantly associated with greater income inequality. This result is consistent with the hypothesis of a positive linear relationship between financial development and income inequality. Financial sector development and exports are found to be significantly and positively related to economic growth, while income inequality is directly related to more rapid economic growth in ECOWAS countries. A vital policy implication of the results is that the countries in the ECOWAS sub-region should target financial development towards the poor to reduce income inequality by implementing policies that will widen the access to financial markets by the poor. Financial sector policy reforms should focus on better access to financial services by the poor to enable them engage in productive investments in small and medium enterprises and also invest in education of their children. To this end, special finance institutions such as microfinance banks and cooperative banks should be established to service the poor.

JEL classification: G2, D63, O16, C3

Key words: Financial development; inequality; economic growth; simultaneous equation and fixed effects model; ECOWAS.

1.0. INTRODUCTION

In general, financial development is expected to enhance growth by enabling the efficient allocation of capital and reducing borrowing and financing constraints. Financial sector is instrumental in achieving both short and long run economic performance through its intermediating activities in transforming and channeling deposits from the surplus economic units to the deficit units. The absence of efficient financial markets has been widely adjudged one of the challenging factors to economic growth in developing countries, in particular,

[1] Dr. Patricia A. Adamu is a Senior Programme Manager at the West African Institute for Financial and Economic Management (WAIFEM), CBN Learning Centre, P.M.B. 2001, Satellite Town, Lagos, Nigeria. Email: paadaamu@yahoo.com. The views expressed in the paper are those of the author and do not represent those of WAIFEM

ECOWAS[3] member countries. In the literature, countries with well developed financial system experience higher and faster economic growth trajectories, (Kargbo and Adamu, 2009; Acemoglu, Aghion, Lelarge, Van Reenen and Zilibotti, 2007; Greenwood and Smith, 1997; Greenwood and Jovanovic, 1990; Mckinnon, 1973; Shaw, 1973; Schumpeter, 1911; Bagehot, 1873. Financial sector development has also been identified as a vital factor in inclusive development, (Beck, 2010; Kargbo and Adamu, 2010; Demirgue-Kunt, 2006; Onwioduokit, and Adamu, 2005; Levine, 2005; Beck, Demirguc-Kunt and Levine, 2004). Based on its importance in accelerating economic growth, financial sector development has attracted keen interest of governments of most countries in the performance of their financial markets, (Ewah, Esang and Bassey, 2003). Economic growth in a modern economy hinges on an efficient financial sector that pools domestic savings and mobilizes foreign capital for productive investments, (Bekaet and Harvey, 1997).

The deterioration in economic performance and the consequent slow of growth in African countries in the late 1970s and early 1980s brought about the structural adjustment programme (SAP). SAP was instrumental to reforms of financial deregulation and liberalization, including the promotion of indirect monetary policy operations, central bank instrument independence, interest rates liberalization, elimination of administrative credit allocation, increased bank supervision and restructuring in a bid to restore and maintain solvency of commercial banks. These reforms were necessary when it became obvious that developing the real sector of the economy requires the presence of a strong financial system that would efficiently mobilize savings and channel credit to the deficit economic units. Financial reform is expected to build and foster a competitive and healthy financial system to support financial development and to avoid systemic distress. Pundit argue that as financial sector develops, the benefits trickle down to the poor even as the economy develops, (Jalilian and Kirpatrick. 2007; and Odhiambo 2010a/b).

Despite the various reforms that have been implemented in the financial sector, economic performance has not improved remarkably in the sub-region, (Senbet and Otchere, 2005), with financial intermediation and sophistication still considered relatively low and shallow when compared to other global economic communities. What then is the appropriate role of financial reform in economic development process? Although, there has been improvement in the GDP growth rate across sub-Saharan African countries and in the ECOWAS sub-region,

[2] The Economic Community of West African States comprises fifteen countries namely: Benin, Burkina Faso, Cape Verde Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

it is not clear whether the reforms carried out in the financial sector propelled the economic growth. Again, the improved growth has not translated to poverty reduction as there is widespread of poverty in the sub-region; growth has been immiserizing. Studies relating to financial reforms and poverty reduction are still quite scanty. This study attempts to bridge the gap and to ascertain the extent of the finance-growth nexus in the ECOWAS sub-region. Also, there is seemingly inadequate information on the aspects of financial sector development or reforms - whether financial deepening, intermediation efficiency or capital account, interest rate and banking sector entry liberalization - that are more crucial for poverty alleviation and economic development. Hitherto, studies that attempt a comparative analysis using a regional grouping like the ECOWAS are relatively scarce. Finally, the relationship between financial development and income distribution has perhaps not been given much attention in extant literature. Indeed, while recent work has established a robust link between financial sector development and economic growth, policy makers may be more interested in the distribution of the benefits of accelerated growth. Moreover, given concerns about income distribution *per se*, a policymaker faced with certain policy options may wish to know how and which policies affect both growth and income distribution. Hence, it is important for policy makers to know whether finance can be used as an instrument to affect income inequality and in what context it might be useful to do so.

To this end, this study attempts to address those issues by employing a simultaneous equation model to explicate the relationship among the variables, financial development, income inequality and economic development in ECOWAS countries. It is expected that the empirical results would corroborate the findings of Banerijee and Newman (1993) and Galor and Zeira (1993) which show that financial development has a linear relationship with income inequality. The focus of this study on ECOWAS countries is considered germane and desirable as income inequality in the sub-region has remained high despite almost three decades of economic and financial reforms.

The paper is structured into five sections. Following the introductory section is section two which reviews the relevant literature. Section three discusses the theoretical framework and methodology, while section four presents and analyzes the empirical results. Section five concludes the paper.

2.0 LITERATURE REVIEW

A lot of empirical research has given substantial support to the view that financial development has a significant effect on the pattern of income distribution.

Specifically, it reduces inequality, improves access of credit to the poor, alleviates extreme poverty, and consequently improves welfare without distorting economic efficiency. (Bittencourt, 2006; Hanohan, 2004; Demirguc-Kunt et al , 2004; Bulir, 1998; Li Sqiure et al, 1998). Batuo, Guide and Mlambo (2011) are of the opinion that theory provides two contrasting views on the impact of finance on inequality. One view posits an inverted U-shaped relationship between financial development and inequality. One such study by Greenwood and Jovanovic (1990) on finance-growth-inequality nexus predicts a Kuznets curve relationship between finance and inequality. In the early stages of development, when the financial sector is underdeveloped, inequality increases with financial markets development. However, this would tend to reduce as the economy develops moving to the intermediate phase and then to a mature phase of development in which more economic agents would see their income increase as they gain access to the financial intermediary sector, income inequality will reduce. But Clarke, Xu and Zuo (2003) using a panel data of developing and less developing countries in the period 1960 to 1995 hypothesize that inequality is lower in countries with better developed financial sector, but find no evidence of an inverted U-shaped relation between finance and inequality as predicted in the Greenwood and Jovanovic (1990) study.

Still on U-shaped relationship between financial development and inequality, Liang (2006) uses a dynamic panel estimation to investigate the relationship between financial development and inequality in China's rural and urban areas. The empirical results confirm a negative and linear relationship between financial development and inequality in both rural and urban areas but present a weak support for the inverted U-shaped relationship. However, Banerjee and Newman (1993) and Galor and Zeira (1993) suggest a linear relationship between financial development and income inequality. Their basic theoretical assumption is that financial market imperfections such as financial information asymmetries, transactions cost, and contract enforcement costs, may be especially binding on the poor, who lack collateral, credit track record and network relationships. As such, even when the poor may have projects with high return, they may still be credit rationed. This reduces the efficiency of capital allocation and limits the social mobility of the poor. Under such circumstances, income inequality rises with the development of financial markets. Furthermore, the relationship between financial development and reduction in income inequality is both a positive and a causal one, and this causality may run both ways. For example, as the share of the income held by the poor grows, they may increase their demands for financial services, which may drive the positive association between finance and growth. On the other hand, by increasing growth, finance may contribute to increasing the incomes of the poor.

The literature is replete with studies that posit that a well-functioning financial system has the potential to foster the accumulation of physical capital, improve economic efficiency and thus promote long term growth, (Christopoulos and Tsionas, 2004; Demetrides and Andrinova, 2004; Levine 2003; Minier, 2003; and Bekaert et al 2001; Levine et al. 2000;). The 'trickle down' theory of development economics is one of the main theoretical constructs used in understanding the linkage between finance and poverty reduction. This theory holds that as the financial sector develops, the benefits trickle down to the poor even as the economy expands. It has been asserted that the poor saves relatively more of their income. (Todaro and Smith, 2011). This brings to bare the important role the financial sector can play in mobilizing savings from the surplus economic units to the deficit units. Jalilian and Kirpatrick (2007) and Odhiambo (2010a/b) find that financial deepening through improvement in intermediating efficiency lowers cost and improves access to credit by the poor. This access to funds will increase productivity as the number of people without access to bank declines, thereby boosting economic growth. However, not all the deficit economic units have easy access to these funds, (Adewuyi and Olowookere, 2011). Sowa (2002) opines that financial reforms can lead to poverty reduction if growth is engendered in the economy, and that financial reform can directly lead to poverty reduction if it causes restructuring of the financial system in a way that makes credit available to the poor, thereby improving their welfare. Still on the impact of financial development on reducing inequality, Bakwena and Bodman (2008) argue that a deepened financial system positively affects poverty reduction, while Juzhong Zhuang et al (2009) note that financial system through its positive impact on growth, indirectly contributes to poverty reduction. This is because an effective financial system ensures that scarce capital is channeled to its best alternative use. Tressel and Detragiache (2008), are of the view that financial reforms have led to financial deepening, and more efficient allocation of investments. For instance, Cetorelli and Strahan (2006) find that the removal of inter-state branching restrictions in the United States in the 1980s led to improvement in small-sized tirms' access to funds.

However, the development of financial markets has an impact on the distribution of income, and the direction of that impact is far from settled in the literature. Some argue that the development of financial markets has a positive impact on income distribution because more developed and freer markets widen the availability of credit, thus allowing the poor to invest in building their human and physical capital. Therefore, the poor are presented with an opportunity to invest in their skills and those of their children and also set up new small businesses (Banerjee and Newman, 1993). Consequently, by widening the financial

opportunities available to the poor, financial markets have the effect of reducing the skewness in the distribution of income.

Regarding the finance-growth nexus, Obamuiyi and Lorunfemi (2011); Akinlo and Egbetunde (2010); Jalil, Wahid and Shahbaz (2010); Obstfeld (2009); Ngugi and Njenga (2009); Rioja and Valev (2004); Khan and Senhadji (2003); Benhabib and Spiegel (2000); Odedokun (1996); and Mwinde and Eng (1994); opine that financial development is concomitant with economic growth, such that a growing financial sector of an economy open to trade cannot be insulated from cross-border financial flows for long. For instance, Akinlo and Egbetunde (2010) employ vector error correction modeling on data for 1980 to 2005 for ten sub-Saharan African countries, and find that a long-run relationship exists between financial development and economic growth. Rioja and Valev (2004) examine the channels through which financial development influence economic growth in a panel of 74 countries between 1961 and 1995. They find that in more developed countries, financial development has a strong positive effect on productivity and hence growth; but in less developed countries, the effect is mainly through capital accumulation. This finding was also corroborated by Jahil, Wahid, and Shahbaz (2010).

Some studies have also demonstrated that financial intermediaries improve economic development by shifting capital to entrepreneurs, mobilizing savings, managing risk, and facilitating transactions. Finance plays a prominent role in the endogenous growth theory, through its positive impact on the levels of capital accumulation and savings (Romer 1986) and technological innovation (Romer 1990; Grossman and Helpman, 1991; and Aghion and Howitt, 1992). Also, Levine (2005) maintains that financial systems influence growth by easing information and transaction costs and thereby improving the acquisition of information about firms. Clarke, Xu and Zou (2003) results suggest that the growth-spurring effects of financial intermediary development are likely to be associated with positive effects on aggregate income distribution as well. The dampening effect of financial intermediaries on income inequality, however, appears to depend upon the economic structure of the economy. (Kuznet, 1955). The study by Oyaromade (2005) suggests that financial liberalization deepens the financial intermediation function, such that savings respond positively to changes in financial variables, while Greenwood and Jovanovic (1990) argue that financial intermediaries accelerate growth by improving information on firms and by providing efficient capital allocation.

Financial liberalization according to Mckinnon (1973) and Shaw (1973) eliminates the negative effects of financial repression on economic growth. A liberalized financial system with efficient intermediation process increases the size of domestic savings, and enhances monetary policy effectiveness. But Atiyas (1989) find no positive effect of financial system deregulation on economic growth, rather, the countries he studied (Chile, Argentina, Uruguay and Turkey) performed better during periods of regulatory controls.

However, Guiso, Sapienza and Zingales (2006) opine that though financial deregulation leads to improved access to credit and lowers interest rate spread, it could lead to non-performing loans. On the other hand, financial repression results in inefficient allocation of capital, high costs of financial intermediation, and lower rates of return to savers. Low interest rate discourages savings and financial intermediation. Although, this may facilitate government borrowings, it would result in credit rationing by the banking system which can adversely affect investment and hence retard growth. In addition, the low and negative real interest rate could culminate in macroeconomic instability. This is because it diverts funds away from the banking sector and this reduces available credit for investment and hence limits growth. Therefore, financial repression creates severe inefficiencies that restricts financial intermediation, increases the spread between deposit and lending rates, and reduces saving and investment in an economy. (Mwega, Mwangi, and Ngola, 1990; Roubini and Sala-Martin, 1991; Hussain, Mohammed and Kameir, 2002; Agenor, 2004).

In determining the link between financial development and income inequality, Jauch and Watzka (2012) explore theoretical models and predict that better developed financial markets lead to decreasing levels of income inequality regarding labour and entrepreneurial income. They, however, conclude that a positive relationship exist between financial development and income inequality within countries. According to them, better-developed financial markets lead to higher gross income inequality. The positive relationship is highly significant but is only of a small magnitude. An increase in the provision of credit by ten percent according to them, leads to an increase in the Gini coefficient by 0.23 for the within estimation.

But Kuznets (1955) is of the view that economic growth may increase income inequality at the early stage of development, but reduces it at the mature stage of industrialization. This notwithstanding, a liberalized financial sector promotes economic growth, and there is a growing consensus among researchers that economic growth can reduce inequality and lead to poverty reduction. This view is also held by Banerjee and Newman (1993), Galor and Zeira (1993), who predict

that better developed financial markets lead to a reduction in income inequality. They were also able to reveal that financial market imperfections can perpetuate the initial distribution of wealth in the presence of indivisible investments suggesting a negative relationship between the two. But Greenwood and Jovanovic (1990) envisage an inverted-U-shaped relationship between financial development and income inequality. In other words, in the early stages of financial development, during which only a small part of society benefits from this development, income inequality increases. They, however, conclude that after a certain stage of financial and economic development is reached, further financial development will diminish income inequality. This is because financial development brings with it better credit availability which allows household choices and decisions to be made based more on economic optimality and less on inherited wealth. (Banerjee and Newman, 1993; Galor and Zeira, 1993; Greenwood and Jovanovic, 1990). In their study, Greenwood and Jovanovic, (1990) find that initially, with financial development, financial intermediaries generally improve household capital incomes which however, come at a small fixed cost. Hence, poor households cannot afford using banks for their savings, and this increases inequality, because only wealthy-born households are able to use bank finance. However, as the economy develops and grows over time, poorer households become richer and can also begin using bank finance. Therefore, inequality after some point decreases with financial and economic development. However, others point out that since the poor do not have equal access to credit due to lack of collateral and connections, financial markets development may actually exacerbate income inequality. As such the financial reforms undertaken by many African countries to deepen and develop their financial markets may be correlated with a persistent increase in inequality. This is because those who are relatively well-off are better equipped to exploit the new financial opportunities that the liberalization of financial market entails, (Batuo, Guidi and Mlambo, 2011).

The impact of financial liberalization on investment was also examined. It was found that real interest rate affects money supply positively and impacts on the quantum of private investment and its efficiency, (Fowowe, 2011; Laumas, 1990; Gelb, 1989; De Melo and Tybout, 1986). The conclusion is that financial development leads to an upward shift in investment and that investment is positively related to interest rates, especially in the post reform era.

The link between financial development and institutions was investigated by Chinn and Ito (2002) with the use of panel data analysis for period 1977 - 1997. They find that financial development, captured by private credit and stock market activities and capital controls, are correlated when institutions and the

legal system are well developed. Also, Tressel and Detragiache (2008) in their cross-country study over 1973 – 2005 periods support the view that the banking sector reforms led to financial deepening, but cautioned that it was only in countries with institutions that place checks and balances on political power. In his own part, Aryeetey (2003) opine that financial liberalization of the financial sector may cause aggregate growth to decline, amidst presence of institutional and structural bottlenecks, such that the desired economic growth will not be achieved.

Stiglitz (1994) asserts that a positive relationship exist between financial repression and economic growth. The argument is that financial liberalization has led to many banking crises and output volatility. (Demirgue-Kunt and Detragiache, 1999; Stiglitz, 2000; Kaminsky and Schmukler, 2003). Financial repression refers to the notion that a set of government regulations, laws, and other non-market restrictions prevent the financial intermediaries of an economy from functioning at their full capacity. Interest rate ceilings, liquidity ratio requirements, high bank reserve requirements, capital controls, restrictions on market entry into the financial sector, credit ceilings/restrictions or directions of credit allocation, and government ownership of banks are some of the policies which cause financial repression. Also, La Porta et al (2002) suggest that higher degree of government ownership of banks is associated with lower levels of banking development, and slower pace of growth in real activity. These repressive policies lead to low level of credit facilities and subsequently affect the efficiency of capital allocation, with an overriding negative effect on economic performance.

However, the Neo-structuralist Schools of thought (Keynes-Tobin-Stiglitz) see some repressive policies like directed credit scheme and low real interest rate as promoting investment and hence, helping to stimulate economic activities. But the financial liberalization School of thought (Goldsmith-Mckinnon-Shaw) is of the view that policies aimed at maintaining a positive real interest rate in the economy would encourage savings mobilization for productive activities which would guarantee long-run economic development. This School of thought also believes that a low or negative real interest rate would shore up government borrowings, which could crowd out private credit. To corroborate this view, Mckinnon (1973) and Shaw (1973) posit that interest rates administratively held at low levels would affect savings adversely, distort investments and retard economic growth. But Tobin (1965) is of the view that high interest rates due to financial liberalization would put prices on a higher trajectory through cost-push effect, thereby reducing supply of real credit for investment in the short-run, and hence systematically reducing economic growth rate. Thus far, empirical studies

exploring the linkage between financial reforms and financial development remain inconclusive.

3.0 THEORETICAL FRAMEWORK AND METHODOLOGY

3.1 Theoretical Framework

Greenwood and Jovanovic (1990) present a theoretical model in which financial development fosters economic development, which, in turn, facilitates necessary investment in financial infrastructure. The model predicts an inverted U-shaped relationship between income inequality and financial sector development, with income inequality first increasing and then decreasing – before eventually stabilizing – as more people join financial coalitions. Owing to capital market imperfections, only rich economic agents can borrow enough to run these indivisible, higher-return technologies. Once again, the initial distribution of wealth has long-run effects on income distribution and growth. Holding all else equal, these models suggest that countries with larger capital market imperfections (i.e. higher hurdles to borrow funds to finance indivisible investment) should have higher income inequality. Consequently, one should observe a positive relationship between financial development and income inequality (the linear hypothesis). Clarke et al (2003)

Financial sector development might affect income inequality if agents require access to finance in order to migrate to the modern sector. Since, as suggested by Kuznets (1955), income inequality is likely to be higher in the modern sector (industry and services), and if entry into this sector is made easier when it is easier to gain access to finance, inequality will be greater in economies with larger modern sectors. In particular, a positive interaction is expected between financial depth and the modern sector (as characterized by industry and service sectors). In other words, in the early stages of development, an economy's financial markets are virtually nonexistent and it grows slowly. Financial superstructure begins to form as the economy approaches the intermediate stage of the growth cycle. Here the economy's growth and savings rates increase, and the distribution of income across the rich and poor widens. By maturity, the economy has developed an extensive structure for financial intermediation. In the final stage of development the distribution of income across economic agents stabilizes, the savings rate falls, and the economy's growth rate converges (although perhaps non-monotonically) to a higher level than that prevailing during its infancy. (Greenwood et al, 1990).

Financial development, captured by the share of domestic credit to the private sector in GDP and domestic bank credit-GDP ratio is expected to be positively related to poverty reduction and economic growth, while low real interest rates support investment and hence, help to stimulate economic activities. But on the other hand, the financial liberalization school of thought (Goldsmith-Mckinnon-Shaw) is of the view that policies aimed at maintaining a positive real interest rate in the economy would encourage savings mobilization for productive activities which would guarantee long-run economic development.

3.2 ***The Model***

To investigate the relationship between financial development, income inequality and economic growth in ECOWAS countries, a 2-equation simultaneous equation model is specified and estimated using panel data for the 15 ECOWAS member countries during a 12-year period. In the first equation, economic growth, proxied by per capita real income, is specified to depend on financial development, income inequality, and other determinants of economic growth such as domestic investment, exports and the exchange rate. In the second equation, income inequality is hypothesized to depend on real per capita income, financial development, the share of modern sector in GDP, government expenditure and the quality of human capital.

Following Clarke et al. (2003), Galor and Zeira (1993) and Banerjee and Newman (1993), it is expected that financial development would have a positive impact on income inequality measured by Gini coefficient. Some control variables are included in the econometric estimation. These include: real per capita GDP, which is taken as a proxy for the stage development of a given economic system or the economic growth. According to Kuznets (1955), the relationship between inequality and economic development follows an inverted U-pattern with inequality rising at the initial stage of development and then falling at the later phases. Secondary school enrolment rate is used as a proxy of human capital development. An increase in education implies an increase in the supply of skilled labour, a decrease in the relative skilled/unskilled wage and an overall decrease in income inequality. However, a steady increase in the supply of skilled labour may also keep the relative skilled/unskilled wages constant in the presence of skill biased technological change. Therefore it is important to include a proxy for the educational level in the estimation equation. Other standard control variables are the rate of inflation, exchange rate, as proxies for macroeconomics policies; share of total government expenditure, and the sum of the added value of manufacture and service sectors as share of GDP as a proxy for the development of the modern sector. This last variable follows from the work of Kuznets (1955) who argued that income inequality depends on the sectoral structure of an economy.

Accordingly, an econometric model is specified where it is hypothesized that economic growth depends on financial development (alternatively measured by 3 variables, namely, the ratio of broad money to GDP, domestic credit to the private sector as a percentage of GDP, and the ratio of bank credit to GDP), the investment-income ratio, the real exchange rate, the ratio of exports to GDP, and an income inequality index (measured by the GINI coefficient). Thus,

RY = f(M2YR, DCYR, BKYR, INVYR, EXRT, XPYR, GINI) ..... (1)
Where:

RY = real gross domestic product (GDP) per capita
M2YR = broad money stock as % of GDP (a measure of financial development)
DCYR = domestic credit to private sector as % of GDP (a measure of financial development)
BKYR = bank credit as a % of GDP (a measure of financial development)

INVYR = aggregate real investment as a % of real GDP
EXRT = exchange rate
XPYR = ratio of export receipts to GDP
GINI = Gini index (a measure of income inequality)

Note: the first three explanatory variables (M2YR, DCYR and BKYR) are measures of financial development; the next three (INVYR, EXRT, and XPYR) are "control" variables; while the last variable (GINI) is a measure of income inequality. The GINI coefficient of inequality is the most commonly used measure of inequality. The coefficient varies between 0, which reflects complete equality and 1, which indicates complete inequality. Thus, the higher the GINI coefficient is, the greater the degree of income inequality within a country.

From *a priori* reasoning, the ratio of broad money supply to GDP, domestic credit to private sector, bank credit as a ratio of GDP, (measures of financial development) are expected to be positively related to economic growth. Similarly, the coefficients of domestic investment, export earnings, and income inequality, proxied by Gini coefficient, are expected to be positively related to economic growth, while the sign of the coefficient of exchange rate is expected to be negative, implying a negative relationship with economic growth.

These apriori sign expectations come from economic theory. An expansion in money supply tends to boost demand for goods and services, raise productivity and spur growth. Therefore, a positive relationship exists between money supply and economic growth. Again, increase in domestic credit will snowball into higher

productivity and redound to economic growth. The higher the level of domestic investment is, the more rapid will be the rate of economic growth since investment increases the capital stock and boosts aggregate demand. Also, more export earnings will enhance economic growth through increased income and output. Income inequality is expected to have a positive relationship with economic growth at the initial and intermediate stages of economic development. It is at the final stage of economic development or the maturity stage that income inequality tends to decline.

According to Greenwood et al, 1990, and following Kuznets (1955), income inequality is likely to be higher in the modern sector. This is because in the early stages of development, an economy's financial markets are underdeveloped, but as the economy approaches the intermediate stage of the growth cycle, the financial superstructure begins to form. Here the economy's growth and savings rates both increase, and the distribution of income across the rich and poor widens. By maturity, the economy has developed an extensive structure for financial intermediation. In the final stage of development the distribution of income across economic agents stabilizes, the savings rate falls, and the economy's growth rate converges (although perhaps non-monotonically) to a higher level than that prevailing during its infancy. Hence, financial development has not only been considered as pro-growth, but also pro-poor because of its effects on income inequality. However, Luisa Blanco Raynal (2007) opines that financial development decreases inequality by increasing the income of the poor. In this case, a negative relationship is expected to exist between financial development and income inequality. In other words, a more developed financial system will enhance the access of the poor to capital, all other things being equal, and raise their income. This will lessen the inequality in income. But in the presence of financial market imperfections, income inequality may widen.
Accordingly, we hypothesize that:

GINI = g(RY, DCYR, BKYR, MODERN, GYR, HK)…….. (2)

Where:

MODERN = ratio of value added in manufacturing and service sectors to GDP
GYR = ratio of government expenditure to GDP
HK = human capital
and other variables are as already defined.

From *a priori* theoretical consideration, real GDP per capita, a proxy for economic growth, domestic credit to the private sector, and bank credit to GDP ratio

(measures of financial development), the quality of human capital development, increased government expenditure, and the modern sector (measured by the sum of the value added of the manufacturing and services to GDP ratio) are expected to be positively related to income inequality. The financial sector in the ECOWAS sub-region is developing and shrouded in imperfections. This reflects the difficulty households and corporations experience in their bid to obtain credit. In other words, financial sector imperfections limit access to credit by private individuals. Therefore, the more the private sector, especially the poor are unable to access credit, the wider will be the gap in income inequality. An increase in human capital development (education) implies an increase in the supply of skilled labour, a fall in income inequality. However, a continuous increase in the supply of skilled labour may also keep the relative wages constant in the presence of skill biased technological change. A positive sign of the coefficient of human capital indicates that human capital development creates a larger gap in income distribution, suggesting that the more educated one is, the bigger the distributional impact. Also, a positive sign of the coefficient of the modern sector indicates that countries with small sized modern sector – a characteristic of most ECOWAS countries – tend to have higher income inequality. Hence, a positive relationship exists between these variables and income inequality. Both higher per capita real income and financial development are therefore positively associated with the income inequality. According to the inverted U-shape hypothesis, financial development should be significant and positive. Also, the real GDP per capita is expected to be positive and significant. Using the augmented Kuznets hypothesis: sector structure will affect how financial development impacts inequality. In particular, a positive relationship is expected between financial development and the importance of the modern sector (as measured by manufacturing and service sectors value added).

3.3 *A simultaneous equations model of growth and income inequality*

In order to accurately investigate the relationship between economic growth, financial development, and income inequality in ECOWAS countries, a 2-equation simultaneous equation model has been specified and will be estimated using 3 alternative econometric techniques, viz., 2-Stage Least Squares employing pooled data; 2-Stage Least Squares utilizing the Fixed Effects Model; and Dynamic Panel Data Model. Taking the logarithms of the variables and linearizing equations (1) and (2), gives a double log specification. One of the advantages of using double logarithms is that the coefficients obtained can be interpreted as elasticities. The simultaneous equations model can now be formally written as:

$$LRY_t = a_0 + a_1LM2YR_t + a_2LDCYR_t + a_3LBKYR_t + a_4LINVYR_t + a_5LEXRT_t + a_6LXPYR_t + a_7GINI_t + \mu_t + \ldots \quad (3)$$

$$Gini_t = \beta_0 + \beta_1LRY_t + \beta_2LBCYR_t + \beta_3LBKYR_t + \beta_4LMODERN_t + \beta_5LGYR_t + \beta_6LHK_t + \varepsilon_t \ldots \quad (4)$$

Where:

'*L*' stands for natural logarithms. The terms μ_t and ε_t are stochastic error terms.

3.3 ***Econometric Methodology***

This system of simultaneous equations has 2 endogenous variables, namely, RY and GINI, while there are 9 predetermined variables, viz., M2YR, DCYR, BKYR, INVYR, EXRT, MODERN, GYR, XPYR, and HK. Note that the 2 structural equations are identified. They both satisfy the ORDER condition (the necessary condition) of identification. In this context, it may be pointed out that using the ORDER condition of identification, each equation is over-identified. The two structural equations also satisfy the RANK condition (the necessary and sufficient condition) of identification. The equations can therefore be estimated by two-stage least squares (2SLS) estimator. Greene (2003), Iyoha (2004), and Wooldridge (2010) show that the 2SLS estimator yields estimated coefficients that are consistent, asymptotically normal and asymptotically efficient, Greene (2003, pp. 398-400 & 405-407), Iyoha (2004, pp. 118-119) and Wooldridge (2010, pp 191-192 & pp 194-195). However, for completeness, since the study involves the use of panel data, the structural coefficients of the model are also estimated by utilizing the Fixed Effects model and the dynamic panel model. The results for these 2 additional techniques are reported in the Appendix.

3.5 ***Sources of Data***

This paper uses annual data for 15 ECOWAS countries covering the period 2001 through 2012, and was obtained from the *World Bank database* also published in *World Development Indicators* (WDI, World Bank), 2013. The data for GINI (a measure of inequality) was sourced from the *UNU-WIDER World Inequality Database*, 2014 and *Human Development Indicators,* 2013.

4.0 ANALYSIS OF RESULTS

The Two Stage Least Squares (2SLS) estimation technique was employed to estimate the model. The variables were estimated in log form, hence the "L" before the variables. Recall that the 2SLS estimator is a generalized instrumental

variable technique where all the predetermined variables are used as instruments during the first stage. This guarantees that the estimated coefficients possess the desirable properties of consistency and asymptotic efficiency. The coefficient estimates were calculated using the GRETL software. Note that 3 stars (***), 2 stars (**), and 1 star (*) indicate that a regression coefficient is significantly different from zero at the 1% level, 5% level, and 10% level respectively. The total absence of stars indicates that the regression coefficient is not significantly different from zero even at the 10% level. Recall that all the variables in the regression equations are in logarithms; hence, the estimated regression coefficients should therefore be read off as elasticities.

4.1 ***Two-stage Least Squares Econometric Results and Interpretation***

We now present the 2SLS econometric estimates of the equations of the model (using pooled data) and their economic interpretation.

4.2 ***Equation explaining per capita real income***

Two Stage Least Squares, using 167 observations
Dependent variable: LRY
Instrumented: LGINI

	Coefficient	*Std. Error*	*Z*	*p-value*	
Const	-5.82627	3.82615	-1.5228	0.12782	
LM2YR	-0.305988	0.173968	-1.7589	0.07860	*
LDCYR	0.265555	0.0738509	3.5958	0.00032	***
LBKYR	-0.0782369	0.054177	-1.4441	0.14871	
LINVYR	-0.0149276	0.0990713	-0.1507	0.88023	
LEXRT	-0.0287658	0.0269222	-1.0685	0.28530	
LXPYR	0.367634	0.098463	3.7337	0.00019	***
LGINI	3.20971	1.09837	2.9222	0.00348	***

Mean dependent variable	6.419713	S.D. dependent variable	0.516483
Sum squared residual	34.47249	S.E. of regression	0.465627
R-squared	0.331576	Adjusted R-squared	0.302148
F(7, 159)	15.03003	P-value(F)	5.49e-15

Hausman test -
Null hypothesis: OLS estimates are consistent
Asymptotic test statistic: Chi-square(1) = 12.0788
with p-value = 0.000509991

The overall fit is respectable with an R^2 of over 33 percent, indicating that at least one-third of the systematic variations in per capita real income have been

explained by the regressors in the equation. This level of fit is quite acceptable since the study uses panel data. The F-statistic of 15.0 is highly significant, easily passing the significance test at the 1 per cent confidence level. Consequently, the hypothesis of a log-linear relationship between per capita real income and the regressors in the equation cannot be rejected at the 1 percent level of significance. The coefficients of DCYR, XPYR and GINI were found to be very significant in the determination of economic growth in the ECOWAS countries. They all pass the statistical significance test at the 1 percent confidence level. DCYR, the ratio of domestic credit to GDP has a positive sign and is highly significant, indicating that financial development is positively associated with economic growth. Thus, the higher the level of financial development of a country, the greater will be its rate of economic growth. Similarly, in the dynamic panel model estimated, the share of bank credit in GDP and the share of export earnings in GDP were highly significant in explaining economic growth in ECOWAS countries during the period of study. See Appendix 3 for details. The high significance of the DCYR variable is also confirmed in the Fixed Effects model in Appendix 1. The coefficient of this variable reports an elasticity of 0.27, meaning that a 10 percent increase in the level of financial development would boost economic growth by approximately 3 percent. The coefficient of exports is positive and highly significant demonstrating that exports drive economic growth. With a coefficient of 0.37, we may conclude that a 10 percent increase in exports will result in approximately 4 percent rise in the rate of economic growth. The coefficient of the Gini index is positive and significant, indicating that higher levels of income inequality are associated with more rapid economic growth in ECOWAS countries. These results are consistent with the findings of Batuo et al (2011), Banerjee et al (19930 and Galor et al (1993). M2YR, an alternative measure of financial development reports a negative sign but then it only passes the significance test at the 10% confidence level. All the other variables report coefficients that are not significantly different from zero.

4.3 ***Equation explaining income inequality (GINI)***

Two Stage Least Squares, using 167 observations
Dependent variable: LGINI
Instrumented: LRY

	Coefficient	*Std. Error*	*Z*	*p-value*	
Const	2.30593	0.197671	11.6655	<0.00001	***
LDCYR	-0.0299989	0.0160446	-1.8697	0.06152	*
LDKYR	0.0346638	0.0107596	3.2217	0.00127	***
LMODERN	0.0944394	0.0281303	3.3572	0.00079	***
LGYR	0.0519135	0.0257258	2.0180	0.04360	**
LHK	0.0150108	0.0182351	0.8232	0.41041	
LRY	0.124343	0.0333477	3.7287	0.00019	***

Mean dependent variable	3.683275	S.D. dependent variable	0.117002
Sum squared residual	1.699268	S.E. of regression	0.103055
R-squared	0.288166	Adjusted R-squared	0.261472
F(6, 160)	13.70384	P-value(F)	1.57e-12

Hausman test -
Null hypothesis: OLS estimates are consistent
Asymptotic test statistic: Chi-square(1) = 11.1932
with p-value = 0.000820976

The overall fit of this equation is fairly good with an R^2 of about 29 percent, indicating that approximately 29 percent of the systematic variations in the Gini index are explained by the regressors used. The F-value of 13.7 easily passes the significance test at the 1 percent confidence level. Thus, the hypothesis of a significant log linear relationship between the GINI index and the regressors in the equation cannot be rejected at the 1 percent confidence level. The coefficients of real GDP per capita (RY), the ratio of bank credit to GDP (BKYR) and the share of modern sector in GDP (MODERN) are positive and highly significant. They all pass the significance test at the 1 percent confidence level. The positive sign exhibited by RY indicates that higher levels of per capita income are associated with greater income inequality. The positive sign reported by MODERN means that a higher share of modern sector value added in GDP is associated with greater income inequality. This result is also consistent with that of Kuznet (1955). Finally, the positive sign of BKYR, the share of bank credit in GDP, shows that greater degree of financial development is associated with higher income inequality. These results are also confirmed in both the Fixed Effects model and the dynamic panel model estimations in Appendices 2 and 4. GYR, the ratio of government expenditure in GDP has a positive sign and is significantly different from zero at

the 5% confidence level. Finally, DCYR, another measure of financial development has a negative sign but only passes the significance test at the 10% confidence level. The coefficient of human capital is positively signed but not significantly different from zero even at the 10% confidence level.

The results of the statistical test for differing group (country) intercepts as reported in the Fixed Effects model in Appendices 1 and 2 validate the rejection of the null hypothesis of a common intercept for all the countries in the sample, as the F-statistics easily passes the significance test at the 1 percent confidence level.

Note: The value of the constant term reported in Appendices 1 and 2, namely, 0.935, and 3.808 for the growth and Gini equations respectively, are the averages for all 15 ECOWAS countries. The individual or country-specific constant terms are reported below for each equation. For the growth equation (RY), values of the intercept range between 0.256 (for Guinea) and 1.911 (for Ghana). Thus, the autonomous level of per capita real income is highest in Ghana and lowest in Guinea. Other countries lie in between these values, with Cote d'Ivoire also reporting high levels of autonomous per capita real income during the period, 2001-2012. For the Gini equation, the constant term can be seen to range from 3.612 (Togo) and 4.034 (Cape Verde). Therefore, the level of inequality in Cape Verde is the highest and Togo has the lowest value. (See Table 1 below for details).

Table 1: <u>Estimated Country-Specific Intercepts:</u>

Country Name	**Country Intercepts**	
	RY	**GINI**
1. Benin	0.650	3.749
2. Burkina Faso	0.756	3.827
3. Cape Verde	1.038	4.034
4. Cote d'Ivoire	1.816	3.927
5. Gambia	0.542	3.889
6. Ghana	1.911	3.936
7. Guinea	0.256	3.732
8. Guinea Bissau	1.232	3.722
9. Liberia	1.574	3.801
10. Mali	0.667	3.649
11. Niger	0.534	3.689
12. Nigeria	1.109	4.028
13. Senegal	0.954	3.803
14. Sierra Leone	0.487	3.721
15. Togo	o.496	3.612

5.0 SUMMARY AND CONCLUSION

This paper has investigated the degree of inter-relationship between financial development and income inequality and between inequality and economic growth in ECOWAS countries using data for 2001 through 2012 for 15 ECOWAS member countries. To achieve these objectives, a 2-equation simultaneous equation model was specified and estimated using the two stage least squares (2SLS) estimator. This estimator yields consistent and asymptotically efficient estimates of structural parameters. Also, for the econometric estimation, a fixed effect model was estimated because it takes cognizance of cross-country heterogeneity, allowing for different country-specific constant terms.

Therefore, a major contribution of the paper to the literature on financial development, inequality and growth in ECOWAS countries is the use of simultaneous equations modeling with fixed effects model estimation technique and the dynamic panel data model estimator. In addition, the paper pioneers in its consideration of ECOWAS countries as a group in contradistinction to previous studies which focused on individual countries and other regions of the world.

From the empirical findings, financial development measured by the ratio of domestic credit to GDP is positively and significantly associated with economic growth. However, the ratio of broad money stock to GDP, an alternative measure of financial development, is negatively related to economic growth. The coefficient of exports is positive and highly significant demonstrating that exports drive economic growth in the ECOWAS sub-region. The coefficient of the Gini index is positive and significant; indicating that more rapid economic growth in ECOWAS countries is associated with higher levels of income inequality. The real GDP per capita, ratio of bank credit to GDP and the share of modern sector in GDP are positively and significantly associated with greater income inequality. This result is consistent with the inverted U-shaped relationship between income inequality and the financial sector development of Kuznet (1955), Greenwood and Jovanovic (1990) and also the linear relationship between financial development and income inequality of Batuo et al (2011). At the early stages of development, an economy's financial markets tend to grow slowly. As the economy approaches the intermediate stage of the growth process, the distribution of income across the rich and the poor widens, due to capital markets imperfections which makes it extremely difficult for the poor to borrow funds to finance indivisible investment. With ECOWAS countries still at the intermediate stage of development, the financial system is shallow and access to credit is restricted, thus, the income inequality tends to increase. In addition, income inequality is higher in the modern sector since only few people initially benefit from the higher income possibilities in the modern sector, and the fact that most

countries in the ECOWAS sub-region are characterized by small sized modern sector. The ratio of government expenditure in GDP was found to be positively related to income inequality.

A vital policy implication of this study is that the countries in the ECOWAS sub-region should target financial development towards the poor to reduce income inequality by implementing policies that will widen the access to financial markets, especially by the poor in the ECOWAS sub-region. Financial sector policy reforms should focus on better access to financial services by the poor to enable them engage in productive investments in small and medium enterprises and also invest in education of their children. To this end, special finance institutions like microfinance banks, cooperative banks should be established to carter to the poor.

References

Acmoglu, D., P. Aghion, C. Lelarge, J. Van Reenen, and F. Zilibotti. (2007). "Technology, Information, and the Decentralization of the Firm", *The Quarterly Journal of Economics*, MIT Press, Vol. 122(4), pp. 1759-1799, November.

Adewuyi, I. D. and J. K. Olowookere. (2011), "The contributions of capital market to economic development in Nigeria", *International Journal of Economic Development Research and Investment*, Vol. 2 No. 1; April

Agenor, P. (2004), *The Economics of Adjustment and Growth, 2nd ed*. Cambridge, Massachusetts: Harvard University Press.

Aghion, Philippe and Peter Howitt, (1998), *Endogenous Economic Growth*. MIT Press,
Cambridge, MA.

Akinlo, E. A. and T. Egbetunde. (2010), "Financial Development and Economic Growth: The Experience of 10 sub-Saharan African Countries Revisited", *The Review of Finance and Banking*, Vol. 2, Issue 1, pp. 17-28.

Aryeetey, Ernest. (2003), "Recent Developments in African Financial Markets: Agenda for Further Research", *Journal of African Economies*, Vol. 12, AERC Supplement 2, pp. 111-152.

Atyas, I. (1998), "The Private Sectors response to Financial Liberalization in Turkey: 1980-1992", *World Bank PPR Working Papers,* No. 147.

Bagehot, W. (1873), "*Lombard Street*: A Description of the Money Market", *http://oll.libertyfund.org/titles/128,* H.S. King, London.

Bakwena and Bodman. (2008), "The role of Financial Development in Natural Resource abundant Economies: Does the nature of the resource matter?"*Macroeconomic Research Group Discussion Papers, 22.*

Banerjee, A. V. and A. F. Newman. (1993), "Occupational Choice and the Process of Development", Journal of Political Economy 101(2): 274-298.

Batuo, M.E., Guidi, F., and Mlambo, K. (2011), "Financial Development and Income Inequality: Evidence from African Countries", http://www.afdb.org/fileadmin/uploads/afdb/Documents/Knowledge/SessionII.2.3_1.FinancialDevelopmentandIncomeInequality.pdf

Beck, T. (2010), "Finance and Oil: Is there a Resource curse in Financial Development"?, *European Banking Centre Discussion Paper* No. 2011-004.

Beck T., Demirgüç-Kunt, A., and R. Levine (2004), "Finance, Inequality and Poverty: Cross-Country Evidence," *World Bank Policy Research Working Paper, 3338,* World Bank, Washington D.C.

Bekaert, G. C., R. Harvey, and C. Lundblad. (2005), "Does financial liberalization spur growth?" *Journal of Financial Economics*, 77(1):3–55.

Benhabib, J. and M. M. Spiegel. (2000), "The role of Financial Development in Growth and Investment", *Journal of Economic Growth,* 5: 341-360.

Bittencourt, M. (2006), "Financial Development and Inequality: Brazil 1985-99", *Economic Discussion Papers* 06/582, University of Bristol.

