WEST AFRICAN INSTITUTE FOR FINANCIAL AND ECONOMIC MANAGEMENT (WAIFEM)

WEST AFRICAN FINANCIAL AND ECONOMIC REVIEW

Volume 11 **December 2014** **Number 1**

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AN ECONOMETRIC ANALYSIS OF THE RELATIONSHIP BETWEEN EMPLOYEE COMPENSATION AND SELECTED MACROECONOMIC VARIABLES IN NIGERIA

By: Milton A. Iyoha* And Nosakhare Liberty Arodoye

Abstract.

Government compensation of employees is crucial to the growth of an economy in developing and developed countries. This study analyzes the relationship between employees' compensation and 3 key macroeconomic variables in Nigeria, namely, growth rate of real gross domestic product, inflation rate and total government expenditure, using annual time-series data for the period of 1981 through 2011.In order to fully investigate the inter-relationships between employees' compensation and the selected macroeconomic variables, the Vector Auto regression methodology was utilized. The results of the multivariate Johansen co-integration test reveal a stable and long-run relationship between employees' compensation and the selected macroeconomic variables in Nigeria. The Granger Causality test shows a unidirectional causal relationship between employees' compensation and total government expenditure in Nigeria. The Forecast Error Variance Decomposition shows that a substantial percentage of variations in employees' compensation is accounted for by its 'own shocks' and moderately by innovations in total government expenditure. On the basis of the findings, the paper recommends that policymakers in Nigeria should augment recurrent expenditure in order to enhance employees' compensation and promote economic growth.

JEL CLASSIFICATION: B22, C22, E24, J3, J4, J5
Keywords: Compensation of Employees, Macroeconomic variables, VAR, Nigeria.

1. Introduction

The history of employees' compensation in Nigeria is as old as the history of the nation's minimum wage. Employees' compensations represent a key component of aggregate economic activities and have a significant impact on the welfare of citizens. The size of employees' compensation has been of great concern to Stakeholders in virtually every State of the nation and the Federal Government of Nigeria over the last several years. It is apparent that strong Gross Domestic Product (GDP) growth, for instance, could translate into high employment and enhanced employees' compensation. Total employee compensation is expected to grow over time in most modern economies. This has also been true for Nigeria. See details in Table 1.

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At the heart of the pursuit of economic growth in recent decades has been the assumption that it leads, overtime, to improvements in employees' compensation and in the welfare of the citizens. Hence, this paper proceeds to empirically estimate the relationship between compensation of employees and 3 selected macroeconomic variables in Nigeria. These macroeconomic variables are: growth rate of real gross domestic product, inflation rate and total government expenditure.

Results from studies linking employee compensations to macroeconomic variables abound in extant literature. However, most of the studies on Nigeria have not empirically examined the interrelationships. This study seeks to fill that gap. To this end, the paper is divided into five Parts. Part I is the Introduction. Part II is the Review of Related Literature while Part III focuses on model specification and methodology. Part IV dwells on the econometric results including their interpretation. Part V contains the conclusion of the paper.

2. Review of Related Literature

Bloom and Northrup (1961) explain in their work that Workmen's Compensation was designed to assure prompt payment of benefits to employees injured on the job or afflicted by occupational diseases; or in case of a fatality in industry, to pay benefits to dependents. They note further that Workmen's compensation does not cover accident or injury outside of working hours, but only such accidents as occur on or pertain to the job. In a separate but similar study by Bartol et al. (1998) as cited in Igbinomwanhia (2010) defines compensation as 'all forms of financial returns and tangible benefits that employees receive as part of an employment relationship'. In Nigeria, the Employees' Compensation Act ("the Act" or "ECA") enacted in year 2011 by the Federal Government of Nigeria repeals the Workmen's Compensation Act (WCA) of 2004. This Act was designed to ensure an open and fair system of guaranteed and adequate compensation for employees or their dependants in the event of death, disease or disability arising out of, or in the course of, employment. The Act also provides for the payment of compensation to employees suffering from mental stress, occupational disease and injuries. It is noteworthy that the ECA has given employees' compensation a renewed vigor but given the red tape associated with the manner in which government agencies work in Nigeria, has tended to delay progress in the process of recovering claims by ways of employee compensation. Some of the highlights of the Employees' Compensation Act of 2011 include;

- definition of an 'employee' and coverage of the Act;
- establishment of the Nigeria Social Insurance Trust Management Board ('the Board') and the Employee's Compensation Fund (the Fund);
- contribution to the Employees' Compensation Fund – every employer is required to keep complete and accurate particulars of its payroll, and the employer is required within the first two years of commencement of the Act to make a minimum monthly contribution of 1.0 percent of its total monthly payroll into the Fund;

- provides for compensation of employees for occupational diseases and injuries sustained outside the normal workplace if the nature of the business of the employer extends beyond the usual workplace;

- assessment in an independent contractor/subcontractor relationship;

- payment of compensation to employees suffering from mental stress, etc.;

- right to examine the books of an employer;

- right of appeal by employers shall be made in writing within 180 days of the receipt of a decision by the Board; and

- penalties for non-compliance to decisions made by the Board.

Adeoti and Isiaka (2006) give a clear and direct definition of the concept of employees' compensation, as "the total of all rewards which employees get in return for their services". They further asserted that in recent years, certain categories of Staff have shifted their attention from financial compensation to non-financial compensation by ensuring that their basic physiological and safety needs are satisfied by their employers. In a similar development, Fleck et al. (2011) points out that employers' ability to raise wages and other compensation is tied to increase in labor productivity, and that productivity and compensation trends reflect long-term changes in production.

Bosworth and Perry (1994), as cited in Sachdev (2007), point out clearly that wages are quite different from compensation simply because they represent a measure of take-home pay and do not include employer contributions for social insurance, pension contributions and employer payments for health and other fringe benefits. Sachdev particularly notes in his study that there has often been a rising gap between total compensation and take-home pay, and he further explained that fringe benefits make up an increasing share of total compensation, and that as such, total compensation, which includes fringe benefits,, is the more accurate measure of wages to use when examining the wage-productivity gap.

Ramune and Milita (2010) explain in their study that compensation is at the core of any employment exchange, and it serves as a defining characteristic of any employment..In a separate but more explicit study, Henderson (2003) avers that compensation system results from the allocation, conversion, and transfer of a portion of the income of an organization to its employees for their monetary and "In-Kind" claims on goods and services. He further points out that the monetary claims on goods and services are wages or salaries paid to an employee in the form of money, or a form that is quickly and easily transferable to money at the discretion of the employee, and the in-kind claims as claims on goods and services made available and paid for, either totally or in some percentage, by the employer. In the same study, Henderson interestingly gives eight compensation dimensions to include; pay for work and performance, pay for time not

worked, loss-of-job income continuation, disability income continuation, deferred income, spouse (family) income continuation, Health, Accident, and liability protection and income equivalent payments.

In their study of the economic influence on employees' compensation, Noe, Hollenbeck, Gerhart and Wright (2004) note that when the cost of living is rising rapidly, labour markets demand pay increases. They further explain that the federal government often tracks trends in the nation's cost of living with the Consumer Price Index, and that studying changes in the consumer price index will help employers prepare for changes in the demands of the labour market.

Edmiston (2005) conceptually and empirically examines the relationship between Workers' compensation and state employment growth across the U.S states and the District of Columbia from 1976-2000. He notes that the workers' compensation costs reveal a statistically significant impact on employment and wages but elasticities are very small, suggesting that Workers' compensation costs are not a likely cause of jobs woes in most states. He further examines how unemployment compensations have an impact on employment and how wages are close to but slightly greater than workers' compensation. In a different study, Frydman and Molloy (2009) examine the relationship between tax rates and logarithm of salaries plus current bonuses; they analyze the simple correlation of the key variables and conclude that there is no meaningful relationship between changes in taxes and salaries, noting that tax policy does not affect any aspect of executive pay.

Gerhart, Minkoff and Olsen (1995) are of the view that employee compensation plays a key role in an organization because it is at the heart of the employment relationship, being of critical importance to both employees and employers. They further point out that employees typically depend on wages, salaries, and so forth to provide a large share of their income and on benefits to provide income and health security. They conclude the study by averring that the ultimate choice of a best compensation strategy of an organization depends on its fit with other human resource activities and its fit with the business strategy.

Clements, Gupta, Karpowicz and Tareq (2010), in their influential paper on evaluating government employment and compensation, maintain that some of the useful criteria for evaluating compensation of employees may include; government compensation as a share of GDP and as a share of total government spending, government compensation of employees as a share of domestic revenues and government compensation of employees in relation to non- wage outlays. Also, In his interesting study of the evaluation of the macro drivers of growth, employment and income in the Chinese economy, Dic (2007) indicates that China was able to achieve both rapid economic growth and rapid employment expansion, based on a labor – intensive growth path, but quickly points out that the drawback of such economic growth is that the growth of labor compensation tended to lag seriously behind that of economic growth. But more specifically Lindenboim, Kennedy and Grana (2011) warn in their examination of the share of labour compensation and aggregate demand that an increase in the share of labour compensation is not necessarily in the best interest of workers, if it is owed to real wages that fall less than productivity.

Yamoah (2013) tests for the relationship between compensation and employee productivity using a convenient sampling technique for about 60 respondents which consisted of all employees of Ghana commercial banks in the greater Accra region of Ghana, and his study showed that compensation has a direct influence on employee productivity and clearly showed that this can only be achieved if there is transparency in the reward system and if the rewards meet the aspirations of the beneficiaries. In another study by the Congressional Budget Office of the United State in 2012, In examining how the compensation of Federal Civilian employees compare with that of employees in the private sector, they point out that the federal and private-sector work forces differ in characteristics that can affect compensation, such as experience, education and occupation. They seek to account for differences in individuals' level of education, years of work experience, occupation, size of employer, geographical location and various demographic characteristics in determining employees' compensation.

Hartwig, Kahley, Restrepo and Retterath (1997) utilize a cross sectional time series technique in establishing a strong association between economic growth and rising frequency, severity and loss ratios, and also pointed out that the converse is also true. Their findings displace the conventional wisdom on this subject, which has held that workers' compensation packages generally improve during economic expansions and worsen in recessions. Similarly, the study by the Institute for Work and Health (2009) notes that there are often fairly strong relationships between the frequency of Workers' compensation claims worked per hour which tend to decline with recession and to increase in times of economic recovery.

Agburu (2012) in his evaluation of the recent trends in wage and salary administration in Nigeria applying a simple empirical cross – sectional methodology for his study discovered that there has been a lack of close relationship between pay (or compensation, general) and employee productivity in Nigeria, and also that the cost of living has been rising astronomically relative to wages and salaries paid workers as the aggregate, and he concludes that the cost of living occupies the centre stage when it comes to the ranking of variables impinging on wages and salaries administration in Nigeria. In a similar study, Osemeke (2012) notes that effective management and the conduct of appraisals by private sector organizations in Nigeria determine adequate compensation payable to its workforce, and also that there is a significant relationship between the compensation of employees' of the private sector organizations and the attainment of the organization's objectives.

A recent study by Meer and West (2013) examines how a wage floor impacts employment by directly assessing employment dynamics, and their study reveal that an effect of minimum wage is more pronounced on new job growth, and they further note that minimum wage should be indexed to inflation, because the effects of wage floor on employment are limited by the erosion due to inflation. In conclusion, they hold that permanent real increases in the minimum wage are likely to have greater impacts on employment than the nominal changes that the authors studied.

As shown in Table 1 and Figure 1w, total compensation of employees has trended upward with the increase in both the Real Gross Domestic Product and total government expenditure through the period of 1981 to 2011.For example, as at 1981 while compensation of employees was

N9,469.07m, that of Real Gross Domestic Product and total government expenditure were N13,580.32m and N11,413.70m respectively. Furthermore, in 1990 the compensation of employees increased to N16,561.98m and Real Gross Domestic Product and total government expenditure grew as well to N84,344.61m and N60,268.20m respectively. In 2010 and 2011, compensation of employees was about N8,706,286.02m and N9,472,250.85m which hence indicated that there are consistency in the growth of the compensation of employees in Nigeria, also the Real Gross Domestic Product and total government expenditure increased from N10,310,655.64m to N11,590,120.18m, and N4,194,217.88m to N4,299,155.10m respectively. The growth in Real GDP and in total government expenditure seems too often to have impacted on the marginal and steady growth in employee compensation in Nigeria over the years.