Bulíř, Aleš. (1998), "Business cycle in Czechoslovakia under central planning: were credit shocks causing it?", *Journal of Comparative Economics*, 26, 226–245, Article No. JE981518

Cetorelli, N. and P. E. Strahan. (2006), "Finance as a barrier to entry: Bank competition and Industry structure in Local U.S. Markets", *Journal of Finance,* Vol. 61, No. 1, pp. 437-461.

Chinn, M. D. and H. Ito. (2002), "Capital Market Liberalization, Institutions and Financial Development: Cross Country Evidence", *NBER Working Paper,* No. 8947.

Chirstopoulos D. K. and E. G. Tsionas, (2004), "Financial Development and Economic Growth: Evidence from Panel Unit Root and Cointegeration Tests", *Journal of Development Economics*, vol. 73, 55-74.

Clarke, George, Xu Lixin Colin, and Heng-fu Zou. (2003), "Finance and Income Inequality: Test of Alternative Theories", *World Bank Policy Research Working Paper* 2984, March.

De Melo, J. and J. Tybout. (1986), "The Effects of Financial Liberalization on Savings and Investment in Uruguay", *Economic Development and Cultural Change,* 34 (April): 561-587.

Demirguc-Kunt, Asli. (2006), "Finance and Economic Development: Policies Choices for Developing Countries", *World Bank Policy Research Working Paper* No. 3955.

Demirguc-Kunt, A. and E. Detragiache. (1999), "Financial Liberalization and Financial Fragility", in Boris Pleskovic and Joseph E. Stiglitz (Eds.), *Annual World Bank Conference on Development Economics 1998,* (The World Bank, Washington, DC).

Ewah S.O.E, A.E. Essang, and J.U. Bassey. (2009), "Appraisal of capital market efficiency on economic growth in Nigeria", *International Journal of Business and Management*, 4(12), 219-225.

Fowowe, B. (2011), "Financial sector reforms and Private investment in sub-Saharan African Countries", *Journal of Economic Development 79,* Vol. 36, No. 3.

Galor, O. and J. Zeira. (1993), "Income Distribution and Macroeconomics", *Review of Economic Studies* 60 (1): 35-52.

Goldsmith, R. W. (1969), *Financial Structure and Development.* New Haven, CT: Yale University Press.

Greene, W.H. (2003), *Econometric Analysis, 5th ed.,* Prentice Hall: Upper Saddle River.

Greenwood, J. and B. Jovanovic. (1990), "Financial Development, Growth, and the Distribution of Income," *Journal of Political Economy* 98(5): 1076-1107.

Greenwood, J. and B. Smith. (1997), "Financial Market in Development and the Development of Financial Markets, *Journal of Economic Dynamics and Control.* 21, pp. 145-181.

Grossman, G. and E. Helpman. (1991), *Innovation and Growth in the Global Economy,* Cambridge: MIT Press, Chapters 1-5.

Guiso, L., P. Sapienza and L. Zingales. (2006), "The cost of Banking Regulation", *NBER Working* Paper, No. 12501.

Honohan, Patrick, (2004), "Financial Development, Growth, and Poverty: How Close are the Links?", *World Bank Policy Research Working Paper No. 3203*.

Hussain, N. H., N. Mohammed and E. M. Kamier. (2002), "Resource Mobilization, Financial Liberalization and Investment: The Case of some African Countries".

Iyoha, M. A. (2004), *Applied Econometrics.* Benin City: Mindex Publishing, Benin City.

Jalil, Abdul, Wahid, N. M. Abu and Muhammad Shahbaz. (2010), "Financial Development and Growth: A positive, monotonic relationship? Empirical evidence from South Africa", *MPRA Paper 27668.*

Jalilian, H. and C. Kirkpatrick. (2007), "Does Financial Development contribute to Poverty reduction?", *Journal of Development Studies,* 41(4): 636-656.

Jauch, S. and S. Watzka. (2012), "Financial Development and Income Inequality: A panel Data Approach", *CEIFO Working Paper,* No. 3687, Category 6: Fiscal Policy, Macroeconomics and Growth, October.

Juzhong Zuang et al. (2009), "Financial Sector Development, Economic Growth and Poverty Reduction: A literature Review", *ADB Economic Working Paper Series, No. 173*, October.

Kaminsky, G. and S. L. Schmukler. (2003), "Short-term pain, Long-run Gain: The effects of Financial Liberalization", *NBER Working Paper,* No. 9787.

Kargbo, M. S. and P. A. Adamu. (2010), 'Financial development and economic growth in Sierra Leone', *Journal of Monetary and Economic Integration*, 9(2): 30–61.

Khan, M. S. and A. S. Senhadji. (2003), "Financial Development and Economic Growth: A Review and New Evidence", *Journal of African Economics,* Vol. 12, AERC Supplement, pp. 89-110.

Kuznets, Simon, (1955), "Economic Growth and Income Inequality," *American Economic Review* 45 (1), 1-28.

La Porta, R., F. Lopez-de-Silanes, and A. Shleifer. (2002), "Government Ownership of Banks", *Journal of Finance,* Vol. 57, No. 1, pp. 265-301.

Laumas, P. S. (1990), "Monetization, Financial Liberalization, and Economic Development and Cultural Change", *University of Chicago Press,* vol. 38(2), pp 377-90, January.

Levine, R. (2005), *Finance and Growth: Theory and Evidence,* in Aghion, P. and S. N. Durlauf (Eds.), *Handbook of Economic Growth*, Vol. 1A, pp. 865-934, London: Elsevier.

Levine, Ross. (2003), "Stock Market Liquidity and Economic Growth: Theory and Evidence," in Luigi Paganetto and Edmund S. Phelps (eds), *Finance, Research, and Education, and Growth*, 1-24, New York: Palgrave MacMillan.

Levine, R., L. Norman, and B. Thorsten. (2000), "Financial intermediation and growth: Causality and causes", *Journal of Monetary Economics*, 46(1):31–77.

Li, H., L.Squire and H. Zou. (1998), "Explaining International and Intertemporal Variation in Income Inequality", *The Economic Journal*, 108(446): 26-43.

Liang, Zhicheng. (2006), "Financial development, growth and regional disparity in post-reform China", *Research Paper, UNU-WIDER*, United Nations University (UNU), No. 2006/90, ISBN 9291908703, Pp 4-17

Mbutu, M., R.W. Ngugi and G. Njenga. (2009), "Financial Sector Development and Economic Growth in Africa", *Africa Finance Journal, http://profiles.uonbi.ac.ke/rosengugi/publications*

Mckinnon, R. I. (1973), *Money and Capital in Economic Development,* Washington D.C., The Brookings Institute.

Minier, J. (2003), "Are small stock market different?", *Journal of Monetary Economics*, 50, 1593-1602.

Murinde, V. and F.S.H. Eng. (1994), "Financial Development and Economic Growth in Singapore: Demand-following and Supply-leading?", *Applied Financial Economics,* 4(6), 391-404.

Mwenga, F.M., S.M. Ngola and N. Mwangi. (1990), "Real interest rates and the mobilization of private savings in Africa", *AERC Research Paper 2, November.*

Obamuyi, T. M. and S. Olorunfemi. (2011), "Financial Reforms, Interest Rate Behaviour and Economic Growth in Nigeria", *Journal of Applied Finance and Banking,* Vol. 1, No. 4, pp. 39-55.

Obstfeld, M. (2009), "International Finance and Growth in Developing Countries: What have we Learned?", *IMF Staff Papers,* Vol. 56, Issue 1, pp. 63-111, April.

Odedokun, M. O. (1996), "Alternative Econometric approaches for analyzing the Role of the Financial Sector in Economic Growth: Time-series Evidence from LDCs", *Journal of Development Economics,* 50, 119-146.

Odhiambo, N. M. (2010a), "Are Banks and Stock Markets positively related? Empirical evidence from South Africa", *Journal of Applied Business Research,* 26(6): 17-26

Odhiambo, N. M. (2010b), "Financial Deepening and Poverty Reduction in Zambia: An Empirical Investigation", *International Journal of Social Economics,* 37(1): 41-53.

Onwioduokit, E.A. and P.A. Adamu. (2005), "Financial Liberalization in Nigeria: The Relative Impact on the Economy", Selected Papers for the *2005 Annual Conference Proceedings of the Nigerian Economic Society*. Lagos: NES.

Oyaromade, R. (2005), "Financial Sector Reforms and Financial Savings in Nigeria", *Selected Papers for the Nigerian Economic Society Conference*, pp. 427-448.

Raynal, Luisa Blanco. (2007), *Essays on Economic Development in Latin America,* ProQuest, The University of Oklahoma, Dept. of Economics.

Rioja, F. and N. Valev. (2004), "Finance and the Sources of Growth at various stages of Economic Development", *Economic Inquiry,* 42(1), 127-140.

Romer, P.M. (1990), Endogenous Technological Change", *Journal of Political Economy, Vol. 98, No. 5, October*

Romer, P.M. (1986), "Increasing Returns and Long run Growth", *Journal of Political Economy,* Vol. 94, No. 5, October

Roubini, N. and X. Sala-Martin. (1991), "Financial Repression and Economic Growth", *NBER Working Paper,* No. 3876, October.

Schumpeter, J. (1911), *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle,* Cambridge: Harvard University Press.

Senbet, L. W. and I. Otchere. (2005), "Financial Sector Reforms in Africa: Perspectives on Issues and Policies", prepared for the *Annual World Bank Conference on Development Economics (AWBCDE),* Dakar, January.

Shaw, E. S. (1973), *Financial Deepening in Economic Development,* New York: Oxford University Press.

Stiglitz, J. E. (2000), "Capital Market Liberalization, Economic Growth and Instability", *World Development,* 28(6): 1075-1086.

Stiglitz, J. E. (1994), "The Role of the State in Financial Markets", *Proceedings of the World Bank Annual Conference on Development Economics*, The World Bank.

Stiglitz, J. E. (1989), "*Financial Markets and Development", Oxford Review of Economics Policy* 5(4): 55 – 68.

Sowa, N. K. (2002), "Financial Sector Reform Policies and Poverty Reduction", 5th AERC Senior Policy Seminar co- sponsored with The Bank of Tanzania on Poverty Reduction and Macroeconomic Management in Africa, in Dar es Salaam, Tanzania, February 12-14, 2002.

Tobin, J. (1965), "Money and Economic Growth", *Econometrica,* 33(4): 671-684.

Todaro, M. P. and S. C. Smith. (2011), *Economic Development, 11th Edition.* Pearson Education Ltd, NY, p. 220.

Tressel, M.P. and E. Detragiache. (2008), Do Financial Sector Reforms Lead to Financial Development", Evidence from new dataset", *International Monetary Fund, Business and Economic Working Paper,* pp. 1-44, December.

United Nations Development Programme. (2014), H*uman Development Statistical Tables,* http://hdr.undp.org/en/data

UNU-WIDER, (2014), '*World Income Inequality Database* (WIID3.0A)', June**.** http://www.wider.unu.edu/research/WIID-3a/en_GB/database/

Wooldridge, J. M. (2010), *Econometric Analysis of Cross Section and Panel Data*. Cambridge, Mass.: MIT Press.

World Bank. (2013), *World Development Indicators*, Washington, D.C.: World Bank.

Appendices

Appendix 1: Two-Stage Least Squares: Fixed-effects, using 180 observations

Dependent variable: LRY

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	0.935005	3.06372	0.3052	0.76062	
Ldcyr	0.210688	0.0399877	5.2688	<0.00001	***
Lbkyr	-0.11293	0.0292571	-3.8599	0.00016	***
Lm2yr	0.0861682	0.0508013	1.6962	0.09181	*
Linvyr	0.0313219	0.0292279	1.0716	0.28550	
Lexrt	0.0679088	0.04171	1.6281	0.10548	
LGINIhat	1.23543	0.824952	1.4976	0.13623	

Mean dependent variable	6.409815	S.D. dependent variable	0.506638
Sum squared residual	1.873008	S.E. of regression	0.108535
R-squared	0.959235	Adjusted R-squared	0.954107
F(20, 159)	187.0684	P-value(F)	1.37e-99
Log-likelihood	155.4781	Akaike criterion	-268.9562
Schwarz criterion	-201.9041	Hannan-Quinn	-241.7694
Rho	0.781334	Durbin-Watson	0.335804

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(14, 159) = 148.403
with p-value = P(F(14, 159) > 148.403) = 1.53098e-083

Appendix 2: Two-Stage Least Squares: Fixed-effects, using 180 observations

Dependent variable: LGINI

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	3.80812	0.606329	6.2806	<0.00001	***
Ldcyr	-0.0122632	0.0225518	-0.5438	0.58736	
Lbkyr	0.0226695	0.0119308	1.9001	0.05923	*
LMODERN	0.139404	0.0581445	2.3975	0.01767	**
Lgyr	0.00349972	0.0225448	0.1552	0.87683	
Lhk	0.0246977	0.0360835	0.6845	0.49468	
Lryhat	-0.125381	0.144912	-0.8652	0.38822	

Mean dependent variable	3.680278	S.D. dependent variable	0.116887
Sum squared residual	0.357021	S.E. of regression	0.047386
R-squared	0.854016	Adjusted R-squared	0.835653
F(20, 159)	46.50787	P-value(F)	5.42e-56
Log-likelihood	304.6537	Akaike criterion	-567.3074
Schwarz criterion	-500.2553	Hannan-Quinn	-540.1207
Rho	0.326674	Durbin-Watson	1.222886

Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: F(14, 159) = 38.2427
with p-value = P(F(14, 159) > 38.2427) = 1.23568e-043

Appendix 3: Dynamic Panel Model: 1-step dynamic panel, using 165 observations

Dependent variable: LRY

	Coefficient	*Std. Error*	*z*	*p-value*	
LRY(-1)	1.07209	0.0297407	36.0478	<0.00001	***
Const	-0.29278	0.174528	-1.6776	0.09343	*
Lm2yr	-0.00902568	0.0203978	-0.4425	0.65814	
Ldcyr	-0.0206542	0.0132156	-1.5629	0.11809	
Lbkyr	0.00931591	0.00200819	4.6389	<0.00001	***
Linvyr	0.0260746	0.0160125	1.6284	0.10344	
Lexrt	0.00213925	0.00370145	0.5779	0.56330	
Lxpyr	-0.040631	0.0119369	-3.4038	0.00066	***
LGINI	-0.00987773	0.0371121	-0.2662	0.79012	

Sum squared residual 0.309422 S.E. of regression 0.044536

Number of instruments = 73

Test for AR(1) errors: z = -2.90734 [0.0036]

Test for AR(2) errors: z = -1.23333 [0.2175]

Sargan over-identification test: Chi-square(64) = 88.6428 [0.0224]

Wald (joint) test: Chi-square(8) = 15475.3 [0.0000]

Appendix 4: Dynamic Panel Model: 1-step dynamic panel, using 150 observations

Dependent variable: LGINI

	Coefficient	*Std. Error*	*z*	*p-value*	
LGINI(-1)	0.378202	0.0986858	3.8324	0.00013	***
Const	-3.0478e-05	0.00235193	-0.0130	0.98966	
LRY	0.0738361	0.101136	0.7301	0.46535	
LMODERN	0.0750078	0.0427486	1.7546	0.07932	*
Lgyr	0.00718423	0.0221023	0.3250	0.74515	
Ldcyr	-0.0368399	0.0295347	-1.2473	0.21227	
Lbkyr	0.0288703	0.00857735	3.3659	0.00076	***
Lhk	-0.022613	0.0305971	-0.7391	0.45987	

Sum squared residual 0.522486 S.E. of regression 0.060659

Number of instruments = 62

Test for AR(1) errors: z = -2.04431 [0.0409]

Test for AR(2) errors: z = -1.35335 [0.1759]

Sargan over-identification test: Chi-square(54) = 98.0111 [0.0002]

Wald (joint) test: Chi-square(7) = 43.062 [0.0000]

GOVERNMENT EDUCATION EXPENDITURE, TAXATION AND GROWTH IN NIGERIA.

By Milton A. Iyoha and Nosakhare L. Arodoye*

Abstract

This study analyzes the dynamic responses, causality and interrelationships among government education expenditure, taxation and economic growth in Nigeria. VEC Granger causality and the VECM were analyzed between the periods 1981 and 2013, The VEC causality test indicated that unidirectional causality exist among government expenditure on education, taxation and economic growth in Nigeria, though with the advent of the economic recession 2008/2009, a bi-directional causation emerged between the economic recession indicator, government education expenditure and human capital development. The Forecast Error Variance Decomposition further indicated that the predominant variations in Nigeria's education expenditure and the growth rate in real per capita GDP were largely due to the rising trends in the country's tax revenue profile. Also, variability in the shocks of economic growth, 'own shocks' of economic recession and human capital development mainly account for the large share of variability in economic recession. The VECM estimation evaluated the dynamic adjustment of the multivariate model and found that the economy moderately adjusts to change in the country's government expenditure on education, and that the responsiveness of government expenditure on education is significant and exceeds the responsiveness of human capital development, RGDP per capita growth rate and total tax revenue. These error correction coefficients were significantly and differently influenced with the advent of economic recession. The implications of the study were explicitly stated and next recommended a well restructured and future-oriented fiscal policy that would ensure a rapid attainment of the country's macroeconomic goals.

Keywords: Government Education Expenditure, Taxation, Economic Growth, VECM, Nigeria.
JEL: C32, E62, H20, H52, I 22, O15.

1.0 INTRODUCTION

"*A strong revenue base is imperative if developing countries are to be able to finance the spending they need on public services, social support and infrastructure*" (Lagarde, Managing Director of IMF 2015)

* Milton A. Iyoha is a professor of Economics and Statistics, University of Benin, Benin City, Edo State, Nigeria. Nosakhare L. Arodoye is of the University of Benin. The Views expressed in this paper those of the authors and don not represent those of the University of Benin. Corresponding Authors Prof. M. A. Iyoha. E-mail: iyohama@yahoo.com.

*"We very much want to help developing countries raise more revenue through taxes because this can lead to more children receiving a good education and more families having access to quality health care"(*Kim, Managing Director of World Bank 2015*)*

"Education is coterminous with social progress" (Anonymous)

The important role of education in human welfare and social progress is incontrovertible. It is not surprising therefore that the governments of every country in the world give special attention to education and often devote significant percentages of their annual budgets to the promotion of education. The United Nations Educational, Scientific and Cultural Organization (UNESCO) even found it desirable to suggest that a minimum percentage (25%) of every country's annual budget should be allocated to the education sector. The issue of taxation and tax revenue generation would then arise as ways must be found to finance the burgeoning educational expenditures. It becomes imperative, therefore to examine the relationship between total tax revenue, government spending on education and human capital development. It is well known that human capital development has enormous impact on long-term growth. Thus, a country which can efficiently raise tax revenues can effectively improve on her productive spending in areas such as those on investment in higher education, improved on-the-job training and undertaking massive funding of research and development (R&D) as a means of promoting the country's long–term economic growth. Too often, investment in public education is measured by government budgetary allocations to the education sector, and spending on the latter may rise or fall over time depending on the fiscal operations of the government.

Previous empirical tests of the links among government expenditure on education, taxation and economic growth in Nigeria were more concerned with the nature, extent and degree of the relationships and did not particularly focus on the dynamic effects of the shocks resulting from government expenditure on education and total government tax revenue on economic growth. The present study attempts to fill this gap by empirically considering the inherent inter-relationships as well as the adjustment mechanism that exist among these key variables. Following the introductory remarks in this section, the next section reviews literature relevant to this study. The theoretical framework, model specification and methodology are considered in section three, while section four presents and interprets the various estimation outputs. Section five presents policy implications of results and recommendations, while section six concludes the study.

2.0 LITERATURE REVIEW

Economic theory has shown that in order to fully analyze the growth effects of government expenditure on education, one must as a matter of importance account for any offsetting implications of the requisite taxation and the corresponding effects on human capital development. In view of this, the literature review in this paper will cover previous studies on government expenditure on education, tax revenue generation, and human capital development. -

In their study of the link between public education expenditure, taxation and growth using panel data from 23 developed countries over the period, 1960-2000, Blankenau, Simpson and Tomljanovich (2007) state that 'education expenditures are a key to sustained economic growth'. They note further that taxation can alter the positive growth effects from increased public education expenditures and also that including both sides of the government budget sheet is essential when estimating long-term growth effects. The study reveals that a positive relationship exists between government education expenditure and growth in developed countries; also, that such relationship is sensitive to the imposition of government's budget constraint, and that public expenditures on education improve long-term growth in rich countries.

Davin (2013) examines the interplay between spending, sectoral taxation and growth. His study reveals that agents' preferences for services, education and savings play a major role in the relationship between growth and public education expenditures, as long as production is taxed at a different rate in each sector. He further shows that cross-country heterogeneity in preferences for education, services and savings should be considered when designing a growth-enhancing education policy. In an earlier study, Karras and Furceri (2009) investigates the effects of changes in taxes on economic growth, using annual data from 1965 to 2003 for a panel of nineteen European economies. The results obtained shows that the effect of an increase in taxes on real GDP per capita is negative and persistent.

Bleaney, Gemmel and Kneller (2001) test the endogenous growth model in the context of public expenditure, taxation, and growth over the long run using data from a panel of twenty two OECD countries during the 1970-1995 period. They utilize per capita Gross Domestic Product as a measure for economic growth and other fiscal variables as explanatory variables. They find strong and convincing evidence in favor of fiscal effects on growth as well as a surprisingly strong support for the endogenous growth hypothesis. In a more recent study, Makdad, Dahman and Louaj (2014) examine the relationship between education and economic

growth in Algeria with emphasis on public spending on education and economic growth over the period 1974 through 2012; they employ the Ordinary Least Squares regression estimator, Johansen Co-integration test and causality test. Their study reveals that public spending on education affects economic growth positively in Algeria.

Biggs and Dutta (1999) evaluate the long-run distributional effects of cuts in public expenditure on education by simulating a dynamic model of the earnings distribution, and they use a dual system of education as in the United Kingdom or the United State, where the State finances public education by taxation. They further evaluate a likely long-term impact of changes to education expenditures in the United Kingdom, and suggest that the long-run impact of modest changes to public expenditures on education on inequality of earnings are likely to be substantial. Also in another study by Sims (2004) which analyze the relationship between school funding, taxes, and economic growth employing a set of state-specific dynamic Computable General Equilibrium (CGE) models, seeks to investigate the consequences of an increase in education spending by 2 % and an equal increase in state residents; consumer taxes. Sims finds that a significant number of jobs is created by increasing taxes to support that spending, and also that such strategy has significant net positive near-term and long-term employment effects for each of the 50 states of the USA.

Basu and Bhattarai (2010) in their analysis of the government spending on education, growth and school returns note that human capital is a major driver of economic growth using cross country data, and they reveal from their empirical results that positive correlation exists between economic growth and public spending on education. They further find that public spending on education tends to depress schooling return and the relationship between growth and education appears to be non-linear. On their part, Musaba, Chilonda and Matchaya (2013) analyze the impact of government sectoral expenditure on economic growth in Malawi using annual time series from 1980 to 2007 by adopting the error correction methodology and co- integration estimation techniques. They find that in the short run there is no significant relationship between government sectoral expenditure and economic growth while in the long run there exists a positive effect of expenditure on education on economic growth.

McDonald (1980) evaluates the redistributive effect of public expenditures. His results indicate a redistributive pattern which is pro-poor, pro-black and pro-male. His analysis indicate that educational equity may vary for the same location depending upon an equal distribution of expenditure or fiscal incidence. In assessing the impact of reforming public spending on education and mobilizing

resources, Mehrotra (2004) made the case for new taxes for elementary education, and earmarking of funds from such revenues for elementary education, both at the State and central levels, and that all of these have important consequences for both the efficiency and equity of public education spending.

More recently, in Nigeria, Yakubu and Akanegbu (2015) analyze the impact of education expenditure on economic growth over the period 1981 through 2010 using co integration and Granger causality tests. They find no causality between the growth rate of real GDP and total government expenditure on education but there is a bi-directional causality between recurrent expenditure and total government expenditure. Also, there was no causality between primary school enrolment and the growth rate of real GDP. Also in investigating the empirical relationship between government expenditure and economic growth in Nigeria between 1980 and 2010, Olulu, Erhieyovwe and Andrew (2014) find an inverse relationship between growth and government expenditure on education sector. They further point out that government expenditure on education is insufficient for catering for the expanding sector.

3.0 THEORETICAL FRAMEWORK, MODEL SPECIFICATION AND METHODOLOGY

In attempting to analyze the interrelationship among government expenditure on education, taxation and growth in Nigeria, the study utilizes a generalized Cobb-Douglas Production Function with extension to include tax-financed government services on education that affect production or utility. In the milieu of a Cobb-Douglas Production function, the optimizing government still satisfies a natural condition for productive efficiency that will drive economic growth in Nigeria. A production function used by Barro (1990) with some modifications is therefore adopted. The basic assumptions for the adoption of this production function includes: a closed economy, constant return to scale – with capital stock decomposed into human and non – human capital, and that human investment includes education and training, and no labour-leisure choice. Given these assumption and modifications the study has:

$$y = f(\mathrm{k}) \quad \text{.....(1)}$$

where y is output per worker, and k is capital per worker. k as shown in equation (1) can be decomposed into human and non- human capital. Thus, equation (1) can be rewritten as

$$y = f(h, nh) \quad \text{.....(2)}$$

Where h is human capital (which in this case is the investment in public education) and nh is non- human capital. Next, we introduce technical change. Thus,

$$y = A(h, nh) \quad \text{.....(3)}$$

Where A is technological trend and A > 0. Given the assumption of constant returns to scale, the production function can be re-written as;

$$y = \Phi(h, nh, g) = (h, nh).\Phi(g/h, nh)$$

.....(4)

Where Φ satisfies the usual conditions for positive and diminishing marginal products, so that $\Phi^1 > 0$ and $\Phi^{11} < 0$ and g is assumed to measure the per capita quantity of government purchases of goods and services. Now assume that g is specifically government expenditure on education in Nigeria. Then, equation (4) can be rewritten as;

$$y = \Phi(h, nh, ge) = (h, nh).\Phi(ge/(h, nh)) \quad \text{.....(5)}$$

Where ge is government expenditure on education. Now assume that government education expenditure is financed contemporaneously by tax revenue in Nigeria (that is, total revenue from direct taxes and indirect taxes) and that the government runs a balanced budget. By normalizing the number of households to unity, the following equation emerges:

$$ge = T = \tau y = \tau.(h, nh).\Phi(g/h, nh) \quad \text{.....(6)}$$

Where T is government revenue and τ is the tax rate. To know the contribution of each of the variables to the country's final output (Y), we adopt the approach used by Corsetti (1996) is adopted (where he assumes the Cobb-Douglas production function) and obtains:

$$Y_t = A(v_t K_t)^{\alpha\varepsilon}(u_t H_t)^{1-\alpha}(G_t)^{\alpha(1-\varepsilon)} \quad \text{.....(7)}$$

Where inputs are physical capital (K), human capital (H), public goods (G), v and u are the fractions of total physical and human capital devoted to production of final goods. The productivity of public spending is decreasing in the parameter ε . For ε = 1, public goods is not a required input in the production of final goods.

More explicitly in this study a modified Cobb- Douglas production function of the following form is adopted:

$$Y_t = A_t(HCD_t^{\alpha}, TAX_t^{\beta}, GEXPE_t^{\delta}) \quad \text{.....(8)}$$

Where Y_t is the aggregate output (measured by real GDP per capita growth rate), HCD_t is Human Capital Development, TAX_t is total tax revenue and $GEXPE_t$ is government expenditure on education. These modification are based on the rationale offered by Barro (1990) and Corsetti (1996), who extended their models to allow tax-financed government services to affect the growth of the economy. The investment in education can be represented by government expenditure on education which may increase or decrease depending on government modes of fiscal activities over time. The growth performance of the economy is measured by the real GDP per capita growth rate. The resulting effect of the investment in human capital was measured with the human capital development and finally the extent to which education is financed made the introduction of total tax revenue very relevant in the model. Having identified the main factors that account for the fiscal activities as it affects growth, the study proceeds to the Vector Auto regressive (VAR) framework and estimate the Vector Error-Correction Mechanism (VECM) model as a result of the linear combination that connects the variables in the long run. In order to fully analyze the interrelationship between government education expenditure, taxation and growth in Nigeria, the following 4-variable VAR/ VEC model is specified:

$$V_t = \delta_{it} + \sum_{i=1}^{k} \beta_{ij} V_{t-j} + \varepsilon_{it} \quad \text{.....(9)}$$

$$\Delta V_t = \delta_{it} + \sum_{i=1}^{k} \beta_{ij} \Delta V_{t-j} + \phi_{ij} ECM_{t-j} + \varepsilon_{it} \quad \text{.....(10)}$$

Where V_t = vector of variables [$RGPCR_t$, $GEXPE_t$, TAX_t, HCD_t], V_{t-1} = vector of lagged variables, δ_{it} = vector of intercept terms, β_{ij} = matrix of coefficients, Δ = first difference operator, ECM_{t-1} is error correction term, ϕ_{ij} adjustment coefficient, ε_{it} is stochastic error terms. The variables in the model $RGPCR_t$ is Real Gross Domestic Product per capita growth rate, $GEXPE_t$ is Government Expenditure on Education, TAX_t is Total Tax Revenue and HCD_t is Human Capital Development. The model is estimated to examine the dynamic interrelationships as well as the speed of adjustment between government education expenditure, taxation and growth in Nigeria.

A VEC model with a dummy variable is also specified to capture the effects of the global economic recession of 2008/2009. This then gives a 5-variable VEC model with the dummy variable as an exogenous variable;

$$\Delta V_t = \delta_{it} + \sum_{i=1}^{k} \beta_{ij} \Delta V_{t-j} + \phi_{ij} ECM_{t-j} + \sum_{j=1}^{n} \lambda_N D_{j,t} + \varepsilon_{it} \quad \text{.....(11)}$$

Where $D_{j,t}$ is a dummy variable j at time t, N is the number of endogenous variables, λ_N are N x n vectors with λ as coefficient of the dummy variable and n is the number of dummy variables. In this study, only recent global economic recession is considered, hence n =1.

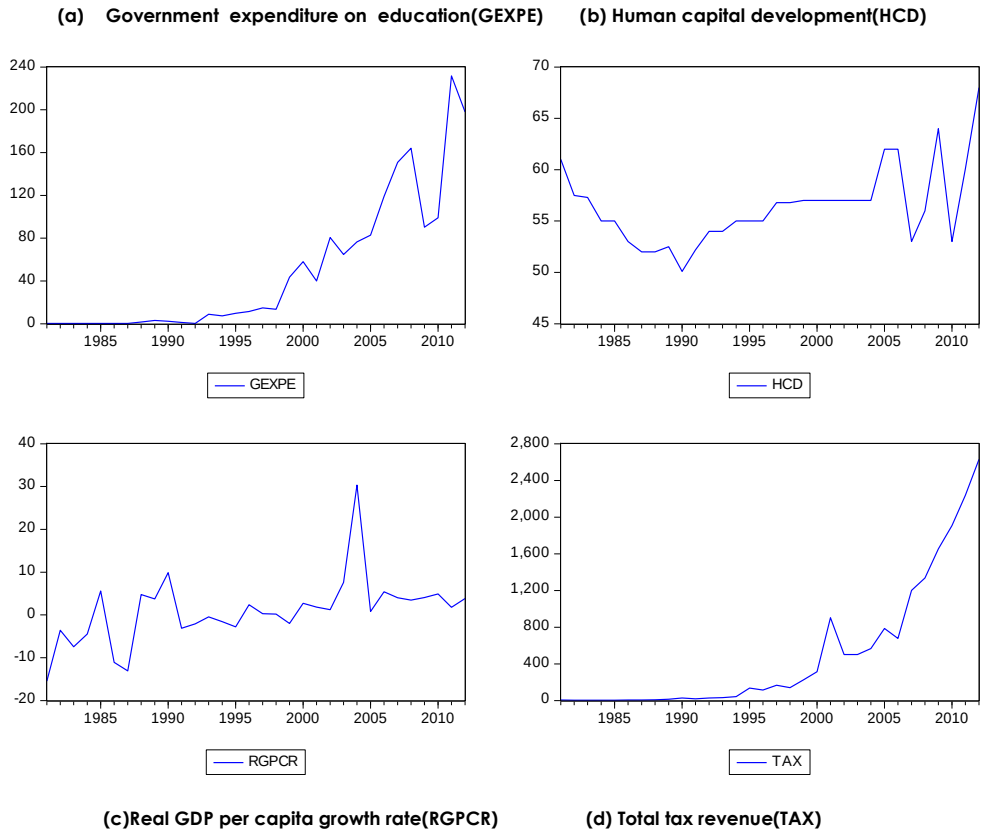
Annual data is collected on all the series from 1981 to 2013 from the Central Bank of Nigeria Statistical Bulletin, World Development Indicator (WDI) and the Federal Inland Revenue (FIRS) Tax gauges. Four variables are used for the analysis, namely, government expenditure on education, real GDP per capita growth rate (representing the growth of the economy), human development index (proxied by primary and secondary school enrolments) and taxation (proxied by government total tax revenue). Every variable in the model is subjected to testing for the existence of a unit root and its order of integration is ascertained. The Augmented Dickey Fuller (ADF) as proposed by Engle and Granger (1987) is employed to test for the presence or absence of unit roots in the time series of the variables while the Johansen co integration technique by Johansen (1991) is used to test whether the variables converge to equilibrium in the long run. The Granger Causality/Block exogeneity test is conducted to determine the causal relationships as well as to determine the predictive ability of one variable beyond that inherent in the other explanatory variables. The VECM model is estimated to determine the speed of adjustment of the vector of the variables to equilibrium in the case of temporary displacement from it. The analysis of the Forecast Error Variance Decomposition (FEVD) is used to deepen understanding of the ingredients of the VEC framework and to also determine to what extent the FEVD for any variable in a multivariate system is explained by innovations (shocks) in each explanatory variable over the given FEVD time horizon.

4.0 EMPIRICAL RESULTS AND INTERPRETATIONS

Time Series Plots

In order to obtain a better understanding of the behavior of the various time series variables over time, figure 4.1 presents plots of all the time series used in this study.

Figure 4.1: Plots of the time series of government spending on public education, human capital development, real GDP per capita growth rate and taxation in Nigeria (1981 – 2010).



Source: Authors' Computation using Eviews 8.0, 2015.

Examine Figure 4.1a to ascertain that the shape of the series plotted shows an upward trend, though with a non-uniform trend over time. In figures 4.1b, 4.1c and 4.1d, the trends appear to be non-stationary over time with the presence of irregular trends having effects on the behaviour of the time series. It is difficult to conclude about their stationarity from a purely visual examination of their plots. In order to obtain accurate results about the stationarity of the time series, models with constant trend will be estimated for each series. Hence, the Augmented Dickey Fuller unit root test will be applied.

Unit Root Test Results

The Augmented Dickey – Fuller (ADF) test for the stationarity of the variables are presented in table 1.

Table 1 : Augmented Dickey Fuller Unit Roots Test Results

Augmented Dickey Fuller at levels					Augmented Dickey Fuller at first difference			
Variables	**ADF test Statistics**	**95% critical value of ADF**	**Order of integration**	**Remarks**	**ADF test Statistics**	**95% critical value of ADF**	**Order of integration**	**Remarks**
GEXPE	1.4064	-2.9677	I(0)	Non-stationary	-7.8501	-2.9677	I(1)	Difference Stationary
TAX	3.9435	-2.9639	I(0)	Stationary	-5.2534	-2.9639	I(1)	Difference Stationary
RGPCR	-4.5776	-2.9604	I(0)	Stationary	-8.3045	-2.9639	I(1)	Difference Stationary
HCD	-0.8249	-2.9762	I(0)	Non-stationary	-8.2310	-2.9639	I(1)	Difference Stationary

Source: Authors' Computation using Eviews 8.0, 2015.

The results of the ADF unit root test show that total tax revenue (TAX) and real gross domestic product per capita growth rate (RGPCR) are stationary at levels and that of government expenditure on education (GEXPE) and human capital development (HCD) are non – stationary in levels, because the corresponding ADF test statistics are less than their respective critical values at 5% level of significance. However, the variables are all stationary in their first differences at 5% significance level.

Johansen Co integration Test Results

Having carried out the stationarity tests and established that all the variables are stationary at first difference, the paper proceeds to test for the long run relationship among the variables using the Johansen co integration test.

Table 2a : Johansen co integration test result

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.817795	89.11273	47.85613	0.0000
At most 1 *	0.450150	38.03409	29.79707	0.0045
At most 2 *	0.387444	20.09080	15.49471	0.0094
At most 3 *	0.164378	5.387354	3.841466	0.0203

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.817795	51.07864	27.58434	0.0000
At most 1	0.450150	17.94329	21.13162	0.1320
At most 2 *	0.387444	14.70344	14.26460	0.0426
At most 3 *	0.164378	5.387354	3.841466	0.0203

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

From table 2a above, the trace statistics point to the existence of two plausible co-integrating equations (that is, the co-integrating equations of r = 0* and r ≤1*) rejecting the null hypothesis of no co-integrating relations among the variables though the third and fourth hypotheses were accepted. In the case of the Maximum Eigenvalue statistics only the first outcome (r =0*) rejected the null hypothesis of no co- integrating relations among the variables.

Also examining the co integrating relationships with the inclusion of the global economic recession Dummy, it is seen that the variables share a common stochastic trend and that they still grow proportionally in the long run.(see table 2(b) below).

Table 2(b) : Johansen co integration test result(extended with dummy variable)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.813383	144.3008	69.81889	0.0000
At most 1 *	0.791567	92.26129	47.85613	0.0000
At most 2 *	0.485529	43.64896	29.79707	0.0007
At most 3 *	0.434148	23.04586	15.49471	0.0030
At most 4 *	0.159696	5.393746	3.841466	0.0202

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.813383	52.03954	33.87687	0.0001
At most 1 *	0.791567	48.61233	27.58434	0.0000
At most 2	0.485529	20.60311	21.13162	0.0591
At most 3 *	0.434148	17.65211	14.26460	0.0140
At most 4 *	0.159696	5.393746	3.841466	0.0202

Generally, both tests show that there is co-integration among the variables, and hence they are likely to converge to equilibrium in the long run. Given this co-integrating relation among the variables, the study continues with the application of the Vector Error Correction (VEC) methodology.

Table 3(a) : VEC - Causality Test Results

Dependent Variable: Government Expenditure on Education D(GEXPE)			
Variables	**Chi- Square**	**df**	**Prob.**
D(RGPCR)	4.712379	3	0.1941
D(HCD)	28.28397	3	0.0000
D(TAX)	2.879837	3	0.4105
Overall System	70.75223	9	0.0000
Dependent Variable: Real GDP per capita growth rate D(RGPCR)			
Variables	**Chi- Square**	**df**	**Prob.**
D(GEXPE)	1.972777	3	0.5781
D(HCD)	0.352932	3	0.9498
D(TAX)	8.613219	3	0.0349
Overall System	15.74451	9	0.0724
Dependent Variable: Human Capital Development D(HCD)			
Variables	**Chi- Square**	**df**	**Prob.**
D(GEXPE)	0.494293	3	0.9201
D(RGPCR)	1.588667	3	0.6620
D(TAX)	3.723284	3	0.2929
Overall System	10.00450	9	0.3501
Dependent Variable: Total Tax Revenue D(TAX)			
Variables	**Chi- Square**	**df**	**Prob.**
D(GEXPE)	6.881942	3	0.0758
D(RGPCR)	3.730299	3	0.2921
D(HCD)	2.943020	3	0.4005
Overall System	12.39268	9	0.1921

Source: Authors' Computation using Eviews 8.0, 2015.

It is clear from the first panel that there is causality running from human capital development to government expenditure on education at the 5% level of significance. In the second panel, causality runs from total tax revenue to real GDP per capita growth rate at 5% significance level while the third panel shows no existence of causality at 5% significance level and the last panel indicates that there is causality from government expenditure on education to total tax revenue. The chronological ordering of the movements in the variables in Nigeria from 1981 through 2013 suggests that government expenditure on education would drive human capital development, and that an enhanced tax revenue-earning

capacity would support an improved government expenditure on education and that these causal factors would increase the country's real GDP per capita growth rate.

With the introduction of the economic recession dummy variable into the VEC model, it is observed the following joint Granger causality test results. (See table 3(b) below)

Table 3(b) :VEC Granger Causality Test(extended with dummy variable)

Dependent variable: D(RGPCR)			
Variable	**Chi-sq**	**Df**	**Prob.**
D(GEXPE)	4.692367	2	0.0957
D(HCD)	2.989934	2	0.2243
D(TAX)	3.959380	2	0.1381
D(D)	3.002399	2	0.2229
overall system	**8.379302**	**8**	**0.3973**
Dependent variable: D(GEXPE)			
Variable	**Chi-sq**	**Df**	**Prob.**
D(RGPCR)	7.622572	2	0.0221
D(HCD)	2.516767	2	0.2841
D(TAX)	40.62790	2	0.0000
D(D)	30.33048	2	0.0000
overall System	**107.4670**	**8**	**0.0000**
Dependent variable: D(HCD)			
Variable	**Chi-sq**	**Df**	**Prob.**
D(RGPCR)	0.925990	2	0.6294
D(GEXPE)	7.485516	2	0.0237
D(TAX)	7.240885	2	0.0268
D(D)	9.045991	2	0.0109
overall system	**15.79290**	**8**	**0.0454**
Dependent variable: D(TAX)			
Variable	**Chi-sq**	**Df**	**Prob.**
D(RGPCR)	6.080703	2	0.0478
D(GEXPE)	8.715400	2	0.0128
D(HCD)	12.21111	2	0.0022
D(D)	19.27291	2	0.0001
overall system	**80.07859**	**8**	**0.0000**
Dependent variable: D(D)			

Variable	Chi-sq	Df	Prob.
D(RGPCR)	4.522827	2	0.1042
D(GEXPE)	12.16277	2	0.0023
D(HCD)	58.89849	2	0.0000
D(TAX)	7.979843	2	0.0185
overall system	**70.74076**	**8**	**0.0000**

Source: Authors' Computation using Eviews 8.0, 2015.

From the above extended Block Granger causality test results (after the inclusion of global economic recession dummy variable in the VEC system), joint causation is noticed with all the equations in the VEC system except that of economic growth at 5% significance level. This expanded variable case shows more robust results unlike the analysis in table 3(a) above where joint causation is only revealed in the equation of government education expenditure. Also, the equation with the global economic recession dummy variable (D) shows a joint causation with all the variables in the system, specifically with a bi-directional causation existing with total government education expenditure, total tax revenue and human capital development.

Variance Decomposition Results

The interrelationships among government expenditure on education, government total tax revenue and human capital development in Nigeria can be further analyzed using the forecast error variance decomposition as shown in table 4(a) below.

Table 4(a) : Forecast Error Variance Decompositions (FEVDs) Estimates

		Explanatory Variables				
Variables	**Quarters**	**S.E***	**GEXPE**	**HCD**	**RGPCR**	**TAX**
	1	12.77378	100.0000	0.000000	0.000000	0.000000
	5	42.87255	13.32086	25.42207	29.41509	31.84199
GEXPE	10	139.5672	5.461052	6.269089	27.52066	60.74919
	1	2.314007	5.384295	94.61570	0.000000	0.000000
	5	4.407698	20.55169	67.38923	6.753913	5.305167
HCD	10	7.549035	18.51726	51.01522	15.59844	14.86908
	1	7.452766	12.03364	32.59715	55.36921	0.000000
	5	12.24966	31.94728	15.66119	24.19530	28.19623
RGPCR	10	35.19052	23.31275	6.004692	15.97220	54.71036
	1	189.1284	10.07149	1.699714	4.340617	83.88818
	5	873.0649	9.109616	2.551792	20.23229	68.10630
TAX	10	3213.833	8.255468	0.434812	25.42066	65.88906

Source: Authors' computation using E-views 8.0, 2015.
S.E*: Standard Errors (in percentages)

The FEVD of GEXPE revealed that the variation in its 'own shocks' falls within the range of about 5.5% to 100% reflecting a decline from the period one over the forecast horizon. Shocks to HCD explained a rising proportion of forecast error variance of the GEXPE up to the 5th period and a subsequent decline over the forecast period. The variations in the shocks of RGPCR and TAX account for a large proportion of the variation in GEXPE with the forecast error variance of TAX accounting for about 60% at the end of the forecast horizon. The variations in the shocks of its 'own shocks' and total tax revenue shows the high significance of the effects of the variability in Nigeria's total tax revenue on the country's government expenditure on education.

The shocks to HCD explain about 95% of 'own shocks' in the first period and subsequently decline to about 51% at the end of the forecast horizon, while GEXPE accounts for a low but rising variance in HCD of about 20% at the 5th period and declining to about 18.6% at the 10th period. Shock of RGPCR explains a low and rising variation in HCD to the tune of 15.6% at the 10th period. Also TAX shock own variations explain low but rising share in the forecast horizon.

The shocks of RGPCR show that the variation in its 'own shock' accounts for about 55% in the start of the forecast horizon and declines to about 16% at the 10th period, while the variation in GEXPE shows fluctuating variations in its shock with about 23% at the end of the forecast horizon. Similarly, the shock of the HCD is as low as about 6% at the 10th period while that of TAX accounts for a rising and significant share of the variation in RGPCR to the tune of about 55% at the end of the forecast horizon. The predominant source of variation in the RGPCR is 'own shock' and the variance of the shock of total tax revenue.

The forecast error variance decomposition of TAX explained by 'own shock' in period one is about 84% while shock in GEXPE, HCD and RGPCR accounts for about 11, 1.7 and 4.3 percent respectively. The variation in the own shock of TAX stays above 60% at the 5th and 10th periods. The shocks of GEXPE and HCD have a low and declining share of the variations of the shock of TAX from the 5th to the 10th period while that of RGPCR shock witnesses a rising share of about 25% at the end of the forecast horizon. Generally, the results reveal that the predominant forecast error variations in Nigeria's expenditure on education and the growth in her real per capita GDP are largely due to the rise in the country's tax revenue.

An analysis of the forecast error variance decomposition of economic recession introduced as a dummy variable (D) is necessary to be able to measure the proportion of its total variability due to shocks in the variable itself relative to shocks in all other variables in the VEC model, at various forecasting horizons.

Table 4(b): Forecast Error Variance Decompositions (FEVDs) estimates of economic recession (D)

Horizons	S.E.*	RGPCR	GEXPE	HCD	TAX	D
1	0.114086	10.25949	0.155904	1.855958	6.616015	81.11263
2	0.272108	18.32786	0.323087	28.40000	7.969191	44.97986
3	0.330863	19.10749	1.666110	31.57761	9.051011	38.59777
4	0.351001	21.93060	1.480415	30.41234	10.53001	35.64664
5	0.359439	20.96388	2.336695	30.75222	11.57867	34.36853
6	0.369884	23.61967	3.429912	29.22851	10.95150	32.77041
7	0.394115	20.87766	7.708325	25.79689	9.646227	35.97090
8	0.468623	19.83713	6.370914	24.28190	9.116286	40.39377
9	0.519755	18.03170	6.766138	24.81143	9.483878	40.90686
10	0.536512	18.54079	7.433486	23.40769	9.955702	40.66233

Source: Authors' computation using E-views 8.0, 2015.
S.E*: Standard Errors (in percentages)

The results of the FEVDs of economic recession variant show that there is a significant role played by 'own shocks' and by the shocks of most of the macroeconomic variables in accounting for the fluctuations in the economy. For instance, the FEVD of D indicates that the variation in its 'own shocks' falls within the range of about 40% to 81%, showing a declining trend throughout the forecast horizon. The variability of the shocks in RGPCR indicates a rising proportion from about 10% to about 23% at the 6th period and subsequently declines to about 18% at the end of the period. Also the variation in the shock from HCD is also substantial within the period rising to about 30% at the mid of the period and declines to 23% at the end of the horizon. The variabilities in the shocks of GEXPE and TAX account for only a small variation of the shocks of economic recession with the forecast error variance of GEXPE amounting to about 7.4% at the end of the horizon while that of TAX at the same time is about 9%. Hence, variabilities in the shocks of economic growth, 'own shocks' of economic recession and human capital development can be said to have predominantly accounted for the large share of variability in economic recession.

Results of the Vector Error Correction Methodology (VECM)

The VEC model is estimated in order to assess the short-run behaviour of government expenditure on education, taxation, human capital development and economic growth and the adjustment of the long run model i.e capturing the speed of adjustment to the long run equilibrium in the respective vectors of the multivariate system. The speed of adjustment to disturbance in the long run equilibrium of the respective vectors is given by the magnitude of the Error Correction Mechanism (ECM).

Table 5(a): Vector Error Correction Methodology (VECM) Results.

System Equations				
Variables	**D(GEXPE)**	**D(HCD)**	**D(RGPCR)**	**D(TAX)**
ECM	-0.426502	-0.095390	0.279345	-8.322227
	(0.28704)	(0.05200)	(0.16747)	(4.24995)
	[-1.48585]*	[-1.83446]**	[1.66800]**	[-1.95819]**
D(GEXPE(-1))	-0.020617	-0.013965	-0.141398	5.809375
	(0.23615)	(0.04278)	(0.13778)	(3.49640)
	[-0.08730]	[-0.32645]	[-1.02627]	[1.66153]**
D(GEXPE(-2))	-0.322976	0.027987	-0.219426	10.59669
	(0.31366)	(0.05682)	(0.18300)	(4.64408)

	[-1.02969]	[0.49255]	[-1.19902]	[2.28176]**
D(GEXPE(-3))	-0.176848	-0.028397	-0.012168	-2.343190
	(0.28879)	(0.05231)	(0.16849)	(4.27580)
	[-0.61238]	[-0.54281]	[-0.07222]	[-0.54801]
D(HCD(-1))	-2.052212	-0.732352	0.377401	-29.97649
	(1.46743)	(0.26583)	(0.85616)	(21.7268)
	[-1.39850]*	[-2.75496]***	[0.44081]	[-1.37970]*
D(HCD(-2))	4.468294	-1.054979	-0.054794	0.130724
	(1.52266)	(0.27583)	(0.88838)	(22.5445)
	[2.93453]***	[-3.82468]***	[-0.06168]	[0.00580]
D(HCD(-3))	1.993529	0.545736	0.394716	-30.44972
	(2.06280)	(0.37368)	(1.20352)	(30.5418)
	[0.96642]	[1.46043]*	[0.32797]	[-0.99699]
D(RGPCR(-1))	-1.164664	-0.174950	0.144501	-13.76049
	(0.79170)	(0.14342)	(0.46191)	(11.7219)
	[-1.47109]*	[-1.21985]	[0.31283]	[-1.17391]
D(RGPCR(-2))	-0.634118	-0.101802	0.153986	-17.08189
	(0.64166)	(0.11624)	(0.37437)	(9.50047)
	[-0.98824]	[-0.87579]	[0.41132]	[-1.79800]**
D(RGPCR(-3))	0.010974	-0.074166	0.239256	-8.572187
	(0.49317)	(0.08934)	(0.28774)	(7.30184)
	[0.02225]	[-0.83017]	[0.83152]	[-1.17398]
D(TAX(-1))	0.005430	-0.010022	0.020243	-0.928380
	(0.03948)	(0.00715)	(0.02304)	(0.58459)
	[0.13753]	[-1.40124]*	[0.87873]	[-1.58808]*
D(TAX(-2))	-0.033023	-0.001747	0.008007	0.058450
	(0.02785)	(0.00504)	(0.01625)	(0.41229)

	[-1.18589]	[-0.34627]	[0.49283]	[0.14177]
D(TAX(-3))	-0.011802	-0.010028	0.046954	-0.597997
	(0.02937)	(0.00532)	(0.01714)	(0.43485)
	[-0.40183]	[-1.88485]**	[2.74009]***	[-1.37517]*
C	12.72605	2.066637	-2.994073	143.1304
	(5.42274)	(0.98234)	(3.16385)	(80.2889)
	[2.34679]	[2.10378]	[-0.94634]	[1.78269]
Summary Statistics				
R-squared	0.921215	0.825551	0.681726	0.533840
Adj. R-squared	0.848058	0.663563	0.386186	0.100978
Sum sq. resids	2284.373	74.96483	777.6121	500773.9
S.E. equation	12.77378	2.314007	7.452766	189.1284
F-statistic	12.59224	5.096372	2.306715	1.233280
Log likelihood	-101.3533	-53.51768	-86.26660	-176.8142
Akaike AIC	8.239520	4.822692	7.161900	13.62958
Schwarz SC	8.905622	5.488794	7.828003	14.29568
Mean dependent	7.060714	0.464286	0.295851	93.77857
S.D. dependent	32.77029	3.989450	9.512600	199.4673

Note: Standard Errors are in parenthesis and t- values are in brackets [ ].
/**/ = Significant at 10%, 5% and 1% levels with critical values of 1.282, 1.645 and 2.326 respectively. F- statistics significant at 10%, 5% and 1% with critical values of 2.16, 2.71 and 4.07**
Source: Authors' Estimation Results Using E-views 8.0, 2015.

From table 5(a), the impact of government expenditure on education (1.66153 and 2.28176) in relation to total tax revenue is positive and significant in lags 1 and 2 at 5% significance level with the strongest impact in lag 2.

The impact of human capital development (-1.39850 and -2.93453) in relation with government expenditure on education is negative and significant at 10% in lag 1 while it becomes positive and significant at 1% in lag 2. The HCD (-2.75496. -3.82468 and 1.46043) with its lagged values are significantly related (with negative and significant relationships in its lag1 and 2 – at the 1% significance level and becomes positive and significant at lag 3 – at the 10% significance level) while the impact of HCD (-1.37970) in relation with total tax revenue is negative and significant at the 10% significance level for the one-period lagged value.

The impact of real gross domestic product per capita growth rate (-1.47109 and -1.79800) in relation to government expenditure on education is negative and significant at the 10% significance level in lag 1 while such relationship with total tax revenue is negative and significant at 5% significant level in lag 2.

The impact of total tax revenue (-1.40124 and -1.88485) in relation with HCD is negative at both lag 1 and lag 3, at the 10% and 5% significance level, respectively. The impact of TAX (2.74009)in relation with RGPCR is positive and significant at 1% significance level in lag 3, and the impact of TAX(- 1.58808 and – 1.37517) with its lag 1 and 3 values are negative and significant at 10% significance levels.

The coefficient of determination (R^2) of 0.92 , 0.82, 0.68 and 0.53 in the three lags of the vectors of the variables of interests account for at least 53% and at most 92% of the systematic variation in economic activities while their F- statistics (12.592, 5.096, 2.306 and 1.233) are significant at 1%, 10% and 25%, respectively.

The central issue in the estimation of the VECM is the adjustment of the economy to changes in government expenditure on education, taxation (proxied by total tax revenue) human capital development and real GDP capita growth rate shown by the coefficient of ECM_{t-j}. The GEXPE has adjustment coefficient of 0.4265 (in absolute value) which indicates that the economy adjusts to change in GEXPE by about 43% in a given period. The coefficient of ECM is rightly signed (negative) and significant at 10% level. The size of the absolute value of the ECM clearly shows that the speed of restoration to equilibrium in a case of any temporary disequilibrium from it is moderate. Human Capital Development, Real GDP per capita growth rate and total tax revenue have ECM coefficients of 0.0953, 0.2793 and 8.3222, respectively in absolute value. The ECM of HCD is correctly signed and significant at 5% level with a low speed of adjustment of about 9%. The ECM coefficient of RGPCR is not correctly signed though significant at 5% level with a low speed of adjustment of about 27%. Lastly the absolute value of the ECM for TAX is 8.3222. Though correctly signed and significant at 5%, it is, however, not between zero and unity as required by theory. Clearly, the speed of adjustment is overblown and the speed of restoration to equilibrium in case of a temporary disequilibrium may overheat the economy. However, the speed of adjustment of government expenditure on education is slightly superior to that of the other variables that their absolute values of the coefficient of ECM lies between zero and unity, correctly signed (that is, negative) and significant like that of the human capital development.

The introduction of an economic recession dummy variable into the VEC model yields the following estimates of the Vector Error Correction model

Table 5(b): Vector Error Correction Methodology (VECM) Results.

Vector Error Correction (VEC) estimates (with dummy variable)				
	System Equations			
Variables	**D(RGPCR)**	**D(GEXPE)**	**D(HCD)**	**D(TAX)**
ECM	-0.338673	-1.006641	0.021223	-2.210561
	(0.12061)	(0.25305)	(0.05023)	(2.73473)
	[-2.80792]***	[-3.97801]***	[0.42248]	[-0.80833]
DRGPCR(-1))	-0.440106	0.202584	0.037353	5.558774
	(0.17822)	(0.37392)	(0.07423)	(4.04095)
	[-2.46940]***	[0.54179]	[0.50321]	[1.37561]
D(RGPCR(-2))	-0.332773	0.241355	0.079665	-2.300309
	(0.17819)	(0.37385)	(0.07421)	(4.04019)
	[-1.86752]**	[0.64560]	[1.07343]	[-0.56936]
D(GEXPE(-1))	-0.054565	0.185884	0.028628	3.553619
	(0.05774)	(0.12115)	(0.02405)	(1.30925)
	[-0.94496]	[1.53435]	[1.19035]	[2.71424]
D(GEXPE(-2))	0.085230	-0.259587	-0.022296	0.466131
	(0.06326)	(0.13272)	(0.02635)	(1.43431)
	[1.34731]*	[-1.95590]	[-0.84623]	[0.32499]
D(HCD(-1))	-0.844534	-3.278159	-0.548473	11.52319
	(0.58909)	(1.23594)	(0.24535)	(13.3568)
	[-1.43362]*	[-2.65237]	[-2.23544]	[0.86272]
D(HCD(-2))	-1.270878	3.192667	-0.590473	21.90166
	(0.66090)	(1.38659)	(0.27526)	(14.9849)
	[-1.92295]**	[2.30253]	[-2.14515]	[1.46158]
D(TAX(-1))	-0.039639	0.004388	0.004047	-0.404952
	(0.01441)	(0.03023)	(0.00600)	(0.32666)
	[-2.75133]***	[0.14518]	[0.67448]	[-1.23967]
D(TAX(-2))	-0.031	-0.018178	0.003826	-0.143873
	(0.01206)	(0.02529)	(0.00502)	(0.27336)
	[-2.57123]***	[-0.71866]	[0.76197]	[-0.52632]
Constant	6.470784	17.79204	-0.617635	73.24864
	(2.27137)	(4.76540)	(0.94601)	(51.4997)
	[2.84885]	[3.73359]	[-0.65289]	[1.42231]
Dummy variable	-2.384277	-30.01708	0.060858	325.7409
	(8.58757)	(18.0170)	(3.57666)	(194.710)
	[-0.27764]	[-1.66604]**	[0.01702]	[1.67295]

Summary Statistics				
R-squared	0.583828	0.860073	0.686895	0.538490
Adj. R-squared	0.364789	0.786428	0.522104	0.295590
Sum sq. resids	1018.474	4483.066	176.6707	523583.5
S.E. equation	7.321468	15.36069	3.049337	166.0031
F-statistic	2.665415*	11.67855***	4.168261***	2.216920*
Log likelihood	-95.44111	-117.6711	-69.16451	-189.077
Akaike AIC	7.09607	8.578075	5.344301	13.33846
Schwarz SC	7.609846	9.091848	5.858073	13.85224
Mean dependent	0.330780	13.00667	-0.013333	98.24333
S.D. dependent	9.186272	33.23827	4.411015	197.7896

Note: Standard Errors are in parenthesis and t- values are in brackets [ ].
/**/ = Significant at 10%, 5% and 1% levels with critical values of 1.282, 1.645 and 2.326 respectively. F- statistics significant at 10%, 5% and 1% with critical values of 2.16, 2.71 and 4.07**
Source: Authors' Estimation Results Using E-views 8.0, 2015.

The impact of economic growth in relation to lag values of RGPCR (-2.46940 and -1.86752) is positive and significant at 1% and 5% significance levels, respectively. However, the impact of government expenditure on education in relation to economic growth (- 0.94496 and 1.34731) is negative and insignificant in lag 1 period but positive as well as significant at 10% significance level in the lag 2 period. Note that this relationship exhibits a lesser impact in the VEC system without the dummy variable. Also, the impact of human capital development in relation to economic growth was negative and significant at 5% and 10% significance levels in both lags. Total tax revenue posts negative and significant impact on economic growth at 1% significance level at both lag periods. These findings of a negative relationship between economic growth and total tax revenue is contrary to the study's previous results in the VEC system without the dummy variable and this suggests that the global economic recession had adverse effects on Nigeria's total tax revenue.

More importantly, the global economic recession variable (represented with a dummy variable) reveals a negative relationship with economic growth, although the relationship is insignificant. Nevertheless, this negative relationship signifies a reduction in Nigeria's output growth during the recession. Note that a negative relationship as well as a significant impact is revealed between economic recession and government education expenditure at 5% significance level leading to a decline in government expenditure on education. For instance, the Central Bank of Nigeria reports that government recurrent expenditure on education falls from a high of N164.0 billion in 2008 to a low of N137.1 billion in

2009. These findings agree with those of previous studies which show an adverse effect of economic recession on Nigeria's economic growth.

The coefficients of determination (R^2) of 0.58, 0.86, 0.68 and 0.53 in the VECM which incorporates the economic recession dummy variable mean that the variables in the regression are only able to account for between 53% and 86% of the systematic variations in economic growth. The model incorporating a dummy variable representing economic recession shows F- Statistics of 2.66, 11.67, 4.16 and 2.21, but only two of them are significant at the 1% and 10% levels.

The RGPCR has adjustment coefficient of -0.34, which is rightly signed and significant at 1% level. It also lies between zero and unity as required by theory. The magnitude of the adjustment coefficient of the RGPCR equation indicates that the economy would adjust towards equilibrium 34% of an initial deviation in a given period. The size and sign of the absolute value of the coefficient of ECM associated with RGPCR indicates that in the event of displacement from equilibrium the speed of restoration to equilibrium is rather quite reasonable compared to that of GEXPE with coefficient of the absolute size of –1.00 (about 100% in absolute terms), though rightly signed and significant at 1% significance level but the speed of adjustment is overblown and the speed of restoration to equilibrium in case of a temporary disequilibrium may overheat the economy which is also an indication of the adverse effects of the global economic recession. This is evidenced by adjustment of the economy to change in GEXPE by about 43% before the introduction of the dummy variable into the VEC system as shown by the result in table 5 above.

The paper further conducts the co integrating regression of economic growth (RGPCR) on the other variables including the dummy variable, the lagged value of the residuals derived from the co integrating regression of GDP on GEXPE, HCD, TAX and D represented by C(1) which is also the ECM value. It is found to be negative, significant and ranges between 0 and 1 as required by theory, and it further validates the long – rum equilibrium relationship among the variables. Also, the coefficient of the dummy variable(C(11)) further substantiates the negative relationship between economic recession and economic growth. And the DW statistics of 1.75 also shows the absence of autocorrelation in the RGPCR equation in the VEC system.

Table 6: Analysis of the economic growth equation in the VEC System (incorporating the recession dummy variable)

Co integrating regression of economic growth on other exogenous variables is given as;

D(RGPCR) = C(1)*(RGPCR(-1) + 0.329626465339*GEXPE(-1) - 1.2925554515*HCD(-1) - 0.0704577086729*TAX(-1) + 87.616380135) + C(2)*D(RGPCR(-1)) + C(3)*D(RGPCR(-2)) + C(4)*D(GEXPE(-1)) + C(5)*D(GEXPE(-2)) + C(6)*D(HCD(-1)) + C(7)*D(HCD(-2)) + C(8) *D(TAX(-1)) + C(9)*D(TAX(-2)) + C(10) + C(11)*D

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.338673	0.120614	-2.807920	0.0112
C(2)	-0.440106	0.178224	-2.469399	0.0232
C(3)	-0.332773	0.178190	-1.867519	0.0773
C(4)	-0.054565	0.057744	-0.944958	0.3565
C(5)	0.085230	0.063259	1.347306	0.1937
C(6)	-0.844534	0.589093	-1.433618	0.1679
C(7)	-1.270878	0.660900	-1.922951	0.0696
C(8)	-0.039639	0.014407	-2.751325	0.0127
C(9)	-0.031000	0.012056	-2.571229	0.0187
C(10)	6.470784	2.271365	2.848853	0.0103
C(11)	-2.384277	8.587569	-0.277643	0.7843

R-squared	0.583828	Mean dependent var	0.330780
Adjusted R-squared	0.364789	S.D. dependent var	9.186272
S.E. of regression	7.321468	Akaike info criterion	7.096074
Sum squared resid	1018.474	Schwarz criterion	7.609846
Log likelihood	-95.44111	Hannan-Quinn criter.	7.260434
F-statistic	2.665415	Durbin-Watson stat	1.754596
Prob(F-statistic)	0.031651		

Short-run analysis of the relationship between economic growth and the global economic recession of 2008 to 2009.

Lastly, the short run significance of the inclusion of a dummy variable (D) in the economic growth equation in the VEC system is investigated with the use of the Wald test. This was analyzed with the formulation of the following null hypotheses: There is no significant relationship between the dummy variable representing the global economic recession (during the 2008 to 2009 period) and economic growth in Nigeria.

Table 7: Wald test of the significance of the relationship between economic growth in Nigeria and the global economic recession of 2008-2009.

Equation: d(rgpcr) = c(10) + c(11)*D

Test Statistic	Value	Df	Probability
F-statistic	4.120759	(2, 19)	0.0326
Chi-square	8.241519	2	0.0162

Null Hypothesis: C(10) = C(11) = 0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(10)	6.470784	2.271365
C(11)	-2.384277	8.587569

Restrictions are linear in coefficients.

Table 7 shows the test of the null hypothesis [with a normalized restriction: C(10) = C(11) = 0], where C(11) is the coefficient of the dummy variable. It is evident, with the probability values of the Wald test statistics less than 5%, that the dummy variable is significant in explaining the short-run effects of the global economic recession on economic growth. As a result of this, the null hypothesis of no significant relationship between the global economic recession and Nigeria's economic growth is rejected. In particular, the negative value (-2.384277) of the normalized restriction of the null hypothesis shows that a negative relationship exists between economic recession and economic growth in Nigeria. The implication of this analysis is that the global economic recession of 2008 to 2009 did indeed have a significant adverse impact on Nigeria's output growth.

5.0 POLICY IMPLICATIONS AND RECOMMENDATIONS

The findings of this study have the following implications;

1. The main implication of the findings is that including both sides (public expenditure on education and taxation) of the budget is important for proper analysis of the growth effects of public expenditure in Nigeria.
   The impact of total tax revenue in relation to human capital development, government expenditure on education and real gross domestic per capita growth rate is huger. In contrast, the global economic recession of 2008 to 2009 had a smaller though adverse impact on total tax revenue, government education expenditure and human capital development, and on economic growth. These demonstrate that

an ineffective tax administration, planning and policy making, as well as economic recession, may retard the growth of the country through the dearth of tax revenues to finance education

2. Human Capital Development is significantly responsive to public spending on education in Nigeria. Its impact is quite impressive though with low speed of adjustment in case of any temporary displacement from equilibrium. The implication is that reluctance of the Nigerian government to upwardly review budgetary allocations to the education sector as well as the decline in the recurrent education expenditure in 2009 as a result of the global economic recession may be inimical to the growth of human capital and the economy.
3. The speed of adjustment of the growth rate of RGDP per capita is low compared to that of government expenditure on education. The implication is that inability of the ministries, departments and agencies of government saddled with the responsibilities of managing the budgetary allocations to the education sector to do effectively perform their duties would have deleterious impact on national development.

In view of the above findings and their implications, the recommendations of this study include:

1. The government should design an appropriate expenditure programme on education matched by a financing plan and a programme to generate the needed taxes – in order to stimulate economic growth.
2. The government should restructure its expenditure framework to be more growth oriented and future oriented in order to avoid continuous decline in the growth rate of real gross domestic product per capita. In particular, government should pay attention to policies that would expand the 'tax net' in a manner consistent with the country's macroeconomic goals and aspirations.
3. The multiplier accompanying the increase of government spending on education should be successively raised especially in periods of low effective demand and high unemployment. In other words, government should design and implement a forward-looking fiscal policy in order to better provide for manpower training, research and development.

It is believed that, if religiously implemented, these recommendations would to a large extent facilitate the achievement of the country's goal of rapid growth and development.

6.0 CONCLUSION

This study has analyzed the dynamic responses, causality and interrelationships among government expenditure on education, taxation and economic growth in Nigeria in the period 1981 - 2013. In order to achieve needed results, unit root testing, co-integration, VEC Granger causality and the VECM have been employed. The empirical results show that all the variables are stationary in their first difference, and that all the variables are co-integrated. Thus, the co-integration test reveals the existence of a long run equilibrium relationship among the variables.

The VEC causality test reveals that causality runs from human capital development to government expenditure on education, and also from total tax revenue to real GDP per capita growth rate, as well as from government expenditure on education to total tax revenue. The Forecast Error Variance Decomposition further indicates that the predominant variations in Nigeria's expenditure on public education and the growth rate in per capita real GDP are largely due to the rising trends in the country's tax revenue profile, and also variabilities in the shocks of economic growth. The VECM estimation evaluates the dynamic adjustment of the multivariate model. The study finds that the economy adjusts at a moderate pace to a disequilibrium in the country's expenditure on education, and that the responsiveness of government expenditure on education is significant. The predictability of the system is found to be good, reliable, dependable and robust for policy making, analysis and prescription.

The findings of the study have important implication that border on adoption of appropriate macroeconomic policy measures such as the design of a suitable government spending on education matched by an increase in taxes, restructuring of government expenditure framework, focusing on the expansion of government 'tax net' and implementation of a forward-looking fiscal policy which would be consistent with the country's long-run macroeconomic goals.

REFERENCES

Barro, R.J. (1990), 'Government Spending in a Simple Model of Endogenous Growth', The *Journal of Political Economy*. Vol. 98 No. 5 Pp 102 – 125

Basu P and Bhattarai K (2010), 'Does Government Spending on Education Promote Growth and Schooling Returns?' http://tippie.uiowa.edu/economics/tow/papers/basu-spring2010.pdf

Biggs, M.L and Dutta, J. (1999), 'The Distributional Effect of Education Expenditure' *National Institute Economic Review*. No 169 Pp 68 – 77

Blankenau W.F., Simpson B.N and Tomljanovich M.(2007), ' Public Education Expenditure, Taxation and Growth: linking data to theory', *The American Economic Review*. Vol 97, No 2 Pp 393 – 397.

Bleaney, M, Gemmell, N and Kneller, R. (2001), 'Testing the endogenous growth model: Public Expenditure, Taxation and Growth over the long run', *The Canadian Journal of Economics,* Vol. 34 No. 1 Pp 36 – 57. http://www1.worldbank.org/publicsector/pe/pfma06/cje.pdf

Corsetti, G and Roubini, N. (1996), 'Optimal Government Spending and Taxation in Endogenous Growth Models', *National Bureau of Economic Research*. Pp 1 – 38. http://www.nber.org/papers/w5851.pdf

Davin, M. (2013), 'Public Education Spending, Sectoral Taxation and growth'. https://halshs.archives-ouvertes.fr/halshs-00881048/document

Engle, R. F. and Granger, C.W. (1987), 'Co-integration and Error – Correction representation Estimation and testing', *Econometrica*, Vol. 5 No, 2 Pp 251 – 276.

Hibbs, D.A and Madsen, H (1981),'Public Reactions to the Growth of Taxation and Government Expenditure', *World Politics* Vol. 33 No. 3 Pp 413 – 435

Johansen S (1991), 'Estimation and Hypothesis Testing of Co – integrating Vectors in Gaussian Vector autoregressive models', *Econometrica.* Vol 59 No 6. Pp 1551 - 1580

Karras, G. and Furceri, D. (2009), 'Taxes and Growth in Europe', *South – Eastern Europe Journal of Economics. Vol. 2 Pp* 181 - 204

Kim, J.Y (2015), "World Bank, IMF Berth with Joint Initiative to support Developing Countries strengthen tax system", *Business Day Newspaper*. P. 20, July 15

Lagarde, C. (2015), 'World Bank, IMF Berth with Joint Initiative to support Developing Countries strengthen tax system'**,** *Business Day Newspaper*. P. 20. July 15

McDonald, M.B (1980), 'Educational Equity and Fiscal Incidence of Public Education', *National Tax Association.* Vol. 33 No, 1 Pp 45 – 54, http: //www.jstor.org/stable/41862282

Mekdad, Y, Dahmani A and Louaj M (2014), 'Public Spending on Education and Economic Growth in Algeria: Causality Test', *International Journal of Business and Management*. Vol. 2 No.3 Pp 55 -70. http://www.iises.net/download /Soubory/soubory-puvodni/pp55- 70_ijobmV2N3.pdf

Mehrotra, S (2004), 'Reforming Public Spending on Education and Mobilizing Resources: Lesson from International Experience', *Economic and Political Weekly*. Vol. 39 No. 9 Pp 987 – 997.

Musaba, E.C, Chilonda P and Matchanya G. (2013), "Impact of government sectoral expenditure on economic growth", *Journal of Economics and Sustainable Development*. Vol. 4 No, 2
Pp 71 -79.

Olulu, R.M, Erhieyovwe, E. K and Andrew, U (2014), 'Government Expenditures and Economic Growth: The Nigerian experience", *Mediterranean Journal of Social Sciences*. Vol. 5 No. 10 Pp 89 – 94. http://www.mcser.org/journal/ index.php/mjss/article/viewFile/2871/2833

Sims, R (2004), 'School funding, Taxes, and Economic growth: An analysis of the 50 States, *NEA Research Working Paper* Pp 1 – 27.
http://www.nea.org/assets/docs/HE/schoolfunding.pdf

Yakubu, M.M and Akanegbu, B.N (2015), 'Education Expenditure and Economic Growth in Nigeria: Granger Causality analysis', *Journal of Management and Economics*. Vol. 3 No. 4 Pp 1 -6.

WORKERS' REMITTANCE AND AGGREGATE DEMAND: THE CASE OF NIGERIA

By Sowemimo J. E. and Adegboye A. C.[1]

Abstract
In recent years, the focus of policy makers on external financial inflows seems to have shifted remarkably to workers' remittances which have become highly relevant as an external input, especially to developing countries. A simultaneous equations technique is adopted in the study based on annual data for Nigeria in the period 1980 through 2012. The results show a clear pattern of effects from remittances: it has direct positive and significant impacts on consumption, investment, and import demand in Nigeria. More importantly, the multiplier effects of remittances are shown to be quite strong whether based on current elasticities or long run relationships. Apparently, remittances have viable growth enhancing tendencies in Nigeria and can be used as a veritable instrument for addressing short run output shocks and even long run growth.

***Keywords**: Remittances, economic growth, simultaneous equations model, Nigeria*
***JEL Classification**: E2, F43, R23*

I. INTRODUCTION

The growth dynamics of a small open economy such as that of Nigeria is often evaluated by relying heavily on external resource inputs – whether investment, debt accumulation, or transfers. These external sources of funding have created a veritable outlet for a variety of theoretical and empirical research with a vast amount of outcomes. In recent years, the focus on external financial inflows has shifted remarkably to workers' remittances which have become highly relevant as an external input, especially to developing countries. International remittances are transfers of funds by workers (remitters) who are living and working in developed countries typically to their families who are still living in their home countries (Karagoz, 2009).

Indeed, studies have indicated the extensive influence remittances have had on overall external sector performances in recent years. Remittances have contributed large proportions to financial flows in developing countries: during the first decade of the 21st century, remittance flows contributed on average, "about one third of export earnings, more than twice private capital flows, almost 10 times official capital flows, and more than 12 times official transfers" (Barajas

[1] Sowemimo J. E. is of the department of Economics and Statistics, University of Benin, Benin City, Edo State, Nigeria. Adegboye A. C. is of the Department of Economics, Adeyemi College of Education, Ondo State. The views expressed in the paper are those of the authors and do not represent the views of the institutions where they work. E-mail: eseosaidemudia@uniben.edu, cornabi@gmail.com.

et al 2009). Other studies such as those by Aggarwal, Demirgüç-Kunt and Peria (2003) and World Bank (2006) even reckon that remittances have recently become as large as foreign direct investment (FDI) flows to developing countries. Despite this fact that workers' remittance represent a resource inflow which exceeds a variety of other balance of payments flows, it has received scant attention from economists as well as policymakers (ibid, 2009).

In Nigeria, remittance inflows have contributed an increasingly larger proportion of the Gross Domestic Product rising from a paltry 0.03% in 1980 to 8.7% in 2010. The World Bank (2014) estimates that Nigeria alone accounts for around two-thirds of total remittance inflows to Sub Sahara Africa in 2014, receiving a total of $21 billion from its citizens living abroad as home remittance. Moreover, remittances inflows to Nigeria amounted to about 22 percent of receipts from petroleum exports in 2013. Apparently being such a huge portion of the much needed external finance in Nigeria, workers' remittances is expected to constitute a remarkable proportion of aggregate output and contribute significantly to annual economic performance. This therefore implies that empirical studies to these effects are quite germane not only to enrich literature, but also to provide templates for policies aimed at adjusting aggregate demand in the country.

Many reasons may be ascribed to this phenomenon of rising workers' remittance, a major factor being emigration. This has become a tangible option for many Nigerians as an avenue to escape the poor economic conditions at home, to pursue better educational qualifications and skills and sometimes even to escape religious/political or tribal persecutions. Generally, migrants remit income back to their home countries to repay loans acquired to facilitate the emigration, to support family left behind and for some, to put up a nest egg for their eventual return. On this basis Yang (2006) indicates that relative to private capital flows, remittances tend to be stable and to increase during periods of economic downturns and natural disasters (see Yang, 2006). In the same vein, reflecting its percolating nature, remittances do not seem to have adverse effects as surges in other external inflows, including aid flows, which can erode a country's competitiveness (see Rajan and Subramanian, 2005).

In the light of the foregoing, remittances have poverty-alleviating and consumption-smoothing effects on recipient households. However, as Barajas et al (2009) note, the macroeconomic impacts of remittances are not well understood, even though their benefits to individual households and communities have been well demonstrated. This is confirmed by the limited literature on the issue, especially in Africa. Durand, Kandey, Parrado and Massey (1996), on the other hand, in their succinct statement capture the key ways in which remittance can affect the state of an economy : "As they elevate a family's standard of

living, contribute to business formation and lead to community improvements, [remittances] represent a tangible accomplishment." This gives additional impetus to the examination of the macroeconomic effects of remittance inflows to Nigeria.

Following on these, the paper therefore seeks to investigate the remittance-aggregate performance behaviour in Nigeria under the dynamic Keynesian simultaneous equation model and to see how this growing revenue source can be better annexed to improve the economic fortunes of Nigeria. The rest of the study is organised thus, section II presents the review of relevant literature. Section III is the theoretical framework and model specification. Section IV is the presentation and analysis of results. Section V concludes.

II. REVIEW OF LITERATURE

2.1 Theoretical and Empirical Literature

The literature on remittance looks at the phenomenon from two fronts, the microeconomic viewpoint and the macroeconomic perspective. The microeconomics of remittance see remittance behaviour as being driven by a variety of motives among which are altruism, exchange, insurance/moral hazard, investment/loan repayment and finally, inheritance. (Rapoport and Docquier (2005). Funkhouser(1995) proposes a behavioural model of remittance based on the following observable premises; emigrants with higher earning potential will remit more; low income households will receive more; remittance should increase with both the degree of proximity between the migrant and the remaining household members and the migrant's intention to return; remittance by a given migrant should decrease with the number of emigrants from the same household and finally; the time profile of remittances should depend on the comparison between the migrant's time discount factor and their earnings profile abroad.

In the empirical literature, Lucas and Stark (1985) establish the various motives to remit using Botswana as a case study. They find that remittance rose with migrants' earnings, level of education and even their gender. Their results also confirm the insurance hypothesis that remittance tend to increase during economic downturns as migrants increase their send outs to support those left behind. Other works that find positive relationships between remittance levels and recipients' incomes in developing countries include Cox (1987); Cox and Rank (1992); Cox, Eser and Jimenez (1998). This may be explained by the fact that past remittances have contributed significantly to today's income (Rapoport and Docquier, 2005). Ilahi and Jafarey (1999) find evidence to support the loan repayment or investment theory of remittance in their study on Pakistan. They find

that intending migrants borrow from close relatives as well as extended family to meet their travel costs and hence need to remit large sums to pay back.

On the other hand, the macroeconomics of remittance examines how inflows from migrants can affect the home country economy. Traditionally, it was thought that remittance was purely a microeconomic phenomenon considering that inflows were targeted at consumables and had little or no impact on the economy as a whole. However, when remittances become a sizeable source of foreign exchange, it will impact standard macroeconomic variables such as exchange rate, consumption, investments as well as GDP. (Rapoport and Docquier, 2005).

The macroeconomic analysis of remittance mainly either seeks to establish short-run effects or long-run dynamics. Glytsos (2002) in a study involving seven Mediterranean countries find that the impact of remittance on aggregate consumption, investment, imports and output varies from country to country with two countries showing remittance heavily influencing output. Adelman and Taylor (1992) reach similar conclusions; in their findings using data from Mexico, they establish that each dollar of remittance has a multiplier effect of 3 on output. In contrast, El-Sakka and McNabb (1999) in their own study using Egypt's 1967-1999 data conclude that imports financed with remittance have high income elasticity and therefore low multiplier effects.

The long-run view of remittance in the macroeconomic framework mainly seeks to establish the dynamic effects of remittance inflows overtime. Bohning (1975), Rempel and Lodbell (1978) are of the opinion that remittance has little or no dynamic effects. Their central argument is that income from remittance is not productive, rather it goes into the service of consumption, increased idleness and dependency amongst the recipient communities and thereby reduces the available labour supply. However, over the next decade this view of remittance changed from its productive capabilities to its potential for reducing poverty and inequality. The potential as detailed in the studies by Stark, Taylor and Yitzhaki (1988), Taylor and Wyatt (1996); and Azam and Gubert (2005) is realised in the ability of remittance to improve the availability of credit and funds for investment in both human and physical capital. In this way, remittance improve the long run growth potential of the host economy (Rapoport and Docquier, 2005).

In their study, Barajas et al (2009) argue that remittances may not strongly serve to promote long-run economic growth. Their study tackles this question and addresses the main shortcomings of previous empirical work, focusing on the appropriate measurement, and incorporating an instrument that is both correlated with remittances and would only be expected to affect growth

through its effect on remittances. The results show that, at best, workers' remittances have no impact on economic growth. In this direction, Karagoz (2009) investigates whether workers' remittances have growth impact on Turkish economy, by using data for the 1970-2005 period. The time series regression findings show that remittance flow to Turkey had statistically meaningful but negative impact on growth.

In the case of Nigeria, Oshota and Badejo (2015) investigate the relationship between remittances and economic growth using an error correction modeling approach for the period 1981 to 2011. Their results reveal that remittances positively impact on the economic growth of Nigeria: a 1 percent increase in remittances would lead to a 0.19 percent increase in the RGDP in the long run. However, remittances were shown to have a significant negative relationship with output in the short run. Akonji and Wakili (2013) use the seemingly unrelated regression (SUR) analysis and Error Correction Model to study the impact of remittances on economic growth. The result also establishes a significant relationship between net remittance and economic growth.

Akinpelu and Ogunbi (2013) in their study investigate the impacts of remittance inflows on the economic growth of Nigeria using cointegration and causality tests. The result of the study reveal that there is a long run equilibrium relationship among the variables that are employed. Furthermore, a uni-directional causality from Gross Domestic Product to Remittance Inflows is observed. Ukeji and Obiechina (2013) investigate the impact of the workers' remittances on economic growth in Nigeria using an error correction methodology (ECM) over the period 1970 to 2010. The long-run static model and the short run dynamic model indicate that workers' remittances impact positively on economic growth.

2.2 Trends in Remittances and Aggregate Demand in Nigeria

A brief analysis of remittance trend and performance over the years is conducted in this section. Remittance inflows as proportion of overall GDP was low for Nigeria compared to the Sub Saharan Africa region during the 1980s as is shown in columns 2 and 3 in Table 1 below. The ratio, however, rose for Nigeria during the earlier part of the 1990s, perhaps due to greater liberalisation of the financial sector and improvement in domestic banking activities in the country, following the adoption of the structural adjustment programme (SAP) in the 1986 – 1998 period. Nigeria's ratio of remittances to GDP overtook that of SSA during the 1996-2000 period, although this was reversed I the next few years. The average ratio of remittance to GDP rose sharply between 2005 and 2009, reaching 11.12 percent. This value far exceeded the ratio for the region at 3.1 percent for SSA, even though the SSA ratio also rose during the period. The ratio has fallen since 2010

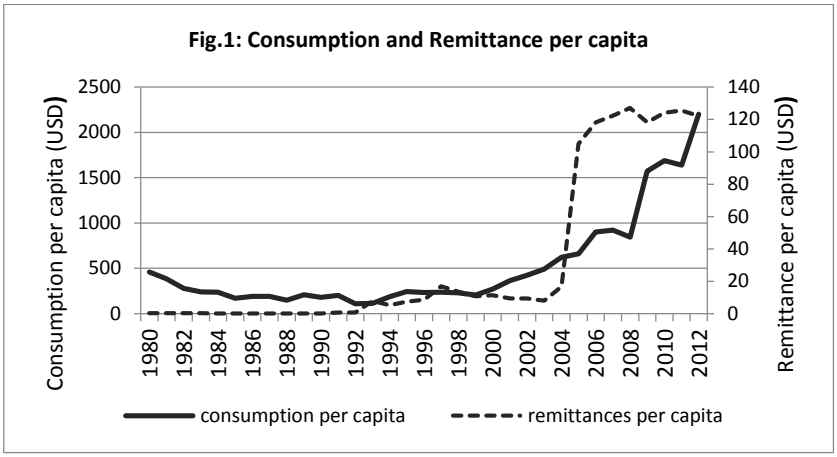
but that of Nigeria still remains higher than that average for the region. Remittances per capita follow a similar trend to the remittance-income ratio. In particular, it can be noticed that since the 2005-2009 period, per capita remittance inflow to Nigeria has remained higher than that of SSA. As a proportion of consumption expenditure, remittances have also followed the same trend with the other ratios. The obvious trend from the analysis is that since the sharp rise in remittance inflows in 2005, Nigeria enjoys higher remittance receipt relative to the general outlook in the SSA region.