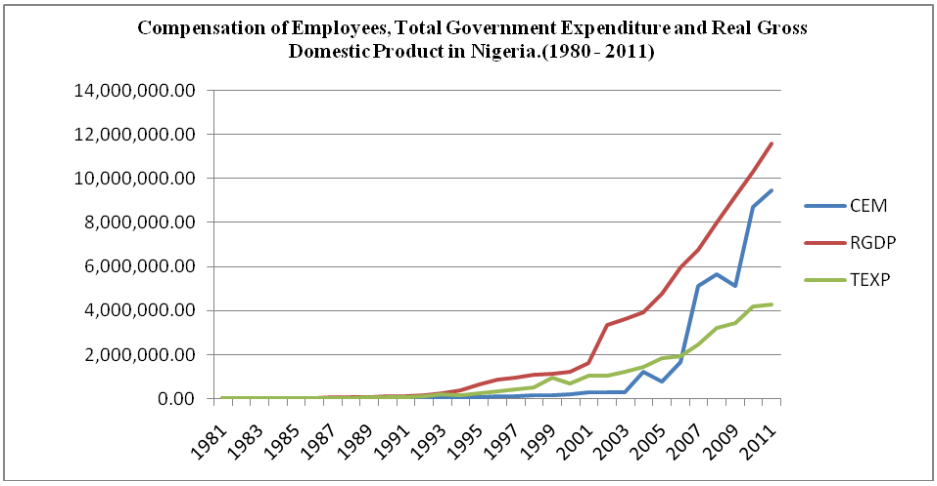
Table 1: Compensation of Employees, Total Government Expenditure and Real Gross Domestic Product in Nigeria (1981 – 2011)

Year	Compensation of Employees (CEM)(N'Mn)	Real Gross Domestic Product (RGDP)(N'Mn)	Total Government Expenditure (TEXP)(N'Mn)
1981	9,469.07	13,580.32	11,413.70
1982	10,907.28	15,905.50	11,923.20
1983	10,385.95	18,837.19	9,636.50
1984	10,477.80	23,799.43	9,927.60
1985	11,812.48	26,625.21	13,041.10
1986	12,402.50	27,887.45	16,223.70
1987	11,273.78	39,204.22	22,018.70
1988	12,624.54	57,924.38	27,749.50
1989	14,422.03	69,713.00	41,028.30
1990	16,561.98	84,344.61	60,268.20
1991	18,783.58	97,464.06	66,584.40
1992	28,733.36	145,225.25	92,797.40
1993	40,976.42	231,832.67	191,228.90
1994	49,647.31	349,244.86	160,893.20
1995	72,302.91	619,806.83	248,768.10
1996	88,569.76	841,457.07	337,217.60
1997	98,300.61	953,549.37	428,215.20
1998	122,807.46	1,057,584.01	487,113.40
1999	136,255.56	1,127,693.12	947,690.00
2000	188,393.71	1,192,910.00	701,059.40
2001	256,527.94	1,594,895.53	1,018,025.60
2002	271,708.10	3,357,062.94	1,018,155.80

2003	296,038.58	3,624,579.49	1,225,965.90
2004	1,203,620.34	3,903,758.69	1,426,200.00
2005	770,484.91	4,773,198.38	1,822,100.00
2006	1,639,623.96	5,940,236.97	1,938,002.50
2007	5,104,099.89	6,757,867.73	2,450,896.70
2008	5,654,272.03	7,981,397.32	3,240,820.00
2009	5,118,410.97	9,186,306.05	3,452,990.80
2010	8,706,286.02	10,310,655.64	4,194,217.88
2011	9,472,250.85	11,590,120.18	4,299,155.10

Source: Central Bank of Nigeria (CBN) Statistical Bulletin Vol.22, Dec., 2011 and Central Bank of Nigeria Annual Report and Financial Statement Dec. 31, 2011.

Figure 1: **Compensation of Employee, Total Government Expenditure and Real Gross Domestic Product in Nigeria (1981 – 2011)**



Source: Computed from table 1, using Microsoft Excel, 2014.

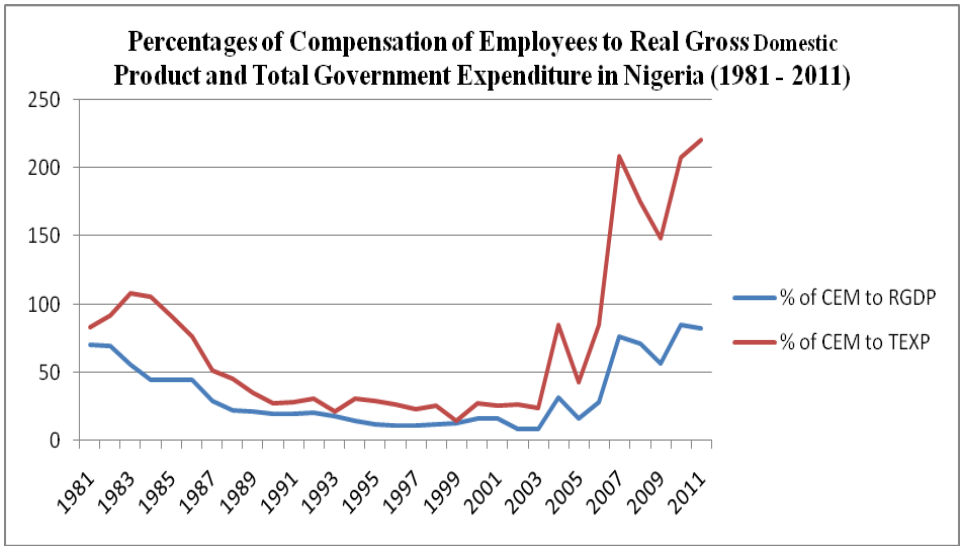
In terms of the percentage of the compensation of employees to Real Gross Domestic Product and total government expenditure in Nigeria, as at 1981, while the percentage of employees compensation to Real Gross Domestic Product was about 69.7 percent, that of total government expenditure was 82.9 percent. Compensation of employees to Real Gross Domestic fell to 55 percent in 1983 while that of total expenditure increased to 107.8 percent in the same period. The percentage of the compensation of employees to Real Gross Domestic Product and total expenditure declined significantly to about 19.6 percent and 27.5 percent in 1990. From 2005 to 2011, there was a higher ratio of compensation of employees to Real Gross Domestic Product and total government expenditure respectively. This was further illustrated in figure 2 where both the percentages of compensations for employees to Real Gross Domestic Product and total government expenditure showed clear upward trends between 1981 and 2011.

Table 2: Percentages of Compensation of Employees to Real Gross Domestic Product and Total Government Expenditure in Nigeria (1981 – 2011)

Year	% of Compensation of Employees to Real Gross Domestic Product.	% of Compensation of Employees to Total Government Expenditure.
1981	69.72641293	82.96231722
1982	68.57552419	91.4794686
1983	55.13534662	107.7772013
1984	44.02542414	105.542125
1985	44.36577214	90.57886221
1986	44.47341008	76.44680313
1987	28.75654713	51.20093375
1988	21.79486427	45.49465756
1989	20.68771965	35.15141987
1990	19.63608582	27.48046233
1991	19.27231433	28.21018136
1992	19.78537479	30.96353993
1993	17.67499809	21.42794316
1994	14.21561652	30.85730783
1995	11.6653942	29.06438165
1996	10.52576099	26.26486874
1997	10.30891667	22.95588994
1998	11.61207609	25.21126703
1999	12.08268079	14.37765092
2000	15.79278487	26.8727172
2001	16.08430992	25.19857457
2002	8.093625436	26.68629889
2003	8.167528973	24.14737474
2004	30.83234481	84.39351704
2005	16.14190001	42.2855447
2006	27.60199582	84.60381038
2007	75.5282597	208.2543866
2008	70.84313435	174.4704126
2009	55.71783637	148.2312369
2010	84.43969353	207.5782963
2011	81.72694246	220.3281953

Source; Computed from Table 2.

Figure 2: Percentages of Compensation of Employees to Real Gross Domestic Product and Total Government Expenditure in Nigeria (1981 – 2011)



Source: Computed from table 2, Using Microsoft Excel, 2014.

Funding the employee compensation is from a variety of sources that include budgetary allocation from government at all levels (Local, State and Federal), loans etc. As at 1981, total compensation of employee was N9,469.07m, that of 1990 was N16,561.98m.This further increased to N188,393.71m in year 2000 and as at 2011, total compensation to employee was N9,472,250.85m.With respect to the growth of compensation of employee, the graph shows a zigzag pattern as shown in figure 1.The implication of this development is that employee compensation should be encouraged to increase labour force participation with attendant multiplier effects of increase in income, and increase in the country's productivity vis-a-vis growth in GDP.

Economic Models of Employee Compensation

Lindenboim et al (2011) theoretically and empirically assess the share of labor compensation and aggregate demand which they obtained from dividing employee compensation(including employees' and employers' contributions to social security system) by total income, represented by Gross Domestic Product at basic prices (GDPbp), at current prices; they interestingly reveal that wage earners share(the ratio between wage earners and the total employment)has a positive effect on the share of labour compensation and that the ratio works as an "adjustment" variable necessary when considering wage earners to estimate income and the total number of the employed when calculating productivity. Employing a somewhat different institutional viewpoint, unlike most studies, Elbaum (1983) points out that job and pay structures within internal labour markets are significantly affected by ongoing bargaining between the firms, workers and their organizations. In a different study, Oyer (2005) analyses the connection

between the condition of business cycle and the fraction of employment cost. He notes in his derivation of a simple model of firms using employees benefit as a hedge against decreases in nominal market wages when wages are downwardly rigid that labour disputes are much likely to be related to benefits when inflation rates are low.

Studenmund (2011), as cited in Zakirov (2013), examines the relationship between labour compensation and productivity in various industries of the United States. He analyzes a fixed effect regression model based on average labor productivity and the total annual hours per workers and later arrives at the following model after a series of modifications:

$$W_{it} = \lambda_o + \lambda_1 Y/L_{i\ t} + \lambda_2 P_{i\ t} + \lambda_3\ h/L_{i\ t} + \beta_1 D1 + \beta_2 D2 + \ldots + \beta_{30} D30 + a_i + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where W_{it} denotes the yearly compensation per worker as dependent variable, Y/L_{it} – productivity or output per person; P – Implicit price deflator; h/L_{it} – hours to employment ratio as independent variables; D1, D2,….D30 are industry dummies, λ_0, λ_1, λ_2, λ_3, β_1, β_2,….β_{30} – the coefficient estimates for the intercept term, a_i – industry specific unobserved effects which are constant over time; ε_{it} - the error term. He analyzes the growth effects of productivity, output prices and annual hours worked per worker on annual compensation per worker based on the model stated above and concludes that the increase in productivity and output prices will lead to rise in annual compensation per worker as expected, and in the same study it was revealed that the total annual hours worked per worker has showed negative impact on annual compensation per worker. Also in an empirical assessment, Rayton (2000) thoroughly examines the relationship between firm performance and compensation structure using labour and related expenditures variables to measure total compensation, and the labour variable represents the costs of employees’ compensation and benefits allocated to continuing operations. He explicitly states that the variables of interest in his study contains information about the magnitude of annual firm expenditures on wages, salaries, incentive compensation, profit sharing, payroll taxes, pension costs, and some other benefit plans. The study concludes that the best performing firms have sharper links between pay and performance than their lower performance counterparts.

Weitzman (1983) presents a theoretical and empirical study of the macroeconomic implications of alternative compensation system, in which he demonstrates a compensation system by adopting a typical monopolistically competitive firm under an existing labor compensation formula, different from one under a conventional theory. He expresses such functional relationship (that is, the compensation function) as follows,

$$W_i = F_i(\lambda_i, Z_i)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Letting Z_i be some economic indicators pertinent to firm i, and other typical economic indicators including price of ouput, profit per worker, or revenue per worker, Weitzman further made an interesting remark that other economic wide variables should not be excluded from Z_i. However, this study specifically considers Nigeria's Real Gross Domestic Product growth rate, inflation rate and Total Government Expenditure as key economic wide variables that will provide better understanding for employees' compensation determination. And also let λ_i stand for a contract parameter, which is quasi-fixed in the short run and ultimately determined by the long run forces of bargaining in a competitive labour market. Weitzman describes the compensation function above as the monetary remuneration of a worker as a function of the slow-moving contract parameter λ_i and the fast moving current performance indicator Z_i, and generally noted that the compensation function has more desirable macroeconomic properties when the wage component is small relative to the share component and that there is a high degree of excess demand for labour by the firm.