Table 1: Trends in Remittance Ratios for Nigeria and SSA

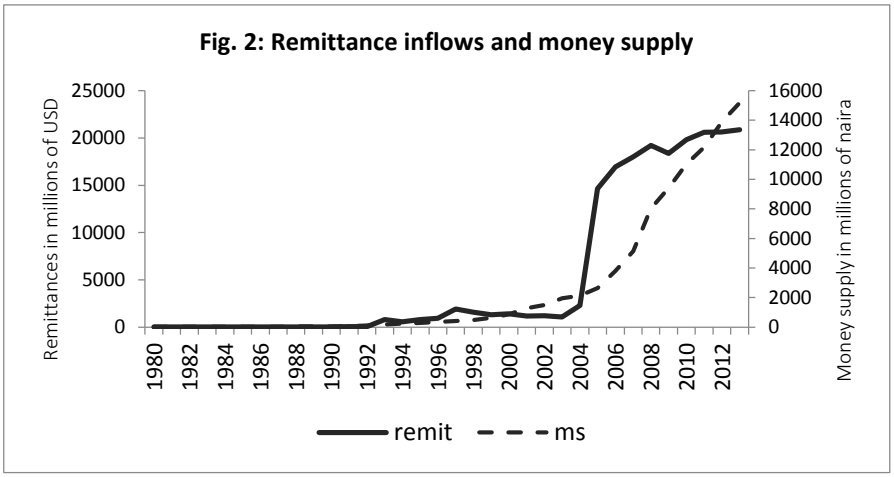
	Remittance income ratio		*Remittance per capita*		*Remittance as proportion of consumption expenditure*	
	Nigeria	**SSA**	**Nigeria**	**SSA**	**Nigeria**	**SSA**
1980-1989	0.03	1.64	0.14	11.88	0.05	2.76
1990-1995	1.89	2.20	3.61	15.61	2.25	3.35
1996-2000	3.92	2.00	12.19	14.61	5.25	3.03
2001-2004	2.21	2.28	10.83	17.95	2.27	3.75
2005-2009	11.12	3.10	118.13	42.34	12.98	5.66
2010	5.37	2.89	124.09	49.59	7.36	5.25
2011	5.01	2.84	125.58	53.10	7.66	5.18
2012	4.48	2.91	122.21	55.27	5.55	4.83
2013	4.06	2.97	120.32	55.28	6.43	5.09

Source: Author's computations based on *WDI* data

The pattern of flows of remittances into Nigeria is further illustrated by considering Nigeria's remittances per capita value with that of per capita consumption in Figure 1 below. Both values were low until consumption per capita started to rise in 2000 while remittances per capita had a sharp jump in 2004. The rise in remittance per capita was truncated in 2007, (reflecting the adverse impact the financial crises in that year) and has remained steady since then. Consumption per capita, however, has continued to rise since 2000. The chart gives indications that remittance inflows may not unconditionally be a major driving factor in aggregate consumption expenditure in Nigeria for the period.



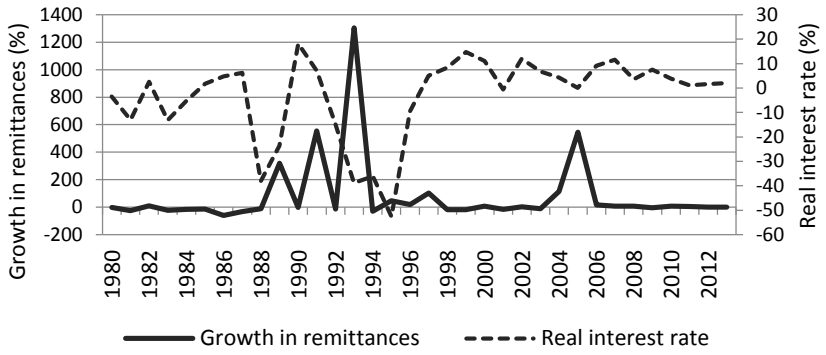
Since the financial sector is a primary factor in remittance inflows, the trends in money supply and remittance inflows to Nigeria may be shown in Figure 2. It can be seen that the two variables started to rise at about the same period. However, money supply has continued to rise steadily while remittances inflows have slowed down remarkably since 2007. The chart gives indication that broad money supply and remittance inflows may trend over time.



Furthermore, the trends in growth of remittance inflows and real interest rate in Nigeria are presented in Figure 3 below. A slight reverse trend can be observed in the chart in that period of rising remittances coincide with periods of lower real interest rate. For instance, while remittances were falling in 1992, real interest rate was rising quite rapidly. Apparently, the increased liquidity provided by

remittance inflows tends to help the banking sector reduce interest rates (Aggarwal, Demirguc-Kunt and Pería, 2006).

Fig. 3: Remittance inflows and real interest rate



III. THEORETICAL FRAMEWORK AND METHODOLOGY

3.1 Theoretical Framework

Theoretical foundations have given ample evidence that worker remittances could influence both Money supply or real interest rate, and economic growth, that is by directly financing an increase in capital accumulation relative to what would have been observed if the recipient economies had been forced to rely only on domestic sources of income to finance investment. Theory also indicates that remittance receipts could conceivably stimulate additional investment in the form of human capital accumulation. They could do so by financing the cost of this investment directly, or by reducing the need for younger members of the household to abandon formal schooling in order to work and contribute to household income. However, the effects on domestic economic growth will depend on the recipients' subsequent participation in the domestic labour force. In the case of the effect of remittances on the growth process, if domestic sector gain access to external financing, the savings gap could be overcome by financing domestic (excess) investment out of the savings by nationals in high income foreign countries. This is the channel this paper mainly pursues through which remittances may exert indirect positive impacts on economic growth.

3.2 Model Specification

Following the works of Glytsos (2002), Tansel and Yasar (2010), the paper adopts a modified dynamic simultaneous equation to capture the effects of remittance

on key macroeconomic variables. The study starts with the basic Keynesian identity:

$$Y = C+I+G+X-M$$

The model is expanded further to incorporate three behavioural equations consisting of the consumption function, the investment function and the import function.

$$C_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 C_{t-1} \quad 1$$

$$I_t = \beta_0 + \beta_1 Y_t + \beta_2 I_{t-1} \quad 2$$

$$M_t = \Lambda_0 + \Lambda_1 Y_t + \Lambda_2 Y_{t-1} + \Lambda_3 M_{t-1} \quad 3$$

$$Y_t = C_t + I_t + G_t + X_t - M_t - XR_t + R_t \quad 4$$

Where C, I, M and Y are endogenous variables, C is private consumption, I is domestic investment, M is imports and Y is GDP proxied by GDPPC[4]. G is government expenditure, X is export, XR is exchange rate and R stands for remittance. The remittance variable, R is brought into the reduced form equation to indicate that the ultimate aim of the estimations is to identify the effects of remittances on growth in Nigeria. However, in order to observe the dynamic effects of remittance on the growth channels, the variable is introduced into each of the behavioural equations (1 - 3). The consumption function chosen is a dynamic long-run partial adjustment function and this is necessary for us to be able determine short run and long-run effects of income on consumption.

According to Stewart and Gill (1998), the equilibrium relationship between C and Y may be defined as

$$C_t^* = \beta_1 + \beta_2 Y_t \quad \ldots\ldots\ldots\ldots\ldots\ldots 5$$

Remittances is part of inflows of disposable income to the households in a stable form (see Ratha, 2003) and thus, it enters into the consumption function to constitute part of wealth. The introduction of wealth and current income into the model implies that a dynamic form is devised for the consumption function. Then, the dynamic adjustment process is defined by the partial adjustment model

$$\Delta C_t = \lambda(C_t - C_{t-1}) + \mu_t \quad \ldots\ldots\ldots\ldots\ldots 6$$

λ tells us the portion of the deviation that is adjusted in any one period. Substituting equation 5 into 6 and adding the remittance variable,

$$C_t = \theta_1 + \theta_2 R_t + \theta_2 Y_t + \theta_3 C_{t-1} + \mu_1 \quad \ldots\ldots\ldots\ldots\ldots 7$$

The investment function derived also includes the remittance variable and an income adjustment variable and is specified as:

$$I_t = \pi_0 + \pi_1 R_t + \pi_2(Y_t - Y_{t-1}) + \mu_2 \quad \ldots\ldots\ldots\ldots\ldots 8$$

[4]GDPPC is selected because it is a useful measure for capturing the wellbeing of people within an economy. It is likely to give a better picture of the possible impact of remittance on units within the society.

The relevance of exchange rate in the foreign sector is considered in the import equation, hence exchange rate is included in the equation as well as remittance and a lagged import variable.

$$M_t = \delta_0 + \delta_1 R_t + \delta_2 Y_t + \delta_3 EXR_t + \mu_3 \quad \text{.....9}$$

Equations 7-9 may be expressed in a reduced form dynamic structural model as

$$Z_{it} = \upsilon_0 + \upsilon_1 C_{t-1} + \upsilon_2 Y_{t-1} + \upsilon_3 M_{t-1} + \upsilon_4 I_{t-1} + \upsilon_5 G_t + \upsilon_6 X_t + \upsilon_7 XR_t + \upsilon_8 R_t \text{.....8}$$

Where Z is any of the endogenous variables C, I, M, Y. The parameter υ is the partial derivative of the endogenous variable Z_{it} with respect to any of the exogenous variables. The partial derivative helps us to measure the multiplier effect of a unit change in any of our exogenous variable on the endogenous variable Z_{it} (see Glytsos (2002) for a more detailed explanation).

3.3.1 Equations and Variables used in the Model

The system of equations above is a simple macro econometric model slightly modified by introducing remittances as an additional source of income for consumption, investment and import purposes. In all, there are four endogenous variables in the model namely, consumption (C), investment (I), aggregate import demand (M) and aggregate income (Y). Consumption is the final private consumption expenditure, investment is proxied by the gross fixed capital formation, import is the gross import of goods and services, and aggregate income is real GDP. Each of the variables is measured in millions of naira. The predetermined variables are either lagged endogenous (C_{t-1}, M_{t-1} and Y_{t-1}) or current exogenous, including remittances (R), exchange rate (EXR), government expenditure (G), and export (EXP). All the variables are taken in log form since the model is an aggregate demand function in general and the coefficients are expected to be elasticities.

In the consumption equation, remittances, current income and lagged consumption are the determinant factors and each of the independent variable is expected to have a positive impact of consumption. Indeed, in each of the equations, remittances are expected to either enhance or augment the endogenous factor since remittances are part of income either at the private or aggregate level. Since the investment equation is a modified accelerator function, the coefficient of output growth is expected to be positive. For the import equation, both current income and lagged import should exert positive effects on current import demand, but in line with the theoretical postulations, exchange rate depreciation should reduce import demand. Hence the coefficient of EXR in the demand equation is expected to be negative. Finally, for the equilibrium equation all coefficients are expected to be positive in line with

Keynesian determination. A look at the equations in the model indicates that each is over-identified.

3.4 Estimation Techniques and Data

This study adopts the two stage least squares (2SLS) and the Seemingly Unrelated Regressions (SUR) technique in other to solve the twin problem of endogeneity and OLS bias inherent in simultaneous equation modelling (Intriligator et al, 1996). The application of the SUR method proposed by Arnold Zellner (1962) is to ensure robustness of the results from which inference may be drawn. SUR methodology is suitable for simultaneous multivariate macro-econometric models as it makes allowances for the possibility of correlation in the error terms. Akonji and Wakili (2013) also adopt this method on a two-equation estimation of the remittance, real income and growth nexus. The data used in the study are initially tested for time series properties. The results shown in the Appendix indicate that though the series possess unit roots, a long run relationship exists among the variables under each of the equations. This enables us estimate the long run relationships in the system using level variables.

Data on workers' remittances are sourced from the World Bank *Migration and Remittances (2014) database*. The other data used in the analysis are sourced from the Central Bank of Nigeria *Statistical Bulletin*. The data are annual time series and are obtained for the period 1980 to 2012.

IV. EMPIRICAL ANALYSIS

The results are herewith presented of the 2SLS and the SUR technique estimation for the GDP equation, the consumption function, the import function and the investment function in separate tables. Variables are logged for a standardized estimation and analysis.

4.1 The Consumption Equation

In table 1 below, the result of the consumption equation is reported. Clearly, the SUR results report better coefficients of the estimates. The diagnostic statistics for the results are quite impressive considering the high adjusted R squared value in the Sur estimates.

TABLE 1: THE CONSUMPTION EQUATION

Variables	**Two Stage Least Squares**		**Seemingly Unrelated Regressions**	
	Coefficient	*T-ratio*	*Coefficient*	*T-ratio*
CONSTANT	5.038	2.345	6.480	4.647
LREMIT	0.058	3.452	0.049	3.890
LGDPPC	0.069	0.674	0.201	3.477
LCONS (-1)	0.469	2.034	0.304	2.078
R-SQUARED	0.890		0.980	
ADJ. R-SQAURED	0.878		0.978	
S-E OF REGRESSION	0.145		0.364	
DURBIN-WATSON	2.238		1.422	

Source: Estimation Output

Each of the coefficients is positive and significant at the 5 percent level. More importantly, the coefficient of remittance indicates that a percentage increase in remittance inflows leads to a 0.05 percent increase in aggregate consumption in Nigeria. Apparently, increased inflow of remittances boosts consumption expenditure in Nigeria. The income coefficient is also positive, confirming the theoretical postulation of a direct relationship between income and consumption. The coefficient value is, however, relatively low, suggesting a marginal propensity to consume of just 0.2 percent. This value can, however, be rationalised considering that a lagged consumption variable is included in the model which may appropriately absorb any large effects that current income levels may have on consumption expenditure.

4.2 The Investment Equation

In the investment equation is shown in Table 2 below and focuses on the SUR results. The remittance coefficient is significant at the 5 percent level and easily passes the significance test. The coefficient of remittance in the investment equation is higher than that of consumption equation. This indicates that remittance may exert more direct impact on investment expenditure than consumption in Nigeria. With the results, a percentage rise in remittance inflow will cause investment to increase by about 0.62 percent. The income adjustment factor fails the test in the equation, suggesting that income growth may not have strong effects on investment in Nigeria. These results also give credence to the ability of remittance to fill the savings-investment gap in Nigeria since remittances

do not only act to augment consumption but also promotes savings that are transferred to investment.

TABLE 5.4: INVESTMENT EQUATION

Variables	**Two Stage Least Squares**		**Seemingly Unrelated Regressions**	
	Coefficient	*T-ratio*	*Coefficient*	*T-ratio*
CONSTANT	-6.764	-7.638	-7.085	-10.59
LREMIT	0.566	10.39	0.618	18.60
LGDP – LGDP(-1)	1.311	2.238	0.086	0.784
R-SQUARED	0.915		0.919	
ADJ. R-SQAURED	0.909		0.913	
S-E OF REGRESSION	0.602		0.592	
DURBIN-WATSON	1.753		0.815	

Source: Estimation Output

4.3 The Import Equation

It is also argued in this study that remittance from abroad can also be a major factor in stimulating import demand in Nigeria. The import equation is reported in Table 3 below and indicates a positive and significant impact of remittances on imports demand in Nigeria. The coefficient shows that a percentage increase in remittances generates 0.38 percent rise in import demand and the same percentage increase in income per capita leads to 0.23 percent rise in import demand. This result indicates that the impact of remittances on import is greater than that of income. Thus, import expenditures respond more to remittance inflows (which are considered to be more stable) than per capita income. The easy access to foreign exchange that remittances afford may have contributed to the strong effect of remittances to growth in Nigeria. Exchange rate has a surprising positive coefficient, suggesting that depreciation would lead to rise in demand for import in Nigeria.

TABLE 3: IMPORT EQUATION

Variables	**Two Stage Least Squares**		**Seemingly Unrelated Regressions**	
	Coefficient	*T-ratio*	*Coefficient*	*T-ratio*
CONSTANT	-5.583	-5.17	-5.199	-7.84
LGDPPC	0.048	0.26	0.238	2.35
LREMIT	0.470	4.67	0.381	8.02
LEXR	0.561	4.16	0.631	9.45
R-SQUARED	0.974		0.980	
ADJ. R-SQAURED	0.971		0.978	
S-E OF REGRESSION	0.413		0.364	
DURBIN-WATSON	1.421		1.422	

Source: Estimation Output

4.4 The GDP Equation

The result of the GDP equation is reported in Table 4 below. Only government expenditure coefficient fails the significance test at the 5 percent level. The coefficient of net export is negative and it shows that international trade may have negative effects on income levels in Nigeria. The investment and consumption coefficients are positive as expected and significant with that of consumption greater than one. This indicates that aggregate income elasticity with respect to consumption expenditure is more than unity. Thus, an increase in aggregate consumption will lead to a *more than proportional* increase in national income in Nigeria. Another indication from the results is that since remittances have positive effects on both consumption and investment, the indirect impact of the variable on aggregate income through consumption and investment will be positive. However, the indirect impact of remittances on aggregate income through the import equation will be negative. The income equation also has impressive adjusted R squared value (for the SUR) estimates at 0.76.

TABLE 4: GDP EQUATION

	Two Stage Least Squares		**Seemingly Unrelated Regressions**	
Variables	*Coeffi cient*	*T-ratio*	*Coefficient*	*T-ratio*
CONSTANT	7.574	0.42	-12.32	-2.962
LDINV	1.778	2.27	0.479	2.356
LCONS	0.736	0.57	1.811	5.989
LGEXP	0.814	0.81	0.161	0.787
LEXPORT-LIMPORT	-1.612	-2.97	-0.334	-3.205
R-SQUARED	0.708		0.787	
ADJ. R-SQAURED	0.664		0.755	
S-E OF REGRESSION	0.449		0.379	
DURBIN-WATSON	1.506		1.15	

Source: Estimation Output

4.5 Output Multipliers

The general aim of the study is to observe the overall impact of remittances on income levels in Nigeria and thereby determine the growth effects of remittances. The previous analyses have discussed the results of the individual equations in the model and highlighted the positive and significant impacts of remittances in each of the channels identified through the behavioural equations. The multiplier analysis conducted in this section focuses on collapsing the first three equations in the model into the income (Y) equation in order to observe the overall effect of remittances on income. The output (income) multipliers results are shown in Table 5 below.

The current and long run (steady-state) multiplier coefficients are reported. The multiplier coefficient for remittances is quite high at 0.79 for current and 0.57 for steady state. Thus, a percentage rise in remittance inflows will generate a 0.79 percent growth in per capita income in the short run and 0.57 percent growth in the long run. These are quite high elasticities and it expressly shows the ability of remittance inflows to boost income growth in Nigeria both in the short run and in the long run. Indeed, only the multiplier coefficient of lagged consumption exceeds that of remittances; neither government expenditure nor exports have higher multipliers than remittances. This result corroborates the assertion by a World Bank (2014) report that indicates that remittance inflows (in volume) compete favourably with oil export revenues in Nigeria. This study has generally

shown that the multiplier effects of remittances are quite higher than that of exports in the country.

The results obtained above can be easily rationalised. First, it has been shown that remittance inflows operate significantly through each of the channels of aggregate expenditure in the economy. Remittances appear to have more direct impacts on aggregate expenditure because it is not generally encumbered by the challenges often associated with other external finances. For instance, the effects of foreign aid inflows have been known to be nullified by mismanagement and inefficient use by recipient governments (Hadjimichael et al., 1995; Hansen and Tarp, 2000; and Hudson and Mosley, 2001). Moreover, remittances boost individual households' access to better living and could reduce poverty levels.

Table 5: Output Multipliers

	Remittance	C_{t-1}	***GEXP***	***EXRT***	***EXPORT***	GDP_{t-1}
Current	0.79	1.71	0.49	-0.65	0.75	-0.38
Steady state	0.57	1.24	0.36	-0.47	0.54	-

Source: Author's computations

V. CONCLUSION

In this study, the growth effects of workers' remittances inflow to Nigeria have been examined. Workers' remittances have become a rather unique external resource inflow in two ways. First, it has risen remarkably over the last decade, not only in Nigeria, but all over the LDCs, thus becoming a major source of external finance available to these countries. Second, remittance inflows constitutes a unique external financing structure that provides better leverage for reaching households and businesses in LDCs. Focusing on Nigeria, a simultaneous equations technique was adopted in the study using annual data for the period 1980 to 2012. The results show a clear pattern of effects from remittances: it has direct positive and significant impacts on consumption, investment, and import demand in Nigeria. More importantly, the multiplier effects of remittances were shown to be quite strong whether based on current elasticities or long run relationships. Apparently, remittances have viable growth enhancing tendencies in Nigeria and can be used as a veritable instrument for directing short run output shocks and even long run growth. The study therefore suggests that channels of remittance receipts should be improved and a better linkage with the formal sector devised in the country.

REFERENCES

Adelman, I., and J.E. Taylor. (1992), "Is Structural adjustment with a human face possible? The case of Mexico", *Journal of Development Studies*. 26: 387-407

Aggarwal, R., Demirguc-Kunt, A. and M. S. M. Pería. (2006), "Do Workers' Remittances Promote Financial Development"?, *World Bank Policy Research Paper* 3957 (Washington: World Bank).

Akinpelu, Y.A., O.J Ogunbi, B. Oladejo and O.S. Omojola (2013), "Effects of Remittance Inflows on Economic Growth of Nigeria", *Developing Country Studies,* 3(3), 63 – 79.

Akonji, D.R. and Wakili A.M. (2013), "The impact of Net Migrant Remittance on Economic Growth: Evidence from Nigeria", *International Journal of Humanities and Social Science*, 3(8): 303 - 315

Anarfi, J., Kwankye, S., Ababio O. and Tiemoko R. (2003), "Migration from and to Ghana: A Background Paper", *Working paper C4*, Development Research Centre on Migration, Globalisation and Poverty.

Azam, J.P and F. Gubert (2002), "Those in Kayes. The impact of remittances on their recipients in Africa", *Working Paper DT/2002/11*, Development, Institutions et Mondialisation.

Barajas, A., R. Chami, C. Fullenkamp, M. Gapen and P. Montiel (2009), "Do Workers' remittances Promote economic Growth"?, *IMF working paper wp/09/153*.

Bohning, W.R. (1975), "Some thoughts on emigration from the Mediterranean Basin", *International Labour Review*, 111(3): 251-277

Cox, D. (1987), "Motives for Private Transfer", *Journal of Political Economy*, 95(30): 508-546.

Cox, D. and M. Rank (1992), "Inter-vivos transfers and intergenerational exchange", *Review of Economics and Statistics*, 74:305-314.

Cox, D., Z. Eser and E. Jimenez (1998), "Motives for private transfers over the lifecycle: An analytical framework and evidence from Peru", *Journal of Development Economics*, 55:57-80.

Durand, J., W. Kandel, E.A.Parrado and D.S. Massey (1996), "International Migration and Development in Mexican Communities", *Demography*. 33(2):249-264.

El-Sakka, M.I.T and R. Mcnabb (1999), "The macroeconomic determinants of emigrant remittances", *World Development*, 27(8): 1493-1502

Fayissa, B. and C. Nsiah (2008), "The Impact of Remittances on Economic Growth and Development in Africa", Department of Economics and Finance *Working Paper Series*. Middle Tennessee State University.

Funkhouser, E (1995), "Remittances from International Migration: A comparison of El Salvador and Nicaragua", *Review of Economics and Statistics,* 77(1): 137-146

Glytsos, N.P (2002), "Dynamic Effects Migrant Remittances on Growth: An Econometric Model with an Application to Mediterranean Countries. Centre for Planning and Economic", *Research Working Paper No. 74,* Greece.

Hadjimichael, M.T., D. Ghura, M. Muhleisen, R. Nord and E.M Ucer (1995), "Sub-Saharan Africa: Growth, Savings and investment", 1986-1993", *Occasional Paper 118*, International Monetary Fund.

Hansen, H and F. Tarp (2000), Aid and Growth Regressions. *DERG*, University of Copenhagen, Denmark

Hein, H. (2006), "International migration and national development: viewpoints and policy initiatives in countries of origin: the case of Nigeria", *Working Papers on Migration and Development Series,* Report 6.

Hudson, J.and P. Mosley (2001), "Aid, Policies and Growth: In search of the Holy Grail", *Journal of International Development,* 13: 1023-1038.

Ilahi, N. and S. Jafarey (1999), "Guest worker migration, remittances and the extended family: Evidence from Pakistan", *Journal of Development Economics*, 58: 485-512

Intriligator M.D, R.G. Bodkin and C. Hsiao. (1996), *Econometric Models, Techniques and Applications.* Prentice-Hall, Saddle River, NJ. 2nd Edition.

Lucas R.E.B and O. Stark (1985), "Motivations to remit: Evidence from Botswana", *Journal of Political Economy*, 93(5): 901 -918

Karagoz, K. (2009), "Workers' Remittances and Economic Growth: Evidence from Turkey", *Journal of Yasar University, 4(13), 1891-1908*

Meyers, D. W. (1998), "Migrant Remittances to Latin America: Reviewing the Literature". Inter- American Dialogue and The Tomas Rivera Policy Institute, Washington, D.C. May. www.thedialogue.org/publications/meyers.html.

Newland. K and Patrick. E. (2004), "Beyond Remittances: "The role of Diaspora in Poverty Reduction in their Countries of Origin", Migration Policy Institute.

Oshota, S.O. and Badejo, A.A. (2015), "Impact of Remittances on Economic Growth in Nigeria: Further Evidence", *Economics Bulletin*, 35(1): 247-258

Rajan, R. and A. Subramanian (2005), "What Undermines Aid's Impact on Growth"?, International Monetary Fund *Working Paper 05/126*.

Rapoport, H. and F. Docquier (2005), "The Economics of Migrants' Remittances", *IZA Discussion paper series*, No. 1531

Ratha, D. (2003), "Workers' Remittances: An Important and Stable Source of External Development Finance, in the Global Development Finance: Striving for Stability in Development Finance", Washington, D.C., World Bank, 157-175.

Rempel. H. and R. Lobdell (1978), "The role of urban – rural remittances in rural development", *Journal of Development Studies*, 14: 324-341

Russell, S. S. (1992), "Migrant Remittances and Development", *International Migration: Quarterly Review* 30(3/4): 267–87.

Solimano, A. (2003), "Workers' Remittances to the Andean Region: Mechanisms, Costs and Development Impact", Paper presented at the Multilateral Investment Fund-IDB's Conference on Remittances and Development, May, Quito Ecuador.

Stark, O., J.E Taylor and S.Yitzhaki (1988), "Migration, remittances and inequality: a sensitivity analysis using the extended Gini Index", *Journal of Development Economics*, 28:309-322

Stewart, J. and L. Gill. (1998), *Econometrics*. Financial Times Press, London, 2nd Edition.

Tansel, A. and P. Yasar (2010), "Macroeconomic Impact of Remittances on Output Growth. Evidence from Turkey". *Migration Letters*, 7(2): 132-143.

Taylor, J.E. and T.J. Wyatt (1996), "The shadow value of migrant remittances, income and inequality in a household-farm economy", *Journal of Development Studies*, 32(6): 899-912

Ukeje, E.U. and M.E Obiechina (2013), "Workers' Remittances – Economic Growth Nexus: Evidence from Nigeria, Using an Error Correction Methodology", *International Journal of Humanities and Social Science, 3(7): 97 – 116.*

World Bank (2006), "*The Development Impact of Workers' Remittances in Latin America*, 2: Detailed Findings", *Report No. 37026* (Washington: World Bank).

World Bank (2014), *Migration and Remittances Fact book 2014.* (Washington: World Bank)

Yang, D. (2006), "Coping with Disaster; The Impact of Hurricanes on International Financial Flows, 1970-2002", University of Michigan. Mimeo.

Zellner, A. (1962), "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias", *Journal of the American Statistical Association,* 57(298): 348 -368.

Appendix

1. ADF Unit Root Test

Variable	***ADF value at levels***	***ADF value at first difference***	***Order of integration***
lremit	-0.991	-6033*	I[1]
lgdp	1.395	126.9*	I[1]
lcons	-0.054	-7.439*	I[1]
ldinv	-2.009	-5.389*	I[1]
limport	-0.471	-6.553*	I[1]
Lgdppc	2.412	-5.549*	I[1]
Lexr	-1.766	-4.871*	I[1]
lexport	-0.771	-6.332*	I[1]
Lgexp	-0.813	-7.115*	I[1]

* indicates significance at 5 percent

2. Johansen Multivariate Test for Cointegration

Consumption eq.		**Investment eq.**		**Import demand eq.**		**Equilibrium eq.**	
Trace	*Max-Eigen*	*Trace*	*Max-Eigen*	*Trace*	*Max-Eigen*	*Trace*	*Max-Eigen*
*r = 0**	*r = 0**	*r = 0*	*r = 0*	*r = 0**	*r = 0*	*r = 0**	*r = 0*
r ≤ 1	*r ≤ 1*	*r ≤ 1*	*r ≤ 1*	*r ≤ 1*	*r ≤ 1*	*r ≤ 1**	*r ≤ 1*
r ≤ 2	*r ≤ 2*	*r ≤ 2**	*r ≤ 2**	*r ≤ 2*	*r ≤ 2*	*r ≤ 2*	*r ≤ 2*
						r ≤ 3	*r ≤ 3*
						r ≤ 4	*r ≤ 4*
						r ≤ 5	*r ≤ 5*

** denotes rejection of the hypothesis at 5% significance level.*

THE IMPACT OF FOREIGN AID ON TAX REVENUE IN NIGERIA

By [1]P.B. Eregha, PhD and Ijeoma Nwamaka Alajuronye*

Abstract

The study examines the relationship between foreign aid and tax revenues in Nigeria. Specifically, it has established whether there is significant difference in effects of foreign aid on direct and indirect tax revenue and to determine the overall effects of foreign aid on aggregate tax revenue in Nigeria. The study uses quarterly secondary time series for the period 1970(Q1) to 2012(Q4) on Nigeria collected from the ***statistical bulletin*** *published by Central Bank of Nigeria. A set of vector error correction mechanism (VECM) models which incorporates foreign aid, trade openness, exchange rate and per capital income as explanatory variables with aggregate tax, indirect and direct tax as the dependent variables, respectively is estimated. The time series properties of all the variables are examined and the impulse response and variance decomposition are also estimated and analysed. The stationarity and cointegration tests show that the series are integrated of order one I(1) and there is a significant long run relationship among the variables The results of error correction models show that foreign aid has negative and insignificant effects on direct tax and total tax revenue in Nigeria but in contrast a significant positive effects on indirect tax revenue. The impulse response results also show that foreign aid tends to enhance indirect tax both in the short and long run while the effect of foreign aid on direct tax is short-term and insignificant. The variance decomposition result further show that foreign aid is a major determinant of variation in indirect tax but less significant in explaining the variation in direct tax revenue. The aggregate tax revenue is also found to be less responsive to foreign aid stimulus. The study therefore concludes that though foreign aid might have impaired the effective mobilization of direct tax, it has complimented indirect tax revenues. The policy implication of the findings is that foreign aid might be more effective in stimulating aggregate demand capacity than boosting the aggregate supply since its effects are felt more on domestic consumption (indirect) than investment and labour supply related (direct) tax in Nigeria.*

KEY WORDS: Foreign Aid, Total Tax Revenue, Direct Tax Revenue, Indirect Tax Revenue

JEL CLASSIFICATION: E6, E61, E62, F35, H3, H2, H20, H24

1. INTRODUCTION

Foreign aid as an institution began in 1947 with the Marshall Plan, and almost immediately concerns were raised the impact of large amounts of aid on the behaviour and attitudes of recipient governments (Brautigam and Knack, 2004).

[1]Dr. P. B. Eregha and Ijeoma Nwamaka Alajuruonye are both of the Department of Economics, University of Lagos, Nigeria. The views expressed are those of the authors and do not represent those of the University of Lagos.

After the emergence of foreign aid, there were worries that the European countries were relying too much on external funding and not mobilizing resources domestically themselves for their recovery. As foreign aid expanded beyond Europe, other critics soon raised similar issues. Milton Friedman (1957) argues that by strengthening governments at the expense of the private sector aid would reduce pressure on the government to maintain an environment favourable to private enterprise, the engine of growth and ultimately of self-reliance. From the left, theorists also criticize the "pernicious dependency" syndrome created by the (capitalist) aid system, pointing out that aid creates vested interests such that only powerful classes in poor countries benefit from aid." This indicates that foreign aid is meant to be a form of relief to the government as an augmenting fiscal instrument for achieving macroeconomic objectives (Phirl and Tchereni (2013).

In the 1960s, as foreign aid flows across more developing countries, and as aid programs grew in importance, practitioners began to emphasize that foreign aid must involve "partnership," not dependence. "There is by now a strong consensus," argues David Bell in a 1966 article in *Foreign Affairs*, "that foreign aid in all its forms will produce maximum results only in so far as it is related to maximum self-help." Also, in the 1970s, scholars first gave the term "aid dependence" to a set of institutional problems that seemed to be affecting Bangladesh, Malawi, Nigeria and other countries receiving large amounts of aid (Brautigam and Knack, 2004).

However, in the last decade, economic crisis and unsustainable debt, civil wars, and political instability have all taken their toll. It is difficult to separate the impact of these problems from the possible impact of foreign aid, which is often high in developing countries that suffer from precisely these problems. On the one hand, aid can release governments from binding revenue constraints, enabling them to strengthen domestic institutions and pay higher salaries to civil servants. Aid can provide training and technical assistance to build legal systems and accounting offices. In many countries, aid personnel (sometimes expatriate) manage important government programs, and the infusion of resources and technical assistance can give an important boost to the efficiency and effectiveness of governance, if only in a partial sense (Brautigam and Knack, 2004). Yet despite these likely benefits, it is also possible that, continued over long periods of time, large amounts of aid and the way it is delivered make it more difficult for developing countries to mobilize domestic revenue.

In recent times, the relatively high share of aid in government budgets in some countries has further raised concerns about the detrimental effects of aid dependency on domestic revenue effort, spending programs and budget

planning as well as institution-building (Gupta and Tareq, 2008). This has prompted some scholars (Djankov et al 2008) to argue that windfalls from foreign aid can generate a bigger resource curse than natural resources in terms of their impact on democracy and rent-seeking behaviour. However another different view is that aid is different from natural resources (notably oil) as it is delivered through technical assistance and projects, packaged with conditions, and debt relief. As such, each modality for delivering aid is likely to influence incentives of governments differently (Collier, 2006; Collier and Venables, 2008). Benedek et al (2012) have observed a negative association between total net ODA and total tax revenues. Such foreign aid implication is further buttressed by Benedek, et al (2012) that report a negative relationship between foreign aid and tax revenue for a dataset covering 118 countries including few selected developing countries.

It is against this background that this study examines the effects of foreign aid on tax revenue in Nigeria.

2. EMPIRICAL REVIEW

As reviewed in Njeru (2004), the literature of the impact of foreign aid on government expenditure is inconclusive. A few studies have supported the theoretical proposition that developing countries have been rendering foreign aid fungible by transferring resources from the donor-aided sectors to non-donor aided sectors. Studies using time series data in individual countries have also found no significant diversion and all agree that countries spend foreign aid on the designated purposes (Njeru, 2004).

Feyzioglu et al. (1998) using cross country data from 14 developing countries find that aid is not fungible at aggregate levels in smaller samples, but that increasing the number of countries makes aid fungible. At sectoral levels, the study find that aid is fungible on earmarked concessional loans for agriculture, education and energy, but not for transport and communication sectors. Aid money increased government expenditures on a roughly one to one basis for the smaller samples. Increasing the sample to 37 countries changed the results; a dollar's worth of aid leads to significantly less than a dollar's worth of government expenditure (a weaker flypaper effect). Devarajan et al. (1998), in the study "What does aid to Africa finance?" find that most aid (90%) boosts government expenditure. They reason that about half the aid is used to finance external debt service payments; one quarter finances investments and the other quarter offsets current account deficits. Also, Teera (2002) and Teera and Hudson (2004) examine tax effort across countries by income level and find that low-income countries (LICs) are not fully exploiting their taxable capacity. They also find tax evasion to be an important

determinant of tax performance, and tax revenues in LICs are least responsive to policy change and economic growth.

At sectoral level, aid is highly fungible in health, industry and agriculture. Aid to the energy, transport and communication sectors is partially fungible, while that to education is the least fungible. Njeru (2004) in his empirical results indicate that the flow of foreign aid does influence government spending patterns. On average, an increase in foreign aid stimulates development spending by a higher proportion than does an increase in domestic resources. The finding concurs with those of most studies on aid fungibility, which argue that foreign aid finances general government spending and not the targeted development activities (see among others Pack and Pack, 1993; Feyzioglu et al., 1998; Devarajan et al., 1998). On the issue of aid fungibility, it is increasingly acknowledged that there is nothing basically wrong if aid is integrated into recipient budgets and such monies are put to good use - a situation that depends on the quality of policy and institutional environment (Maipose, 2004).

Contradicting earlier studies, Johannes (2006) employs a welfare utility function to determine how government spending and tax revenue respond to aid flows. The empirical evidence supports the hypotheses that in Cameroon, during 1965-2002, foreign aid has a positive effect on total government expenditure, government investment expenditure and recurrent spending on education, agriculture and communication. The study also provides evidence that, aid flow leads to greater tax efforts. Earlier, Bulir and Lane (2002) showed that aid is significantly more volatile than domestic fiscal revenues and thus poses challenges for short-term fiscal management.

Gupta, Clements, Pivovarsky, Tiongson (2003) examine the revenue response to inflows of foreign aid in 107 countries during the period 1970-2000. The results indicate that while concessional loans are associated with higher domestic revenue mobilization, the opposite is true of grants. On the average, the dampening effect of grants on the revenue effort is modest. For countries plagued by high level of corruption, their result suggests that the decline in revenue completely offsets the increase in grants.

In an attempt to correct for observed inherent econometric problems in earlier empirical studies on revenue-aid nexus, Crater (2010) employs pooled mean group estimator to correct for the problem of heterogeneity and cross-sectional dependence. He reports that Monte-Carlo simulation reveals that this instability emerges when the assumption of a homogeneous long-run relationship between aid and taxation, is violated.

Benedek, Crivelli, Gupta, and Muthoora (2012) inquire if there is still a crowding out effect between foreign aid and revenue for 118 countries from 1980 to 2009 using a robust econometric model. Their results support earlier findings of a negative association between net Official Development Assistance (ODA) and domestic tax revenues, but this relationship appears to have weakened in reflection of greater efforts at mobilizing domestic revenues in many countries. The composition of net ODA matters: ODA grants are associated with lower revenues, while ODA loans are not. They also find that net ODA and grants are negatively associated with VAT, excise and income tax revenues, but have a positive relationship with trade taxes. Aid has a particularly strong negative effect on domestic tax revenues in low-income countries and in countries with relatively weak institutions.

Bhushan and Samy (2012) indicate that aid receipts are higher than taxation revenue and also constitute a significant part of government revenue in several African countries. They examine the effect of foreign aid on taxation for sub-Saharan Africa (SSA) in the period 1972 through 2008. It is reported that aid has no significant impact on taxation generally or in sub-Saharan Africa particularly.

Most of the existing empirical works on the relationship between foreign aid inflows and domestic tax revenue are grounded in the fiscal response framework. Studies based on this approach estimate structural and reduced form equations from the policy maker's utility maximization and constraints on revenue (including borrowing) and expenditure. Public expenditures and revenues in this setting are linked through budget constraint. The coefficients of the structural equations are usually obtained using linear and nonlinear solution approaches to simultaneous equations (Franco-Rodriguez, 2000; Gang and Khan, 1991; McGillivray and Outarra, 2005). The reduced form specifications capture the indirect effects of aid on other variables in the system and are simulated from the structural equations (Gang and Khan, 1991). The findings in much of the literature suggest that aid inflows reduce tax revenue (Franco-Rodriguez, 2000; McGillivray and Outarra, 2005; Otim, 1996). This is usually interpreted to capture the reduced incentives by aid recipient governments to rapidly increase revenue from domestic sources in the face of what is, in some respects, free money. Some studies (Gupta et al., 2004; Remmer, 2004) go further step and disaggregate aid into loans and grants.

Moss et al. (2008) summarize the revenue response to aid literature and suggest that there is broad consensus that aid reduces the incentive to levy taxes and slows the growth of institutions. In spite of the wide use of fiscal response models in empirical work, their ability to link foreign aid inflows and domestic fiscal

outcomes can be severely limited. In particular, utility will not be maximized if theoretically optimal values of target variables are considerably different than what can be obtained from empirical estimations. This will be the case if targets used in planning documents are disconnected from actual outturns (White, 1994). Failure to meet expenditure targets through discretionary reallocation of budgeted resources and supplementary budgets has been a common feature of Uganda's fiscal policy in recent years. This precludes the use of fiscal response models in analysing the association between fiscal policy and foreign aid in Uganda. In addition, both fiscal response and aid fungibility models fail to capture the direct effects of aid on domestic tax institutions and structures, as well as indirect effects that are mediated through certain aspects of donor conditionality. Recent approaches explicitly recognize that aid can affect both revenue flows and tax structures, and focus on the latter. Main contributions to the literature on the effect of aid on domestic tax and governance institutions include that of Moore (2007), Knack (2008), and Besley and Persson (2009a). Besley and Persson (2009b) predict that investment in fiscal capacity reduces as the share of national income generated by natural resources increases. Aid inflows are predicted to have the same impact (Carter, 2010). Knack (2008) shows that increased aid inflows slowdown the development of good quality of institutions for tax policy and administration. There have also been attempts to study the indirect effect of certain aspects of donor conditionality on tax revenue. Gambaro et. al. (2007) also report that aid is associated with an increase in revenue from taxes on trade; it decreases revenue from income taxes.

The main observation from the above review is that the empirical studies on aid and tax nexus is still an on-going debate. There is no clear cut evidence either in support or against positive contribution of aid to tax revenue mobilisation. At best what is deducible from above is that the evidence is mixed and tends to concentrate on cross country studies. Obviously cross country evidence has limitation when it comes to individual country policy inferences. Therefore there is the need to re-examine the issue from the individual country perspectives. Also the existing evidence is limited in scope since little attention is paid to country such as Nigeria. Also the existing studies also concentrate only on aggregate analysis with little attention to the components of aid and tax revenue. This study attempts to widen the scope and provide evidence from Nigeria based on a larger data set on different components of tax revenue. Through such analysis the study attempts to further enrich the debate in literature on tax/aid nexus. The limited applicability of the fiscal response approach in Nigeria's situation also dictates that the standard single equation tax revenue specification is initially employed. Feedback effects (if any) among the variables in the tax revenue specification are then explored using the vector autoregressive framework.

3. THEORETICAL FRAMEWORK AND METHODOLOGY

3.1 Theoretical framework

The link between foreign aid and tax has been studied by conceptualizing an optimizing policy maker working within a given budget constraint to balance the efficiency costs of taxation and benefits associated with public spending (Mirrlees, 1971, 1976, 1986). Foreign aid receipts can thus enable the recipient country to reduce costs of taxation without compromising the level of public service delivery. Extensions to this basic model seek to incorporate specific mechanisms through which aid receipts can affect fiscal policy formulation and outcomes, and include the analysis of aid fungibility, fiscal response and effects of foreign aid on domestic tax structures. Aid is fungible when the increase in expenditure is less than the increase in aid (McGuire, 1978). Aid that is fungible in this sense has the effect of delaying the development of domestic tax structures and governance institutions. Fiscal response theories maintain the tax-expenditure trade-off but allow for variable fiscal targets — either exogenously or endogenously (Heller, 1975; McGillivray, 2009). An important limitation of the exogenous models of fiscal response is their failure to provide clear mechanisms that link aid receipts and tax policy formulation. Endogenous fiscal targets vary over time making it possible for them to be conditioned on country characteristics such as aid receipts. The implications of aid receipts for domestic tax revenue in these models are ambiguous and depend partly on the nature of aid (for example whether grants or loans) as well as incentives of policy makers. Foreign aid inflows and domestic tax policy can also be linked through the effect of the former on domestic tax structures and inflows (Knack, 2008).

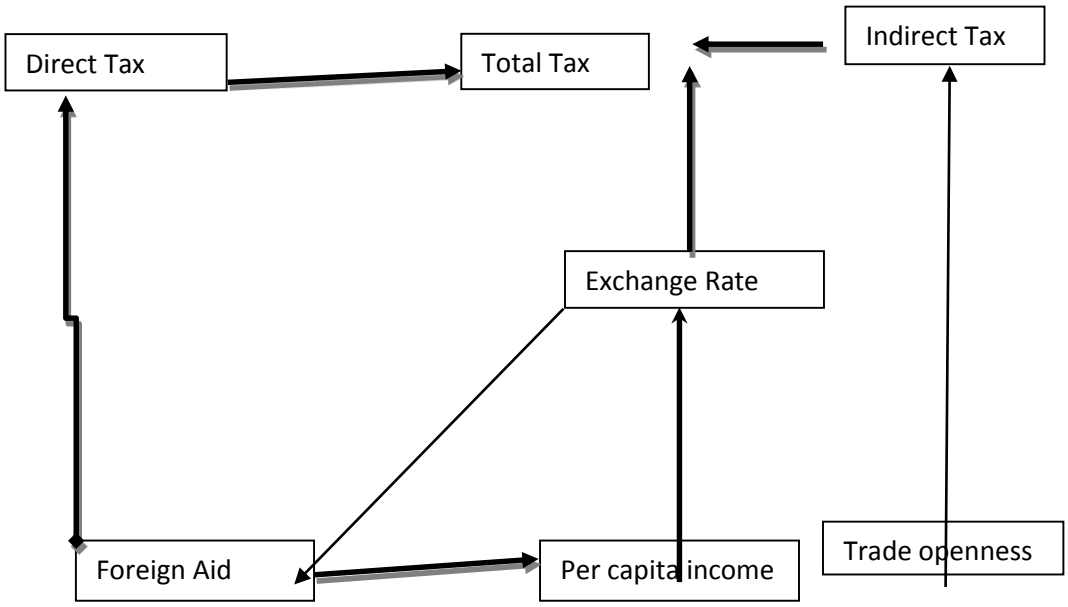
Technical assistance targeting legal, administrative and policy reforms can be expected to result in increased domestic tax revenue collection (Carter, 2010) and an improvement in the quality of domestic governance and political institutions (Moss et al., 2008; Ross, 2004).

Foreign aid can also impact domestic tax revenue through short term changes to certain aspects of the tax base such as imports and salaries (Carter, 2010). There are also secondary (but ambiguous) effects of foreign aid on tax revenue that work through aspects of donor conditionality such as privatization and trade policy reform. The effects of privatization depend on the pre-privatization condition of the affected enterprises. Loss making parastatals that become profit making after privatization undoubtedly contribute to increased tax revenues. There is, however, a risk of losing revenue if profitable public enterprises are privatized. There are also sections of theoretical work that build on utility functions which are maximized with respect to the government budget constraint. This results in specifications which depend on GDP

and some other conventional determinants of tax revenue (Pack and Pack, 1990, 1993; Stotsky and WoldeMariam, 1997).

The theoretical discussion above shows that a causal linkage exists between tax and foreign aid inflow. The transmission mechanism of causal effect between foreign aid, through per capita income, exchange rate to tax revenue could be drawn on basis of which a theoretical nexus between foreign aids and tax revenue could be established. The Figure 4.1 below presents a theoretical schema for the nexus between foreign aid and tax revenue as discussed above.

Figure 3.1: Theoretical Links between Foreign Aid and Tax Revenue



Source: Authors' computation

A cursory look at the diagram above reveals that the central variable in the causal nexus is the per capita income. Increase in the amount of foreign aid inflow if well utilized in the provision of welfare enhancing good and service and also to boost employment will lead to higher income and higher tax base and capacity. The higher income boosts domestic demand and external balance and real exchange rate subsequently affecting the both direct and indirect tax revenue generating capacity of the government. Secondly, the indirect channel is also in tandems with the traditional macroeconomic intuition that increase in government spending as a result of foreign aids can engineer pervasive changes in the macroeconomic mechanism through its multiplier effects.

As clearly shown foreign aid spending may induce fluctuations in the level of income per head and exchange rate. The effect may be positive or negative. For instance, an increase in government consumption spending requires finance. The sources of the finance may be internal through the tax or external through increase in borrowings, aids and other foreign financial assistance or through deliberate increase in the export revenue base. Thus foreign aid plays a crucial role domestic resource mobilization in Nigeria.

Though the above theoretical nexus is economically intuitively plausible, it fails to capture multivariate causality that may arise among the variables and also fail to show the magnitude of the causal effect To bring out the economic significance of the causal effects, the relative contributions of each variable in the linkage must be estimated. This is the focus of next section.

3.2 Model Specification

The theoretical relationship between tax revenue and foreign aid in the preceding section is complemented with econometric analysis. Following the standard convention and practices of other studies (Gupta et. Al 2003; Crater, 2010; Stotsky and Wolde Mariam, 1997 Hisali and Ddumba-Ssentamu, 2012) in this area, tax revenue is expressed as a function of GDP and some other variables, all of which are observable and are employed in the econometric analysis.

$$tax_i = f(aid, Z) \qquad (3.1)$$

Where tax_i represents the aggregate and disaggregate measures of tax revenue (that is, total tax revenue, direct tax and indirect tax). The variable aid is the ratio of foreign aid to gross domestic product and Z represents all other exogenous variables that can influence tax revenue. Equation 3.1 can further be written as:

$$tax_t = \pi_0 + \pi_1 aid_t + \delta \ln Z_t + u_t \qquad (3.2)$$

Following the econometric model approach employed by Benedek et. al. (2012) to analyse the effect of foreign aid on tax revenue for pooled of industrialized, developing and developed countries based on their methodological, the relevance variables to be included in Z are per capita income, exchange rate and the degree of openness of the economy. u = error term.

$$tax_t = \pi_0 + \pi_1 aid_{tt} + \delta_1 exrt_t + \delta_2 top_t + \delta_3 gdppc + u_t \qquad (3.3)$$

top is defined as the percentage ratio of total trade to gross domestic output; while exrt is exchange rate of naira vis-à-vis U.S dollar and gdppc is real per capita income. $\pi_{0-2}; \delta_{1-3}$ is Parameters or co-efficient of explanatory variables. The apriori

expectation is that the coefficients ($\pi_1 and\ \pi_2$) are expected to be positives and significant which implies that higher aid leads to higher tax collection and hence they are complements

3.3 Method of Analysis

The cointegration analysis of Johansen (1990, 1991) and Vector Error Correction Model (VECM) is employed. Under the VECM technique four steps are involved. The first step involving testing the stationarity of the series or their order of integration as the series need to be integrated of same order. The second step is to examine the presence of a long run relationship among the variables in equations. However, the long run coefficients are estimated using the associated cointegration model proposed by Johannes and Julieus (1990). Once the cointegration is confirmed in the model, the residuals from the equilibrium regression can be used to estimate the error correction model in the third step. The model lag length selection is determined by both Schwarz (SIC) and Akaike (AIC) Information Criterion.

The above econometric technique adopted is aimed at establishing the general relationship between tax revenue and aid inflows, both in the long run and the short run. The long run tax revenue and aid equilibrium relationship will be obtained using the Johansen multivariate approach. The Johansen procedure estimates the stochastic process of the form:

$$\Delta y_t = \mu + \prod y_{t-1} + \sum_{t-i}^{n-1} \rho_i \Delta y_{t-i} + \varepsilon_t \qquad 3.4$$

where y_t is an m × 1 vector of variables, $\prod y_{t-1}\, \alpha\beta' y_{t-1}$represent the stationary cointegrating relations. The βparameters are the cointegrating parameters that form linear stationary relations with the non-stationary data series in y_t. The α parameters contain the short run adjusting parameters towards the long run steady state relationship. The ρ_i's are m × m coefficient matrices and provide information about the short run dynamics. μ is the vector of deterministic terms. The m × 1 vector ε_t (is assumed to have mean zero, with no autocorrelation but can be correlated across equations. These assumptions imply that error term ε_t is stationary at levels I(0) and that each member of y_t is either I(1) or I(0).

Following Hisali and Ddumba-Ssentamu (2013) the process of obtaining the long run equilibrium relationship will be done in the following sequence. In the first step, the optimal lag length required to make the residuals a white noise process will be selected. This will be followed by determination of both the rank of Π as well as selection of the deterministic specification in the second step and estimation of

the cointegrating relations to determine the long run equilibrium relationship in the third step. In the final step, residual analysis were undertaken to determine whether the model is acceptable or not. The Johansen procedure to be adopted assumes that the error terms are independent and normally distributed. It was thus necessary to check for normality, autocorrelation and heteroskedasticity of the residual process. The general specification that was utilized is of the form

$$\Delta tax_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i \Delta aid_{t-1} + \sum_{i=1}^{k} \beta_i \Delta z_{t-1} + \lambda ECT_{t-1} + e_{1t} \qquad 3.5$$

where Δ is the first difference operator, and β_i is the vector of coefficients on parameters that are hypothesized to influence tax revenue, Z including aid and its components, per capita income and the degree of openness of the economy. ECT_{t-1} is the error correction term which comprises the one-period lagged residuals of the tax to gross domestic output regression estimated in levels. That is estimating equation 3.4. The error correction term measures the speed of adjustment to the long run equilibrium. The validity of the model reduction was guided by the F test, the R squared and the SC and AIC.

The time series properties of the variables incorporated in empirical model is examined using the Augmented Dickey-Fuller unit root test in order to establish the stationarity process of each of the series. The test involves the estimation of equations with drift and trends as proposed Dickey and Fuller (1988). The test equations are expressed as:

$$\Delta Z_t = \eta_0 + \eta_1 Z_{t-1} + \sum_{i=1}^{n} \pi_i \Delta Z_{t-i} + \nu_t \qquad (3.6)$$

$$\Delta Z_t = \eta_0 + \eta_1 Z_{t-1} + \eta_1 t + \sum_{i=1}^{n} \pi_i \Delta Z_{t-i} + \nu_t \qquad (3.7)$$

The time series variable is represented by Z, t and ν_t as time and residual respectively. The equations. (3.5) and (3.6) are the test model with intercept only, and linear trend respectively

3.4 Sources and Data Description

Based on the nature of incorporated variables in the formulated model, quarterly data for the period 1970 to 2012 will be employed for detail analysis. The time series data are on all the macroeconomic variables for the study will be obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin, and World Development Indicator. The tax to gross domestic product ratio (tax) is total tax revenue divided by GDP whereas trade openness (top) is computed as the ratio of imports plus

exports to gross domestic output. Aid is also scaled by gross domestic product. Per capita income (gdppc) is the total GDP divided by population. Tax revenue, GDP, and aid are measured in billions of naira whereas the population used to is measured in millions of people

4. EMPIRICAL ANALYSIS

4.1 Time Series Properties of the Data

4.1.1 Descriptive Analysis

The descriptive statistic of the relevant variables is presented in table 4.1 showing their mean, median standard deviation, skewness and Kurtosis

Table 4.1: Descriptive Statistics

	AID	DTAX	EXRT	GDPPC	INTAX	TOP	TTAX
Mean	9.03E+08	1852691.	46.90619	58246.11	152240.2	58.45433	2004931.
Median	1.76E+08	86494.30	9.909492	55044.84	11456.90	65.61129	97951.20
Maximum	1.14E+10	12072501	175.5781	83196.87	721499.0	97.32115	12794000
Minimum	25740000	212.4000	0.546781	43470.63	370.0000	19.62060	582.4000
Std. Dev.	2.12E+09	3367447.	60.19133	9418.608	226116.7	20.83405	3586608.
Skewness	3.545570	1.839501	0.834458	0.879828	1.286428	-0.218668	1.807661
Kurtosis	16.24706	5.068141	1.942609	3.290657	3.191380	1.859383	4.952030
Jarque-Bera	404.5025	31.91364	6.993514	5.699057	11.92571	2.673649	30.24509
Probability	0.000000	0.000000	0.030295	0.057872	0.002573	0.262679	0.000000
Sum	3.88E+10	79665698	2016.966	2504583.	6546328.	2513.536	86212025
Sum Sq. Dev.	1.89E+20	4.76E+14	152165.8	3.73E+09	2.15E+12	18230.42	5.40E+14
Observations	43	43	43	43	43	43	43

Source: Author calculation from CBN data Series

The graphical representation of the descriptive historical patterns of the key variables in the model is presented in Figure 4A to 4D. Figure 4A presents the movements of percentage growth rate of foreign Aid and Direct taxes in Nigeria for period 1970 to 2012. The graphical analysis showed erratic movements in both variables suggesting that their growth have been inconsistent swinging both in the positive and negative region. Again, in magnitudes, the analysis showed that growth in foreign aid and direct tax are almost at par over the period with the exception of 2005 when rose quite above tax. The common phenomenon about the variables observed from the analysis is their insistency in growth. Figure 4B represents the movement in trend of foreign aid and indirect taxes in Nigeria from 1970 to 2012. The movements in foreign aid and indirect taxes are quite similar

to the movements in foreign aid and direct tax (Figure 4A). The growths in the two variables are similarly erratic and inconsistent oscillating between positive and negative growths. Again, in 2005, foreign aid recorded astronomic growth far away from indirect taxes. Growth of Figure 4C presents the relational movement in foreign aid and total taxes in Nigeria. There seemed to be no difference of the movement of foreign aid and total taxes from its movement with the other two variations of taxes (Direct and Indirect taxes).

Movements in the variables are characterized with high volatility as growth shifted from positive to negative growths consistently. Figure 4D presents the movement in growth trend of the three tax variations – total tax, direct tax and indirect tax. It is observed from the graph that growths in total tax and direct tax recorded significant growth than the indirect taxes. However, an important observation is that over the periods, growth in direct tax has been higher than that of total taxes. Another important observation from the trend is that all the tax variables have been falling hyperbolically from 2005 up to the 2012 with direct and total tax growing almost at par while indirect lagged behind. This trend underpins the poor performance tax revenue of Nigeria in the recent times.

Figure 4a: Growth rates of Foreign Aid and Total tax revenues in Nigeria

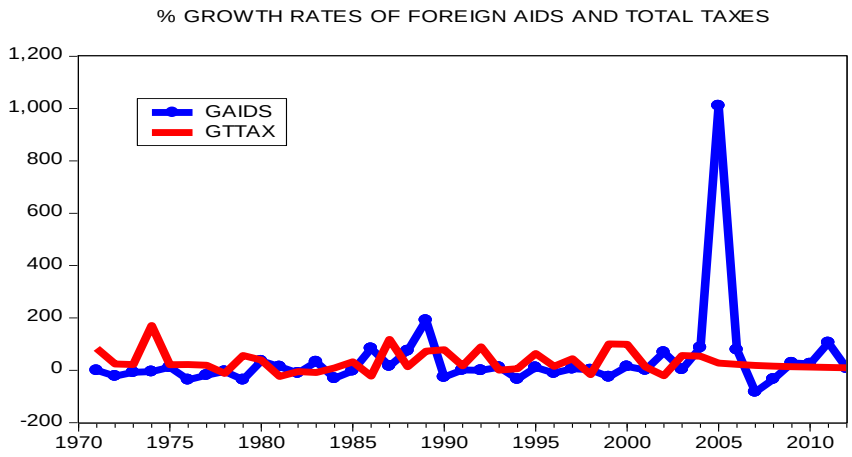


Figure 4b: Growth rates of Foreign Aid and Direct tax revenues in Nigeria

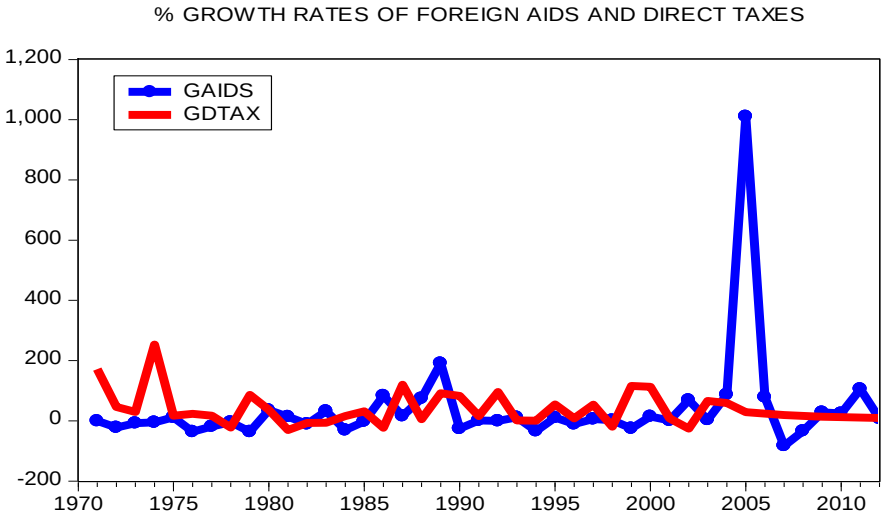


Figure 4c: Growth rates of Foreign Aid eand Indirect tax revenues in Nigeria

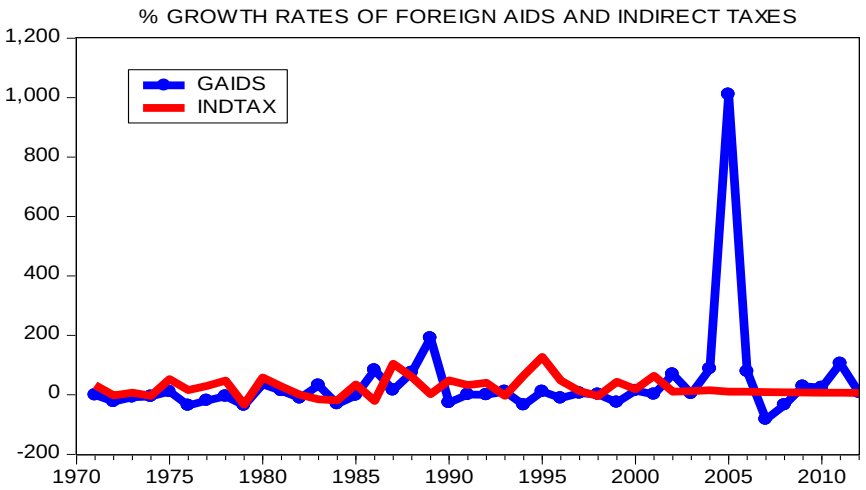
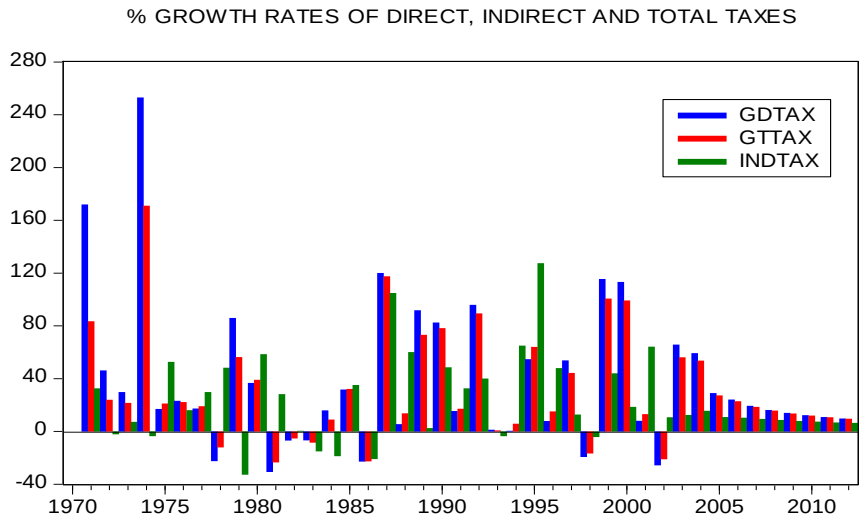


Figure 4d: Growth rates of Disaggregate and Aggregate tax revenues in Nigeria



4.1.2: Unit root and stationary Tests

All the other variables are as defined in the methodology. Table 4.2 below presents the estimates of the ADF for testing the order of integration and stationarity properties of the series. It is evident from the results in Table 4.2 that all the variables are stationary after first differencing. Since the series are integrated of order one or I(1) and the first differences are stationary, the presence of significant cointegration relationships among the variables could be determined.

Table 4.2: ADF statistics for Testing Unit Roots in the Variable[5]s

Variables*	***Series***	***Levels***	***First Differences***	Remark
Total tax	LTTAX	-1.0243	-3.4636	I(1)
Indirect Tax	LINTAX	-0.7441	-4.4312	I(1)
Direct tax	LDTAX	-1.0995	-3.9498	I(1)
Total tax as ratio of GDP	LTTAX	-1.1023	-5.7338	I(1)
Indirect Tax as ratio of GDP	LINTAX	-0.4847	-6.5780	I(1)
Direct tax as ratio of GDP	LDTAX	-1.6683	-7.3361	I(1)

[5] *In attempt to detect and establish the appropriate model for the relationship between foreign aid and tax revenue, the paper expresses the tax variable and aid in two different ways. In the first expression, the actual values of tax revenue (DTAX, INTAX, and TTAX) and aid (AID) are used in the estimation. In the second expression the tax and aid variables are discounted by the gross domestic product and thus are express as ratio of GDP. They are represented as DTAXGDP, INTAXGDP and TTAXGDP for the ratio of direct, indirect and total tax revenue to GDP while the foreign aid as ratio of GDP is AIDGDP*

Per capita GDP	LGDPPC	-2.3530	-3.8024	I(1)
Exchange rate	LEXRT	-0.0490	-5.2348	I(1)
Foreign Aid as ratio of GDP	LAID	-0.5287	-5.7338	I(1)
Trade Openness	LTOP	-2.5411	-6.3300	I(1)
CRITICAL VALUES	**1%**	**-3.6353**	**-3.6422**	
	5%	**-2.9499**	**-2.9527**	

** All the variables are expressed in log forms. All variables are in log forms (L=log)*

Sources: Author's Computations

4.1.3 Johansen's Maximum Likelihood Cointegration Test

Given the non-stationarity properties of the variables at level and the fact that all the variables became stationary after first differencing, the next step is to test for the presence of multivariate cointegration among the variables in models. The multivariate cointegration test established whether there is at least one linear long run relationship among the variables of interest found to be integrated of order one. The Johansen Maximum Likelihood procedure was applied, the estimates are as presented in Table 4.3 for the two classification of the tax and variables below.

Table 4.3: Cointegration Test Results

Ranks	Maximal Eigenvalue	Trace-statistics	Rank	Maximal Eigenvalue	Trace-statistics
	Direct Tax			Direct Tax as ratio of GDP	
r=0	0.163771*	86.84077*	r=0	0.163771*	86.84095*
r=1	0.143005*	56.97231*	r≤1	0.143005*	56.97244*
r=2	0.103124*	31.20035*	r≤2	0.103124	31.20043*
r=3	0.070904	13.02454	r≤3	0.070904	13.02454
r=4	0.004438	0.742796	r≤4	0.004438	0.742798
	Indirect Tax			Indirect Tax as ratio of GDP	
r=0	0.218469*	93.86626*	r=0	0.218469*	93.86638*
r=1	0.139254	52.70075*	r≤1	0.139255*	52.70081*
r=2	0.110807	27.65807	r≤2	0.110807	27.65808
r=3	0.047034	8.045419	r≤3	0.047033	8.045412
r=4	5.94E-07	9.93E-05	r≤4	5.94E-07	9.92E-05
	Total Tax			Total tax as ratio of GDP	
r=0	0.155631	85.07609	r=0	0.155632	85.07631
r=1	0.147016	56.82539	r≤1	0.147016	56.82549
r=2	0.111265	30.26999	r≤2	0.111265	30.27001
r=3	0.060157	10.57125	r≤3	0.060156	10.57125
r=4	0.001258	0.210247	r≤4	0.001258	0.210248

The results of the cointegration tests in Table 4.3 show that the cointegration test statistics tests, confirm that there is at least one cointegration relationship among the variables included in the model. Specifically, the results of the cointegration test suggest that both foreign aid and other tax determinants in the three models

have equilibrium conditions with disaggregates and aggregate tax revenues measures, which kept them in proportion to each other in the long run. This evidence of cointegration among the variables rules out spurious correlations and implied that at least one direction of influence could be established among the variables.

It is important to note that the existence of cointegration vectors among a group of variables may not imply that there is causal influence between pairs of variables included in the model of cointegration test. More specifically, when the tax determinants model incorporating foreign aid, per capital income, exchange rate and trade openness are cointegrated, it does not necessarily mean that changes in foreign aid (the explanatory variable of interest) has significant impact on both disaggregate and aggregate tax revenue measures. Perhaps other variables included might be the source of such long run nexus that accomplish such cointegration.

4.2.0 VECM Long Run Estimates of tax Revenue effects of Foreign aid

To determine the relative significance and relevance of foreign aid on different tax revenue, Vector error correction model (VECM) model is estimated. Three sets of results corresponding to the three measures of tax revenues are reported. Table 4.4a and 4.4b present the estimates for the long run and the ECM terms the two models respectively. As estimates in Table 4.4a and 4.4b show, foreign aid has negative and insignificant impact on direct tax revenue both in the model with actual and share of GDP measures. In sharp contrast, foreign aid has significant effects on indirect tax and aggregate tax revenue. The main import of this different effect of foreign aid on direct and indirect is that foreign aid affects the different tax revenue in different ways. While it may hinder the collection of direct taxes due to the fact that the foreign aid serves as alternative sources with less controversy, the efficient use of the foreign aid may spur increased economic activities and greater domestic demand that may boost the amount of value added taxes, import duties and other forms of indirect taxes in Nigeria.

Apart from aid, the second most important determinant of tax revenue is movement in the exchange rate. It is highly significant but also has negative effects. This suggests that highly volatile exchange rate may be detrimental to the tax revenue mobilization in Nigeria. Trade openness has significant effect only on indirect tax revenue collection as expected since trade liberalization affects inflow of import and export. Per capita income has significant effects on only direct and total tax revenue however the negative sign suggest that tax institutional failure might be bearing heavily on tax collection. The ECM term

shows that there is a feedback effect from short run dynamic to long run equilibrium position. In all the three models, indirect tax model has the fastest speed of adjustment (0.05 and 0.08) respectively. The speed of adjustment of direct and total tax revenue model is relative low and less than the half of indirect tax adjustment speed.

The overall implication of this result is that foreign aid has greater impact on indirect tax than direct tax and overall tax revenue mobilisation in Nigeria.

Table 4.4 Vector Error Correction (Long Run and ECM) Estimates

Variables:	Model I (Direct Tax)	Model II (Indirect Tax)	Model II (Total tax)
Foreign Aid	-1.59[-0.98]	-2.52[-2.41]	-4.90[-3.18]
Trade Openness	-0.29[-0.37]	-1.61[-2.95]	-0.44[-0.57]
Per Capital income	-3.54[-2.87]	-0.71[-0.84]	-3.16[-2.66]
Exchange rate	-0.68[-3.23]	-0.512[-3.56]	-0.23[-1.17]
C	31.6	13.67	41.79
Short Run ECM Terms	-0.039[-3.60]	-0.045[-5.12]	-0.023[-2.48]
Tax and Aid as Ratio of GDP model Estimates			
Foreign Aid	-1.59[-0.98]	-2.52[-2.41]	-4.90[-3.18]
Trade Openness	-0.29[-0.37]	-1.61[-2.95]	-0.44[-0.57]
Per Capital income	-4.13[-1.73]	-2.24[-1.44]	-7.07[-3.12]
Exchange rate	-0.68[-3.23]	-0.51[-3.56]	-0.23[-1.17]
C	31.67	13.67	41.79
Short Run ECM Terms	-0.03[-3.70]	-0.04[-5.18]	-0.02[-2.67]

****Note the values in parenthesis are the t- statistics for the coefficients*

4.3 Impulse Response of Tax Revenue to Foreign Aid shocks

In addition to the VECM long run and short run models estimated above, attempt was also made to examine the impulse response and variance decomposition of

the model. The impulse response result functions (IRFs) show the effects of shocks on the adjustment path of the variables in the VAR model. In essence, IRs shows how these variables react to different shocks in the model. The responses are shown in Table 4.5 only for first, fourth, eight and twelve quarter corresponding to yearly period timing. From the impulse responses[6], indirect tax remains the most responsive tax revenue to foreign aid shocks. While both direct and total tax revenue response to foreign aid shock show a drastic fall in effect over time the response of indirect tax remain positive and significant all through the periods.

Specifically, in all the models, there is at least a time lag in tax response to foreign shocks. None of the tax variables responds to foreign aid shock in the first quarter after the shock is propagated. In the second to fourth quarter the responses of tax variable to foreign aid shocks show that the effects of the shocks on indirect tax is greater than on direct tax. Direct tax responds negatively to the shocks with -0.008, -0.02 and -0.01 in the fourth, eight and twelfth quarters, respectively, while for the same period the effects (0.06, 0.03 and 0.03) of the shock on indirect tax are not only positive but significantly higher. The response of aggregate tax variable mimics the direct tax response which thus suggests that direct tax has great influence on the overall tax collection in Nigeria. The implication of this result is that foreign aid could be used to stimulate higher consumption tax but it has negative implication on income tax. Since income tax dominates overall tax collection in Nigeria, then foreign aid inflow if not well channelled and utilised may compound the domestic resources constraint faced in Nigeria as little revenue will be generated locally from tax sources in the domestic economy. The higher foreign aid flows to this country the higher the tendency for government to be reluctant in reforming tax system for higher tax efficiency.

The receipts of foreign aids by the Nigerian government out-rightly distracts her from optimising her tax policy and thus reaping the attendant benefit because of another source of revenue is practically serving as a buffer thereby creating a loop in the economy as monies that rightly belong to the government are not remitted since appropriate measures are not put in place. The main implication here is that though the government has funds and revenue to carry out her activity. The government is running on a lower level as against what she would have got if there were no aid granted her from any direction.

[6] Also see Appendix 1 for the graphical illustrations of the Impulse Response Function

[7]Table 4.5: Impulse Response of Tax Revenue to Foreign aid shocks

	Quarters	LAID	LTOP	LGDPPC	LEXRT
			Actual values		
DTAX	1	0.00	0.000	0.000	0.000
	4	0.005	0.015	0.050	-0.000
	8	0.019	0.106	0.168	0.084
	12	0.017	0.068	0.131	0.059
INTAX	1	0.000	0.000	0.000	0.000
	4	0.011	0.006	0.014	0.005
	8	0.029	0.054	0.026	0.009
	12	0.043	0.074	0.044	0.038
TTAX	1	0.000	0.000	0.000	0.000
	4	0.003	0.003	0.032	-0.013
	8	0.021	0.077	0.125	0.050
	12	0.025	0.047	0.108	0.029
			As ratio of GDP		
DTax	1	0.000	0.000	0.000	0.000
	4	-.0008	0.009	0.029	0.000
	8	-0.028	0.102	0.124	0.079
	12	-0.018	0.064	0.098	0.054
INTAX	1	0.000	0.000	0.000	0.000
	4	0.016	-0.002	-0.000	0.006
	8	0.025	0.0388	-0.001	0.007
	12	0.025	0.064	0.026	0.033
TTAX	1	0.000	0.000	0.000	0.000
	4	0.004	-0.001	0.016	-0.012
	8	-0.012	0.079	0.089	0.047
	12	-0.002	0.0499	0.083	0.025

4.4 Variance Decomposition of Tax to Foreign Aid Shocks

The decomposition of variation in the tax revenue explained by foreign trade is presented in table 4.6 below. The main essence of variance decomposition is that it measures the proportion of variance in one variable explained by innovations to it and other variables in the models. Specifically, variance decomposition helps in determining the underlining factors explaining movement and fluctuations in other variables. In variance decomposition, the significance of a variable is measured by dividing the response of a variable by its S.E that is reported along

[7] The impulse response for the other variables are presented as appendix 1 preserve space and ensure brevity

with it. The rule of thumb is that the coefficient must be twice as high as the standard error (S.E) of the variable.

Table 4.6: variance Decomposition[8]

	Period	S.E.	TAX variable	LAID	LTOP	LGDPPC	LEXRT
				Actual values			
DTAX	1	0.102	100.0	0.000	0.000	0.000	0.000
	4	0.296	95.23	0.080	0.389	4.288	0.004
	8	0.508	52.55	0.364	10.26	31.18	5.626
	12	0.659	39.09	0.565	13.17	39.00	8.166
INTAX	1	0.067	100.0	0.000	0.000	0.000	0.000
	4	0.196	97.95	0.593	0.209	1.150	0.095
	8	0.252	83.12	3.652	8.677	4.169	0.378
	12	0.326	56.44	8.047	24.72	7.527	3.255
TTAX	1	0.082	100.0	0.000	0.000	0.000	0.000
	4	0.251	96.78	0.047	0.037	2.782	0.348
	8	0.410	65.07	0.544	7.171	24.67	2.528
	12	0.533	50.04	1.269	10.24	34.43	4.008
				As ratio of GDP			
DTAX	1	0.095	100.0	0.000	0.000	0.000	0.000
	4	0.259	98.05	0.041	0.159	1.742	0.002
	8	0.410	52.84	1.109	14.03	24.09	7.917
	12	0.527	35.87	1.472	18.73	32.77	11.14
INTAX	1	0.066	100.0	0.000	0.000	0.000	0.000
	4	0.187	98.57	1.215	0.044	0.010	0.151
	8	0.227	90.02	5.167	4.333	0.078	0.399
	12	0.272	64.98	7.088	22.83	1.751	3.343
TTAX	1	0.0754	100.0	0.000	0.000	0.000	0.000
	4	0.2154	98.57	0.105	0.026	0.867	0.422
	8	0.319	65.19	0.335	11.76	18.89	3.817
	12	0.409	44.93	0.339	18.25	30.72	5.740

Based on this simple rule, a quick summary of the proportion explained by the explanatory variables show that the responses of direct tax and total tax revenue to foreign aid shocks were not significantly different from zero in all the models. In sharp contrast, the responses of indirect tax were relatively higher and significant in all the models. This confirms and consistently supports the results earlier discussed under the VECM and impulse response. A further analysis of the results

[8] See Appendix 2 for the graphical Illustrations

shows that per capita income is the most significant contributor to variation in direct and total tax revenue fluctuation in Nigeria whereas trade openness is the major contributing factor to the fluctuation in indirect tax revenue. This also clearly confirms the result obtained in the ECM model and also asserts the significance of trade policy as the most important determinant of tax revenue in Nigeria.

Foreign aid is found to be the least determinant of the variation in direct and total tax revenue while it ranks second in the case of indirect tax. This further supports the differential effects of foreign aid on direct and indirect tax established in the VECM model. By implication foreign aid has little effects in both short run and long run on direct tax but in contrast it contributes significantly to the fluctuation in indirect tax revenue in Nigeria

5. CONCLUSION

The main objective of this study is to analyse the differential effects of foreign aid on tax revenues in Nigeria. Analyses cut across descriptive analysis to trend analysis, to Augmented Dickey-Fuller, Cointegration and Vector Error Correction as well as impulse response and variance decomposition analyses of which the summary of their outcomes are presented below. The outcome of the stationarity and cointegration tests show that all the variables are integrated after first difference and there is a long run relationship among them. The trace statistic establishes that tax revenue is cointegrated with aid, exchange rate, trade openness and per capita income, indicating their long run relationship.

The results of error correction models show that foreign aid has negative and insignificant effects on direct tax and total tax revenue in Nigeria. In sharp contrast, however, foreign aid has significant effects on indirect tax revenue, confirming the differential effects of foreign aids on tax revenue in Nigeria. The impulse response results also show that a unit per cent shock to foreign aid is likely to induce about 4 per cent boost in indirect tax revenue collection in the long run while a similar shock to foreign aid will result to about 5 per cent in short term and later results in drastic fall in tax revenue by as much as 3 per cent in the long run. This implies that the effect of foreign aid on tax revenue depends on the tax structure and mode of collection. Foreign aid tend to enhance indirect tax both in the short and long run; the effect of foreign aid on direct tax is temporary and transient. The variance decomposition show that the major contributor to the variation on tax revenue especially direct tax and overall tax revenue is the per capita income while the major contributor to indirect tax is the trade openness. This is clearly in line with intuitive reasoning since direct tax is dominated by income tax and indirect tax is invariably sales tax which is dependent on

consumer spending. So fluctuation in income will affect direct tax and fluctuation in tradable will affect indirect tax. Foreign aid is also found only to be a major contributor to indirect tax while it is less significant in explaining the variation in direct tax revenue in Nigeria. This is another confirmation of the differential effect of foreign aid on direct and indirect effects. Overall, the effects of direct tax seem to overwhelm the effect of indirect tax as the aggregate tax and direct tax have similar responses and variance decomposition which are quite different from the responses of indirect tax in all scenarios considered

Owing to the developing nature of Nigerian economy, it is unarguable that both foreign aid and tax revenue are crucial to the discharge of fiscal responsibilities. Against this backdrop, the paper proffers the following recommendations:

(i) The Federal government should first of all see foreign aid as a complement to tax revenue rather than the current substitute ascribed to it.

(ii) There is the need for government to resuscitate its tax institutions in terms of quality and reliable personnel to reflect transparency and probity. The structure of taxes should be designed to reflect the cardinals of taxation including convenience.

(iii) The government should continue to pursue its appropriate foreign policy and receive any foreign aids that are not detrimental to the growth and development of the economy. Some foreign aid are known to be baits, which compromise national sovereignty.

(iv) There is also the need for the federal government to put to an end unnecessary tax holiday to private companies especially those in the domain of monopoly or oligopoly markets. This has adversely affected tax revenue performance in the immediate past.

REFERENCES

Abibi, F., Banyendera, H., (2006), "Taxation of the Informal Sector in Uganda. Uganda Revenue Authority", Kampala.

Ayoki, M., (2008), "Making Uganda's tax more appropriate in meeting national objectives: what works, what doesn't, and why", *Final Report* Submitted to the Ministry of Finance, Planning and Economic Development.

Besley, T.J., Persson, T., (2009a), "The origins of state capacity: property rights, taxation and politics", *American Economic Review* 99 (4), 1218–1244.

Besley, T.J., Persson, T., (2009b), "State capacity, conflict and development", *Discussion Paper* 7336, CEPR.

Brownbridge, M., Mutebile, E.T., (2007), "Aid and fiscal deficits: lessons from Uganda on the implications for macroeconomic management and fiscal sustainability", *Development Policy Review* 25 (2), 193–2 13.

Carter, P., (2010), "Foreign aid and taxation", revisited. www.csae.ox.ac.uk /conferences/2010-EdiA/papers/180-Carter.pdf accessed on 4/5/2012.

Collier, Paul (2005), "Is Aid Oil? An analysis of whether Africa can absorb more aid", Centre for the study of African Economies, Oxford University

Collier, Paul. (2007), "The Bottom Billion: Why the Poorest Countries are Failing and What Can Be Done About It", Oxford and New York: Oxford University Press.

Easterly, William (2006), *The White Man's Burden: Why the West's Effort to Aid the Rest Have Done, So Much Ill and So Little Good*. Penguin. ISBN 1-59420-037-8.

Economist (2013), "The future of aid", economist.com. Retrieved 2013-08-16.

Economist (2009), "Migration and development: The aid workers who really help". *economist.com*. 2009-10-08. Retrieved 2013-08-16.

Franco-Rodriguez, S., (2000), "Recent advances in fiscal response models with an application to Costa Rica", *Journal of International Development* 12,429–442.

Gambaro, L., Meyer-Spasche, J., Rahman, A., (2007), "Does aid decrease tax revenue in developing countries", Unpublished, London School of Economics.

Gang, I.N., Khan, H.A., (1991), "Foreign aid, taxes and public investment", *Journal of Development Economics* 24, 355–369.

Garrett, Laurie. (2007), "The Challenge of Global Health". Foreign Affairs 86 (1).

Gupta, S., Clements, B., Pivovarsky, A., Tiongson, E.R., (2004), "Foreign aid and revenue response: does the composition of aid matter"? In: Sanjeev Gupta, B.C., Inchauste, G. (Eds.), Helping Countries Develop: the Role of Fiscal Policy. International Monetary Fund, Washington, DC.

Heller, S.P., (1975), "A model of public fiscal behavior in developing countries: aid, investment and taxation", *American Economic Review* 65 (3), 429–445 (June).

Hisali, E., (2012a), "The efficacy of central bank intervention on the foreign exchange market: Uganda's experience", *Journal of International Development* 24(2), 185–207.

Hisali, E., (2012b), "Trade policy reform and international trade tax revenue in Uganda", *Economic Modelling* 29, 2144–2154.

Hisali, E., Guloba, A., (2011), Fiscal policy consistency and its implications for macroeconomic aggregates: the case of Uganda. *Journal of International Development* http:// dx.doi.org/10.1002/jid.1801.

ISPNews (2011), "Tied aid strangling nations, says UN", Ispnews.net. Archived from the original on 11 June 2011. Retrieved 2013-08-16.

Knack, S., (2008), "Sovereign rents and the quality of tax policy and administration", *World Bank Working Paper*.

Lancaster, Carol and Dusen Ann Van (2005), *Organizing Foreign Aid: Confronting the Challenges of the 21st Century*, Brookings Institution Press. ISBN 0-8157-5113-3.

Mackinnon, J.G., Haug, A., Michelis, L., (1999), "Numerical distribution functions of likelihood ratio tests for cointegration", *Journal of Applied Econometrics* 14 (5), 563–577.

McGillivray, M., (2009), "Aid, economic reform and public sector fiscal behaviour in developing countries", *Review of Development Economics* 13.

McGillivray, M., Outarra, B., (2005), "Aid, debt burden and government fiscal behaviour in Cote d'Ivoire", *Journal of African Economies* 14 (2), 247–269.

McGuire, M.C., (1978), "A method for estimating the effect of a subsidy on the receiver's resource constraint: with an application to the U.S. local governments, 1964–1971", *Journal of Public Economics*, 10(10), 355–369.

Mirrlees, J., (1971), "An exploration in the theory of optimum income taxation", *Review of Economic Studies* 38 (2), 175–208.

Mirrlees, J., (1976), "Optimal tax theory: a synthesis", *Journal of Public Economics,* 6 (4), 327–358.

Mirrlees, J., (1986), *The theory of optimal taxation*, *Handbook of Mathematical Economics* 3, 1197–1249.

Moore, M., (2007), "How does taxation affect the quality of governance"?, *International Tax Notes* 47.

Moss, T., Petterson, G., van de Walle, N., (2008), "An aid-institutions paradox? A review essay on aid dependency and state building in sub Saharan Africa", In: Easterly, W. (Ed.), *Reinveting Foreign Aid*. The MIT Press, Cambridge, MA.

Mwenda, A., (2006), "Foreign Aid and the Weakening of Democratic Accountability in Uganda", *Foreign Policy Briefing* No. 88. The CATO Institute, Washington, DC.

Otim, S., (1996), "Foreign aid and government fiscal behaviour in low-income South Asian countries", *Applied Economics* 28, 927–933.

Pack, H., Pack, J.R., (1990), "Is foreign aid fungible? The case of Indonesia", *The Economic Journal*, 100 (3), 188–194.

Pack, H., Pack,J.R., (1993), "Foreign aid and the question of fungibility", *The Review of Economics and Statistics*, 75 (2), 258–265.

Remmer, K.L., (2004), "Does foreign aid promote the expansion of government"?, *The American Journal of Political Science* 48 (1).

Ross, M., (2004), "Does taxation lead to representation"?, *The British Journal of Political Science* 34.

Sachs, Jeffrey D. (2005), *The End of Poverty: Economic Possibilities for Our Time*. New York: Penguin Books.

Shah A. (2012), "Foreign Aid for Development Assistance".
http://www.globalissues.org/article/35/foreign-aid-development-assistance

Singer, Peter. (2009), "*The Life You Can Save",* New York:Random House.

Stotsky, J.G., WoldeMariam, A., (1997), "Tax effort in sub-Saharan Africa". *IMF Working Paper* 97/1 07.