3. Model Specification and Methodology.

Given the factors affecting employees' compensation, some of which have been discussed in the theoretical and empirical literatures above and the modification done to Weitzman (1983) compensation function, the study therefore selects three key macroeconomic variables, namely, Growth rate of Real Gross Domestic Product (GRRGDP), Inflation Rate (INFL) and Total Government Expenditure (TEXP). These are key factors in labour market development for which adequate and comprehensive data are readily available in Nigeria. After identifying the important macroeconomic variables that affect the compensation of employees, we proceed by presenting the VAR model depicting the inter-relationship between the compensation of employees and the selected macroeconomic variables. The compact form of the 4-variable VAR model is given in their natural logarithmic form as;

$$\ln Z_t = \phi_i + \sum_{i=1}^{k} \beta_i \ln Z_{t-1} + \varepsilon_t \quad \text{.....(3)}$$

Where;

$\ln Z_t$ = (, lnCEM, lnGDPGR, lnINFL, lnTEXP), the vector of the log values of the compensation of employees, growth rate of gross domestic product, inflation rate and total government expenditure.

ϕ_i = intercepts of autonomous variables.

β_i = matrix of coefficients of all the variables in the model.

Z_{t-1} = vector of the lagged variables.

ε_t = vector of the stochastic error terms.

In consideration of the above, and based on the theoretical discussions, we can specify the system of simultaneous equations which describe the relationship between compensation of employees and 3 selected macroeconomic variables as:

lnGDPGR = f (lnCEM, lnINFL, lnTEXP)..... (4)

lnCEM = h (lnGDPGR, lnINFL, lnTEXP)..... (5)

lnINFL = s (lnGDPGR, lnCEM, lnTEXP)…… (6)
lnTEXP = y (lnGDPGR, lnCEM, lnINFL)…… (7)

Where: lnGDPGR = log value of Growth rate of Real Gross Domestic Product, lnCEM = log value of Compensation of employees, lnINFL = log value of inflation rate and lnTEXP = log value of total government expenditure.

The a priori expectations of the signs of the coefficients in the specified relationship between the compensation of employees and selected macroeconomic variables are shown in Table 3 below;

Table 3: Variables description and apriori sign expectations

Variables	Variable Description	Expected Signs of coefficient
lnGDPGR	log of Real GDP growth rate	+
lnCEM	log of Employees Compensation	+
lnINFL	log of Inflation Rate	-
lnTEXP	log of total Government Expenditure	+

Source: Authors' 2014.

The study employs annual time series data in Nigeria for the estimation of variables for 1981 through 2011. The data were collected from the Central Bank of Nigeria (CBN) Statistical Bulletin volume 22, 2011.

This study conducts unit root and Johansen Co integration tests. It also estimates the Pairwise Granger causality test to establish causal relationships and determine the predictive content of one variable beyond that inherent in the explanatory variables themselves. Finally the study utilizes a multi-equation Vector Auto regression (VAR) methodology in order to investigate the inter relationships among the time series variables. It then derives the Variance decomposition and Impulse Response Functions in order to explore the dynamic structure of the system. Also to avoid producing parameter estimates that may be detrimental to policy making since the period covered is fairly lengthy, it becomes necessary to conduct the structural stability test using the Cumulative Sum of Recursive Residuals (CUSUM) test.

4. Econometric Results

(a) Stationary Tests:

The Dickey Fuller and hence the Augmented Dickey Fuller tests were used [see Dickey and Fuller (1979)] calculated the empirical distribution of t – statistics under the null hypothesis that the series has a unit root. To test the unit root hypothesis, the ADF specification is written in the following forms;

$$\Delta X_t = \beta_o + \rho X_{t-1} + \sum_{i=1}^{m} \lambda_i \Delta X_{t-1} + \varepsilon_t \quad \ldots\ldots (11)$$

$$\Delta X_t = \beta_o + \beta_1 t + \rho X_{t-1} + \sum_{i=1}^{m} \lambda_i \Delta X_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(12)$$

In the two equations, X_t = [GDPGR, CEM, INFL, TEXP]
Where X_t = the logarithm of the variable in period t, t = time trend, $\Delta X_{t-1} = X_{t-1} - X_{t-2}$, , ε_t is the independently and identically distributed disturbance with mean 0 and variance σ^2 and α, β, ρ and λ are the coefficients.

The basic objective of the test is to examine the null hypothesis that $\rho = 1$ in the ADF equation above; against the one-sided alternative $\rho < 1$.Thus the hypotheses of interest are H_0: series contains a unit root versus H_1: series is stationary. The test is conducted allowing for intercept and deterministic trend, or neither in the test regression. From $\hat{\rho}$, one can calculate the ADF test statistic (t) as;

$$t = \hat{\rho} / Se(\hat{\rho}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(13)$$

Where $\hat{\rho}$ is the estimate from the ADF equations above and Se($\hat{\rho}$) is its estimated standard error. If the absolute value of the t-statistics is greater than the absolute value of the MacKinnon critical value at the chosen level of significance, the variable is stationary. Otherwise the series is non-stationary.

(b) Johansen Co-integration Test

The cointegration test proposed by Johansen (1988) and Johansen and Juselius (1990) was used as an econometric method to assess whether or not there is a long-term equilibrium relationship among the variables used for the estimation. The Johansen procedure helps in testing the restrictions imposed by cointegration on a VAR model. In order to effectively carry out the Johansen test, we will first formulate the VAR:

$$X_t = A_O + X_{t-1} A_1 + X_{t-2} A_2 + \ldots + X_{t-p} A_p + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

Where X_t is K-dimension vector of variables which are assumed to be I(1) series (but can also be I(0)), A_i, i=1…p is the coefficient matrix, and ε_t is a K –dimension vector of residuals. The lag order can be determined by the model which minimizes the Akaike Information Criterion (AIC) and Schwarz Bayesian Information Criterion (SBIC). Suppose the appropriate lag order has been found, then the expression in the above model can be rewritten in its Vector Error Correction (VEC) form as:

ΔX_t = A$_o$ + $\prod X_{t-p}$ + $\Gamma_1 \Delta X_{t-1}$ + $\Gamma_2 \Delta X_{t-2}$ + …..+ $\Gamma_{p-1} \Delta X_{t-(p-1)}$ + ε_t …………………. (15)

Where Γ_i = - $\sum_{j=i-1}^{p} A_j$ and Π = $\sum_{j=1}^{p} A_j$, the coefficient matrix Π contains the information concerning the long-run relationship between the X_t variables. The rank of the matrix Π indicates the number of cointegrating relationships that exist between the variables in X_t. To test the hypotheses that there are r cointegration vectors against alternative of (r+1) cointegration vectors, there is the following maximum Eigen value statistics:

$\lambda_{\max}$ (r, r+1) = - T In(1 - $\hat{\lambda}_{r+1}$) ……………………………………………………….(16)

Where λ_{r+1} is an estimated Eigen value. The null hypothesis is r cointegrating vectors, against the alternative of r+1 cointegrating vectors.
Also, the trace statistics is calculated as follows;

$\lambda_{trace}(r)$ = -T $\sum_{i=r+1}^{a} \ln(1-\hat{\lambda}_i)$ ………………………………………………………….(17)

Where λ_t is the smallest value Eigen vectors (p – r) and T is the number of observations.

(c) Granger Causality Tests

A generally accepted way to test for the existence of any temporal statistical relationship with predictive value between two time series is the Granger Causality test (Granger, 1969). This test is conducted in as much as our variables are integrated of the same order and are cointegrated. The equation to test causality is stated as below;

$GDPGR_t = \alpha + \beta CEM_t + \psi INFL_t + \Phi TEXP + \varepsilon_{1,t}$ …………………………(18)

$CEM_t = \Omega + \varphi INFL_t + \theta TEXP_t + \omega GDPGR_t + \varepsilon_{2,t}$ …………………………(19)

$INFL_t = \lambda + \delta CEM_t + \pi TEXP_t + \eta GDPGR_t + \varepsilon_{3,t}$ …………………………..(20)

$TEXP_t = \vartheta + \varpi GDPGR_t + \rho INFL_t + \tau CEM_t + \varepsilon_{4,t}$ …………………………..(21)

Where: α , Ω, λ and ϑ are constants and $\beta, \psi, \Phi, \varphi, \theta, \omega, \delta, \pi, \eta, \varpi, \rho$ and τ are respective parameters. Also, $\varepsilon_{1,t}$ ……….. $\varepsilon_{4,t}$ are the respective error terms.

4.1. Empirical Analysis and Interpretation of the Results

(a) Augmented Dickey Fuller (ADF)

The study tests for unit roots. Augmented Dickey-Fuller (ADF) was employed to perform the test. The results of the stationarity tests of variables are presented in Table 4.

Table 4: Results of Unit Root Tests Results at Levels and first differences.

LEVELS					FIRST DIFFERENCE			
Variables	ADF Test Statistics	95% Critical value of ADF	Order of Integ ra-tion	Remarks	ADF Test Statistics	95% Critical Value of ADF	Order of integr ation	Remarks
LNCEM	2.180603	-2.971853	I(0)	Non Stationary	-6.480364	-2.967767	I(1)	Stationary
LNGDPGR	-3.537956	-2.991878	I(0)	stationary	-3.031183	-3.029970	I(1)	Stationary
LNINFL	-3.056352	-2.963972	I(0)	stationary	-6.021171	-2.971853	I(1)	Stationary
LNTEXP	-1.331663	-2.971853	I(0)	Non stationary	-7.230447	-2.967767	I(1)	Stationary

Source: Authors' Computation Using E-Views 7.0, 2014.

The result in table 4 reveals that the Unit root test applied to the variables at levels I(0), reject the null hypothesis of the presence of unit root in terms of the log values of the growth rate of GDP and Inflation rate in Nigeria, But such hypothesis was accepted in terms of Compensation of Employees and Total Government Expenditure . Similarly, the results show that after the variables were differenced once, they were confirmed to be stationary. The ADF to the first difference of the variables accept the alternative hypothesis of stationarity for all the variables. Thus, the variables are integrated of order one.

(b) VAR Lag Order Selection Criteria

The Johansen co-integration technique requires us to specify the lag order and the deterministic trend assumption for the VAR. As shown in table 5 below, all the criteria indicate the use of lag one (2). This is in order as it helps to save degrees of freedom.

Table 5: VAR Lag Selection Criteria

VAR Lag Order Selection Criteria
Endogenous variables: DCEM DGDPGR DINFLDTEXP
Exogenous variables: C
Date: 01/31/14 Time: 05:31
Sample: 1981 2011
Included observations: 28

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1004.520	NA	2.27e+26	72.03712	72.22744*	72.09530
1	-999.1239	8.864481	4.91e+26	72.79457	73.74614	73.08547
2	-964.6916	46.72952*	1.42e+26*	71.47797*	73.19081	72.00161*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion
Source: Authors' Estimation Results Using Eviews 7.0, 2014.

(c) Johansen Co-integration Results

The study adopted the trace test and Maximum Eigen value tests, the Johansen co integration result shows that the variables of concern in examining the inter relationship between the compensation of employees and selected macroeconomic variables are co integrated. The results of the multivariate co-integration test based on Johansen's co-integration techniques reveal that both the Trace Statistics and Maximum Eigen-value Statistics confirm the existence of co-integrating equations among the variables. Since the variables are co-integrated, the existence of a long- run or equilibrium relationship among the log values of the Compensation of Employees (CEM), Growth rate of GDP (GRGDP), Inflation Rate (INF) and Total Government Expenditure (TEXP) in Nigeria between the periods under study is confirmed. See Table 6 below.

Sample (adjusted): 1983 - 2010
Included observation: 28 after adjustments
Trend assumption: linear deterministic trend
Series: DLNCEM DLNGDPGR DLNINFL DLNTEXP
Lags interval (in first difference): 1 to 1

Table 6: Unrestricted Cointegration Rank Test (Trace and Maximum Eigen value)

Hypothesized No. of Co-integrating Equations	**Maximum Eigen Value Statistics**	**0.05 Critical Value**	**Probabilities**	**Trace Statistics**	**0.05 Critical Value**	**Probabilities**
None	30.13930*	27.58434*	0.0230	71.91282*	47.85613*	0.0001
At most 1	20.93866	21.13162	0.0532	41.77352*	29.79707*	0.0013
At most 2	14.64988	14.26460	0.0434	20.83486*	15.49471*	0.0071
At most 3	6.184982	3.841466	0.0129	6.184982*	3.841466*	0.0129

Source: Authors' Estimation Using E-Views 7.0, 2014.

Note:* denotes the rejection of the hypothesis at 0.05 significance level.