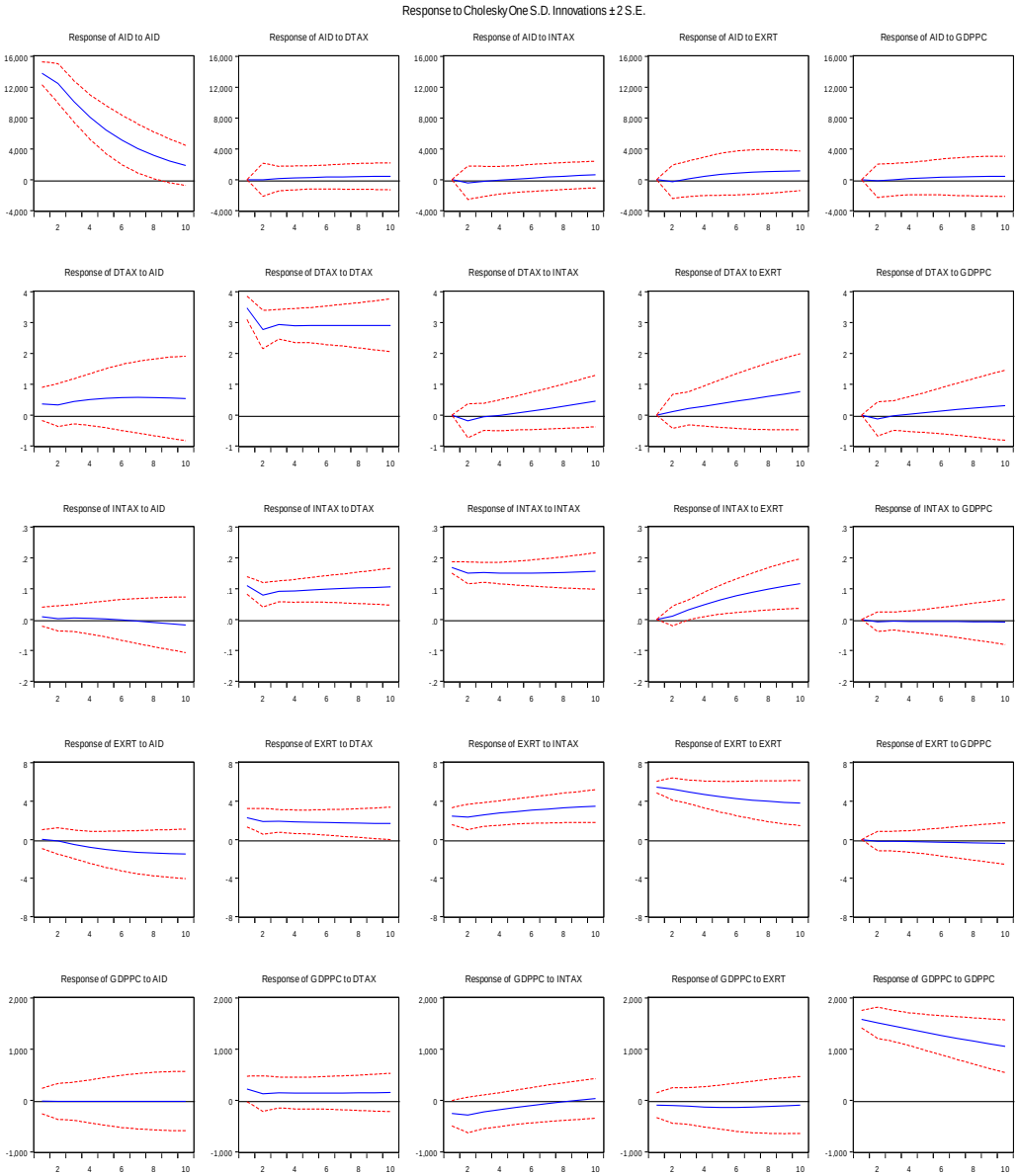
Uganda Revenue Authority, (2010), Raising the tax to GDP ratio in Uganda. *Mimeo*, Kampala.

Wamibu, M.N., (2007), "The revenue elasticity of value added tax in Uganda: 1996/97–2005/ 06", Unpublished MA Economic Policy and Planning, Makerere University. *Research report*.

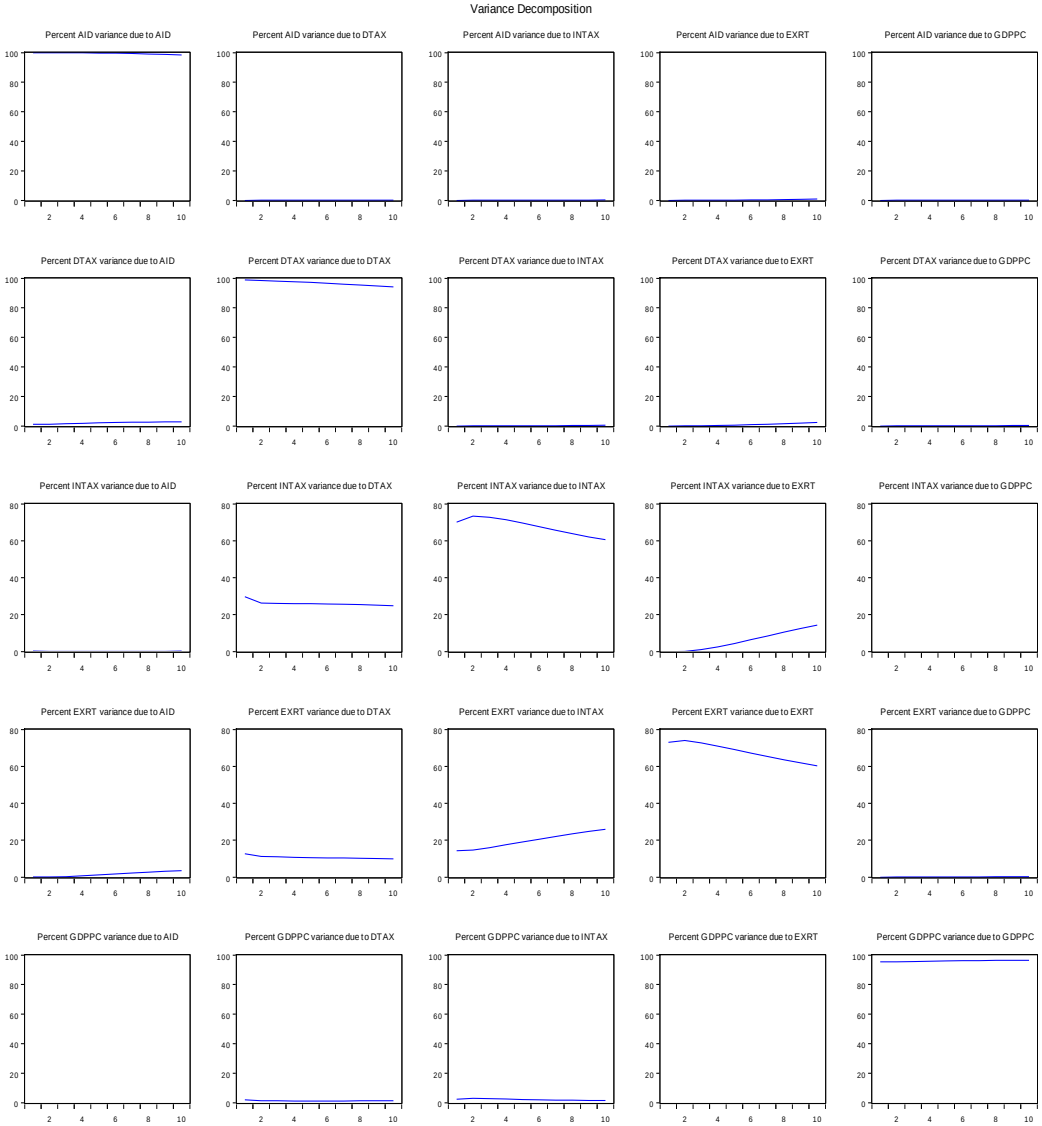
White, H., (1994), "Foreign aid, taxes and public investment: a further comment on Gang and Khan", *Journal of Development Economics,* 45, 155–163.

World Bank, (2010), *World Development Indicators*.

Appendix 1: Impulse Response Function



Appendix 2: Variance Decomposition



Appendix 3: Pairwise Granger Causality Tests
Pairwise Granger Causality Tests
Date: 08/11/15 Time: 10:01
Sample: 1970Q1 2012Q4
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
DTAX does not Granger Cause AID	170	2.98520	0.0533
AID does not Granger Cause DTAX		0.46836	0.6269
INTAX does not Granger Cause AID	170	3.74361	0.0257
AID does not Granger Cause INTAX		0.07607	0.9268
EXRT does not Granger Cause AID	170	4.01270	0.0199
AID does not Granger Cause EXRT		0.59297	0.5539
GDPPC does not Granger Cause AID	170	1.93108	0.1483
AID does not Granger Cause GDPPC		0.46342	0.6299
INTAX does not Granger Cause DTAX	170	3.48718	0.0329
DTAX does not Granger Cause INTAX		1.16264	0.3152
EXRT does not Granger Cause DTAX	170	3.46340	0.0336
DTAX does not Granger Cause EXRT		0.30765	0.7356
GDPPC does not Granger Cause DTAX	170	0.04307	0.9579
DTAX does not Granger Cause GDPPC		2.26526	0.1070
EXRT does not Granger Cause INTAX	170	4.82427	0.0092
INTAX does not Granger Cause EXRT		0.66100	0.5177
GDPPC does not Granger Cause INTAX	170	0.55504	0.5751
INTAX does not Granger Cause GDPPC		3.54106	0.0312
GDPPC does not Granger Cause EXRT	170	0.04861	0.9526
EXRT does not Granger Cause GDPPC		2.85410	0.0605

DOMESTIC RESOURCE MOBILIZATION AND INDUSTRIAL PERFORMANCE IN NIGERIA

By Peter Ubi and Lionel Effiom *

Abstract

This study disaggregates the industrial sector in Nigeria into its formal subsectors and investigates the impact of domestic resource mobilization (DRM) on the subsectors. Estimated results, which are based on an Error Correction Model of the Ordinary Least Squares Methodology, reveals consistency with economic theory with different levels of statistical significance in the different equations specified. The results underlined the fact that adequate mobilization of domestic resources by developing countries can be a source of industrial growth. It also highlights the capacity inadequacy of Nigeria to mobilize and channel domestic resources for the desired industrial growth. The paper recommends a mechanism for the strategic channelling of domestic resources into industrial growth as a veritable option. Also, the implementation of financial policies that would reduce capital flight but encourage domestic savings in Nigeria should be pursued. Finally, the continuous deepening of the financial sector by the monetary authorities is strongly advocated.

Keywords: DRM; building and construction; oil and gas; Manufacturing
JEL CLASSIFICATION: D78, E22 and F65.

1. INTRODUCTION

Most developing nations are blessed with abundant supplies of raw materials, petroleum products and other minerals for which world demand is growing. However, in Africa and specifically in Nigeria, natural resources (both physical and human) are abundant but adequate domestic resource mobilization is needed to explore and exploit them. Such mobilization is not easy without adequate investments in managerial and technical skills. Romer (1993) argues that today's developing nations are poor because their citizens lack access to the ideas that are necessary to generate economic value. Romer (1993) further argues that the lack of such ideas is manifest in the technology gap (viz: the physical object gap and the idea gap) between the rich and poor nations of the world. It is therefore unquestionable that the abundance of natural resources is a necessary but not a sufficient condition for the stimulation of economic growth. One of the sufficient conditions is the efficient mobilization and channeling of scarce resources into areas that can be expected to make the greatest contribution towards the realization of long term economic objectives. These long term economic objectives include but not limited to the achievement of sustained and improved performance of the industrial sector.

Peter Ubi ad Lionel Effiom are of the department of Economics, University of Calabar, Nigeria. The views expressed are those of the authors and does not represent those of the University of Calabar
E-mail: ubipetersamuel@yahoo.com, leoeff2002@yahoo.com

Economic development could be accelarated through emphasis on industrialization (Rostow, 1960), but industrialization may only be fast-tracked through increased public investment. Public investments, on the other hand, can finance the infrastructure necessary for industrial activities to thrive. Only efficiently mobilized revenues (from taxes, savings, remittances etc) can to a large extent change the level and pattern of public investments. In Nigeria for instance, savings averaged 2.5 million naira between1970 and 1980 while industrial output growth rate averaged 39.5 per cent. Between 1990 and 2012, savings was 145.5 million naira and industrial output growth rate declined significantly to 2.3 per cent (CBN Bulletin, 2014). This is an indication of poor mobilization (or channeling) of financial resources into the industrial sector.

But the performance of the industrial sector can be better appreciated if its subsectors are evaluated to ascertain the degree to which DRM has impacted on them individually. Usually, the subsectors of industrial sector are manufacturing, mining and quarry, utilities (electricity and water) and building and construction. Manufacturing as indicated by World Bank (2005) is typically the most dynamic component of the industrial sector. Interestingly, it is the deepening of manufacturing that measures the extent to which the other components of the industrial sector have been effectively utilized.

In Nigeria, owing to the revenue windfall from oil in the 1970s, the industrial sector fairly expanded through the industrial policies that were implemented. Specifically, the manufacturing sub-sector as compared to other sub-sectors greatly benefited from this revenue windfall from oil as its share in gross domestic product (GDP) increased on the average from 6.0 per cent in 1970s to 7.0 per cent in 1980s while the share of mining in GDP increased averagely from 0.5 per cent in 1970s to 1.3 per cent in 1980s. Also, the share of building and construction was 4.2 per cent in 1970s and 16.8 per cent in 1980s while the share of utilities in GDP was averagely 0.005 per cent in 1970s and 0.007 per cent in 1980s. With the apparent low contribution of the various sub-sectors including manufacturing and a relatively higher contribution of agriculture to GDP of over 30% in the 1980s, Nigeria cannot escape from being classified as an underdeveloped economy.

Given this classification, the study investigates the impact of domestic resource mobilization on the industrial sub-sectors in Nigeria. While progress in the literature on DRM in Nigeria has been substantial, literature on its specific role in stimulating industrial sub-sector development is still quite scanty and limited to assessing the relationship between DRM and economic growth only. The rest of the paper proceeds thus: section 2 explores the empirical and theoretical issues on DRM, and in section 3, an overview of the dynamics of the Nigerian industrial subsector is provided. While the methodology, model and data of the study are captured

in section 4, empirical results are presented and discussed in Section 5. Section 6 concludes the work with some policy recommendations.

2. EMPIRICAL AND THEORETICAL ISSUES

There are a multiplicity of definitions of domestic resource mobilization (D.R.M.). But in spite of these nuances of definitions, there seems to be a common thread running through them. All the definitions point to the fact that it is concerned with increased revenue generation from savings, taxes, remittances and other sources as well as reducing capital flight in order to boost revenue generation. It also includes productive allocation of these resources into socially and economically desirable investments. Broadly speaking, DRM encompasses the mobilization of both financial and human resources in the domestic economy for sustainable investments. It is widely acknowledged by scholars that financing domestic investments from domestic resources is potentially the largest source of long term financing for any economy that desires sustainable development. This is because a well conceived DRM strategy is a necessary condition for developing countries to exit the aid dependence syndrome. Interestingly, Khan (2007) points out that domestic revenue flows/sources are less volatile than external revenue flows/sources. Enhanced domestic resource mobilization increases a country's capacity to achieve long-term development objectives which includes reduction of unemployment, high level of industrialization etc. In Nigeria, the fragmented and uncoordinated state of domestic resource mobilization and the resultant inefficient intermediation between savings and investment are the key bottlenecks to self-sustainable industrial development. The problems of inefficient or absence of domestic resource mobilization (specifically, finance) in the face of market failure in developing countries has dominated attention in recent times because of its importance. In a developing economy such as Nigeria, it is not only the shortage of funds that actually impede industrial and economic development but the inability to mobilize the scarce available funds for productive investment. Given that Nigeria is faced with internal and external growth constraints, it is expected that more emphasis than is currently the case, be placed on the improvement of the financial system and its components for the mobilization of domestic resources for industrial cum economic development.

Empirically, Ogunleye and Fashina (2010) employ Arellano-Bond GMM technique on a panel of 38 sub-Saharan Africa (SSA) countries and found that savings and investment are the only variables that contributed positively and significantly to economic growth while all the fiscal (tax) revenues, though positive, are insignificant. The implication of this result is two-fold. First, it confirms the weak nature of domestic resource mobilization process in most developing countries.

Second, it suggests the need for an improved domestic mobilization process in developing countries. Andabai (2011) investigates the relationship between domestic resources with emphasis on domestic credit mobilization and economic development in Nigeria using non-parametric statistics for a sample size of 10 years. The results indicates that there exist a significant relationship between domestic credit mobilization and economic development in Nigeria.

In the same vein, Abeng (2006) carries out a qualitative study in Nigeria that concludes that it is relatively efficient to domestically mobilize resources in an economy that is highly monetized. In his view on the subject, Abeng (2006) avers that in an undeveloped economy where a large proportion of economic activities takes place in the underground economy, domestic resource mobilization is limited. Deductively, in such an undeveloped economy, savings becomes precautionary as opposed to investment driven motivation which creates structural savings trap and inevitably affects investment and industrial growth. Also, the existence of the hidden economy that accounts for over 50 per cent of economic activities (as in Nigeria) greatly hinders efficient and effective fiscal revenue mobilization. This buttresses the implications of the results obtained by Ogunleye and Fashina (2010) as earlier discussed and strengthens the fact that developed countries that have highly monetized economies are more vigorous in mobilizing domestic resources (tax revenues).

Theoretically, the Endogenous growth theory as developed by Romer (1986) which explains the long-run growth rate of an economy on the basis of endogenous factors as against exogenous factors of the neoclassical growth theory reinforces the necessity of domestic resource mobilization. Also, DRM further supports the notion implied by the Harrod-Domar and Solow neoclassical growth models that increased savings and investment facilitate long term growth. For simplicity, Romer's aggregate production function/model takes the form:

$$Y = AK^{\alpha+\beta}L^{1-\alpha}.$$

Where A an index of technology is assumed to be constant rather than rising over time. This implies that there is no technological progress for now. With some mathematical manipulation (which is not the focus of this study) and the assumption of Romer's positive capital externality, an endogenous growth that is not exogenously driven by increases in productivity is derived.

3. DYNAMICS OF THE INDUSTRIAL SUBSECTOR IN NIGERIA

Industrialization drives economic growth and fast tracks the achievements of structural transformation. Before independence in Nigeria, industrialization was not part of the British colonial economic policy which was anchored on making the colonies primary product producers and importers of finished goods. (Mordi, Englama and Adebusuyi, 2010). Thus, the first indigenous administration after political independence in 1960 pursued the transformation of the Nigerian economy into a modern industrial economy. This was manifest in the National Development plans (1962-1968, 1970-1975, 1975-1980 and 1981- 1985) which embraced rapid industrialization as one of the core national development objectives.

The process of industrial development in Nigeria is categorized into four phases after independence (Mordi, Englama and Adebusuyi, 2010). These phases are: phase one which started from the end of the Civil War through the oil boom period (1970-1979). This period was marked by the centralization of industrial planning and considerable government involvement in industrial activity. Phase two was the oil burst era (1980-1985), when the glut in the international oil market reduced drastically Nigeria's foreign exchange earnings thus impacting negatively on industrial activities. Phase three was the structural adjustment period (1986-1998) in which government sought to rationalize its role by reducing direct participation in industrial activities. Finally, phase four (1999-2007) is regarded as era of the consolidation of structural reforms.

The performance of the industrial sector can be objectively analyzed based on the examination of industrial production during these phases. This is shown in Table one.

Table 1**: Compound Growth Rates of Industrial Subsectors in Selected Periods (In Percentage)**

Industrial Subsectors	End of Civil War (1970-1979)	International Oil Glut (1980-1985)	SAP Period (1986-1998)	Consolidation of Structural Reforms (1999-2007)
MAN.	23.4	23	0.9	7.3
MIN/QUA	38.6	-0.12	23.5	25.30
BUILD/CON	19.4	11.88	11.92	40.8
UTILS	28.02	-13.55	21.78	28.69

Source: Computed by the authors from Table 1 in Appendix 1.

N/B: MAN = Manufacturing, MIN/QUA = Mining and Quarry,
BUILD/CON. = Building and Construction, UTIL = Utilities (electricity and water). The formula used in computing compound growth rate is:

$$R = \sqrt[t]{\frac{N2}{N1}} - 1 \quad - \quad - \quad - \quad - \quad -- \quad - \quad (1)$$

Where: R = Compound growth rate N_1 = Previous year production
N_2 = Current year production t = Exponential time period

An examination and analysis of Table 1 using the compound growth rates as shown in equation 1 would show the performance of the industrial sub sectors in the selected time periods. The uniqueness in using compound growth rate is that it being exponential, has the ability of capturing the rate of growth over a period of time. Table one reveals that manufacturing output during phases one and two (1970-1979 and 1980-1985) has steadily increased over the years with an overall positive average growth rate (percentage rate of change) of 23.4 per cent for the two periods. This was a modest performance but the performance declined considerably during phases three and four (1986-1998 and 1999-2007) with an average performance of 0.9 per cent and 7.3 per cent, respectively. Mining and quarry intensified in phase one and negatively decreased in phase two with an average growth rate of 38.6 per cent and -0.12 per cent respectively. Notwithstanding the unimpressive performance of the mining and quarry subsector in phase two, the subsector recorded on the average a 23.5 and 25.3 per cent positive rate of growth during the third and fourth phases, respectively. The building and construction subsector made quite a good performance in phase one with a positive growth rate of 28.02 per cent but declined considerably in phase two with a negative growth rate of -13.6 per cent. However, this negative growth rate was reversed in phases three and four as the subsector recorded a 21.8 and 28.7 per cent positive growth rates, respectively.

Utilities subsector recorded an average positive growth rate of 21.0 per cent in the four phases. Putting all the subsectors together, the paper finds that the industrial sector recorded an average positive simple growth rate of 31.9 per cent in all the four phases (1970-2007), though this growth rate is not significant. It can be deduced that the positive growth rate of the industrial sector is an indication of increased industrial activities in the periods under reference.

4. THE MODEL AND DATA

The primary objective of this study is to quantitatively determine the impact of domestic resource mobilization on industrial subsectors in Nigeria. The period of analysis covers 1970-2013. This is the longest period for which numerical data is available and accessible. The econometric approach is based on a time series data regression. To achieve this objective, a model based on the theory of endogenous growth, with relevant modifications was specified and estimated for the four basic industrial subsectors over the period as earlier mentioned. The endogenous growth model in its simplest form is stated thus: Y = f(A, K and L).

Where Y = Output

A = Technology

K = Capital and L = Labour.

It is assumed that "A" is constant; therefore, output (Y) becomes a function of only capital and labour. In specifying the model for this study, savings (SAV), tax revenue (TAR), remittances (REM) and credit to the private sector-GDP ratio (CDP) are regarded as domestic capital (resources) while labour force and capital flight (CAF) are regarded as control variables. On the basis of this, the functional form of the models for the four subsectors is specified as:

MAN = *f*(SAV, TAR, REM, CDP, CAF, LAB) - - (1)

Where:

MAN = Manufacturing sector performance which is measured by manufacturing output-GDP ratio.

BUC = *f*(SAV, TAR, REM, CDP, CAF, LAB) - - (2)

Where:

BUC = Building and construction sector performance which is measured by building and construction output-GDP ratio.

MIQ = *f*(SAV, TAR, REM, CDP, CAF, LAB) - - (3)

Where:

MIQ = Mining and quarry sector performance which is measured by mining and quarry output-GDP ratio.

UTIL = *f*(SAV, TAR, REM, CDP, CAF, LAB) - - (4)

Where:

UTIL = Utilities (electricity and water) sector performance which is measured by utilities output-GDP ratio.

It should be noted that the values of all the output of the various subsectors are in millions of naira and all other variables are as previously defined. The basic relationship to estimate is a dynamic linear version of equations (1), (2), (3) and (4) as shown in an econometric form:

$$\ln MAN = a_0 + a_1 \ln SAV + a_2 TAR + a_3 REM + a_4 \ln CDP + a_5 \ln CAF + a_6 \ln LAB + E_1 \quad - \quad (1)$$

$$\ln BUC = a_0 + a_1 \ln SAV + a_2 TAR + a_3 REM + a_4 \ln CDP + a_5 \ln CAF + a_6 \ln LAB + E_2 \quad - \quad (2)$$

$$\ln MIQ = a_0 + a_1 \ln SAV + a_2 TAR + a_3 REM + a_4 \ln CDP + a_5 \ln CAF + a_6 \ln LAB + E_3 \quad - \quad (3)$$

$$\ln UTIL = a_0 + a_1 \ln SAV + a_2 TAR + a_3 REM + a_4 \ln CDP + a_5 \ln CAF + a_6 \ln LAB + E_4 \quad - \quad (4)$$

where all the variables are as previously defined and E_1, E_2, E_3, and E_4 are the error terms of the respective equations. The sign of all the elasticity coefficients are expected to be positive in all the equations except for capital flight (CAF) that is expected to be negative. The inclusion of remittances (REM) in the model is based on the fact that it has become a major source of foreign exchange for most developing countries including Nigeria. Also, domestic savings (SAV) is regarded as one of the veritable tool for capital formation needed for the production of capital goods and output. Tax revenue (TAR) is included in the model in order to ascertain the level of domestic financial revenue mobilized by government. The inclusion of capital flight as a control variable is to ascertain the level of responsiveness of output to it, given the fact that an increase in capital flight is regarded as the inability of a country to efficiently mobilize and retain its domestic financial resources (UNCTAD, 2007). In the same vein, credit to the private sector-GDP ratio is a measure of financial sector development which is necessary for efficient mobilization of financial resources in the domestic economy. Finally, the specification of labour force (LAB) in the model is to capture the economically active population necessary for industrial production.

This paper adopts the co-integration and error correction paradigms to investigate the relationship between industrial subsector performance and other explanatory variables as specified above. Given data instability in Nigeria occasioned by policy instability cum economic disruptions etc, it becomes increasingly useful to test the time series property of the variables included in regression analysis for meaningful economic results. The paper adopts the general to specific approach to arrive at the parsimonious estimate by eliminating jointly insignificant variables. The error correction term shows the speed of adjustment to restore equilibrium in the dynamic model. In particular, the ECM coefficient shows how quickly variables converge to equilibrium and the ECM term is expected to have a negative sign (Udah, 2010).

A time series data set was obtained from different sources. The data on industrial subsectors' output and remittances (REM) were obtained from World development indicators. Savings (SAV), tax revenue (TAR) and credit to the

private sector GDP-ratio (CDP) were obtained from Central Bank of Nigeria, Statistical Bulletin, (2014). Labour force was from National Bureau of Statistics 2012 and capital flight (CAF) from Boyce and Ndikumana (2012) and World development indicators, 2013.

5. PRESENTATION AND DISCUSSION OF RESULTS

5.1. Presentation of Results

The first step involved in the estimation of a linear relationship is the comprehensive pre-testing procedure to investigate the characteristics of the time series variables. Using the augmented Dickey-Fuller tests, the results as presented in Table 5.1 show that all the series (variables) are stationary at first difference except the ECM(-1) variable that is stationary at level. That is, the result indicates that the variables BUC, CAF, CDP, LAB, MAN, MIQ, REM, SAV, TAR and UTIL are integrated of order one - 1(1). Therefore, a co-integration test was carried out to confirm and determine the existence of a long-run relationship among the variables as specified in the various equations.

Table 5.1: ADF UNIT ROOT TEST

Variables	**ADF Statistics (Computed)**		**5% Critical Value**		**Remark**
	Level	**1st Difference**	**Level**	**1st difference**	
BUC	-0.855884	-3.136243	-2.9320	-2.9339	I(1)
CAF	-1.310726	-6.105927	-2.9320	-2.9339	I(1)
CDP	-1.833536	-4.751646	-2.9320	-2.9339	I(1)
LAB	-1.775855	-3.713925	-2.9320	-2.9339	I(1)
MAN	-2.097624	-6.187157	-2.9320	-2.9339	I(1)
MIQ	-1.095433	-3.377534	-2.9320	-2.9339	I(1)
REM	-2.112968	-4.665185	-2.9320	-2.9339	I(1)
SAV	-1,143507	-3.05370	-2.9320	-2.9339	I(1)
TAR	-1.688743	-4.757445	-2.9320	-2.9339	I(1)
UTIL	-1.509890	-3.459672	-2.9320	-2.9339	I(1)
ECM(-1)	-4.089508	-	-2.9320	-	I(0)

Source: Computed by authors using E-views

The Johansen cointegration test as shown on tables 5.2, 5.3 and 5.5 in appendix reveals that there is a long-run relationship between the explanatory variables captured in the models and manufacturing output-GDP ratio (MAN), building

and construction-GDP ratio and utility-GDP ratio, respectively. The result indicates five cointegrating equation(s) at 5 per cent and 1 per cent levels. The conclusion drawn from the result is that there exists a unique long-run relationship between the dependent variables (MAN, BUC and UTIL) and the independent variables (LAB, CDP, CAF, SAV, REM and TAR), respectively. The identified cointegrating equations can then be used as an error correction term (ECM) in the error correction model. This series will form the error correction variable, similar to the residuals generated when using the Engle-Granger two-stage method. Table 5.4 is the cointegration estimate for mining and quarrying model which shows that the ECM is integrated of order zero - 1(0). It should be noted that the stationarity of the ECM variable at levels implies that there exist a long-run relationship among the variables in the equation.

Having established the extent and form of cointegrating relationships between the variables in the models, an over parameterized error correction model was estimated. At this level, the over parameterized model is difficult to interpret in any meaningful way: its main function is to allow us to identify the main dynamic patterns in the model. But this study will be concerned with the parsimonious model that is more interpretable. Tables 6.6, 6.7, 6.8 and 6.9 in appendix show the results of the parsimonious models.

From table 5.6 in appendix, the current value of remittances (REM) has a positive sign that is in line with economic theoretical expectation. The coefficient of remittances is statistically insignificant at 5 per cent level. The implication of this result is that the current level of remittances has an insignificant effect on the current level of manufacturing performance even though a 1 per cent rise in the current level of remittances will lead to 0.433387 per cent increase in the current level of manufacturing performance, all things being equal. In the same table, the current and lagged values of savings (SAV) are contemporaneously positive and are all statistically insignificant at 5 per cent level. Thus, there is 95 per cent confidence level that a 1 per cent increase in current and lagged values of savings would engender an insignificant 4.650187 and 2.535798 per cent increase in manufacturing performance, respectively, all things being equal. This means that an improvement in savings over the years would definitely lead to an insignificant improvement in manufacturing performance in Nigeria. The current and lagged values of tax revenue (TAR) are positive and statistically insignificant at 5 per cent level. Thus, a 1 per cent rise in tax revenue would enhance and sustain manufacturing growth performance in Nigeria by 0.915794 and 0.276834 per cent, respectively.

The current value of Labour force (LAB) is positive and conforms to economic theory. This implies that a 1 per cent increase in the current labour force will lead to 2.701131 per cent increase in the level of manufacturing performance, ceteris paribus. Labour force variable is statistically significant at 5 per cent level. The coefficient of the current value of financial deepening variable (as measured by credit to the private sector-GDP ratio) is also positive (in line with economic theory) and is statistically significant at 5 per cent level. Also, the current and lagged values of capital flight (CAF) have a negative sign that is in line with apriori expectation. The coefficients of capital flight are statistically significant at 5 per cent level. The implication of this result is that a 1 per cent rise in the current and lagged values of capital flight will lead to 0.217188 and 0.215971 per cent decrease in the current level of manufacturing performance, respectively, all things being equal.

The strong significance of the coefficient of the error correction mechanism (ECM) supports the paper's earlier argument that the variables are indeed co-integrated. The ECM shows a relatively high speed of adjustment (44 per cent) of the short-run and long-run equilibrium behaviour of manufacturing performance and its explanatory variables.

The adjusted R^2 shows that about 51 per cent of the total variation in manufacturing performance (measured by manufacturing output-GDP ratio) is determined by changes in the explanatory variables. Thus, it is a good fit. The F-statistics (14.0) indicates that all the variables are jointly statistically significant at 5 per cent level. The Durbin Watson statistics of 1.97 reveals that it is within the acceptable bounds, thus it is good for policy analysis.

From table 5.7 in appendix, the current and lagged values of capital flight (CAF) have a negative sign that is in line with economic theoretical expectation. The current and lagged coefficients of capital flight are statistically significant and insignificant, respectively at 5 per cent level. The implication of this result is that a 1 per cent rise in the current and lagged values of capital flight will lead to 0.051384 and 0.016207 per cent decrease in the current level of building and construction performance respectively in Nigeria, all things being equal. The coefficient of the current value of financial deepening (CDP, as measured by credit to the private sector-GDP ratio) is also positive in line with economic theory and is statistically significant at 5 per cent level. Thus, a 1 per cent rise in financial deepening would increase building and construction performance by 0.225172 per cent, ceteris paribus. The current value of labour force (LAB) is positive and conforms to economic theory. This implies that a 1 per cent increase in the current labour force will lead to 3.470160 per cent increase in the level of building and

construction performance, ceteris paribus. Labour force variable is statistically significant at 5 per cent level.

The current value of remittances (REM) has a positive sign that is in line with economic theoretical expectation. The coefficient of remittances is statistically significant at 5 per cent level. The implication of this result is that the current level of remittances has a significant effect on the current level of building and construction performance even though a 1 per cent rise in the current level of remittances will lead to 0.041577 per cent increase in the current level of building and construction performance, all things being equal. In the same table, the lagged value of savings (SAV) is contemporaneously positive and is statistically significant at 5 per cent level. Thus, a 1 per cent increase in lagged value of savings would engender a significant 0.116323 per cent increase in building and construction performance, all things being equal. This means that an improvement in savings over the years would definitely lead to a significant improvement in building and construction performance in Nigeria. The current and lagged values of tax revenue (TAR) are positive but only the current value of tax revenue is statistically significant at 5 per cent level while the lagged value is statistically insignificant. Thus, a 1 per cent rise in tax revenue would enhance and sustain building and construction performance in Nigeria by 0.55836 per cent and 0.009227 per cent respectively.

The strong significance of the coefficient of the error correction mechanism (ECM) supports our earlier argument that the variables are indeed co-integrated. The ECM shows a relatively high speed of adjustment (46 per cent) of the short-run and long-run equilibrium behaviour of building and construction performance and its explanatory variables.

The adjusted R^2 shows that about 71 per cent of the total variation in building and construction performance (measured by building and construction output-GDP ratio) is determined by changes in the explanatory variables. Thus, it is a good fit. The F-statistics (20.3) indicates that all the variables are jointly statistically significant at 5 per cent level. The Durbin Watson statistics of 2.5 reveals that it is within the acceptable bounds, thus it is good for policy analysis.

From table 5.8 in appendix, the lagged coefficient of mining and quarrying (MIQ) has a positive sign that is in line with economic theoretical expectation. The lagged coefficient of mining and quarrying is statistically significant at 5 per cent level. The implication of this result is that a 1 per cent rise in the lagged value of mining and quarrying will lead to 1.164086 per cent increase in the current level of mining and quarry performance in Nigeria, all things being equal. The current

value of labour force (LAB) is positive and conforms to economic theory. This implies that a 1 per cent increase in the current labour force will lead to 2.351972 per cent increase in the level of mining and quarrying performance, ceteris paribus. Labour force variable is statistically insignificant at 5 per cent level.
The current and lagged coefficients of financial deepening variable (CDP) as measured by credit to the private sector-GDP ratio) are also positive in line with economic theory and are statistically significant and insignificant respectively at 5 per cent level. Thus, a 1 per cent rise in financial deepening would increase mining and quarrying performance by 0.207036 per cent and 0.651411 per cent respectively, ceteris paribus. In the same vein, the current coefficient of capital flight (CAF) is negative and in line with the apriori expectations. A 1 per cent rise in capital flight would lead to a significant 0.044199 per cent decrease in mining and quarrying performance.

The current value of remittances (REM) has a positive sign that is in line with economic theoretical expectation. The coefficient of remittances is statistically insignificant at 5 per cent level. The implication of this result is that the current level of remittances has an insignificant effect on the current level of mining and quarrying performance even though a 1 per cent rise in the current level of remittances will lead to 0.021540 per cent increase in the current level of mining and quarrying performance, all things being equal. In the same table, the lagged value of savings (SAV) is contemporaneously positive and is statistically significant at 5 per cent level. Thus, a 1 per cent increase in lagged value of savings would engender an insignificant 0.543142 per cent increase in mining and quarrying performance, all things being equal. This means that an improvement in savings over the years would definitely lead to an insignificant improvement in mining and quarrying performance in Nigeria. The current value of tax revenue (TAR) is positive and is statistically insignificant at 5 per cent level. Thus, a 1 per cent rise in tax revenue would enhance and sustain insignificantly mining and quarrying performance in Nigeria by 0.070067 per cent.

The strong significance of the coefficient of the error correction mechanism (ECM) supports an earlier argument in the paper that the variables are indeed co-integrated. The ECM shows a relatively high speed of adjustment (45 per cent) of the short-run to long-run equilibrium behaviour of mining and quarrying performance and its explanatory variables.

The adjusted R^2 shows that about 57 per cent of the total variation in mining and construction performance (measured by building and construction output-GDP ratio) is determined by changes in the explanatory variables. Thus, it is a good fit. The F-statistics (18.2) indicates that all the variables are jointly statistically

significant at 5 per cent level. The Durbin Watson statistics of 2.1 reveals that it is within the acceptable bounds, thus it is good for policy analysis.

Table 5.9 in appendix, the current value of labour force (LAB) is positive and conforms to economic theory. This implies that a 1 per cent increase in the current labour force will lead to 1.771243 per cent increase in utility subsector performance, ceteris paribus. Labour force variable is statistically insignificant at 5 per cent level.

The current coefficient of financial deepening (CDP, as measured by credit to the private sector-GDP ratio) is also positive in line with economic theory and is statistically significant at 5 per cent level. Thus, a 1 per cent rise in financial deepening would increase mining and quarrying performance by 0.079958 per cent respectively, ceteris paribus. In the same vein, the current coefficient of capital flight (CAF) is negative and in line with the a priori expectations. A 1 per cent rise in capital flight would lead to a significant 0.796136 per cent decrease in utility performance. In the same table, the coefficient of savings (SAV) is contemporaneously positive and is statistically insignificant at 5 per cent level. Thus, a 1 per cent increase in savings would engender an insignificant 0.1.627477 per cent increase in utility performance, all things being equal.

The current value of remittances (REM) has a positive sign that is in line with economic theoretical expectation. The coefficient of remittances is statistically significant at 5 per cent level. The implication of this result is that the current level of remittances has a significant effect on the current level of utility performance. Thus, a 1 per cent rise in the current level of remittances will lead to 0.883161 per cent increase in the current level of utility performance, all things being equal. The current value of tax revenue (TAR) is positive and is statistically significant at 5 per cent level. Thus, a 1 per cent rise in tax revenue would enhance and sustain significantly utility performance in Nigeria by 0.098097 per cent. Also, the lagged coefficient of tax revenue is positive and statistically insignificant at 5 per cent level.

The strong significance of the coefficient of the error correction mechanism (ECM) supports our earlier argument that the variables are indeed co-integrated. The ECM shows a relatively high speed of adjustment (59 per cent) of the short-run and long-run equilibrium behaviour of utility performance and its explanatory variables.

The adjusted R^2 shows that about 66 per cent of the total variation in utility performance (measured by utility output-GDP ratio) is determined by changes in

the explanatory variables. Thus, it is a good fit. The F-statistics (10.2) indicates that all the variables are jointly statistically significant at 5 per cent level. The Durbin Watson statistics of 1.7 reveals that it is within the acceptable bounds, thus it is good for policy analysis.

5.2. Discussion of Results

The parsimonious results in all the industrial subsectors show that the coefficients of labour force have the correct or expected *a priori* sign and only statistically significant in manufacturing and building/construction subsectors but statistically insignificant in mining/quarry and utilities subsectors. This strongly underscores the relative importance of labour force in an improved industrial sector performance in Nigeria. This is because labour force which is more of human capital is expected to increase the productivity of firms. The statistical significance of labour in manufacturing and building/construction subsectors may not be completely unconnected with the fact that manufacturing and building and construction activities in developing countries including Nigeria are largely labour intensive while its statistical insignificance in the other two subsectors, though positive (quarry/mining and utilities) buttresses the fact that if labour is properly mobilized in these subsectors, it has the potential of boosting their performance. As a matter of emphasis, on the relative importance of labour in the determination of industrial subsector performance in Nigeria, the parsimonious results in all the industrial subsectors show that only the labour variable, comparatively, has a greater significant impact of 2.7 and 3.4 per cent on manufacturing and building/construction subsectors performance, respectively while it has an insignificant impact of 1.7 and 2.3 per cent on utility and mining/quarry subsectors performance, respectively.

The coefficient of tax revenue is not only positive and statistically significant in building/construction and utility subsectors but is equally consistent with a priori expectation in all the industrial subsectors. This shows that an increase in tax revenue will boost Nigeria's industrial performance in all the industrial subsectors, all things being equal. This is more so as an increase in tax revenue will enhance the government's capacity to invest in the subsectors. But the fact that tax revenue is only statistically significant in building/construction and utility subsectors further buttresses the weakness of resource mobilization in Nigeria as noted by Ogunleye and Fashina (2010). The coefficient of financial deepening that is used as a control variable is significant and correctly signed in all the subsectors. This result is a testimony to the fact that financial deepening is necessary for an enhanced industrial subsector performance in Nigeria. In the estimated models, the coefficient of remittances is positive and statistically significant in building/construction and utility equations while savings is positive

and only statistically significant in building and construction equation. This supports the fact that remittances in Nigeria are actually not invested in manufacturing or mining activities; rather they are used to offset bills and also finance immediate consumption activities.

This result indicates that capital flight is negative and statistically significant in all the equations. This clearly supports the inability of Nigeria to efficiently mobilize and retain its domestic financial resources to meet their investment needs as advocated by UNCTAD, (2007). Specifically, this study has demonstrated that resource mobilization is not efficient in Nigeria. The result also supports the assertion that efficiently mobilized domestic resources have the capacity to improve industrial subsector performance in Nigeria.

6. CONCLUSION AND POLICY IMPLICATIONS.

This study sets to investigate the level of domestic resource mobilization and its impact on industrial subsectors in Nigeria. On the whole, the estimated results of the four industrial subsectors reveal that the variables are all correctly signed and meet the a priori expectations with different levels of statistical significance in the different models. The fact that the signs of coefficients of estimated variables in the various industrial subsector equations conform to economic theoretical expectations underscores the relative importance of these variables in industrial subsector growth. Thus, by implication, the study establishes that adequate mobilization of domestic resources by developing countries can be a source of industrial growth. But Nigeria's capacity to adequately mobilize domestic resources for the desired industrial growth has not been significant over the years. The paper recommends, among others, further deepening of the financial sector by the monetary authorities and the implementation of financial policies that would reduce capital flight but encourage domestic savings. Government might also think in the direction of initiating a mechanism for the strategic channelling of remittances into the industrial sector.

REFERENCES:

Abeng, M. O. (2006), "Financial sector reforms outcomes in Nigeria: A Quantitative Evaluation", *CBN Bullion*. A Publication of the Central Bank of Nigeria. 30(2),53-67.

Andabai, P. W (2011), "Financial intermediation and Economic development in Nigeria (1999-2009)".

Boyce, J. K. and Ndikumana L (2012), "Capital Flight from Sub-saharan African Countries: Updated estimates", 1970-2010, *Political Economic Research Institute*, 16-22.

CBN Statistical Bulletin (2013), The Central Bank of Nigeria, Abuja.

CBN Statistical Bulletin (2014), The Central Bank of Nigeria, Abuja.

Khan, S A and L Bamou (2007), "An Analysis of Foreign Direct Investment Flows to Cameroon" in I. Ajayi (ed.) *FDI in Sub-Saharan Africa: Determinants, Origins, Targets, Impact and Potential*. Nairobi: African Economic Research Consortium (AERC)

Mordi, C. N.O, Englama A. and Adebusuyi, B, S. (2010), "The Changing Structure of the Nigerian Economy". A publication of The Central Bank of Nigeria, Abuja.

Ogunleye, E.K. and Fashina, D. A. (2010), "The imperatives for domestic resource mobilization for sustained post-crisis recovery and growth in sub-saharan Africa". *African Centre for Economic Recovery.*

Romer, P. M. (1986), "Increasing Returns and Long Run Growth", *Journal of Political Economy* 94(5): 1002-1037.

Romer, P. (1993), "Idea gaps and Object gaps in Economic development". *Journal of Monetary Economics*, (32) 543-572.

Rostow, W. W. (1960), *The process of Economic growth.* 2nd Edition, Oxford, Clandon Press.

Udah, E. B. (2010), "Industrial Development, Electricity Crisis and Economic Performance in Nigeria". *European journal of Economics, Finance and*

Administrative Sciences.105-121. Accessed 8 March 2014. Available: http://www.eurojournals.com (August 6, 2011).

UNCTAD (2007), "Economic development in Africa: domestic resource mobilization and Development". Available: www.unctad.org/en/docs/aldcafrica2007_en.pdf (accessed Aug. 1, 2013).

World Bank (2005), *African Development Indicators* 2005, CD-ROM.

APPENDIX:

Table 1: Components of the Industrial Sector in Nigeria (₦m), 1970-2013

Year	Industrial Production	Mining and Quarrying	Manufacturing	Utilities (electricity and water)	Building and Construction
1970	819.1	32.90	317.6	37.2	269.90
1971	1,012.0	50.40	307.7	41.2	411.50
1972	1,215.3	65.00	381.1	50.6	520.10
1973	1,416.5	68.10	472.7	54.2	578.90
1974	4,927.4	462.18	1,182.0	80.35	1,676.96
1975	7,463.0	502.90	1,186.5	75.63	1,814.57
1976	9,159.9	691.40	1,463.6	89.85	2,605.81
1977	9,600.5	833.36	1,695.6	114.05	2,990.84
1978	9,041.7	848.10	2,169.0	144.87	3,077.19
1979	10,863.7	861.94	2,599.2	218.2	3,192.32
1980	10,922.9	875.09	3,485.9	264.7	3,671.17
1981	89,072.8	865.18	13,837.9	454.6	2,773.00
1982	83,206.5	850.90	15,633.5	483.4	2,488.00
1983	71,967.8	654.24	10,797.4	543.8	2,256.00
1984	77,888.8	575.61	9,532.8	514.7	1,906.00
1985	85,097.4	419.77	12,032.4	519.1	1,532.00
1986	82,860.9	239.65	11,582.6	467.4	1,920.00
1987	81,596.5	274.05	12,041.6	496.24	2,175.00
1988	85,146.6	310.84	13,713.9	547.35	2,467.00
1989	93,971.6	578.17	14,011.5	1,066.96	3,854.45

1990	115,591.4	652.64	14,702.4	1,177.99	4,350.75
1991	108,081.0	735.05	16,078.5	1,297.44	4,900.33
1992	109,682.6	916.45	15,357.2	1,405.19	6,109.72
1993	109,344.2	1,202.87	14,788.1	1,600.77	8,019.10
1994	106,747.6	1,548.72	14,591.4	1,795.16	10,324.60
1995	108,162.7	2,067.67	13,836.1	1,915.3	13,784.38
1996	114,992.2	2,406.34	13,953.4	2,006.29	16,042.21
1997	116,576.9	2,816.40	14,010.0	2,037.58	18,775.74
1998	117,870.3	3,731.67	13,046.3	2,020.65	24,877.83
1999	110,558.6	4,129.09	13,494.6	2,109.56	27,527.52
2000	121,756.6	4,581.76	13,958.8	2,200.25	30,603.92
2001	128,418.6	5,990.93	14,935.1	16,400.03	40,744.13
2002	123,553.5	7,055.66	16,439.4	18,824.68	47,985.41
2003	149,878.7	8,401.33	17,369.6	22,397.41	58,905.42
2004	156,486.8	13,037.93	19,436.8	26,829.65	166,078.47
2005	159,161.4	17,286.35	21,305.1	29,387.42	215,786.12
2006	155,165.5	27,261.45	23,305.9	42,614.82	250,332.27
2007	151,699.1	31,427.07	25,535.5	45,778.44	266,463.99
2008	146,519.6	36,158.59	27,806.8	52,670.64	306,581.64
2009	147,428.5	40,577.51	30,013.8	62,148.5	347,690.73
2010	146,974.1	45,691.79	33,910.3	70,293.71	394,666.15
2011	147,201.3	52,384.23	39,110.3	80,712.94	456,039.02
2012	149,984.4	59,076.67	37,147.6	39,766.32	221,994.37
2013	152,187.8	65,769.10	39,001.8	41,070.41	229,264.57

Source: World Development Indicators, 2012 and 2013.

Table 5.2: COINTEGRATION RESULT FOR MANUFACTURING MODEL

Series: MAN REM LAB CPS CAF SAV TAR

Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.807846	210.8343	124.24	133.57	None **
0.684307	143.2065	94.15	103.18	At most 1 **
0.651391	95.93415	68.52	76.07	At most 2 **
0.386137	52.72822	47.21	54.46	At most 3 *
0.355442	32.72090	29.68	35.65	At most 4 *
16.131022	14.71408	15.41	20.04	At most 5
4.091705	3.943647	3.76	6.65	At most 6

*(**) Denotes rejection of the hypothesis at 5%(1%) significance level. L.R. test indicates 5 cointegrating equation(s) at 5% significance level.

Table 5.3: COINTEGRATION RESULT FOR BUILDING AND CONSTRUCTION MODEL

Series: BUC REM LAB CPS CAF SAV TAR

Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.806163	234.4218	124.24	133.57	None **
0.741304	167.1516	94.15	103.18	At most 1 **
0.644137	111.7155	68.52	76.07	At most 2 **
0.517020	69.35388	47.21	54.46	At most 3 **
0.450661	39.51491	29.68	35.65	At most 4 **
20.50328	14.95429	15.41	20.04	At most 5
5.073758	3.141392	3.76	6.65	At most 6

*(**) Denotes rejection of the hypothesis at 5%(1%) significance level. L.R. test indicates 5 cointegrating equation(s) at 5% significance level.

Table 5.4 : COINTEGRATION FOR MINNING AND QUARRY

ECM AT LEVEL

ADF Test Statistic	-4.089508	1% Critical Value*	-3.5930
		5% Critical Value	-2.9320
		10% Critical Value	-2.6039

*MacKinnon critical values for rejection of hypothesis of a unit root.

Table 5.5: COINTEGRATION FOR UTILITY MODEL

Series: BUC REM LAB CPS CAF SAV TAR
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.806163	225.4218	124.24	133.57	None **
0.741304	156.2634	94.15	103.18	At most 1 **
0.644137	100.6443	68.52	76.07	At most 2 **
0.517020	55.45387	47.21	54.46	At most 3 **
0.450661	37.46491	29.68	35.65	At most 4 **
15.25032	14.95429	15.41	20.04	At most 5
3.173758	3.141392	3.76	6.65	At most 6

*(**) Denotes rejection of the hypothesis at 5%(1%) significance level. L.R. test indicates 5 cointegrating equation(s) at 5% significance level.

Table 5.6: Parsimonious result for the Manufacturing (MAN) Equation.
Dependent Variable: LOG(MAN)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOG(LAB))	2.701131	0.843531	3.202172	0.0000
D(LOG(CDP(-1)))	0.351900	0.117664	2.990719	0.0001
D(LOG(CAF))	-0.217188	0.101453	-2.140774	0.0008
D(LOG(CAF(-1)))	-0.215971	0.102345	-2.110225	0.0006
D(LOG(REM))	0.433387	0.365236	1.186594	0.2508
D(LOG(SAV))	4.650187	3.678951	1.263998	0.2224
D(LOG(SAV(-1)))	2.535798	3.730583	0.679732	0.5053
D(LOG(TAR))	0.915794	0.793947	-1.153469	0.2638
D(LOG(TAR(-1)))	0.276834	0.883313	-0.313404	0.7576
ECM(-1)	-0.439433	-0.120855	-3.636403	0.0000
C	2.101429	1.016749	2.066811	0.0011
R-squared	0.518343	Mean dependent var		4.152576
Adjusted R-squared	0.501467	S.D. dependent var		1.951799
S.E. of regression	2.039109	Akaike info criterion		4.544599
Sum squared resid	74.84335	Schwarz criterion		5.063229
Log likelihood	-54.89669	F-statistic		14.65355
Durbin-Watson stat	1.978966	Prob(F-statistic)		0.000000

Table 5.7: Parsimonious result for Building and Construction (BUC) Equation.
Dependent Variable: LOG(BUC)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOG(CAF))	-0.051384	-0.012631	-4.068086	0.0000
D(LOG(CAF(-1)))	-0.016207	0.234653	-0.069068	0.9457
D(LOG(CDP))	0.225172	0.089466	2.516844	0.0010
D(LOG(LAB))	3.470160	1.592293	2.179347	0.0018
D(LOG(REM))	0.041577	0.010114	4.098679	0.0000
D(LOG(SAV(-1)))	0.116323	0.033406	3.482099	0.0002
D(LOG(TAR))	0.055836	0.020166	2.768818	0.0006
D(LOG(TAR(-1)))	0.009227	0.450053	0.020502	0.9839
ECM(-1)	-0.457371	0.098155	-4.659681	0.0000
C	3.535363	2.586262	1.366977	0.2045
R-squared	0.712265	Mean dependent var		3.797617
Adjusted R-squared	0.709210	S.D. dependent var		0.868549
S.E. of regression	1.038346	Akaike info criterion		3.206640
Sum squared resid	18.32877	Schwarz criterion		3.772417
Log likelihood	-34.49627	F-statistic		20.35567
Durbin-Watson stat	2.552389	Prob(F-statistic)		0.000000

Table 5.8: Parsimonious result for Mining and Quarrying (MIQ) Equation.
Dependent Variable: LOG(MIQ)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOG(MIQ(-1)))	1.164086	0.578023	2.013909	0.0030
D(LOG(LAB))	2.351971	6.940340	0.338884	0.7388
D(LOG(CDP))	0.207036	0.036048	5.743342	0.0000
D(LOG(CDP(-1)))	0.651411	1.057783	0.689051	0.5462
D(LOG(CAF))	-0.044199	0.016767	-2.636070	0.0020
D(LOG(REM))	0.021540	0.271241	0.079412	0.9376
D(LOG(SAV(-1)))	0.543142	0.563010	0.964711	0.8518
D(LOG(TAR))	0.070067	0.525223	0.133404	0.8954
ECM(-1)	-0.446109	0.090164	-4.947750	0.0000
C	5.325332	0.969328	5.493839	0.0000
R-squared	0.571913	Mean dependent var		-5.628162
Adjusted R-squared	0.558614	S.D. dependent var		1.210311
S.E. of regression	1.496394	Akaike info criterion		3.137497
Sum squared resid	38.06631	Schwarz criterion		4.203275
Log likelihood	-45.09371	F-statistic		18.19750
Durbin-Watson stat	2.144830	Prob(F-statistic)		0.000000

Table 5.9: Parsimonious result for Utility Equation.
Dependent Variable: LOG(UTIL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOG(LAB))	1.771243	1.525319	1.161228	0.2570
D(LOG(CDP))	0.079958	0.030552	2.617111	0.0010
D(LOG(CAF))	-0.796136	0.310550	-2.563632	0.0014
D(LOG(SAV))	1.627477	0.900793	1.806716	0.0834
D(LOG(REM))	0.883161	0.275290	3.208111	0.0000
D(LOG(TAR))	0.098097	0.036838	2.662929	0.0003
D(LOG(TAR(-1)))	7.41E-03	0.193247	0.000384	0.9997
ECM(-1)	-0.587620	0.268599	-2.187722	0.0020
C	5.238120	0.265028	19.76444	0.0000
R-squared	0.666749	Mean dependent var		-5.686014
Adjusted R-squared	0.641218	S.D. dependent var		0.570775
S.E. of regression	0.570428	Akaike info criterion		4.007457
Sum squared resid	7.809306	Schwarz criterion		3.011891
Log likelihood	-22.83932	F-statistic		10.55401
Durbin-Watson stat	1.759324	Prob(F-statistic)		0.00000

SEARCHING FOR ENVIRONMENTAL KUZNETS CURVES OF SOME BASICS IN AFRICA[9]

By Douglason G. Omotor and Christopher O. Urubu

Abstract

This study has investigated the relationship between per capita income and environmental degradation in Africa, based on longitudinal data for the period 1990, 1995 and 2000. The study estimates the environmental Kuznets curves for two indicators of environmental quality, namely: lack of access to sanitation, and lack of access to safe water, with a view to establishing whether the estimated relationships conform to the inverted U-shape hypothesis. The results of the empirical investigation generally suggest that evidence of an EKC for lack of access to sanitation is relatively weak. No concrete evidence is found to support the existence of an EKC for lack of access to safe water. The turning point levels of income established for the various indicators of environmental quality are however, generally low. This suggests that African countries may be turning the corner of the environmental Kuznets curve, much faster, and at lower levels of income than expected. This also implies that African countries do not need to wait long ("*the invention of the penicillin*") for a high threshold per capita income for them to appreciate cleaner environment. Consequently, African countries should still keep up efficiency improvements in form of active policy intervention to prevent environmental degradation. However, these results are tentative considering the limited time coverage for the study. Even so, the period could not be extended to more recent years without losing a great many countries from the selected countries. Such an effort would have made it impossible to generalize the findings for Africa.

Keywords: Environmental Kuznets Curve, Safe Water, Sanitation, Environmental Degradation. Economic Growth, Africa.

JEL Classification:I15, Q56, Q53

1. INTRODUCTION

It is a truism that individual nations rationally strive to improve the living standards of their people; they could also jointly move in principles and probably in actions to accomplish this belief as one will find in the laudable goals of the United Nations Organisation, among others. In the course of achieving this process through economic development and industrialization, pollution problems arise. Pollution in any form it manifests has adverse public health consequences which affect

[9] Professor Douglason G. Omotor is of the West African Institute for Financial and Economic Management (WAIFEM). Professor Christopher O. Urubu is of the department of Economics Delta State University, Abraka, Nigeria. The views expressed are those of the authors and do not represent the views of the institutions where they work. Corresponding e-mail: yomotor@yahoo.com

human lives and productivity. The precarious consequence is aggravated further if the rapid growth of the population puts more pressure on natural resources use.

In Africa, environmental challenges constitute some of the serious problems that confront the people. Africa is the world's second-largest and second most populous continent, after Asia. The continent straddles the equator and encompasses 53 countries; it is still the only continent that stretches from the northern temperate to southern temperate zones. Two of the biggest challenges that the African continent faces today are delivery of portable water to the ever increasing population and inadequate sanitation. A 2006 United Nations Children's Fund Report reckons it that more than 1.5 million children under the age of five in Africa die each year because they lack access to safe water and proper sanitation. Although water is a renewable resource, its availability in time and space is limited; being largely determined by climate, geography and other bio-physical conditions of a particular region as well as a set of technologies that enhance water conservation and usage (TERI, 2000; cited in Barua and Hubacek, 2008).

Most African economies in the wake of liberalization policies occasioned by globalization experienced above 5 per cent economic growth for over half of the last decade; thus making the economies enter a new stage of development. Although the region is greatly affected by the international financial crisis that crysatlised into global economic crisis, the global crisis caused average growth rate to plummet to 2.9 per cent in 2008/2009, it is anticipated rebounding to 4.5 per cent in 2010 (African Economic Outlook, 2009). The rebound is largely attributable to the reform package of trade liberalization, financial deregulation, democratization and increased foreign direct investment since the mid-1980s. Even so, the increased growth rate of the African population has been worrisome. The continent particularly, sub-Saharan Africa is believed to be headed for a "population emergency" (The Dailygreen, http://www.thedailygreen.com /environmental-news/latest/africa-population-47010905 [27/05/2010]). In 1960, as reported by The Dailygreen, one African city had 1 million residents. Rural exodus is continuing at such a pace that already strained cities are struggling to provide enough services, such as health care, and infrastructure, sewage treatment, safe water to support the population growth. If this toll continues, with economic growth rate below 7 per cent (the rate believed to support population growth of this magnitude), the quality of environmental resources or services will deteriorate.

Environmental degradation has definite adverse effects on human welfare, mainly in terms of reduced wellbeing and livelihood opportunities of individuals who are directly affected. The World Bank (1992) documents this through different

indicators of environmental degradation, in terms of health and productivity effects. The indicators include water pollution and water scarcity, air pollution, solid and hazardous wastes, soil degradation, deforestation, loss of biodiversity and atmospheric changes. Some studies have, however, suggested that as economies grow, environmental degradation becomes inevitable in the early stages of the development process. The relationship between economic growth measured by income per capita and environmental degradation is what the inverted U-shaped curve also called the Environmental Kuznets Curve (EKC) explains. The EKC is used to describe the trend of development with regard to a specific factor, such as a pollutant, access to clean water, access to proper sanitation, deforestation, etc. As the EKC explains, during the early stage of the development process, the intensity of environmental degradation is limited to activities such as subsistence farming and agriculture. The quantities of waste generated during this low level of production are modest and biodegradable. As development activities proceed, the impacts of agricultural activity, resource extraction, industrial or manufacturing activities and volume of waste generated intensify; causing widespread environmental degradation. As development reaches the highest level, income per capita increases so do living standards and the public desire for a clean healthy environment is ensued. Figure 1A depicts, the development-environment relationship may be put into three stages of economic development- the pre industrial stage (agriculture), industrial economy stage and post-industrial stage (service economy).

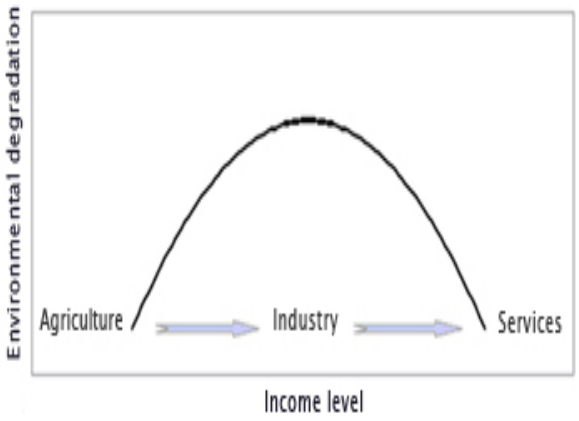


Figure 1A The Environmental Kuznets Curve.

Grossman and Krueger (1991) are the first to propose this relationship with the implication that if the EKC proposition holds true, then economic growth becomes one possible means of achieving environmental improvement over time! Since the seminal work by Grossman and Krueger, the literature on the theory and

empirics of the EKC has been quite substantial (see for example Harbaugh, Levinson and Wilson, 2002; Khanna, 2002; Copeland and Taylor, 2004; Barbier, 1997; List and Gallet, 1999; Baiard, 2012; Nasir, M., Rehman, F.U. 2011; Orubu and Omotor, 2011)[1].

In this study, it is estimated EKCs for two indicators of environmental quality that have scantly featured in studies of the phenomenon, namely lack of access to sanitation, and lack of access to safe water respectively, for selected groups of African countries. The question could be posed as to whether lack of access to sanitation, and lack of access to safe water could be regarded as environmental indicators. In many countries in Africa, a large proportion of the population obtains water for domestic use from unhygienic and often polluted sources such as streams, rivulets and shallow wells. Pollution of underground water is also common, and this usually arises from the indiscriminate disposal of domestic and industrial waste. Generally, safe water is regarded as a local public good, but the reality is that many households in the typical African country expend a large fraction of their energy and time in searching for water (Orubu, 2006), and those who cannot pay for the use of safe water are naturally constrained to obtain water from unhygienic sources . In the same vein, poor sanitation facilities manifest mainly in the absence of facilities for the disposal of human waste such as excreta. Unsafe water and poor sanitation facilities are therefore channels of a number of water-borne diseases arising from living in an unhygienic environment. Ensuring access to clean water and sanitation, therefore plays a crucial role in environmental sustainability, as identified in the Millennium Development Goal 7, which includes a target to half the proportion of the population without sustainable access to water and sanitation by 2015 (Cheng, J.J. *et.al.,* 2012).

As indicators of environmental quality, lack of access to water and sanitation facilities have featured in few studies of the environmental Kuznets curve (see for example Tsuzuki, 2007 and Tsuzuki, 2008). Alstine and Neumayer (2009) also suggest that as indicators of environmental quality, both clean water and adequate sanitation could actually exhibit linearly negative EKCs.

The aim of this study is to analyze the relationship between per capita gross domestic product and environmental quality in Africa. The specific objectives are to:

- specify and estimate conventional EKCs for two indicators of environmental quality, namely: lack of access to sanitation and lack of access to safe water in African countries; and

- identify and analyze the effect of other variables such as population density, educational attainment and policy influences on the quality of the environment.

The hypothesis of the study is that the relationship between per capita income and the aforementioned indicators of environmental quality traces inverted U-shaped curves.

The empirical literature on the EKC for African countries remains relatively scanty. The significance of testing for the existence of an EKC stems from the fact that, it is far from being a mere academic exercise. Its existence or absence has important policy implications. If an EKC is indeed a generalized phenomenon in African countries, this would be an indication, *ceteris paribus*, that environmental degradation could fall in the long run as incomes become sufficiently high, and that current measures, which address the problem of environmental degradation are possibly effective. The corollary of the EKC phenomenon is that the most critical solution to the problem of environmental unsustainability is to increase economic growth (Stern, 2004a, 2004b). It should, however, be noted that in spite of the significant role assumed for increased economic growth and rising income in the process of improving environmental quality, efficient technologies that reduce the residual intensity of production as well active policy intervention are equally important in all efforts to improve the quality of the environment in African countries, as elsewhere. If the EKC proposition fails to hold for the two indicators of environmental quality chosen for this study, this will be an indication that a more active policy intervention process would be necessary to curb environmental consequences and make sustainable development a reality. This study, apart from filling a gap in knowledge, therefore provides a comparative frame and basis for charting the future direction of environmental policy in African countries.

2. REVIEW OF LITERATURE

Establishing the EKC hypothesis to hold will mean that there is a significant relationship between the indicators of the environmental quality and income per capita (expected to vary for different indicators). To reiterate, the EKC hypothesis states that in the early stages of economic growth degradation and pollution increase, but beyond some level of income, the trend reverses, so that at high-income levels economic growth leads to environmental improvement (Stern, 2003). Since the pioneering work of Grossman and Krueger (1991) on the potential impacts of NAFTA (North American Free Trade Agreement) and the provocative results of Shafik and Bandyopadhyay (1992) study that are used in the 1992 World

Development Report (IBRD 1992), the EKC phenomenon has become standard fare in technical conversations about environmental policy. In the process, several theoretical expositions and empirical studies have equally rationalized its fundamentals and feasibility. This section is divided into three parts, beginning with a brief of the theoretical literature. This is followed by a review of the empirical literature, while an overview of some environmental issues in Africa concludes the section

2.1 Theoretical Literature

A number of factors are commonly believed to explain the existence of the EKC relationship (see Selden and Song, 1994, Grossman and Krueger, 1995; McConnell, 1997; Barbier, 1997; Agras and Chapman, 1999; e Barros, Mendonca and Nogueira, 2002; Martinez–Zarzoso and Bengocheo – Morancho, 2003; Copeland and Taylor, 2004). This sub-section briefly explains some of the salient economic factors that underline the rising and declining of environmental degradation as economic growth proceeds. These proximate factors according to Stern (2003:3), mostly relate to scale, output and input effects, and state of technology effect:

(a) **scale** production implies expanding production at given factor-input ratios, output mix, and state of technology;

(b) **output mix** changes results from differences in pollution intensities of different industries; spill-over of population pressure, net migration, which are typical in the course of economic development;

(c) changes in **input mix** involve the substitution of less environmentally damaging inputs for more damaging inputs and vice versa; and

(d) improvements in the **state of technology** encompasses changes in production efficiency (using less of the polluting input per unit of output ceteris paribus) and changes in process of specific emissions (emission of less pollutant per unit of output)

What the proximate factors infer specifically, is that higher scale implies higher output levels (and hence income) capable of yielding degradation abatement economies. In later stages of the development process, with yet higher incomes, changing output mix as well less residual-producing input mix are associated with environmental improvement methods of production that are significantly propelled by improvements in technology. Moreover, proponents of the EKC hypothesis further argue that these proximate factors at higher levels of development, structural change towards information-intensive industries, enforcement of environmental regulations, efficient technologies and higher

environmental policy instruments, result in services that are less material intensive. Series of papers have developed theoretical models to explain how technologies and policy choices might result in different time paths of environmental quality. It is important to point out that though earlier studies on the EKC made different simplifying assumptions about the economy and were able to establish the inverted U shape curve of environmental degradation, some of the recent studies have developed and estimated complex models to explain varying interactive processes but there is no inevitability about this. The results have been based on the assumptions made and the value of particular parameters on the one hand; and the choice of environmental indicator(s) on the other hand. Stern (2003) for instance notes that if the EKC for environmental indicators are monotonic as more recent evidence suggests, then the ability of a model to produce an inverted U-shaped curve is not necessarily a desirable property. Thus the development of an appropriate theoretical model for the rationalization of the EKC phenomenon is yet to be conclusive. The next sub-section formally reviews some of the empirical evidence.

2.2 Review of Empirical Evidence

The empirical analyses of EKC studies initially follow two generational trends (Yandle, Bhattarai and Vijayaraghavan, 2004:8). In the first generation, efforts are focused on first, establishing whether a given indicator of environmental degradation displays an inverted-U relationship in association with rising levels of per capita income, including the calculation of the threshold where environmental quality improves with rising per capita income. The second generation of research following advancement in the frontiers of economic science moves to test the foundation of earlier work. Main issues handled in the second generation range from use of additional data sets and additional statistical techniques, extended search of the EKC to include more indicators such as deforestation, biodiversity conservation, and indicators of environmental amenity like sanitation, other than air and water pollution. This section briefly summarizes findings of some them though not chronologically.

Grossman and Krueger (1991) produce the first EKC study as part of a study of the potential environmental impacts of NAFTA. They develop a cross-country panel that estimates EKCs for SO_2, dark matter (fine smoke), and suspended particles (SPM) using Global Environmental Monitoring System (GEMS) data set for 42 developing and developed countries. After adjusting for the effect of geographical characteristics of different cities, time-trend effects in levels of pollution, and location and type of the pollution measurement device, Grossman and Krueger find EKC patterns of relationship for SO_2 and SPM. The turning points

for both pollutants are precisely estimated at $4772-5965 while the concentration of suspended particles appeared to decline even at low income levels.

Shafik and Bandhopadhyay (1992) are the first to carry out a major study to test the EKC hypothesis, after Grossman and Krueger (1991). They estimate EKCs for ten indicators using different functional relationships. EKC is not established for deforestation; however, lack of clean water and lack of urban sanitation are found to decline uniformly with increasing income, over time. Evidence of an inverted U-shaped relationship between local air pollutant concentrations and income levels is confirmed with turning points between $3000 and $4000. Municipal waste and carbon emissions per capita increase unambiguously with rising income, while river quality tends to worsen with increasing income.

Seldon and Song (1994) examine the two air pollutants studied by Grossman and Krueger, along with oxides of nitrogen and carbon monoxide using longitudinal data primarily developed for developed countries. Their results lend support to the existence of an EKC for each of the four air pollutants. The EKC turning points for the fixed effects version of their model are SO_2, $10391; NO_x, $13383; SPM, $12275; and CO, $7114 (using 1990 US dollars and U.S. GDP implicit price deflator).

Panayotou (1993) also estimates the EKC relationship with four environmental quality indicators- that is, sulfur dioxide (SO_2), nitrous oxides (NO_x), suspended particulate matters (SPM), and deforestation. They find an inverted U-shaped relationship between income and environmental degradation. Torras and Boyce (1998), however, find evidence of inverted N-shape for heavy particles and dissolved oxygen, while they establish the existence of N-shaped relationships for sulfur dioxide and smoke.

Coondoo and Dinda (2002) however, argue that a change in the level of economic activity causes a change in environmental quality and vice versa, pointing out that the direction of causality between the level of income and environmental quality is not always unidirectional from level of income to environmental quality. Consequent upon this, it is argued that when environmental degradation shows irreversibility, it becomes difficult to sustain higher levels of economic growth (Arrow *et. al.* 1995). In order to minimize biases in the estimation process, real income per capita should thus be treated as an endogenous variable, while real income and environmental quality should be considered simultaneously when the EKC hypothesis is examined. This strand of analysis may be more appealing with the application of vector autoregression analysis (VAR).

Many other studies have used various variants of environmental indicators and techniques of analyses. For instance, Tsuzuki (2008) applies three variants of water pollutant discharges per capita (PDCs) as indicators to evaluate their relationships with purchasing power parity-based gross national income (PPP-GNI) per capita. Other economic parameters are proportions of access to safe drinking water and appropriate sanitation, amount of domestic water usage and integrated parameters of water, sanitation and economic indicators ($WSEI_{1,\ 2}$). Three measures of PDCs are biochemical oxygen demand (PDC-BOD), total nitrogen (PDC-TN) and total phosphorus (PDC-TP) discharge per capita. Series of statistical methods are applied in the study; these are in the range of regression analysis, varimax rotation method with Kaiser Normalization and multiple linear regression. The analyses on PDC-BOD are conducted for 50-60 countries/areas; while those on PDC-TN and PDC-TP were conducted for 33-49 countries/areas. Sources of data are mainly the World Bank (2002), UNEP/CEP (1994), UNEP, (various issues), WHO/UNICEF (2004) and FAO (2006). The period of analysis is 1998-2002.

Some of the estimated results of Tsuzuki (2008) study show that first, the relationship between PDC-BOD and PPP-GNI posts an inverted U-shaped curve with a vague peak in the range of US$2100-2600 $person^{-1}$ $year^{-1}$. PDC-TN is inversely related to increase in PPP-GNI; while EKC is established for PDC-TP and PPP-GDI relationship with turning point in the range of US$13,000-14,000 $person^{-1}$ $year^{-1}$ PPP-GNI per capita.

Lee, Chiu and Sun (2010) revisit EKC hypothesis for water pollutant using a generalized method of moments (GMM) for 97 countries during the period 1980-2001. Aggregately, no EKC relationship was established between real income and biological oxygen demand (BOD) emissions. However, with further decomposition of the countries into four regional groups- Africa, Asia and Oceania, America, and Europe, the empirical results show evidence of existence of the inverted U-shaped EKC relationships for America and Europe but not for Africa and Asia and Oceania. The estimated turning points are approximately, US$13,956 and US$ 38,221 for America and Europe respectively which are higher than those in previous studies. Table 1 provides more results of specific studies on the environment-income nexus.

2.3 An Overview of Current Environmental Issues in Africa

The continent is characterized by a number of environmental problems, which include: soil erosion, desertification, deforestation, water and air pollution, relatively high carbon intensity, habitat loss and threatened wild life population, and poor sanitation facilities and practices (African Development Bank, 2006). While soil erosion generally results from overgrazing and other poor farming practices induced mainly by population pressure, desertification has been traced

to rapid deforestation arising from intense use of forest wood as fuel and timber. ADB (2006) notes that increasing scarcity of forests in many African countries is illustrated by a generally declining forest-to-people ratio, which is currently less than half of what it was four decades ago.

Safe water and sanitation services are two other important indicators of environmental quality in any country. Lack of access to safe water generally refers to the proportion of the population without reasonable access to an adequate amount of safe water from improved sources such as household connections, public taps, boreholes, protected wells, or spring or rain water connections. On the other hand, lack of access to improved sanitation services refers to the proportion of the population without adequate access to excreta disposal that can prevent human, animal and insect contact with excreta. A more holistic view of sanitation would cover *inter alia*; safe collection, management, storage, treatment and disposal/reuse/recycling of human excreta; solid wastes (trash or rubbish); *sullage* or grey water; etc. These two measures of environmental quality indirectly indicate a country's disease prevention capability. For, over the period 1985 – 1989, a number of African countries were characterized by a situation in which less than 70% of the population had no access to safe water, whereas, in many developed countries, more than 95% of the population have access to safe water (World Bank, 2003; Orubu, 2006). In this category of developing countries are such countries as Benin, Burundi, Central African Republic, Cote d'Ivoire, Ethiopia, Guinea-Bissau, Mali, Mozambique, Nigeria, Sierra-Leone, Sudan and Uganda. However, over the years, the proportion of the population in African countries without access to safe water has trended downward from about 43% in 1990 to 36% in 2000. The trend for access to sanitation follows generally the same pattern; with the proportion of the population without access falling from 50% in 1990 to about 43% in 2000 (ADB, 2006). Generally as incomes rise, individuals, on the aggregate are able to afford water services, or even sink their personal water boreholes; in the same way, such individuals are able to provide better sanitary facilities for themselves at the household level, or use their lobbying power to influence general environmental policy at the local or state level.

It should be noted that there are other intervening influences on the environment in the typical developing country. The United Nations Research Institute for Social Development (UNRISD) has particularly noted the role of population pressure on environmental resources as in Asian and African countries. Generally, as population density increases, the pressure on environmental resources increases, leading to environmental degradation, particularly in the absence of appropriate complementary policies (UNRISD, 1994). Implicitly therefore, rising incomes may not necessarily be associated with improved environmental quality in the

absence of policy mainstreaming to address the adverse effects of population pressure. Since the 1990s, environmental policy advocacy, particularly at the international level, has been in favour of integrating the principles of environmental sustainability in the overall process of planning for sustainable human development at all levels. The Millennium Development Goal Number 7 is the ultimate expression of this vision (World Bank, 2003:12). Many African countries, based on the acceptance of the concept of sustainable development, have therefore come to recognize the need to mainstream environmental sustainability into the process of planning for development. Thus by the beginning of this 21st century, most African countries had established national environmental policy institutions/ and completed the preparation of their environmental plans, apart from participation in a number of international treaties on the environment such as those for Climatic Change, Ozone Layer, Chlorofluorocarbon, Law of the Sea, and Biological Diversity. Appendix 1 contains a summary of the commitment to environmental concerns by way of creation of environmental agencies, and international conventions and treaties signed up to the early 2000s. There is therefore sufficient reason to suppose that African countries quite appreciate the need for well-directed policies of environmental protection and management. However, as the African Development Bank (ADB, 2004) has observed, in spite of the significant strides made at the national and regional levels in establishing policy frameworks for environmental management and control, environmental degradation and low environmental quality continue to pose significant constraints on sustainable development in Africa.

3. FRAMEWORK OF ANALYSIS AND METHOD OF STUDY

As already demonstrated in the review of the theoretical literature, the *scale, input output mix, and technological effects,* are critical proximate causes of the EKC relationship. Specifically, higher scale implies higher output levels (and hence income) capable of yielding material intensive abatement economies. In later stages of the development process, with yet higher incomes, changing output mix as well less residual-producing input mix are associated with environmental friendly methods of production that are significantly propelled by improvements in technology. For these reasons, it is expected that during the later stages of development, environmental degradation will begin to decline. A number of concrete attempts have been made to provide a theoretical framework, on the basis of which, the existence of the EKC phenomenon can be formally rationalized.

3.1 Theoretical Framework

The critical issue is to explain how environmental degradation relates to income, producing an inverted U-shape. Lopez (1994) sees the environment (and implicitly its quality) as a factor of production, whose efficiency could improve over time. Stokey (1998) shows that the inverted U-shape of the EKC could emerge from a situation in which efforts to control environmental degradation are not expended until a certain threshold is reached as income increases with economic growth. Beyond this threshold, environmental degradation presumably begins to decline, as abatement effort begins to increase with rising incomes. This view is not significantly different from that of Lieb (2001), who argues that an EKC can only be generated when society reaches a point of satiation in consumption. Magnani (2001) posits that the EKC results when the collective preferences of individuals for better environmental quality are converted into public policy, while Kemp-Benedict (2003) formulates the EKC hypothesis using a model in which environmental impact is seen as the product of such factors as population pressure, the degree of societal affluence, as well as the state of technology.

Most of the existing studies of the EKC – both theoretical and empirical – make different simplifying assumptions about the economy, in terms of how preferences, technology and other factors interact to produce an inverted U-shaped curve. Some of these assumptions include those of infinitely lived agents, exogenous/endogenous technological change, and whether or not pollution or environmental degradation is as a result of production activities or consumption (Selden and Song, 1994). McConnell (1997), for instance considers a model based on overlapping generations in which pollution is assumed to be generated by consumption, rather than by production (see Stern, 2004a:1422; John and Peachenino, 1994). Andreoni and Levinson (2001) have, however, argued that none of these special assumptions is needed to explain the existence of the EKC, and that increasing returns to scale in abatement are sufficient to generate the inverted U-shaped relationship between environmental degradation and income. In an earlier paper, Levinson (2000) had derived a polynomial pollution-income curve from a model based on the utility maximizing behavior of economic agents, in which pollution rises at lower levels of income, but falls at higher levels. Although Levinson's model appears plausible and conforms to the standard specification of the EKC model, it is doubtful if economic agents, on the aggregate in a typical African economy abate environmental wastes through voluntary self efforts the way the model conceives it[2].

A much more appealing explanation of the EKC, particularly from the point of view of the typical developing country is that based on willingness to pay for environmental quality and services ((Boyce and Torras, 2002; Ekins 1997;

Munasinghe, 1996, 1998, 1999). As pointed out by Stagl (1999), the common assumption is that the poor have little demand for environmental quality. Consequently, they are constrained by their current income level and consumption needs to do nothing about improving the environment. But as society gets richer, its members have the capacity to intensify demand for a healthier and sustainable environment, and by calling upon government to impose more stringent environmental control measures[3]. Thus at higher levels of income, the income elasticity of demand for environmental quality is higher, and economic agents on the aggregate are not only willing and able to pay for a 'green' environment, they are also expected to exert pressure on the authorities to enforce environmental regulations. In the strict sense therefore, the EKC may well be evidence that in some cases, institutional reforms as income increases have made private users of environmental resources to internalize the social costs of their activities (Arrow et al., 1995). It should be noted that the balance of power is often in favour of economic agents whose activities result in negative environmental externalities, and that asymmetric informational and obstructive power usually enables them to sway environmental policy in their own favour. Consequently, the extent to which they can be forced to internalize the external cost of their wastes generation will depend critically on the forcefulness of the policy authorities. The relationship between environmental degradation and income as depicted in the EKC (in the face of a multiplicity of intervening factors), is therefore intended only to represent a long term relationship between the two variables[4].

3.2 Data Sources and Description

The data used for the empirical analysis in this study are obtained from the World Bank: *World Development Indicators (various issues)*. Consistent longitudinal data points (panels) used for the empirical analysis are 1990, 1995 and 2000. This is the period for which consistent data points were available for the selected countries as the span could not be extended to retain the same number of countries. They are generally national level data. Where necessary, African Development Bank's, *Gender, Poverty and Environmental Indicators on African Countries,* and other World Bank (2000) data files are used to complement. The environmental indicators used in this study, are discussed briefly namely: lack of access to sanitation and lack of access to safe water respectively. The terms of unit of measurement, span, descriptive statistics, as well as their simple correlation with per capita GDP are also presented below.

Lack of Access to Sanitation (ASN): In this work, lack of access to sanitation (ASN) is measured as the proportion of the population (in percentage) without

adequate access to faecal disposal services or systems that can prevent human, animal and insect contact with faeces. The data series used covers 20 African countries. Because of the absence of relatively consistent time series for the individual countries, the cross-sections are spaced over 1990, 1995, and 2000, respectively, making a total balanced panel of 60 observations. The summary statistics for ASN are as shown in Appendix 3. Among the countries covered in the sample, on the average, Egypt has the smallest proportion of population without access to sanitation (6%), while Ethiopia records the largest proportion of the population without access to sanitation (92%). The mean values recorded for each country also reflect these trends (see Fig. 1). As for the correlation between access to sanitation and per capita GDP, it is negative. This is shown by the Pearson correlation coefficient of -0.3556, in Table 2. The negative sign of the coefficient is a possible indication that as per capita income increases; the number of persons without access to sanitation facilities will tend to decline.

Lack of Access to Safe Water (ASW): Lack of access to safe water (ASW) is measured by the proportion of the population without reasonable access to an adequate amount of water from improved sources such as household connections, public taps, boreholes, protected wells, or spring or rain water connections. As in the case of access to sanitation, the data series for access to safe water covers the cross-sectional points in 1990, 1995 and 2000, but for 24 African countries (see Appendix 2), making a total balanced panel of 72 observations. The relevant summary descriptive statistics are shown in Appendix4, while trend of the mean values are displayed in Fig. 2. Among the countries listed in this data set, Angola has the highest proportion of the population without access to safe water (65%), while Egypt records the lowest mean of 15%. The smallest minimum value for the proportion of the population without access to safe water is recorded by Lesotho (9%), while the largest maximum value is recorded by Central Africa Republic. The Pearson correlation coefficient between per capita GDP and ASW is -0.6278, thus also indicating a possible inverse relationship between the two variables, in other words, as income increases, the proportion of the population without access to safe water will tend to decline.

3.3 Specification of the Empirical Model

Following standard practice, the basic EKC equation, can be specified in quadratic form as,

$$\ln(ED)_t = \beta_1 + \beta_2 \ln(PCGDP)_t + \beta_3 \ln(PCGDP)^2 + e_t \qquad (1)$$

where:

ED = indicator of environmental degradation/

t = time

ln = natural logarithm of the relevant variable

e = stochastic disturbance term with zero mean and finite variance

By the illustration of Wen and Cao (2009), Equation (1) can invoke seven forms of environment-income relationships as reported in Table 3 with the reverse U-shape EKC as only one of the seven possibilities, provided the coefficients are statistically significant at points of *a pirori*.

In this study, pooled data are used for the empirical analysis. One advantage of such data over cross-sectional and time series data is that they have both cross-sectional and time series characteristics, and implicitly rely on the premise that differences across the units under investigation can be captured by differences in the intercept term. Such models can be generally specified to take care of fixed and random effects. Taking into account the quadratic form of the EKC equation specified above, the basic estimable equation could be re-expressed as;

$$\ln(ED)_{it} = \alpha_i + \gamma_t + \beta_1 \ln(PCGDP)_{it} + \beta_2 (\ln(PCGDP))^2_{it} + \varepsilon_{it} \quad (2)$$

where, i = 1, 2, 3, …, n; t = 1, 2, 3, …, T; N = nT (for a balanced panel).

In equation (2), the first two terms on the right hand side are intercept parameters that vary across countries (i), and years (t). Here, the implicit assumption is that, although environmental degradation/quality may be different between one country and the other at any given level of income, the income elasticity is the same for all countries at a given level of income. On the other hand, the time specific intercepts take care of time-varying variables that are omitted from the model, including stochastic shocks.

The importance of country-specific and time-specific effects is often recognized in studies of the EKC, and a few authors have incorporated them in their empirical estimations (see for example, Stern and Common, 2001). The inclusion of country effects is generally justified if per capita income or other explanatory variables are correlated with country-specific time invariant factors such as geography; climate and resource endowments (see Neumayer, 2004), while year-specific time effects could be required in specifying the EKC model, if there are global changes in environmental quality, as may be explained by advances in technology (see Alstine and Neumayer, 2009) and global environmental action. For a substantial number of African countries, income is highly correlated with

natural resource endowment. In the same vein, global environmental developments, particularly since the 1990s have presumably had their impacts on the quality of the environment of the typical African country, as already discussed under the general overview of the state of the environment in African countries in this work. Both of these observations justify the inclusion of country and time effects in the specification.

A number of some studies also indicate a possible N shaped environment-income relationship, whereby the indicator of resource use or environmental stress begins to worsen again at higher incomes (see for example, Shafik and Bandyopadhyay, 1992; Bruyn and Opschoor, 1997; Bengochea-Morancho, Higon-Tamarit and Martinez-Zarzoso, 2001; Dijkgraaf and Vollebergh, 2001; Martinez-Zarzoso and Bengochea-Morancho, 2003, Binder and Neumayer, 2005). In such a case the EKC equation will assume a cubic form such as,

$$\ln(ED)_{it} = \alpha_i + \gamma_t + \beta_1 \ln(PCGDP)_{it} + \beta_2 (\ln(PCGDP))^2_{it} + \beta_3 (\ln(PCGDP))^3 + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

In equation (3), if $\beta_3 > 0$, this would be symptomatic of an N-shaped curve. A key interest in this work is estimating the turning-point levels of both quadratic and cubic versions of the EKC equation where the environmental indicators are at maximum: $\pi = \exp[-\beta_1/(2\beta_2]$ (see Stern, 2004). Generally, equations of this type (2 and 3) can be estimated, taking into account, both fixed and random effects. Fixed effects models treat α_i and γ_t as regression parameters, while random effects models treat them as components of the random disturbance. In this study, the Hausman test is used to choose between the relevant fixed and random effects models.