(d) Results of Granger Causality Tests

Granger causality test is adopted in testing the direction of causality between the compensation of employees and selected macroeconomic variables in Nigeria. The test determines the predictive content of one variable beyond that inherent in the explanatory variables themselves. Thus, with the multivariate Granger causality result, it is evident that there is unidirectional causality between the compensation of employees and total government expenditure in Nigeria, but such causal relationship does not affect the growth of GDP. Though, unidirectional causality runs from total government expenditure to economic growth as shown in table 7. Hence, it is suggested that policy makers should adopt optimal fiscal policies to enhance the compensation of employees as well the growth of the country's Gross Domestic product.

Table 7: Granger Causality Test Results

Pairwise Granger Causality Tests
Date: 05/16/14 Time: 02:40
Sample: 1981 2011
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LNGDPGR does not Granger Cause LNCEM	22	0.45188	0.6439
LNCEM does not Granger Cause LNGDPGR		1.36538	0.2819
LNINFL does not Granger Cause LNCEM	29	0.25103	0.7800
LNCEM does not Granger Cause LNINFL		1.53453	0.2360
LNTEXP does not Granger Cause LNCEM	29	1.95598	0.1633
LNCEM does not Granger Cause LNTEXP		1.36808	0.2737
LNINFL does not Granger Cause LNGDPGR	22	0.67863	0.5205
LNGDPGR does not Granger Cause LNINFL		0.86752	0.4378
LNTEXP does not Granger Cause LNGDPGR	22	2.14242	0.1480
LNGDPGR does not Granger Cause LNTEXP		0.24888	0.7825
LNTEXP does not Granger Cause LNINFL	29	0.76827	0.4749
LNINFL does not Granger Cause LNTEXP		1.46420	0.2512

Source: Author's Estimation Results Using Eviews 7.0, 2014.

(e) The Vector Autoregression (VAR) Results.

The results of the Forecast Error Variance Decomposition (FEVD) and the Impulse Response Functions (IRFs) are given below:

Table 8: Results of Variance Decomposition in Percentage.

Explanatory Variables						
Dependent Variable	**Quarters**	**S.E**	**LNCEM**	**LNGDPGR**	**LNINFL**	**LNTEXP**
FEVD of LNCEM	**1**	0.434742	100.0000	0.000000	0.000000	0.000000
	2	0.509205	95.38773	3.949703	0.311252	0.351314
	3	0.571874	95.78647	3.650986	0.247719	0.314825
	4	0.629083	96.00154	3.264937	0.451744	0.281779
	5	0.676719	96.27728	2.911783	0.511857	0.299084
	6	0.717379	96.50892	2.636534	0.470229	0.384315
	7	0.752685	96.59430	2.454839	0.427244	0.523613
	8	0.783828	96.58571	2.332226	0.395312	0.686749
	9	0.811708	96.51753	2.234729	0.374415	0.873331
	10	0.837091	96.41187	2.150619	0.362342	1.075169
FEVD of LNGDPGR	**1**	1.011160	1.142624	98.85738	0.000000	0.000000
	2	1.095233	1.965318	92.90185	0.071394	5.061443
	3	1.113548	1.913110	89.87541	2.074887	6.136588
	4	1.158777	4.836518	83.02158	6.024772	6.117134
	5	1.166320	5.550078	82.03380	6.286351	6.129769
	6	1.172567	6.438177	81.27380	6.221407	6.066619
	7	1.176332	7.023765	80.76619	6.181972	6.028069
	8	1.179452	7.475474	80.37176	6.154499	5.998265
	9	1.182032	7.866242	80.03221	6.129373	5.972179
	10	1.184582	8.253707	79.69213	6.106870	5.947291
FEVD of LNINFL	**1**	0.612182	1.118336	12.25085	86.63081	0.000000
	2	0.825159	7.268902	21.63935	68.46679	2.624957
	3	0.850972	6.905650	25.50919	65.11692	2.468248
	4	0.855972	6.826763	25.21312	65.50486	2.455260
	5	0.860449	6.988378	25.64549	64.91786	2.448274
	6	0.861946	7.127721	25.71059	64.69301	2.468680
	7	0.862390	7.170594	25.68425	64.65881	2.486349
	8	0.862788	7.184686	25.67083	64.63783	2.506658
	9	0.863053	7.206256	25.66348	64.60786	2.522405
	10	0.863271	7.236904	25.65238	64.57696	2.533748
FEVD of	**1**	0.179532	0.397514	0.276081	27.06003	72.26637

LNTEXP						
	2	0.199807	15.05634	0.235415	23.85029	60.85796
	3	0.226845	13.34779	0.512827	26.72614	59.41325
	4	0.245605	17.10893	0.451106	25.40185	57.03812
	5	0.259329	18.87542	0.548271	24.58815	55.98816
	6	0.271590	21.13288	0.544982	23.72586	54.59628
	7	0.282851	23.31385	0.531053	22.86933	53.28577
	8	0.293138	25.61343	0.519876	21.96657	51.90012
	9	0.302671	27.77093	0.510888	21.15840	50.55978
	10	0.311627	29.82276	0.504993	20.41310	49.25915

*Standard error of variance

Source: Author's Estimation Results, 2014.

(f) Forecast Error Variance Decomposition (FEVD)

The other strand of analysis in the VAR methodology is the Forecast Error Variance Decomposition (FEVD). Here the paper determines the percentage of variances in each endogenous variable that is determined by the other variables. This can help provide the amount of influence the endogenous factors exert on each other. The FEVD results are reported in table 9 above. From table 8,the forecast error decomposition of the log value of CEM shows that through the 10-quarter period of the analysis, lnCEM variations were mostly explained by itself (that is by 'own shock') and, after some time, such variation moderately accounted for by TEXP with about 87% at the end of the horizon . The contributions of GDPGR and INFL are not very strong over the period, showing that changes in CEM are only slightly determined by growth rate of GDP and inflation rate in Nigeria.

The variance in the growth rate of GDP is explained by 'own shock' with about 98%, CEM, INFL and TEXP at the end of the ten periods was 8.25%, 6.11% and 6.0% respectively. The implication of this is that the variance of the growth of GDP is not much influenced by employees' compensation, inflation rate and total government expenditure in Nigeria.

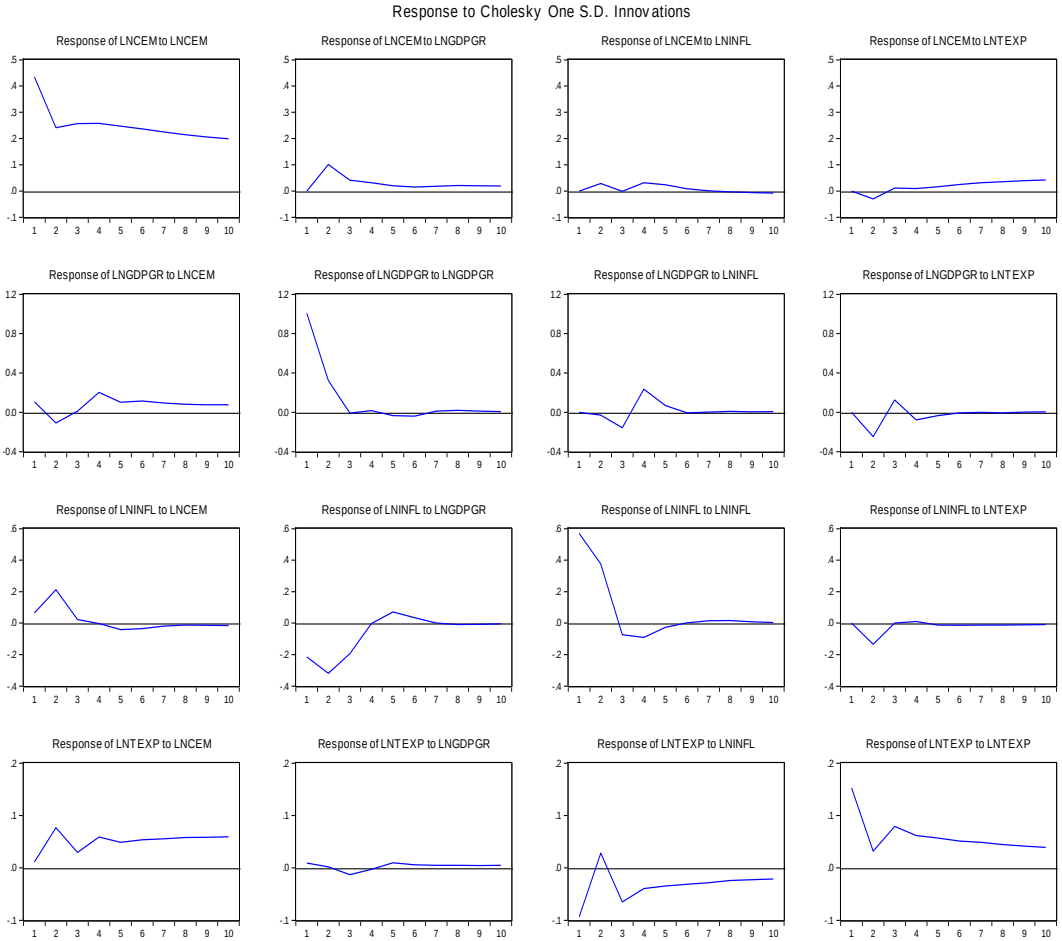
It is also observed that the variation in INFL is predominantly explained by 'own shock' and moderately by CEM, RGDP and TEXP which account for about 7.2, 25.6 and 2.5 percent, respectively at the end of the horizons. This implies that the growth rate of GDP accounts more for the variation in INFL than employees' compensation and total spending by government in Nigeria in the review period.

An examination of the variance decomposition of TEXP shows that a substantial amount experienced by TEXP is attributed to its 'own shock' in the first period, but fades out at the end of the horizon. It is noteworthy that the about half of the total variation in total expenditure in Nigeria is as a result of the variations in employees' compensation which accounted for about 30 percent. Meanwhile, INFL and GDPGR marginally contributed to such variations.

(g) Impulse Response Functions

In order to further conduct the dynamic analysis of employees' compensation within the dynamic framework, the Impulse Response Functions (IRFs) based on the VAR results were examined. Results are presented in the form of the dynamic impulse responses of the variables in the VAR (i.e. ln CEM, lnGDPGR, lnINFL, and lnTEXP) to an increase in each relevant variable equivalent to the sample standard deviation. The results are presented in figure 1 below. They reveal the proper ordering and they gave a visual understanding of the forecast error variance decomposition explained in table 9 above.

Figure 1: Multiple Graphical Responses of variables in the VECM System

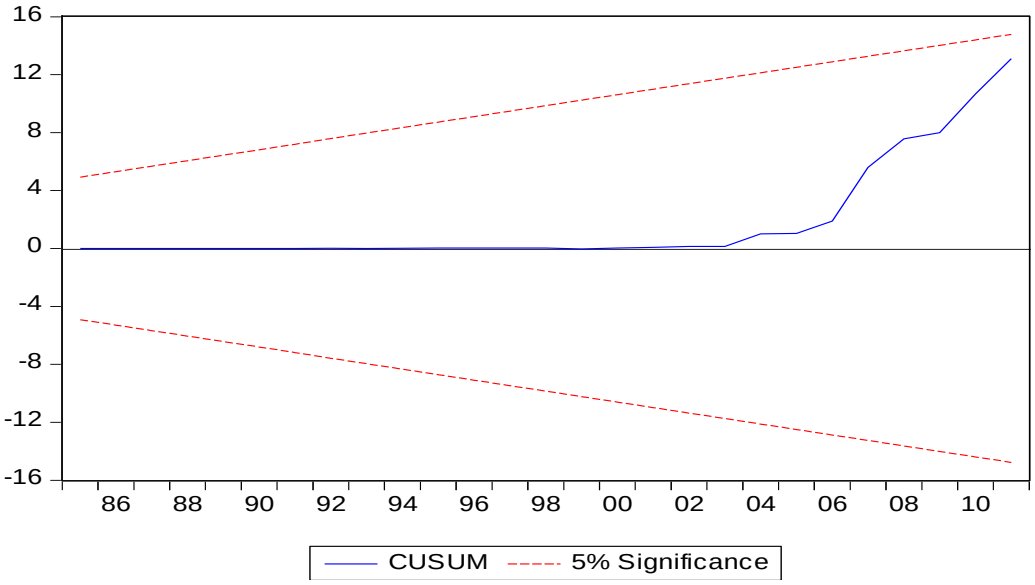


Source: Authors' Estimation Using E-Views 7.0, 2014

(h) Structural Stability Test

A CUSUM test of stability was conducted to establish the robustness of the model. As revealed from the graphical result in figure 2 below it did not at any point exceed the graphical plot of the recursive residuals at 5% significance level. Thus the hypothesis of structural stability will hence be accepted in line with our graphical evidence. These findings indicate that the VAR model is appropriately specified and the parameters obtained are structurally stable, and the results from the model are likely to be dependable in explaining the inter-relationship between employees' compensation and selected macroeconomic variables in Nigeria.

Figure 2: **Plot of Cumulative Sum (CUSUM) of Recursive Residual**.



Source: Authors' Estimation Using E-Views 7.0, 2014.

5. Policy Implications of Results and Conclusion

This paper has examined the inter-relationship between employees' compensation and selected macroeconomic variables in Nigeria using the Vector Auto regressive (VAR) methodology and utilizing annual time series data of employees' compensation and the 3 selected macroeconomic variables for 1981 through 2011. It was found that employees' compensation may have significant inter-relationship with selected macroeconomic variables in a number of ways. In particular, any increase in government public sector spending could drive employees' compensation and this may in turn have a significant impact on economic growth. The test for co-integration confirmed that there is a stable long-run relationship between employees' compensation and the selected macroeconomic variables, namely, the growth rate of GDP, inflation rate and total government expenditure in Nigeria. The Granger Causality result shows evidence of a unidirectional causality between employees' compensation and total government expenditure and also between the latter and economic growth. This suggests that government should make conscious and deliberate efforts to incorporate employees' compensation into its medium and long-term expenditure frameworks in Nigeria. The Forecast Error Variance Decomposition revealed that substantial percentage of variations in employees' compensation in Nigeria is accounted for by its 'own shock' and moderately by the variations in total government expenditure. Overall, the results of the study suggest that policy makers in Nigeria should lay emphasis on sizeable recurrent expenditure in order to facilitate enhanced employees' compensation.

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THE IMPACT OF REAL EXCHANGE RATE ON ECONOMIC GROWTH: EVIDENCE FROM NIGERIA

By: Patricia A. Adamu[1]

Abstract

This study examines the relationship between economic growth and the real effective exchange rate in Nigeria using co-integration and error correction modeling, for the period 1981-2012. It was found that a long-run equilibrium relationship exists between economic growth, the real effective exchange, investment-consumption ratio, broad money stock, the ratio of government expenditure to income, and real agricultural output. Real exchange rate and the other macroeconomic variables were found to be positively related to economic growth. In particular, real agricultural output, investment-consumption ratio, broad money stock, the ratio of government expenditure to income, were found to be key drivers of economic growth in Nigeria during the period of study. Most importantly, a depreciation of the real effective exchange rate was found to boost economic growth. In order to ensure rapid growth, there is need to implement policies that would contribute to macroeconomic stability, promote sound economic fundamentals, and maintain an equilibrium real exchange rate. It is therefore recommended that the monetary authorities should continue to utilize a managed floating exchange rate regime. Since agriculture is a very strong driver of economic growth, implementation of robust policies to improve agricultural productivity is highly recommended.

JEL Classification: D51, E5, E64, F31, O4

Keywords: Real **effective** exchange rate, economic growth, co-integration and error correction modeling

1.0 Introduction

Real exchange rate is a relative price. It is the price of one currency relative to another currency, or equivalently the price of foreign currency expressed in domestic currency. The real exchange rate is the ratio of the market exchange rate to the purchasing power parity (PPP) conversion factor, and it is a measure of the international competitiveness of an economy. An overvalued real exchange rate increases the price of domestic goods abroad, leading to lower demand for exports. This leads to a deterioration of the trade balance, and the converse is the case with an undervalued real exchange rate.

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Exchange rate is an important tool of macroeconomic management. The objectives of exchange rate policy in Nigeria are to: maintain a favourable external reserves position, diversify the export base and reduce dependence on imports and oil exports, ensure external balance, guarantee stability and sustainability of exchange rate, and narrow the gap between official and parallel exchange rates.

Prior to 1986, precisely from 1970s to mid 1980s, Nigeria had a fixed exchange rate regime which could be inimical to growth under certain circumstances. This is because a fixed exchange regime can lead to speculative attacks on a weak currency due to the delay in the relative price adjustments. Hence, many countries, especially developing and emerging countries suffer from a 'fear of floating' syndrome, (Calvo and Reinhart, 2002; Adamu, 2009). Calvo (2003), avers that when there is a 'sudden stop' of inflow of foreign investment, the countries end up in currency crashes and capital flight follows, as was evident in the East Asia and Latin America in the 1990s. When Nigeria adopted the structural adjustment programme in 1986, a flexible exchange rate regime was embraced but this has resulted in a progressive depreciation of the Naira over the years. This was attributable to fiscal dominance, declining oil prices, capital flow reversals, and heightened demand for foreign exchange. In general, high volatility in exchange rates tends to inhibit macroeconomic performance of a country.

The economic policy framework embarked upon during SAP (1986 – 1988/89) was designed to correct the structural distortions in the economy and create a conducive environment for stable growth and development. The framework was structured with emphasis on short to medium term macroeconomic stabilization with a view to reducing the inflationary pressures which had been elevated and achieving a viable balance of payments position which had worsened in the wake of high importation exacerbated by highly overvalued naira exchange rate.

The exchange rate was deregulated through the establishment of second-tier foreign Exchange Market (SFEM) which later graduated into foreign Exchange Market (FEM) and Inter-Bank Foreign Exchange Market (IFEM). Consequently, the over valuation which hitherto plagued the naira exchange rate was removed as the rate was devalued sharply to allow it to reflect economic fundamentals and move towards its fundamental equilibrium exchange rate (FEER). This was expected to contribute to the "adoption of a realistic exchange rate policy". It is very important to keep exchange rate at its fundamental equilibrium exchange rate that would restore internal and external balances in the economy with redound to the country's competitiveness.

The policy literature has identified at least five competing definitions of the real exchange rate (RER). All definitions agree that RER is a relative price but there are disagreements on which relative price should be called "the" real exchange rate.

This part of the paper leans heavily on the works of Omoruyi (2012a & b). According to him, an early definition of the real exchange rate is the nominal exchange rate (E) corrected (that is multiplied) by the ratio of the foreign price level or trading partners' inflation (p^f) to the domestic price level (p^d), (see equation 1.1 below). This definition is referred to as the purchasing power parity (PPP) real exchange rate (E_{ppp}).

$RER_{ppp} = E.p^f/p^d$…… (1.1)

But recent definition has viewed real exchange rate as the relative price of tradables (p^fT) to non-tradables (p^dN), that is,

$RER = E.p^fT/p^dN$ ……..… (1.2)

Where:

P^fT = world price of tradables

P^dN = domestic price of non-tradables.

A third version of the definition of real exchange rate is that which relates to the domestic relative price of tradables to non-tradables.

$RER = p^dT/p^dN$ …… (1.3)

Where:

P^dT = domestic relative price of tradable goods

P^dN = domestic price of non-tradable goods

The fourth definition is that RER is one which relates to the domestic relative price of importable goods (Pm) to non-tradable (N).

$RER = P_m/P_n$ ……. (1.4)

Where:

P_m = domestic relative price of importable

P_n = domestic price of non-tradable

Finally, real exchange rate has also been defined as the ratio of domestic relative price of exportable goods to non-tradable goods.

$RER = P_x/P_N$ ……..…… (1.5)

Where:

P_x = domestic relative price of exportable goods

P_N = domestic price of non-tradable goods

This paper identifies with the PPP definition of the real exchange rate (Equation 1.1) because of its simplicity and operational tractability. The PPP is a long-run rate and is used to explain the movements in the long-run real exchange rate. When the economic fundamentals change, the PPP equilibrium real exchange rate also changes, resulting in misalignment of the nominal exchange rate from equilibrium.

It is generally believed that effective management of the exchange rate would spur production and economic growth, improve price incentives and stabilize inflation, ensure fiscal viability, improve efficiency in resource allocation, enhance export competitiveness, and balance of payments equilibrium. Conversely, poor management of exchange rate or exchange rate misalignment would result in macroeconomic instability, distort investment decisions, inhibit productive endeavours, and hamper export growth. Thus, the real exchange rate impacts on

investment, output, income, employment, fiscal deficits, interest rates, foreign reserves, current account, the balance of payments, and hence growth.

The real exchange rate did not feature in the first generation of neoclassical growth models because they were closed-economy models; as such, the real exchange rate did not play any role. The most recent generation of neoclassical growth models (reviewed in Romer 1994) can be thought of as putting flesh on these analytical bones. They consider, inter alia, the system of property rights (e.g. patent and copyright protection), the intensity of competition (e.g. the presence or absence of entry barriers), and the extent and nature of education and training as factors shaping the incentive and ability to innovate and emulate, as ingredients in endogenizing technical change. Again it is not obvious that the real exchange rate is of first-order importance for the development of these arrangements. But other narratives give the real exchange rate more prominence. Therefore, minimizing exchange rate volatility is an essential part of the growth process. If the exchange rate is kept at an appropriate level and excessive volatility is avoided, the country can exploit its capacity for growth and development. The stability of exchange rate revolves round the equilibrium exchange rate, which in turn depends on the stability of economic fundamentals, notably money supply, inflation, output growth etc. Thus, money stock as well as other economic fundamentals should be kept at a level consistent with equilibrium exchange rate.

The significance of real exchange rate (RER) cannot be overemphasized as it is used to determine the status of a currency, that is, whether the currency is over-valued or undervalued in relation to its equilibrium level. It gives an indication of a country's international competitiveness. Changes in RER indicate the need for depreciation or appreciation of a currency. For instance, an appreciation of RER suggests the need to devalue the nominal exchange rate, while depreciation is an indication of a country's international competitiveness. RER is also useful for external adjustment in order to maintain external competitiveness. In addition, changes in RER affect allocation of resources and expenditure pattern in the economy by switching domestic demand from tradable to non-tradable goods and vice versa.

The principal objective of exchange rate policy or management is to remove maladjustment which may manifest in exchange rate overvaluation or undervaluation and therefore move the rate to its fundamental equilibrium value which is expected to bring about internal and external balance. Fundamental equilibrium exchange rate (FEER) which is the real rate or the market equilibrium rate, will generate a current account surplus or deficit that is equal to the underlying capital flows over the business cycle, geared towards maintaining internal balance (low inflation and low unemployment) and healthy balance of payments purposes in a liberalized trade regime. Stability of FEER is critical because the greater the stability of the exchange rate, the greater the level of trade (the demand for exports), the higher the production of the export goods, more capital inflows, and the greater the level of capital formation.

Previous studies in extant literature have focused on exchange rate determinants and on its uncertain effect on output, using either single equation or simultaneous equation modeling approach. But this study diverges from earlier studies because it utilizes co-integration and error correction modeling approach to investigate the impact of real exchange rate on economic

growth in Nigeria. This study will also determine the various options of exchange rate management, and make recommendations to policymakers on the best possible measures of exchange rate management in Nigeria that would accelerate growth.

This paper is organized into seven sections. Following the introductory section is section 2, which presents an overview of determinants of exchange rate movements. Section 3 reviews relevant literature. Section 4 looks at exchange rate regime and economic growth nexus. Section 5 discusses the theoretical framework, the model and methodology of the study. Section 6 presents and analyzes the empirical results. Section 7 summarizes and concludes the paper. It also proffers policy recommendations for the effective management of exchange rate for economic growth.

2.0 Brief Overview of Determinants of Exchange Rate Movements

Real exchange rate is the product of the nominal exchange rate and the ratio of the price indices for two countries, for example, the foreign country and home country. An increase in real exchange rate implies that foreign goods are more expensive relative to home goods. This would cause a substitution away from imports towards exports. In other words, imports become more expensive; this not only reduces the demand for them, but also increases the demand for exports, all things being equal.

A rise in net exports is frequently referred to as an improvement of the current account and a fall as deterioration. Although this terminology is confusing from a welfare perspective, as there is nothing particularly good or bad about such changes in the current account, it does make sense from a stability perspective. In general, this need not be the case, which led Marshall (1923) and Lerner (1944) to analyze under which conditions an increase in the real exchange rate leads to an improvement of the current account. To do this, they defined the price elasticity of export demand $\varepsilon_x \equiv (Q / X)X' > 0$ and the price elasticity of import demand $\varepsilon_m \equiv (Q/ M)M'' > 0$ to derive what is now known as the Marshall-Lerner condition, starting from initial equilibrium:

$CA'(Q) > 0 \leftrightarrow \varepsilon_x + \varepsilon_m > 1$ …… (2.1)

Suppose there is a surplus on the home country current account, indicating that the value of exports of goods and services is higher than the value of imports, it implies that imports are too expensive (or exports are too cheap), then the relative price of imports will decline. Similarly, a deficit on the current account will increase the relative price of imports. Under this simple, adjustment mechanism, the Marshall – Lerner condition determines whether or not the equilibrium real exchange rate is stable, or not.