Khanna (2002) has pointed out that income is only one of the several factors which help to determine exposure to pollution, or declining environmental quality generally, identifying such factors as race, education, population density, housing tenure and the structural composition of the workforce as also critical (see also Panayotou, 1997; Torras and Boyce, 1998). Technically, finding an EKC in the presence of other modifying factors provides a more persuasive basis for validating the hypothesis. It is therefore necessary to experiment by expanding the basic model to include such factors as population density (POPDEN), the literacy rate (EDUC), and a dummy variable (DUM), to reflect the composite influence of internationally coordinated environmental policy pressure. By 1995, most African countries had signed a number of international environmental treaties and prepared their own environmental strategy frameworks. A value of 0

is therefore assigned to this dummy for years before 1995, and 1 thereafter. The higher the population density, the greater will be the intensity of pollution, as well as the pressure brought to bear on environmental services and resources. On the other hand, high literacy rates exert a definite effect on the willingness to maintain or create improved environmental quality, hence it is expected that pollution should fall as educational attainment increases. Education also tends to tilt the balance of power in favour of the citizenry. Thus as the largest proportion of a country's population becomes more educated, the people become more knowledgeable about the environment and the consequences of its deterioration on human wellbeing, and are therefore better placed to influence environmental policy; demand for a better quality environment, and would generally be more willing to pay for environmental services. One other purpose for 'hybridizing' the basic model is to establish if the EKC phenomenon is stable in the presence of other variables. The estimable equation (dropping the cubic term, for simplicity) is,

$$\ln(ED)_{it} = \beta_0 + \beta_1 \ln(PCGDP)_{it} + \beta_2 (\ln(PCGDP))^2{}_{it} + \varphi_j \sum_{j=1}^{n} \ln(X)_{it} + \gamma_i + u_{it}$$

.....(4)

Where,

X = vector of other explanatory variables that include POPDEN and EDUC, DUM,

Where,

POPDEN = population density; EDUC = literacy rate, DUM = policy dummy variable.

The equations are generally estimated using ordinary least squares (OLS) in the quadratic, augmented and cubic formulations. Their corresponding random and fixed effects formulations are also estimated. It should be noted that in OLS estimation, cross-sectional differences are likely to have important effects on the parameters of the equations, whereas in random and fixed effects formulations, such between-country variations are eliminated, and the estimated coefficients are based on time-series variation. It should be noted that in applying OLS to equations of the forms specified above, it is usually necessary to assume that that the composite error is uncorrelated with the explanatory variable. Even when it is assumed that the error term u_{it} is uncorrelated with the explanatory variables, pooled OLS could still be biased if γ_i and the explanatory variables are correlated (see Wooldridge, 2000: 421). The results of the random and fixed effects estimations as here presented should therefore ordinarily be considered as analytically superior to those of the OLS estimations. The latter, however, provide a useful starting point, and basis for comparison.

4. EMPIRICAL RESULTS AND DISCUSSION

The regression estimates are presented for the basic ordinary least squares (OLS) model, its augmented version and the standard cubic model, with their corresponding random effects (RE) and fixed effects (FE) formulations. Turning points are reported for all the equations, except in the cases where imaginary roots are indicated. It should be noted, however, that only turning points derived from equations with statistically significant coefficients are of analytical importance. In all, twelve equations are estimated for each environmental indicator.

4.1 Results for Lack of Access to Sanitation (ASN)

These are as summarized in Appendix 5. The results for the basic OLS model for ASN are consistent with the existence of a conventional EKC, with turning points estimated at $1160.95 and $1344.63 for the basic OLS and its corresponding RE formulation, respectively. The coefficients for the corresponding FE model, even though properly signed, are not statistically significant. However, the RE estimator is consistent as indicated by the Hausman test. Insignificant coefficients are generally reported for all versions of the augmented form. Thus there is relatively weak evidence in support of the existence of a conventional EKC for lack of access to sanitation. For the cubic model, only the results of the standard form establishes a second turning point and statistically significant coefficients, indicating the possible existence of an N-shaped EKC for lack of access to sanitation.

4.2 Results for Lack of Access to Safe Water (ASW)

The summary is shown in Appendix 6. The coefficients of PCGDP and $PCGDP^2$ for both the quadratic and their corresponding values in the augmented forms are properly signed, but none of them is statistically significant. The same observation applies to the cubic version. Thus given the data set available for this environmental indicator, the existence of an EKC is not established.

4.3 Summary of the Results

As for lack of access to sanitation, (ASN) the OLS results for the basic quadratic form and the corresponding RE specification support the existence of an inverted U-shape EKC. Augmentation of the basic model does not, however, produce significant coefficients, (though correctly signed). The least squares cubic model establishes two turning points. However, given the highly insignificant coefficients in all the other equations estimated, evidence in favour of a conventional EKC is considered relatively weak. Finally, the results for lack of access to safe water (ASW) unambiguously failed to establish the existence of an EKC. The estimated

turning points are relatively low, in comparison to those obtained from older existing studies particularly for other forms of environmental indicators (see Grossman and Krueger, 1995). This finding is not unprecedented as Dasgupta, Laplanta, Wang and Wheeler (2002) had earlier noted that environmental improvements are possible for developing countries with peak levels of environmental degradation that will be lower than in countries that developed earlier. Selected plots for some of the equations estimated are as shown in Fig.3 – Fig.4. Please note that, as previously explained; ASN and ASW refer, respectively to lack of access to sanitation and lack of access to safe water.

5. POLICY IMPLICATIONS AND CONCLUSION.

The empirical analyses suggest relatively weak evidence supporting the existence of a conventional EKC for lack of access to sanitation facilities in the African countries considered in the study. The results also fail to establish an EKC for lack of access to safe water, or indeed any relationship between this indicator and per capita income. A number of the estimated constants are statistically significant, thus indicating that there are variables omitted in the study which may be critical to the reduction of environmental degradation. The turning points established are relatively low, in comparison to those obtained from older existing studies. Two competing propositions can be harnessed to explain these low levels. First, implication of the 2007 GNI per capita classification of countries into low income (US$3705 or less), and high income (US$3706 or more) using the World Bank Atlas method. Over eighty percent of African countries used in this study are grouped under low income countries. This may suggest that per capita GDP of Africa countries have not yet reached the perceived turning point (Lee *et. al.* 2010). The second strand may suppose that African countries do not need to wait long ("*the invention of the penicillin*") for a high threshold per capital income for them to appreciate cleaner environment. With increasing knowledge of the impact of environmental degradation, African countries may be turning the environmental Kuznets curve faster than envisaged. Technically this may suggest that the EKC may be shifting over- time and depending on the series of human activities, the turning points could appear earlier if human activities are environmentally friendly and sustainable. The observation of the EKC shifting over-time is yet to receive significant attention in the existing literature. From any angle one perceives these interpretations; a more general implication is that African countries should still keep up efficiency improvements in form of active policy intervention (and in the face of market failures) to prevent environmental degradation. However, a basic limitation of this study is the data points- 1990, 1995 and 2000. As such, the results generally should be viewed as tentative as much could have changed since 2000. Even so, the period covered is one of which

consistent data points were available for the selected countries as the span could not be extended to more recent years at a loss of many countries from the selected ones. The remaining countries in the sample selected would be too few to permit generalization of findings for Africa.

Notes

1. For helpful surveys of the EKC phenomenon, see Dinda (2004), and Stern (2004b). See also Hilton (2006) and Ciegis, Stremikiene, and Mativsaityte (2007).
2. The authors are grateful to an anonymous AERC referee for pointing this out to us. The modified Levinson's explanation can be collapsed into five basic equations (a social utility function, a pollution function, a modified pollution function, an abatement function, and a constraint, respectively);

   $U = U(C,P),\ P = P(C,F),\ P = C - C^{\alpha}F^{\beta},\ A = C^{\alpha}F^{\beta},\quad C + F = Y$

   Where, U = total utility, C = consumption, F = effort expended in abating pollution, A = total abatement, Y = income, while α and β are parameters. From these equations, the consumption-income, and pollution-income equations can be derived as,

$$C + \frac{\beta}{\alpha}C = Y$$

$$C\left(1 + \frac{\beta}{\alpha}\right) = Y$$

$$C = \frac{Y}{1 + \frac{\beta}{\alpha}} = \frac{Y}{\frac{\alpha + \beta}{\alpha}} = \left(\frac{\alpha}{\alpha + \beta}\right)Y$$

$$P = \left(\frac{\alpha}{\alpha + \beta}\right)Y - \left(\frac{\alpha}{\alpha + \beta}\right)^{\alpha}\left(\frac{\beta}{\alpha + \beta}\right)^{\beta}Y^{(\alpha+\beta)}$$

   Note that if $(\alpha + \beta)$>1, abatement will reflect increasing returns to scale, and the pollution curve will correspond to the EKC.

3. This is the view originally expressed by Grossman and Krueger (1991).
4. For a similar view, see Ciegis, Stremikiene and Mativsaityte (2007: 46).

REFERENCES

Adreoni, J. and A. Levinson. (2001), ''The simple analysis of the environmental Kuznets curve'', *Journal of Public Economics 8, 269-286*

African Development Bank. (2002 and 2006), *Gender, Poverty and Environmental Indicators on African Countries*. Tunis.

African Development Bank (2004), *Africa Development Bank Group's Policy on the Environment*. Tunis.

African Economic Outlook *(2009,) www.africaneconomicoutlook.org/ [24/05/2010]*

Agras, J. and D. Chapman (1999), "A dynamic approach to the environmental Kuznets curve hypothesis'', *Ecological Economics*. 28(2): 267-277, February

Alstine, J.V., and E. Neumayer (2009), "The environmental Kuznets curve"; Department of Geography and Environment and Centre for Environmental Policy and Governance (CEPG), London School of Economics and Political Science .Processed paper. http://www.2./se.ac.uk/geography AndEnvironment/whosWho/profiles/neumayer/pdf/EKC.pdf. Downloaded 16-10-09.

Arrow, K., Bolin, B., Costanza, R., Dasgupta, P., Folke, C., Holling, C.S., Jansson, B.-O., Levin, S., Ma¨ler, K.-G., Perrings, C., Pimentel, D., (1995), "Economic growth, carrying capacity, and the environment", *Ecological Economics* 15: 91–95.

Barbier, I.B; (1997), ''Introduction to the environmental Kuznets curve'', *Environment and Development Economics*, 2: 369-381

Barua, Anamika and K. Hubacek (2008), "An empirical analysis of the environmental Kuznets curve for water pollution in India", *International Journal of Global Environmental Issues*, 9(12) Numbers 1-2: 50-68(19).

Baiard, D. (2012), "Innovation and the environmental Kuznets curve: the case of CO, NMVOCs and Sox in the Italian regions" No. 279 (01-12), Dipartimento di economia politica e metodi quantitative Università degli studi di Pavia.

Bengochea-Morancho A.; F. Higon-Tamarit and I. Martinez-Zarzoso (2001), ''Economic growth and CO2 emissions in the European Union'', *Environmental and Resource Economics*.19(2): 165-172

Binder, S., and E. Neumayer, (2005), Environmental pressure group strength and air pollution: An empirical analysis, *Ecological Economics*, 55: 527-538.

Boyce, J. K. and M. Torras. (2002), ''Rethinking the environmental Kuznets curve''. In J.K. Boyce (ed.), *The Political Economy of the Environment*, Cheltenham, Edward Elgar, 47-66.

Cheng, J.J. *et.al.* (2012), Summary Analysis: Quantifying Water Supply, Sanitation and Millennium Development Goals. United Nations University Institute for Health, Water and Environment.

Coondoo, D. and S. Dinda (2002), "Causality between income and emission: a country group-specific econometric analysis", *Ecological Economics,* 40: 351-367.

Copeland, B.R, and M.S. Taylor (2004), "Trade, growth and the environment", *Journal of Economic Literature".* 42; 7-71

Daly, H.E. (1977), *Steady State Economics: The Economics of biophysical equilibrium and moral growth,* San Francisco: W.H. Freeman

Dasgupta, S., B. Laplante, H. Wang, and D. Wheeler. (2002), "Confronting the environmental Kuznets curve", *Journal of Economic Perspectives,* 16(1): 147-168.

de Bruyn, S.M., and J. B. Opschoor (1997), "Developments in the throughput-income relationship: Theoretical and empirical observations", *Ecological Economics,* 20(3) 255-267.

de Bruyn, S.M; vanden Bergh, and J.B. Opschoor (1998), "Economic growth and emissions: Reconsidering the empirical basis of the environmental Kuznets curve", *Ecological Economics.* 25(2): 161-176,May.

Dijkgraaf, E. and H.R.J. Vollebergh (2001), "A note on testing for environmental Kuznets curves with panel data", *Nota di Lavoro*, 63.01, Fonazione Eni Ennco Mattei

e Barros, F. G., A. F. Mendonca & J. M. Nogueira. (2002), "Poverty and environmental degradation, The Kuznets environmental curve for the Brazilian case", *Department of Economics Working Paper* 267; University of Brasilia. December.

Ekins, P. (1997), "The Kuznets curve for the environment and economic growth: Examining the evidence", *Environment and Planning*, Vol.29: 805-830.

Grossman, G.M. and A.B. Krueger. (1991), "Environmental impacts of a North American Free Trade Agreement", *Discussion Paper No. 158*, Woodrow Wilson School, Princeton University, Princeton, N.J.

Grossman, G.M. and A.B. Krueger (1995), "Economic growth and the environment", *Quarterly Journal of Economics*, May, 353-377

Harbaugh, W., A. Levinson and D. Wilson. (2002), "Re-examining the empirical evidence for an environmental Kuznets curve", *Review of Economics and Statistics*, 84(3): 541-551

John, A. and, R. Peachenino. (1994), "An overlapping generations model of growth and the environment", *Economic Journal* 104: 1393-1410

Kemp-Benedict, E. (2003), "Traveling along the environmental Kuznets curve'', Case Study No. 2.

Khanna, N. (2002), "The income elasticity of non-point source air pollutants: Revisiting the environmental Kuznets curve", *Economics Letters,* 77 387-392

Lee, Chien-Chiang, Yi-Bin Chiu and Chia-Hung Sun (2010), The environmental Kuznets curve hypothesis for water pollution: Do regions matter? *Energy Policy* 38: 12–23.

Levinson, A. (2000), "The ups and downs of the environmental Kuznets Curve", UCF/Center *Conference on Environment,* Orlando, FL.

Lieb, C.M (2001), "The environmental Kuznets curve and satiation. A simple static model", *Environment and Development Economic, 7*, 429-448

List, J.A. and C.A. Gallet.(1999), "The environmental Kuznets curve: Does one size fit all?", *Ecological Economics*. 2 :383-399.

Lopez, R. (1994), "The environment as a factor of production: The effects of economic growth and trade liberalization", *Journal of Environmental Economics and Management.* 27(2): 185-204.

Magnani, T., (2001), ''The Environmental Kuznets curve: Development path or policy result'', *Environmental Modelling and Software*, 16, 157-166

Martinez-Zarzoso, I. and A. Bengochea-Morancho. (2003), ''Testing for an environmental Kuznets curve in Latin American Countries", *Revista de An'alisis Economico*, 18(1): 3-26, June

McConnell, K.E., (1997), ''Income and the demand for environmental quality''. *Environment and Development Economic,* 2, 383-399

Munasinghe, M., (1996), ''An overview of environmental impacts of macroeconomic and sectoral policies", In M. Munasinghe (ed). *Environmental Impacts of Macroeconomic and Sectoral Policies,* Washington DC. World Bank, 1-14

Munassinghe, M. (1998), ''Countrywide policies and sustainable development: Are the linkages perverse?", *The International Yearbook of Environmental and Resource Economics. 1998/1999: A Survey of Current Issues*, 33-88.

Munassinghe, M.; (1999), ''Is environmental degradation an inevitable consequence of economic growth: Tunnelling through the environmental Kuznets curve", *Ecological Economics*. 29: 89-109.

Neumayer, E. (2002), Can natural factors explain any cross-country differences in carbon dioxide emissions?", *Energy Policy*, 30(1) 7-12.

Neumayer, E. (2003), *Weak Versus Strong Sustainability*. Cheltenham and Northampton, Edward Elgar.

Nasir, M., Rehman, F.U., (2011), "Environmental Kuznets Curve for carbon emissions in Pakistan: An empirical investigation", *Energy Policy*, 39:1857-1864.

Orubu, O.C., Omotor, D.G., (2011), "Environmental Quality and Economic Growth: Searching for Environmental Kuznets Curves for Air and Water Pollutants in Africa", Energy Policy, 39:4178-4188.

Orubu, C. O., (2006), ''Water resources, environment and sustainable development in Nigeria", *Journal of Human Ecology.* 19(3), 169-181.

Orubu, C.O., D.G. Omotor and P. Awopegba (2009), "Economic Growth and Environmental Quality: Searching for Environmental Kuznets Curves in Africa", *Final Report* submitted to the African Economic Research Consortium (AERC), Nairobi, Kenya.

Panayotou, T. (1997), ''Demystifying the environmental Kuznets curve: Turning a black box into a policy tool", *Environment and Development Economics*, 2: 465-484

Panayotou, T., (1993), "Empirical tests and policy analysis of environmental degradation at different stages of economic development", *Working Paper*

WP238, Technology and Employment Programme, International Labour Office, Geneva.

Report and Studies Series No. 174. UNEP/GPA Coordination Office & SPREP. 45 pp.

Selden, T.M. and D. Song. (1994), "Environmental quality and development: Is there an environmental Kuznets curve for air pollution?", *Journal of Environmental Economics and Management*, vol. 27: 147-162

Shafik, N. and S. Bandhopadyay. (1992), ''Economic growth and environmental quality: Time series and cross country evidence", Working Paper WPS 904: Background Paper for *World Development Report*, World Bank, Washington, D.C.

Stagl, Sigrid. (1999), ''Declining economic growth for environmental degradation? A literature survey on the environmental Kuznets curve hypothesis", Wirtschaftsuniversitat Wien Working paper No 6. http://epub.wu-wien.ac.at epub. Downloaded 25/26 June 2008.

Stern, D.I. (2003), The Environmental Kuznets Curve. www.ecoeco.org/pdf/stern.pdf *[28/05/2010]*.

Stern, D.I. (2004a), "Comment on: Cole M.A. (2003), "Development, trade and the environment: how robust is the environmental Kuznets curve?", *Environment and Development Economics,* 8, 557-580

Stern, D.I. and M.S. Common. (2001), ''Is there an environmental Kuznets curve for sulphur?", *Journal of Environmental Economics and Management*: 41(2): 162-178.

Stern, David I. (2004b), ''The rise and fall of the environmental Kuznets curve", *World Development,* Vol 32, No 8, 1419-1439.

Stokey, N., (1998), "Are there limits to growth?", *International Economic Review,* 39(1), 1-31

The Dailygreen, http://www.thedailygreen.com/environmental-news/latest/ africa- population-47010905 [27/05/2010]

Torras, M. and J.K. Boyce. (1998), ''Income, inequality and pollution: A reassessment of the environmental Kuznets curve", *Ecological Economics*: 25(2): 195-208. May.

Tsuzuki, Y. (2008), "Relationships between water pollutant discharges per capita (PDCs) and indicators of economic level, water supply and sanitation in developing countries", *Ecological Economics.* 68(1-2):273-287.

Tsuzuki, Y., (2007), Relationships between pollutant discharges per capita (PDC) of domestic wastewater and the economic development indicators. *Journal of Environmental Systems and Engineering* (Dobokugakkai Ronbunsyu, Category G) 63 (4), 224–232 (in Japanese with English abstract).

UNDP (2007), "Statistics of the human development report". http://hdr.undp.org/en/statistics/.

UNEP (1999a), Regional overview of land-based sources and activities affecting the coastal and associated freshwater environment in the West and Central African Region. UNEP/GPA Co-ordination Office & West and Central Africa Action Plan, Regional Co-ordinating Unit. 110 pp.

UNEP (1999b), Overview on land-based sources and activities affecting the marine environment in the ROPME Sea Area.UNEP/GPA Coordination Office & ROPME. 127 pp.

UNEP (2000a), "Overview of land-based pollutant sources and activities affecting the marine, coastal, and freshwater environment in the Pacific Islands Region. Regional Seas"

UNEP (2003a), Regional seas strategies for sustainable development. 40 pp.

UNEP (2003b), "Global international waters assessment", *GIWA Regional assessment,* No. 23, Caspian Sea. 68 pp.

UNEP/CEP (1994), "Regional overview of land-based sources of pollution in the Wider Caribbean Region", *CEP Technical Report No. 33.*

UNEP/RSP (2006), "United Nations environmental programme, Regional Seas Programme homepage", http://www.unep.org/ regionalseas/.

UNRISD, (1994), "*Environmental Degradation and Social Integration*", *Briefing Paper No 3,* Geneva.

Van, P.N., and T. Azomahou (2007), "Nonlinearities and heterogeneity in environmental quality: an empirical analysis of deforestation", *Journal of Development Economics* 84, 291–309.

Wen, G. and Z. Cao (2009), "An Empirical Study on the Relationship between China's Economic Development and Environmental Quality------Testing China's Environmental Kuznets Curve", *Journal of Sustainable Development*. 2(2): 65-71.

WHO/UNICEF (2004), "Meeting the MDG drinking water and sanitation target: A mid-term assessment of progress. 33p".

Wikipedia, http://en.wikipedia.org/wiki/Africa [27/05/2010

Wooldridge, J.M. (2000), *Introductory Econometrics: A Modern Approach,* Singapore, South Western College Publishing.

World Bank (1992), *World Development Report 1992: Development and the Environment,* Oxford University Press, New York

World Bank (1992), *World Development Report*, 1992. Oxford Univ. Press, New York. 308 pp.

World Bank (2002), *World Development Report* 2002: Building Institutions for Markets.

World Bank. (2000), *Data Files*. New York.

World Bank. (2003), *World Development Indicators.* New York.

World Commission on Environment and Development (WCED). (1987), *Our Common Future*, Oxford University, Press, New York.

Yandle, B., M. Bhattarai and M. Vijayaraghavan (2004), Environmental Kuznets curves: A review of findings, methods, and policy implications. *PERC. Research Study* 02–1 Update, 38 pp.

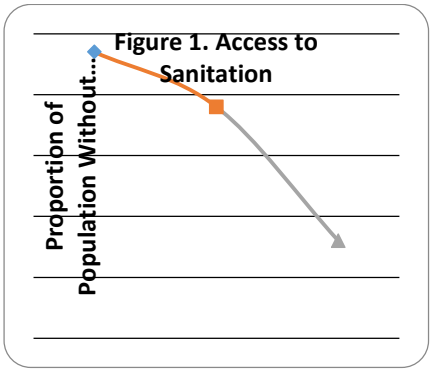


Figure 1. Access to Sanitation
Proportion of Population Without...

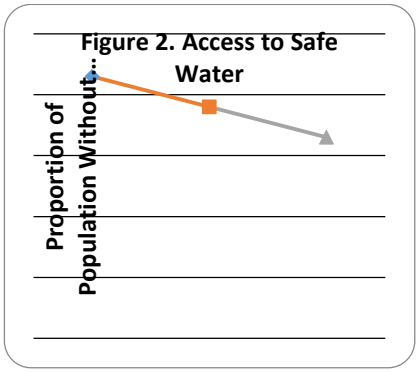


Figure 2. Access to Safe Water
Proportion of Population Without...

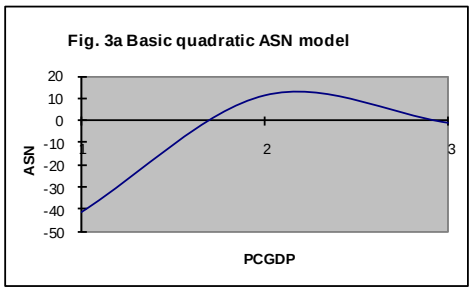


Fig. 3a Basic quadratic ASN model
20
10
0
-10
-20
-30
-40
-50
ASN
2
3
PCGDP

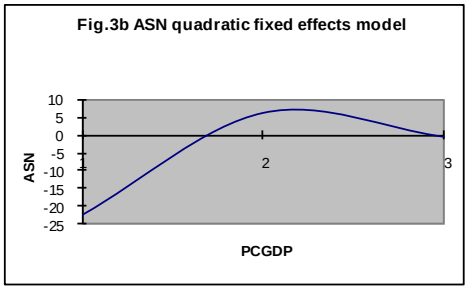


Fig.3b ASN quadratic fixed effects model
10
5
0
-5
-10
-15
-20
-25
ASN
2
3
PCGDP

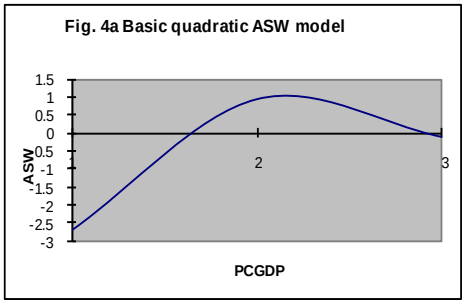


Fig. 4a Basic quadratic ASW model
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
ASW
2
3
PCGDP

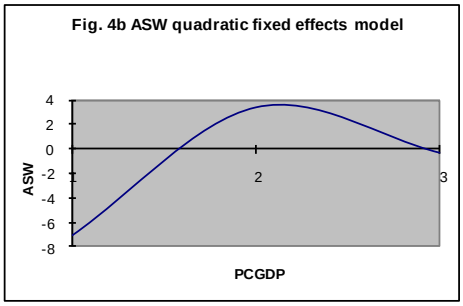


Fig. 4b ASW quadratic fixed effects model
4
2
0
-2
-4
-6
-8
ASW
2
3
PCGDP

Table 1. Summary of some empirical studies of the relationship between income per capita and environmental quality.

Indicator	Author(s)	Type of Curve	First Peak US$	Second Peak US$
SO_2	Grossman and Krueger (1991)	N-shape	4,100	14,000
	Shafik (1994)	Reverse U-shape	3,700	n.a.
	Grossman and Krueger (1995)	N-shape	13,400	14,000
	Seldon and Song (1994)	Reverse U-shape	8,900	n.a
	Panayaotou (1993)	Reverse U-shape	10,700	n.a.
Suspended Particulate	Grossman and Krueger (1991)	Linear	n.a.	n.a.
	Shafik (1994)	Reverse U-shape	3,300	n.a.
	Grossman (1993)	Reverse U-shape	16,000	n.a.
	Seldon and Song (1994)	Reverse U-shape	9,800	n.a.
	Panayaotou (1993)	Reverse U-shape	9,600	n.a.
	Orubu, Omotor and Awopegba (2009)	Reverse U-shape	280	n.a.
Dust	Grossman and Krueger (1991)	N-shape	5,000	10,000
	Grossman (1993)	N-shape	4,700	10,000
	Grossman and Krueger (1995)	N-shape	6,200	10,000
NO_x	Grossman (1993)	Reverse U-shape	18,500	n.a.
	Seldon and Song (1994)	Reverse U-shape	12,000	n.a.
	Panayaotou (1993)	Reverse U-shape	5,500	n.a.
CO	Grossman (1993)	Reverse U-shape	22,800	n.a.
	Seldon and Song (1994)	Reverse U-shape	6,200	
CO_2	Shafik (1994)	Linear	n.a.	n.a.
	Khanna (2002)	Linear	n.a.	n.a,
	Orubu, Omotor and Awopegba (2009)	Reverse U-shape	7,900	n.a.
	Orubu, Omotor and Awopegba (2009)	N-shape	700	5700
Dissolved Oxygen in Water	Shafik (1994)	Linear	n.a.	n.a.
	Grossman (1993)	Reverse U-shape	8,500	n.a.
	Grossman and Krueger (1995)	Reverse U-shape	2,700	n.a.
Pathogenic Bacteriain water	Shafik (1994)	N-shape	1,400	11,400
	Grossman and Krueger (1995)	Reverse U-shape	8,000	n.a.
	Grossman (1993)	Reverse U-shape	8,500	n.a.
Local Air Pollutant	Shafik and Bandhopadhyay (1992)	Reverse U-shape	3,000	4,000

n.a. = not available as value cannot be calculated for.

Table 2: Pearson Correlation between PCGDP and Indicators of Environmental Quality

S/N	Environmental Indicator	Correlation Coefficient	P – Value	Significance
1	ASN	-0.3556	0.1239	Sig at 12%
2	ASW	-0.6278	0.0010	Sig. at 1%

Source: Authors' computations from the raw data

Table 3. Signs and Relationships of the Parameters.

S/N	Signs	Type of Relationship
1	$\beta_1>0$, $\beta_2=\beta_3=0$	Linear shape, monotonically increasing, as income rises, environmental pressure is increasing.
2	$\beta_1<0$, $\beta_2=\beta_3=0$	Linear shape, monotonically decreasing, as income rises, environmental pressure is decreasing
3	$\beta_1>0$, $\beta_2<0$, $\beta_3=0$	Reverse U-shape, as reaches a threshold, environmental pressures decreases as income rises
4	$\beta_1<0$, $\beta_2>0$, $\beta_3=0$	U-shape
5.	$\beta_1>0$, $\beta_2<0$, $\beta_3>0$	N-shape, similar to the U-Shape. But as income rises further, environmental pressure increases again
6.	$\beta_1<0$, $\beta_2<0$, $\beta_3>0$	Reverse N-shape, environmental pressure decreases first, then increases, and later decreases.
7.	$\beta_1=\beta_2=\beta_3=0$	Horizontal line, income does not affect environmental pressure.

Source: Wen and Cao (2009).

Appendix 1: Government Commitment to the Environment in African Countries

S/N	Country	Main Government Environmental Authority	Any Envir. Strategy/Action Plan ?*	**Treaties: Year of Participation** Climatic Change	Biodiversity
1	Algeria	Na. Agency for Protection of the Environment	Yes	1994	1995
2	Angola	Ministry of Environment	-	2000	1998
3	Benin	Ministry of Environment	Yes	1994	1994
4	Botswana	Ministry of Environment	Yes	1994	1996
5	Burkina Faso	Ministry of Environment and Water Affairs	Yes	1994	1993
6	Burundi	Environmental Agency	Yes	1997	1997
7	Cameroon	Ministry of Environment and Forestry	Yes	1995	1995
8	Cape Verde	-	Yes	-	-
9	C. Afr. Rep.	-	-	1995	1995
10	Chad	Environmental Protection Agency	-	1994	1994
11	Comoros	Ministry of Production and Environment	Yes	-	-
12	Congo	Environmental Agency	Yes	1997	1996
13	Congo DRC	Ministry of Environment	Yes	1995	1995
14	Cote d'Ivoire	National Environmental Agency	Yes	1995	1995
15	Djibouti	Environmental Protection Agency	Yes	-	-
16	Egypt	Egyptian Environmental Affairs Ministry	Yes	1995	1994
17	Eq. Guinea	-	Yes	-	-
18	Eritrea	Eritrean Agency for the Environment	Yes	1995	1996
19	Ethiopia	Environmental Protection Agency	Yes	1994	1994
20	Gabon	-	Yes	1998	2000
21	Gambia	National Environmental Agency	-	1994	1994
22	Ghana	Environmental Protection Agency	Yes	1995	1994
23	Guinea	National Directorate of the Environment	Yes	1994	1993
24	Guinea-Bis.	National Council for the Environment	-	1996	1996
25	Kenya	Ministry of Environment & Nat. Resources	Yes	1994	1994
26	Lesotho	Ministry of Tourism, Environment & Culture	Yes	1995	1995
27	Liberia	Environmental Protection Agency	-	2002	2000
28	Libya	Dept. of Environment & Nat. Resources	-	1999	2001
29	Madagascar	National Office for the Environment	Yes	1996	1996
30	Malawi	Min. of Nat. Resources & Env. Affairs	Yes	1994	1994
31	Mali	Environmental Agency	Yes	1995	1995
32	Mauritania	Min. of Rural Dev. & Environment	Yes	1994	1996
33	Mauritius	Ministry of Environment	Yes	1994	1993
34	Morocco	Department of the Environment	Yes	1996	1995
35	Mozambique	Environmental Agency	Yes	1995	1995
36	Namibia	Ministry of Environment	Yes	1995	1997
37	Niger	National Directorate of Meteorology	Yes	1995	1995
38	Nigeria	Ministry of Environment	Yes	1994	1994
39	Rwanda	Min. of Lands, Env. Forestry & Water Res.	Yes	1998	1996
40	Sao T. & P.	Min. of Social Infrastructure & the Envir.	Yes	-	-
41	Senegal	Min. of Environment / Protection of Nature	Yes	1995	2001
42	Seychelles	Ministry of Environment	Yes	-	-

43	Sierra Leone	Min. of Lands, …, and the Environment	Yes	1995	1995
44	Somalia	-	-	-	-
45	South Africa	Dept. of Environmental Affairs and Tourism	Yes	1997	2000
46	Sudan	Env. Research & Wildlife Dev. Agency	-	1994	1996
47	Swaziland	Min. of Tourism, Env., and Communications	-	1997	1995
48	Tanzania	Min. of Natural Resources and Tourism	Yes	1996	1996
49	Togo	National Meteorological Services of Togo	Yes	1995	1996
50	Tunisia	Min. of Environment & Regional Planning	Yes	1994	1993
51	Uganda	National Env. Management Authority	Yes	1994	1993
52	Zambia	Environmental Council of Zambia	Yes	1994	1993
53	Zimbabwe	Env. Management Agency	-	1994	1995

Source: *World Economic Indicators,* 2003. * Environmental Action Plan Status as at 2003.

Appendix 2. African Countries Covered in the Study for Different Environmental Indicators (marked)

Country	ASN	ASW
Algeria		
Angola	*	*
Benin	*	*
Botswana		
Burkina Faso		
Burundi		*
Cameroon	*	*
Cape Verde		*
C.Afr. Republic		*
Chad	*	
Comoros		
Congo		*
Congo (DRC)		
Cote d'Ivoire		*
Egypt	*	*
Eq. Guinea		
Ethiopia	*	*
Gabon		
Gambia		
Ghana	*	*
Guinea	*	*
Guinea-Bissau	*	*
Kenya		
Lesotho		*
Liberia		
Madagascar	*	*
Malawi	*	*
Mali	*	
Mauritania		
Mauritius		
Morocco	*	*
Mozambique		
Namibia		*
Niger	*	*
Nigeria	*	*
Rwanda		
Sao T. & Principe		
Senegal		*
Seychelles		
Sierra Leone		
South Africa		
Sudan	*	
Swaziland		
Tanzania	*	
Togo	*	*
Tunisia		*
Uganda		*
Zambia	*	
Zimbabwe	*	

Appendix 3: ASN Summary Statistics for Cross-Sections of Selected African Countries (1990, 1995, and 2000)

Country	Mean	SD	Min. Value	Max. Value
Angola	0.743667	0.159124	0.560	0.84
Benin	0.778000	0.019287	0.764	0.80
Cameroon	0.173333	0.081445	0.080	0.230
Chad	0.773333	0.056862	0.710	0.820
Egypt	0.093333	0.035119	0.060	0.130
Ethiopia	0.896667	0.040415	0.850	0.920
Ghana	0.380000	0.010000	0.370	0.390
Guinea	0.433333	0.015275	0.420	0.450
Guinea-Bissau	0.620000	0.147309	0.530	0.790
Madagascar	0.610000	0.030000	0.580	0.640
Malawi	0.250000	0.020000	0.230	0.270
Mali	0.303333	0.005774	0.300	0.310
Morocco	0.330000	0.085440	0.250	0.420
Niger	0.826667	0.025166	0.800	0.850
Nigeria	0.422333	0.050163	0.370	0.870
Sudan	0.526667	0.220303	0.380	0.780
Tanzania	0.133333	0.030551	0.100	0.160
Togo	0.626667	0.035119	0.590	0.660
Zambia	0.326667	0.143643	0.220	0.490
Zimbabwe	0.396667	0.124231	0.320	0.540

Source: Derived by authors from the raw data. Each country value is obtained as average for the three sample points of 1990, 1995, and 2000, respectively.

Appendix 4: ASW Descriptive Statistics for Cross-Sections of Selected African Countries (1990, 1995, 2000)

Country	Mean	SD	Min. Value	Max. Value
Angola	0.6500	0.0300	0.6200	0.6800
Benin	0.4220	0.0530	0.3700	0.4760
Burundi	0.3867	0.0666	0.3100	0.4300
Cameroon	0.4367	0.0551	0.3800	0.4900
Cape Verde	0.3600	0.1179	0.2600	0.4900
C. African Rep.	0.5800	0.2163	0.4000	0.8200
Congo	0.4767	0.0611	0.4100	0.5300
Cote d'Ivoire	0.2033	0.0252	0.1800	0.2300
Egypt	0.1567	0.1762	0.0500	0.3600
Ethiopia	0.7500	0.0100	0.7400	0.7600
Ghana	0.4200	0.0557	0.3600	0.4700
Guinea	0.5067	0.0513	0.4500	0.4700
Guinea-Bissau	0.5367	0.0833	0.4700	0.5500
Lesotho	0.3400	0.2326	0.0900	0.6300
Madagascar	0.5467	0.0153	0.5300	0.5500
Malawi	0.4000	0.0500	0.3500	0.5600
Morocco	0.2867	0.1289	0.1800	0.4500
Namibia	0.2567	0.0252	0.2300	0.2800
Niger	0.4533	0.0379	0.4100	0.4800
Nigeria	0.4670	0.0356	0.4300	0.5010
Senegal	0.2500	0.0300	0.2200	0.2800
Togo	0.4667	0.0208	0.4500	0.4900
Tunisia	0.1867	0.0777	0.1000	0.2500
Uganda	0.5267	0.0252	0.5000	0.5500

Source: Derived by authors from raw data. Each country value is obtained as average for the three sample points of 1990, 1995, and 2000, respectively.

Appendix 5: Summary Estimates of Environmental Kuznets Equations for ASN (n = 60)

Indp. Var	Quadratic Form			Augmented Quadratic Form						Cubic Form		
	OLS Model	Random Effects Model	Fixed Effects Model	OLS Model (1)	OLS Model (2)	Random Effects Model (1)	Random Effects Model (2)	Fixed Effects Model (1)	Fixed Effects Model (2)	OLS Model	Random Effects Model	Fixed Effects Model
CONST	-57.9916 (-4.577)	-41.5060 (-2.631)	-22.2636 (-0.981)	-1.1504 (-0.951)	-0.6731 (-0.560)	-1.3645 (-0.789)	-0.6685 (-0.548)	5.4390 (1.199)	-1.8406 (-0.596)	-334.306 (-2.198)	3.561 (0.022)	299.04 (1.176)
PCGDP	16.2818 (4.591)	11.6546 (2.642)	6.2461 (0.988)	0.1295 (0.296)	0.0397 (0.089)	0.2635 (0.438)	0.0429 (0.095)	0.3035 (0.327)	0.4840 (0.506)	132.59 (2.074)	-7.313 (-0.110)	-99.32 (-1.220)
$PCGDP^2$	-1.1535 (-4.672)	-0.8309 (-2.707)	-0.4533 (-1.032)	-0.0342 (-0.880)	-0.0214 (-0.547)	-0.0448 (-0.840)	-0.0216 (-0.054)	-0.0575 (-0.711)	-0.6066 (-0.723)	-17.410 (-1.951)	1.82 (0.20)	14.265 (1.258)
$PCGDP^3$										0.754 (1.822)	-0.123 (-0.287)	-0.681 (-1.30)
POPDEN				0.1453 (2.010)		0.1057 (0.832)		-1.653 (-2.044)				
EDUC				-1.6924 (-3.758)	-1.5570 (-3.507)	-1.1485 (-2.194)	-1.5054 (-3.257)	1.4236 (0.843)	-1.5826 (-2.217)			
DUM				-0.0468 (-0.277)		-0.0536 (-0.629)		0.0454 (0.343)				
$\bar{R}^2$	0.29	0.95	0.86	0.31	0.38	0.16	0.28	0.89	0.88	0.32		0.87
Turning Point	$1160.95 *	$1344.63 *	$982.27	$6.64	$2.53	$18.93	$2.70	$14.00	$1.49	$999.71* $4847.71**	$16.59 $1159.34	$742.32 $1563.97
Hausman (Prob)		1.4622 (0.4814)				0.000 (1.000)	0.1552 (0.985)				4.177 (0.20)	

Source: Authors' computations from the raw data. Notes: Figures in parentheses under the coefficients are the t-statistics coefficients, and significance levels for the Hausman test statistic. IR denotes the presence of an imaginary root; only turning points derived from statistically significant coefficients are of analytical importance. While *(**) denotes a peak (trough) turning point- indicated only for significant coefficients.

Appendix 6: Summary Estimates of Environmental Kuznets Equations for ASW (n = 72)

Indp. Var	Quadratic Form			Augmented Quadratic Form						Cubic Form		
	OLS Model	Random Effects Model	Fixed Effects Model	OLS Model (1)	OLS Model (2)	Random Effects Model (1)	Random Effects Model (2)	Fixed Effects Model (1)	Fixed Effects Model (2)	OLS Model	Random Effects Model	Fixed Effects Model
CONST	-2.6979 (-0.944)	-3.7871 (-0.981)	-7.1335 (-0.710)	0.9181 (0.322)	-0.5063 (-0.174)	-0.0277 (-0.008)	0.0137 (0.005)	-6.8674 (-0.619)	-5.6881 (-0.545)	24.813 (1.287)	34.053 (1.392)	27.11 (0.516)
PCGDP	0.9423 (0.995)	1.3315 (1.041)	3.3317 (1.031)	0.0778 (0.084)	0.1929 (0.199)	0.3691 (0.341)	0.0010 (0.00)	3.9859 (1.153)	3.1669 (0.939)	-13.11 (-1.340)	-17.97 (-1.450)	-14.19 (-0.53)
$PCGDP^2$	-0.1074 (-1.386)	-0.1412 (-1.351)	-0.3773 (1.452)	-0.0472 (-0.627)	-0.0510 (-0.675)	-0.0732 (-0.786)	-0.0365 (-0.483)	-0.4441 (-1.586)	-0.3784 (-1.377)	2.256 (1.380)	3.098 (1.500)	2.547 (0.578)
$PCGDP^3$										-0.131 (-1.440)	-0.179 (-1.566)	-0.159 (-0.670)
POPDEN				-0.1096 (-2.844)		-0.1121 (-2.278)		-0.6684 (0.640)				
EDUC				0.7300 (2.086)	0.3887 (1.1015)	0.6113 (1.470)	0.5935 (1.6858)	-1.1902 (-0.551)	-0.9053 (-0.980)			
DUM				-0.0914 (-0.824)		-0.0817 (-0.869)		0.2094 (1.211)				
$\bar{R}^2$	0.32	0.21	0.63	0.43	0.37	0.30	0.42	0.62	0.62	0.33	0.37	63
Turning Point	$80.64	$111.41	$82.67	$2.28	$6.63	$12.44	$1.01	$88.91	$65.67	$102.61 $1788,93	*	*
Hausman (Prob)		5.0938 (0.0783)			9.12964 (0.104)		9.093 (0.0281)				3.584 (0.31)	

Source: Authors' computations from the raw data. Notes: Figures in parentheses under the coefficients are the t-statistics coefficients, and significance levels for the Hausman test statistic. IR denotes the presence of an imaginary root; only turning points derived from statistically significant coefficients are of analytical importance. While *(**) denotes a peak (trough) turning point- indicated only for significant coefficients.

However, those result are tentative considering the limited time coverage for the study given so the period would not be extended to more recent years without losing a great many countries from the selected countries. Such an effort would have made it impossible to generating the findings for Africa.