The Dornbusch (1976) model analyzes exchange rate adjustment in a model with sticky prices and rational expectations, and concludes that since prices are sticky and can adjust only gradually over time, the impact-adjustment of the exchange rate to any shocks or new information is magnified, and potentially adjusted by more than what is needed to restore the long-run equilibrium.

Factors affecting real exchange rate include economic fundamentals such as the money supply and real income (real GDP), see Iyoha (2003). A change in the money supply in an economy will affect the exchange rate. For example, an increase in the US money supply relative to Nigeria money supply will cause the price of the dollar to fall. In short, the dollar will depreciate in terms of the Nigerian naira, other factors held constant. A change in real income will also affect the exchange rate. For example, when real income in the United States rises, consumers will buy more goods produced at home and abroad. If consumers buy Nigerian goods, the increased demand for naira will drive up the value of the naira relative to the dollar, thereby causing the dollar to depreciate, and the naira to appreciate.

Market expectations also help determine exchange rates. If investors expect the dollars to decline, they will postpone their purchases in hope of buying dollars at a lower price. Thus, a depreciation expected in the future will cause a reduction in the current demand for dollars, leading to a drop in the current exchange rate. And, since exchange rate in the future will be influenced by the future value of market fundamentals, the expected value of future market fundamentals also affect today's exchange rate.

Other factors include: international terms of trade, world real interest rates, trade policies such as import tariffs, import quotas and export taxes, exchange and capital controls, inflation differentials, current account position, and fiscal and monetary policy actions.

Capital inflows and higher commodity export prices exert appreciating pressures on the exchange rate, which poses a policy challenge in many countries. The concern is that a stronger currency could undermine the competitiveness of their tradable sectors and weaken growth. Also, real exchange-rate misalignment – in particular when due to overvaluation – and higher volatility of the real exchange rate lower growth. Regarding the effect of undervaluation of the exchange rate on economic growth, the evidence is mixed and inconclusive, with some studies suggesting that undervaluation actually hurts growth, (Berg and Miao 2010).

The concern of real exchange-rate appreciation for policymakers stem from its effect on long-run growth. A given appreciation of the real exchange rate may have a differential impact on economic growth depending on whether or not it reflects an equilibrium phenomenon. If the appreciation is driven by a permanent change, then it will imply a long-run equilibrium movement. However, the real exchange rate could overshoot and become overvalued (for instance, if agents overestimate the persistence of the shock, or in case an excess supply of money results from the government's monetization of the external shock – which triggers an overshooting of the price of non-tradable goods. Thus, macroeconomic policy should focus on avoiding overshooting, overheating, and the surge of macroeconomic imbalances that could later become unsustainable.

3.0 Literature Review

The literature exhibits some studies with empirical evidence on the impact of real exchange rate on economic growth in Nigeria. In their study of the effects of exchange rate movements on economic growth in Nigeria, Akpan and Atan (2012), using a Generalized Method of Moments (GMM) procedure, found a statistically significant relationship between exchange rate and economic growth in Nigeria in the short run, but in the long run, the two variables drifted apart. In another study, Dickson (2012) examines the impact of exchange rate volatility on economic growth in Nigeria in the period 1970 – 2009. The results confirm the hypothesis that exchange rate volatility has a significant, negative effect on economic growth.

The evidence on the impact of exchange rate devaluation (depreciation) on growth is mixed and inconclusive. While some studies find a positive relationship between devaluation and economic growth, others posit a negative correlation between the two variables. For instance, Akpan et al (2012); Magud et al (2012); Omojimite et al (2010); Berg et al (2010); Rodrik (2008); Agénor (1995); Gylfson and Schmidt (1983); and Cooper (1971); concur with the finding that undervaluation of currency (a high real exchange rate) can stimulate growth in developing countries, through its positive effect on exports. A rise in net exports is frequently referred to as an improvement in the current account and a fall as deterioration in the current account. Although this terminology is confusing from a welfare perspective, as there is nothing particularly good or bad about such changes in the current account, it does make sense from a stability point of view in this framework.

But Kamin and Klau (1998); Copelman and Wermer (1996); Rodriguez and Diaz (1995); Rogers and Wang (1995); Morley (1992); Agénor (1995); Edwards (1989); Diaz-Alejandro (1965) find that devaluation tends to reduce the output in the short run and hence, slows growth.

Much of the broad empirical evidence about exchange rates and growth can be interpreted in terms of the Washington Consensus (WC). For example, Johnson et al (2007) find evidence that avoidance of exchange rate overvaluations is associated with long-run growth booms, while under-valuations do not matter. Easterly and Levine (2005) note that the black market premium, interpreted as a measure of exchange rate overvaluation, is one of the few reasonably robust policy determinants of growth in a panel regression. Rodriguez and Rodrik (2000) emphasize the dependence of the 'openness' variable on the black market premium and that this may be related to many aspects of macroeconomic disarray, not just closure to trade. Sachs and Warner (1995) find "openness" to be a key variable driving growth; this variable in turn depends critically on the black market premium, which is presumably correlated with (official) exchange overvaluation relative to a set of medium-term fundamentals. In a more direct test, Aguirre and Calderon (2005) find that exchange rate misalignment - measured as residuals from a fundamental equilibrium exchange rate (FEER) regression - helps predict growth in a sample of developed and emerging countries.

Rodrik (2008) dramatically argues differently about the reason exchange rate misalignment matters for growth and also about the empirical relationship: Two main empirical findings are both in sharp contrast to the WC view. In a large sample of developing countries over 1950–

2004 period, he finds that growth over the medium term is much higher in countries with more undervalued exchange rates, and that the effect is linear and similar for both under and overvaluation of exchange rate; implying that overvaluation hurts growth, but undervaluation spurs growth. This evidence is also corroborated by the evidence from Rajan and Subramanian (2007), Dollar and Kraay (2003), Razin and Collins (1997), and Fischer (1993).

However, Rodrik (2008) warns that although undervaluation benefits one country, there is a potential "beggar thy neighbour" implication. Berg et al (2010) conclude that in the long run, exchange rate deviations – especially relative to fundamental determinants – are likely to be unsustainable, but in the medium term, such deviations could be significant and can matter for growth. Finally, they also support the view that overvaluation is bad, while undervaluation is good for growth.

There is a vast literature on the theoretical relationship between the exchange rate and economic growth. However, this statement does not apply to the case of empirical studies, especially for African countries. Developing countries which adopt a fixed exchange rate regime have often suffered from current account and balance of payments deficits, and eventual devaluation of their currencies partly as a result of higher inflation rates than their trading partners. Such a situation has tended to lead to a recession and hampered economic growth, (Ito, Isard, and Symansky; 1999). All other things being equal, depreciation increases exports and results in current account surpluses, which would snowball into nominal currency appreciation, unless the central bank intervenes by sterilizing the inflow. With free capital mobility, capital inflows would also put pressure on the (nominal) exchange rate to appreciate. Ito et al (1999) conclude that successful economic development results in a currency appreciation with improvement in the standard of living, while failure in economic development often results in sharp currency depreciation.

Assessing the impact of macroeconomic policies on growth under a fixed and flexible exchange rate regime, studies have noted that the international spillover effects of short-run fiscal and monetary policy indicate a clear international conflict of interests. Under fixed exchange rates, a small country can only boost output through a fiscal expansion, which if the country is large may reduce output abroad. Similarly, under flexible exchange rates, a small country can only boost output through a monetary expansion, which if the country is large will reduce output abroad, (Marrewijk, 2005). Therefore, to enhance growth, there is need to use appropriate fiscal and monetary policies in tandem with the exchange rate regime.

Rodrik (2008) demonstrates that manipulating the real exchange rate could play a welfare-enhancing role if this serves to improve the internal terms of trade of sectors subject to dynamic learning externalities. He also shows evidence that undervaluation works through its positive impact on the share of tradables in the economy. Hence developing countries that find ways of increasing the relative profitability of their tradables are able to achieve higher growth. Gala (2007) suggests undervaluation is good for growth because increasing-return activities are located in tradables rather than non-tradables. They conclude that episodes of undervaluation are strongly associated with higher economic growth.

In contrast, Prasad, Rajan, and Subramanian (2006) observe that fast-growing developing countries have tended to run current account surpluses rather than deficits. This contradicts the view that developing countries are constrained by external finance and with the presumption that capital inflows supplement domestic saving and enable more rapid growth. According to Prasad et al. (2007) capital inflows appreciate the real exchange rate and hurt growth through reduced investment incentives in manufactures. Even though their focus is on the costs of overvaluation rather than the benefits of undervaluation, their concern with the real exchange rate tend to complement the work of Rodrik (2008).

4.0 Exchange Rate Regimes and Economic Growth

Prior to the adoption of Structural Adjustment Policy (SAP) in 1986, Nigeria operated a fixed exchange rate regime as required under the Bretton Woods system. However, it adopted a flexible exchange rate regime with the SAP. Since then, the country's currency (Naira) has undergone a series of depreciation against the US dollar. The naira depreciated from N0.61 to the US dollar in 1981 to N2.02:$1 in 1986 and further to N8.03 in 1990. In 1994, a policy of guided or managed deregulation which pegged the Naira at N21.886 against the US dollar was put in place. This did not prevent the Naira from depreciating as it went down to N86.322:$1 in 1999 and further depreciated to N120.97, N133.5 in 2002 and 2004 respectively. The exchange rate appreciated to N118.57 in 2008, (Central Bank of Nigeria, 2009). But due to the recent global financial crisis, the Naira depreciated to N150.01 at the end of 2009 (Aliyu, 2011), and by 2013, the Naira further depreciated to N165 to the US dollar. Fluctuation in the real exchange rate in recent years is largely a consequence of the financial meltdown that rocked the global economy. A major reason for this can be attributed to the activities of some commercial banks that engaged in 'round-tripping', a situation in which banks buy foreign exchange from the Central Bank of Nigeria (CBN) and sell to parallel market operators at prices other than the official prices.

Exchange rate regimes have had some implication for economic performance. The question is which exchange rate regime is most closely associated with economic growth. The study of Bordo and Schwartz (1999) gives a comprehensive comparison of the growth of real per capita income over a number of key exchange rate regimes of the international monetary system, during the period 1881-1995. The regimes covered are: the classical gold standard, 1881-1913, the inter-war period 'mixed regime', 1919-1939, the Bretton Woods period, 1946-1970 and the floating rate period, 1973 to present. The Bretton Woods period is further subdivided into the pre-convertible phase, 1946-1958, and the convertible phase 1959-1970. Also the floating period is subdivided into an inflation period, 1973-1982, and a disinflation period, 1983-1995. In summary, Bordo et al (1999) found that the Bretton Woods period, and particularly the convertible period, exhibited the most rapid average output growth of any monetary regime and the inter-war 'mixed regime' period produced the lowest. Undeniably, they acknowledge that the link between the kind of fixed exchange rates provided by Bretton Woods and high economic growth seems less compelling than for other aspects of economic performance, such as inflation, and they attribute this to a number of factors. First, they argue that there is an apparent absence of a link between exchange rate volatility and either investment or trade flows and economic

growth. However, interestingly, taking the entirety of the Bretton Woods period, they found a higher variability of growth than in the recent floating rate period, (MacDonald, 2000).

However, Ghosh, Gulde and Wolf (1995) find modest correlation between fixed exchange rates regime and economic growth, if the 1960s period is considered. Thus, although Ghosh et al (1995) find evidence linking real growth to the growth of investment and trade for fixed exchange regime countries, they also find total factor productivity growth to be an important channel of growth for countries with flexible exchange regime.

Harberger, (2003) identified different causal changes that can affect real exchange rate and hence growth, to include:

i. A capital movement into the country will have no effect on the real price of the dollar if it is all spent on tradables, but to the extent it is spent on non-tradables it will raise their price. Seen a different way, there is no effect of people spending the dollars directly in foreign markets but if they dump the dollars in the local foreign exchange market, they cause the Naira price of the dollar to fall (or with a fixed exchange rate, cause an expansion of the Naira money supply and a consequent rise in the internal price level). This has a negative effect on growth.
ii. Outflows of capital will similarly work to raise the real Naira price of the dollar. Once again, the limiting case would be one where there is no effect for example, keeping the proceeds of an oil price rise abroad.
iii. A rise in the world price of an export product, by adding to the supply of dollars, will lead to a fall in the real price of the dollar -- once again, so long as some of the proceeds of the export price boom are repatriated and spent on non-tradables.
iv. Real cost reduction, which comes with improvement in total factor productivity (TFP) known as technical advancement in the production of a tradable good will have a similar effect to a rise in the price of an export good. If the affected good is exportable, it will lead to increased availability of foreign exchange via increased exports. If it is an importable, it will lead to reduced demand for imports and consequently lower real price of foreign currency.
v. Real cost reduction in the production of non-tradables has the opposite effect. The easiest way to see this is to recognize that an equal percentage real cost reduction in both tradables and non-tradables should have no effect on their relative prices, and hence on the real exchange rate.
vi. The imposition of tariffs and other import restrictions will typically reduce the demand for foreign currency and consequently lead to a reduction in the real Naira price of the dollar.
vii. Taxes on exports will typically reduce the supply of foreign currency and consequently lead to an increase in the real Naira price of the dollar. Subsidies to exports will obviously work in the opposite direction.

Which of these causal chains are more important, and when? Note that the impact on economic growth of movements in the real exchange rate refers to the long-term forces of growth, and not

elements that can cause transitory changes in the time path of the real exchange rate, like the effects of capital inflows or outflows on the real exchange rate, or the effects of export price booms or busts, nor the consequences of trade policy changes on the real exchange rate. But if there is demonstrable long term trends implying that the normal growth of a country entailed a certain typical rate of capital inflow, or a certain typical rate of change of its real export price index, then these sources of real exchange rate change could legitimately be incorporated. Of all the causes of real exchange rate movements that were listed above, only (iv) and (v) -- real cost reductions in tradables and in non-tradables -- represent elements that are integral parts of the process of economic growth, as they affect output positively or negatively. These have a negative impact on the real exchange rate. Thus, the question seems to boil down to whether over the long term, real cost reductions in tradables are or are not stronger than those in the non-tradables area. Finally, in the medium term, the growth in productivity in the production of traded goods will exert a downward pressure on the prices of exports and import-competing goods and an upward pressure on the prices of services, (Balassa (1964), p. 393).

Why might the real exchange rate matter for growth? There is good reason and much evidence to suggest that the real exchange rate matters for economic growth. The "Washington Consensus" (WC) holds the view that real exchange rate misalignment implies some sort of macroeconomic disequilibrium that is itself bad for growth. The reasoning is that fixed exchange rates in the presence of loose monetary policy may cause an appreciating real exchange rate and an unsustainable current account deficit, eventually requiring a domestic contraction or import controls when foreign financing disappears, (Berg and Miao, 2010). Krueger (1983) emphasized that such misalignments would reduce the openness of the country to trade and retard growth.

In summarizing the WC manifesto, Williamson (1990) opined that the test of whether an exchange rate is appropriate is whether it is consistent in the medium run with macroeconomic objectives. In the case of a developing country, the real exchange rate needs to be sufficiently competitive to promote a rate of export growth that will allow the economy to grow at the maximum rate permitted by its supply-side potential, while keeping the current account deficit to a size that can be financed on a sustainable basis. The exchange rate should not be more competitive than that, because that would produce unnecessary inflationary pressures and also limit the resources available for domestic investment, and hence curb the growth of supply-side potential.

There is another way to think about establishing which misalignment concept drives growth. A key difference between the WC and the Rodrik (2008) views on misalignment is that according to the WC view, both undervaluation and overvaluation should be bad for growth, since overvaluations imply external imbalance, and under-valuations entail internal imbalance and excessive inflation. But in contrast, Rodrik (2008) asserts that overvaluation should be bad for growth, while undervaluation promotes growth, because it can help compensate for institutional weaknesses in developing countries that otherwise imply that the traded goods sector will be too small.

5.0 Theoretical Framework and the Model

5.1 Theoretical Framework

Real exchange rate is either in equilibrium, that is, at the point of equilibrium of the current account, or in disequilibrium when it is undervalued or overvalued. Undervaluation arises when the nominal exchange rate is set below its equilibrium value at the foreign exchanges. This hypothesis supports the notion that in the process of growth, real cost reduction comes faster in the tradables than non-tradables, giving rise to increased productivity in the tradable sector relative to the non-tradable sector, (Harberger, 2003; Ito, Isard, and Symansky, 1999). With reference to China and other emerging countries of Asia, international competitiveness, that is, undervalued real exchange rate seems to have promoted economic growth via export-led growth strategy in the tradables. (Magud and Sosa, 2011). On the contrary, Berg and Miao (2010) argues that any real exchange-rate misalignment from its long-run (fundamentals' based) equilibrium will lower growth – regardless of whether it is over or under-valuation.

Harberger (2003), Maguf and Sose et al (2011) corroborate the theoretical proposition that undervaluation results in: trade and current account surplus which is at the expense of domestic standard of living (because of attendant inflation) and long-run growth and developments; real wages are lower than they need to be, while profit rates in the tradable sector are higher than normal or necessary for international competitiveness.

For a depreciation of a country's currency to improve its current account balance, however, the Marshall-Lerner condition has to hold. According to the Marshall – Lerner condition, the sum of the price elasticities of export and import demand must exceed unity. Under such condition, a depreciation of the domestic currency will improve the current account balance, while an appreciation will worsen it. Empirical estimates show that the Marshall – Lerner condition is fulfilled for most countries, but only after a sufficiently long period of time has elapsed to ensure that the export and import quantities can adjust to the change in relative prices. According to the J-curve effect, the initial response to a depreciation of the domestic currency is to deteriorate the current account balance, leading to an improvement only after an adjustment period of about one year.

The literature on export-led growth is essentially about the advantages of keeping the prices of exportables high enough to make it attractive to shift resources into their production. Using the real exchange rate to provide an incentive to shift resources into tradables provides a boost to national income insofar as there are conditions making for higher productivity in the sector. It can continue without driving down prices so long as external demand is elastic, unlike the situation with non-tradables, where demand is purely domestic and therefore relatively inelastic. It thus allows the structure of production to be disconnected from the structure of consumption. If higher incomes and faster growth support higher savings, then it will become possible to finance higher levels of investment out of domestic resources. If learning-by-doing or technology transfer is relatively rapid in sectors producing for export, then there will be additional stimulus to the overall rate of growth.

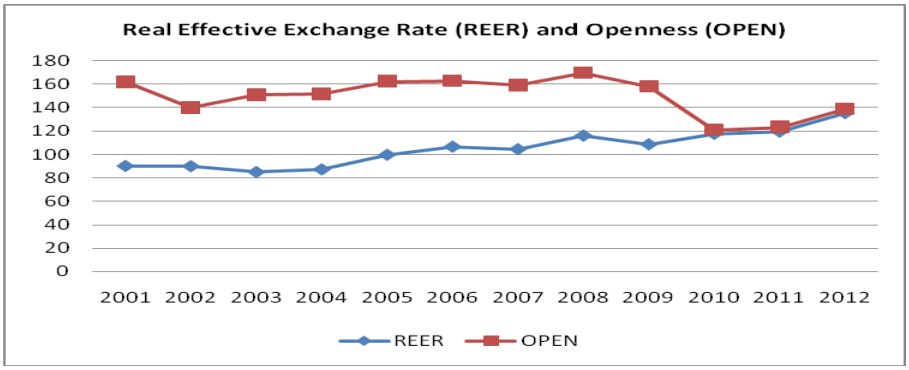


Figure 1: Real Exchange Rate (REER) and Openness (OPEN)

A high real exchange rate (depreciation) can invigorate growth in developing countries through its positive effect on exports. Fig. 1 shows the trend in REER and openness. It can be confirmed that a depreciation of the real exchange rate increases the degree of openness in the economy and stimulates exports. This tends to increase output and hence growth. Also see Fig. 2 below.

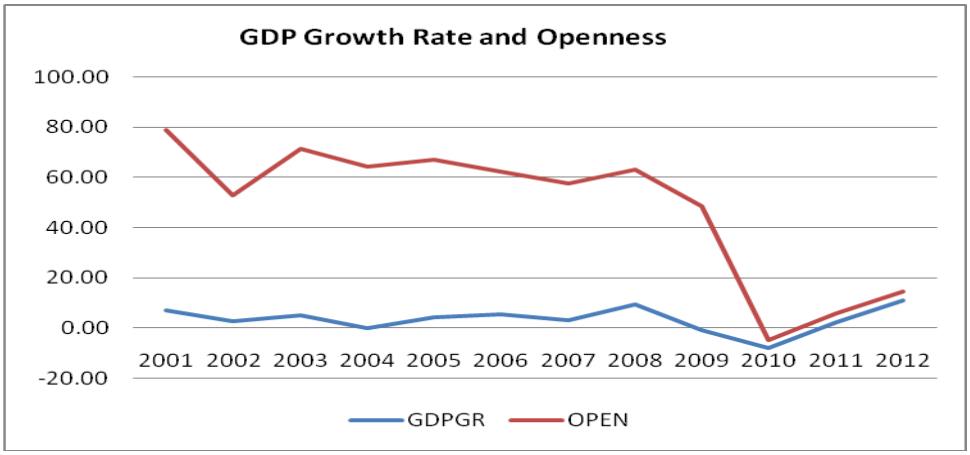


Figure 2: GDP Growth Rate and Openness

Apart from openness, other control variables such as money supply, resource balance, investment-consumption ratio, reserves-GDP ratio, terms of trade, the ratio of total government expenditure to GDP, and the level of external demand to GDP ratio will impinge on the real exchange rate movements and hence output.

In general, an expansion in money supply, all things being equal, will boost demand which will snowball into increased output, and hence growth. But if the substitution effect outweighs the income effect, the real exchange rate will appreciate, causing output to fall. This will retard growth as can be seen from the trend in money supply and GDP growth rate depicted in Fig. 3 below.

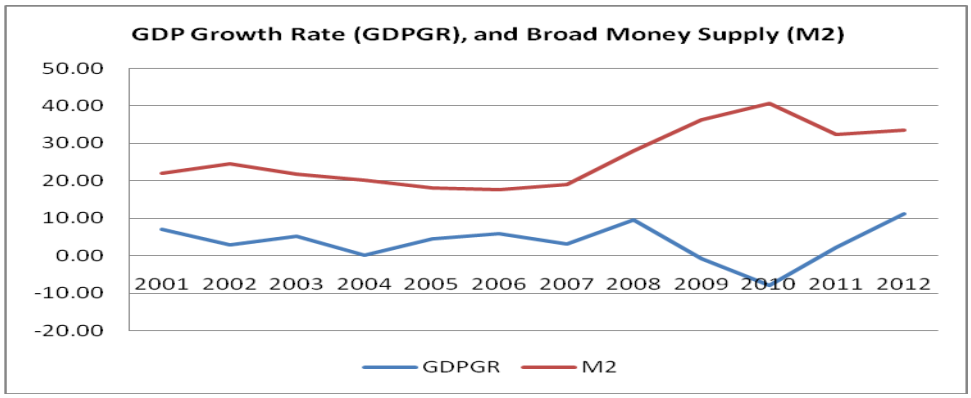


Figure 3: GDP Growth Rate and Broad Money Supply

The horizon of analysis also matters in determining the effect of real exchange rate misalignment. In the medium term, such deviations based on fundamentals, can significantly affect growth positively, but in the long run, it would affect growth negatively, (Berg and Miao, 2010). Exchange rate regimes have had some implication for economic performance. Since this study covers the pre-SAP and post-SAP periods with fixed and flexible exchange rate regimes, a dummy variable will be included in the model in order to determine the effect of the different regimes on growth.

An improvement in the terms of trade implies that the value of imports is greater than that of exports. This tends to depreciate real exchange rate. All things being equal, exports will increase because they will become cheaper, while imports will be more expensive and would shrink. The increase in exports imply an increase in output, and hence growth.

An increase in the share of investment in consumption depreciates the exchange rate, and increases output, while a fall in investment – consumption ratio would appreciate the exchange rate and reduce output. Therefore, investment-consumption ratio is positively related to economic growth.

Resource balance, a measure of the ratio of trade balance to GDP, can have an effect on domestic absorption. A rise in resource balance enhances output through improvement in domestic absorption, and therefore spurs growth.

Reserves-GDP ratio is an index of business confidence that could encourage or inhibit investment in the economy. High reserves to GDP ratio would, all things being equal, encourage inflow of investment and depreciate the exchange rate, which will increase output and hence growth. The converse will be the case with low reserves to GDP ratio.

A high ratio of government expenditure to GDP will appreciate exchange rate and all things being equal, reduce output. It is therefore expected that an inverse relationship exists between government expenditure and growth.

An increase in the level of external demand measured by the ratio of exports-GDP implies a depreciation of exchange rate. This would spur output and growth. Fig. 4 shows the trends among some of the variables. It can be seen that a linear relationship exist among the variables.

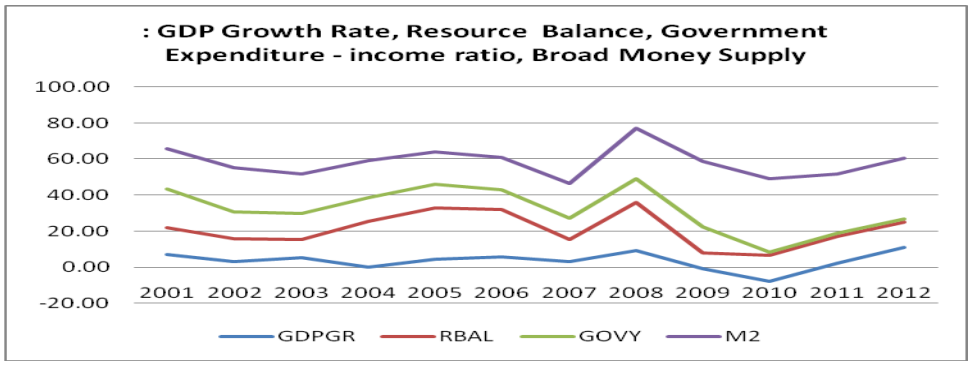


Figure 4: GDP Growth Rate, Resource Balance, Government Expenditure Income ratio, and Money Supply

Since this study includes the SAP and post-SAP periods, dummy variables will be used to determine the impact of the exchange rate regimes and trade strategy on output and hence growth.

5.1 Model Specification

Following Akpan and Etan (2012), Azeez et al. (2012), Oriavwote and Oyovwi (2012), Rodrik (2008), Eichengreen (2007), Harberger (2003), and Krueger (1998), and Razin and Collins (1997), an econometric model is specified where it is hypothesized that economic growth depends on the real exchange rate, terms of trade, openness, resource balance (trade balance/GDP ratio), investment/consumption ratio, reserves/GDP ratio, total Government expenditure/GDP ratio; level of external demand/GDP, real agricultural output, and broad money supply.

Thus, we present the following econometric equation:

GDPGR = F(RER, KAB, INVCONR, TBALYR, M2, OPEN, RESYR, GEXPYR, RQAGR, XPTYR, EXRDUMMY1, U_t)……(5.1)

Where:

RY = GDP growth rate, a proxy for economic growth
REER = real effective exchange rate
KAB = capital account balance
INVCONR = investment/consumption ratio
TBALYR = resource balance (trade balance/GDP ratio)
M2 = broad money supply
OPEN = openness
RESYR = reserves/GDP ratio

GEXPYR = total Government expenditure/GDP ratio
RQAGR = real agricultural output
XPTYR = level of external demand/GDP (exports/GDP)
EXRDUMMY1 = exchange rate regimes
U_t = stochastic error term
Taking logarithms of the variables and linearizing equation (5.1) gives the following relation:

$$LY = \alpha_0 + \alpha_1 LREER + \alpha_2 LKAB + \alpha_3 LINVCONS + \alpha_4 LTBAL + \alpha_5 LM2 + \alpha_6 LOPEN + \alpha_7 LRESY + \alpha_8 LGOVY + \alpha_9 LAGRIC + \alpha_{10} EXDDY + U_t) \quad (5.2)$$

Where:
'L' stands for natural logarithms. Since this is a double log specification, the regression coefficients are elasticities.

On a priori basis, from relation (5.2), it is expected that the coefficients of real effective exchange rate (REER), investment-consumption ratio, resource balance, broad money supply, openness, reserves to GDP ratio, level of external demand, the ratio of government expenditure to GDP, and real agriculture output will have a positive relationship with output and hence growth; while an inverse relationship is expected to exist between the coefficients of capital account balance with output.

A positive coefficient for the real effective exchange rate variable will support the hypothesis that a depreciation of the real effective exchange rate contributes to economic growth in Nigeria. An improvement in the capital account balance implies that the value of exports is greater than that of imports. This tends to appreciate real exchange rate and retards growth through reduced investment incentives in manufactures. All things being equal, following appreciation of exchange rate, imports will increase because they will become cheaper, while exports will reduce since they have become more expensive. Thus, a positive capital account balance will have a negative relationship with growth.

An increase in the share of investment depreciates the exchange rate, and increases output, while a fall in investment – consumption ratio would appreciate the exchange rate and reduce output. Therefore, investment-consumption ratio is positively related to economic growth.

An increase in resource balance, a measure of the ratio of trade balance to GDP, raises domestic absorption. This would increase output and hence growth.

Broad money supply has a positive relationship with economic growth, since an increase in money supply will increase output all things being equal.

Openness translates to trade liberalization, depreciating the exchange rate with redound to increased output. Thus, openness is positively related to economic growth.

Reserves-GDP ratio is an index of business confidence that could encourage or inhibit investment in the economy. High reserves to GDP ratio would all things being equal, encourage

inflow of investment and depreciate the exchange rate, which will increase output and hence growth. The converse will be the case with low reserves to GDP ratio.

A high ratio of government expenditure to GDP will depreciate exchange rate and all things being equal, increase output. It is therefore expected that a direct relationship exist between government expenditure and growth.

An increase in the level of external demand measured by the ratio of exports-GDP implies a depreciation of exchange rate. This would spur output and growth.

5.2 Estimation Methodology

The methodology of co-integration and error correction modelling will be employed in estimating equation (5.2) for the period 1981-2012. Since it involves time series data, and to avoid spurious regression, (Komolafe, 1996; Iyoha, 2004), unit root tests for stationarity of the variables will be undertaken using the Augmented Dickey-Fuller (ADF) unit root test, see Dickey-Fuller (1981). Next, we will test for the existence of a co-integrating relationship among the variables to determine if there is a long-run relationship among the variables**.** Thereafter, an error correction estimating model will be estimated. In addition, an autoregressive distributed lag model will be estimated. This is richer because responses to changes are not instantaneous; rather, the responses are spread over time because uncertainty about the future exists. In other words, the impact of a variable on another depends on what happens not just during the current period but also on past periods. The tests here are resorted to as additional precautionary exercise4 to avoid spurious regressions even as the variables are in ratios, under which setting spurious regressions are hardly an issue.

5.3 Sources of Data

This paper uses quarterly data covering the period 1981Q1 through 2012Q4. The data has over 120 observations for the estimation of the equations of the model, and were obtained from the Central Bank of Nigeria Statistical Bulletin, World Development Indicators published by the World Bank, and the International Monetary Fund Statistics, various issues.

6.0 Econometric Results and Analysis

Since the study uses economic time-series data, it is advisable to begin by verifying the time series properties of the variables employed. That is, it is necessary to find out if the variables are stationary or non-stationary. In particular, it is necessary to determine the order of integration of all the variables involved. This is best accomplished by carrying out unit root tests of the variables.

6.1 Unit root tests

In order to test for the stationarity of variables used in this study, unit root testing of all the macroeconomic variables was carried out using the Augmented Dickey-Fuller (ADF) methodology. The ADF unit root test is widely considered as the most reliable test of stationarity

for economic time series variables. The unit root tests were carried out using the MICROFIT 4.1 econometric software by Paseran and Paseran (1997) and the following results were obtained.

Table 1: **Summary of Unit root tests using the ADF Criterion**

Variable Decision	Order	ADF	Decision
LY	1st difference	-4.29	I(1)
LDREER	1st difference	-4.67	I(1)
LKAB	1st difference	-6.62	I(1)
LINVCONR	1st difference	-4.34	I(1)
LTBALYR	1st difference	-3.78	I(1)
LDLM2	1st difference	-7.36	I(1)
LDOPEN	1st difference	-9.75	I(1)
LDRESYR	1st difference	-10.20	I(1)
LDGEXPYR	1st difference	-7.93	I(1)
LRQAGR	1st difference	-6.42	I(1)
LDXPTYR	1st difference	-7.98	I(1)

Note: 95% critical value for the Dickey Fuller statistics = -3.45

Note that the absolute value of the ADF statistic of each and every variable in Table 1 is greater than the absolute value of the 95% critical value for the Dickey Fuller statistic (3.45). Therefore, all the macroeconomic variables, viz., GDP growth rate (LY), the real effective exchange rate (REER), capital account balance (KAB), the ratio of gross investment to total consumption (INVCONR), resource balance (TBALYR), broad money supply (M2), openness (OPEN), reserves-GDP ratio (RESYR), the ratio of total government expenditure to GDP (GEXPYR), real agricultural output (RQAGR), and level of external demand (EXPYR) are first difference stationary in logs, that is, they are I(1) variables.

6.2 Tests for Co-integration

It can be verified from Table 6.2 below that LRY is co-integrated with LREER, INVCONR, LM2, GEXPYR, and LRQAGR, using the residuals unit root test. The absolute value of the ADF statistics (-10.98) is larger than the 95 % critical value of the Dickey-Fuller test (-4.84).

Table 2: **Co-integration Test results of LY on LREER, INVCONS, LRM2, GEXPYR, and LRQAGR, using data for 1981q1 through 2012.**

Unit root tests for residuals

****

Based on OLS regression of LY on:

INPT REER INVCONS LM2 GEXPYR LRQAGR

127 observations used for estimation from 1981Q2 to 2012Q4

****

	Test Statistic	LL	AIC	SBC	HQC
DF	-8.1316	167.9542	166.9542	165.5400	166.3797
ADF(1)	-10.9772	184.0863	182.0863	179.2579	180.3739

****

95% critical value for the Dickey-Fuller statistic = -4.8425
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

****

Note that when a given set of variables is co-integrated, there exists a meaningful long-run relationship among them and the "Granger Representation Theorem" assures us that the short-run dynamics can then be aptly described by an error-correction model. The standard method of obtaining this is by using the autoregressive distributed lag (ARDL) model.

The co-integration test in table 2 confirms the existence of a long-run equilibrium relationship among the variables. However the long-run coefficients of the variables were estimated using the autoregressive distributed lag model. The results as shown in Table 3 below indicate that all the selected regressors, REER, INVCONR, LM2, GEXPYR, LRQAGR, and EXRDUMMY have a long-run equilibrium with the regresand, LY, as they are statistically significant at the I percent level of significance.

Table 3: **Estimated Long Run Coefficients using the ARDL Approach**

Estimated Long Run Coefficients using the ARDL Approach
ARDL(2,1,2,1,2,2,2) selected based on R-BAR Squared Criterion

****

Dependent variable is LY
125 observations used for estimation from 1981Q4 to 2012Q4

****

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
REER	.3695E-3	.1036E-3	3.5657[.001]
INVCONR	.0071042	.8701E-3	8.1649[.000]
LM2	.043290	.0087765	4.9325[.000]
GEXPYR	-.0033447	.0010444	-3.2026[.002]
LRQAGR	.66402	.033378	19.8940[.000]
EXRDUMMY	.19931	.049095	4.0596[.000]
INPT	3.6550	.26618	13.7316[.000]

****

Utilizing the MICROFIT 4.0 econometric software and using the autoregressive distributed lag technique as well as the maximum R-bar squared criterion; the parsimonious error-correction model is reported in Table 4 below.

6.3 Error-Correction Modeling using ARDL

Table 4: **Parsimonious Error Correction Model for economic growth equation (LRY)**

Error Correction Representation for the Selected ARDL Model
ARDL(2,1,2,1,2,2,2) selected based on R-BAR Squared Criterion

****

Dependent variable is dLY
125 observations used for estimation from 1981Q4 to 2012Q4

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
dLY1	.53405	.078505	6.8027	[.000]
dREER	-.4221E-3	.2065E-3	-2.0440	[.043]
dINVCONR	.0048674	.0029656	1.6413	[.104]
dINVCONS1	-.0038226	.0028159	-1.3575	[.177]
dLM2	.17297	.073533	2.3522	[.020]
dGEXPYR	-.0057772	.0017238	-3.3514	[.001]
dGEXPYR1	.0062251	.0018164	3.4271	[.001]
dLRQAGR	.55113	.035667	15.4520	[.000]
dLRQAGR1	-.30700	.051204	-5.9957	[.000]
dEXRDUMMY	.20432	.070529	2.8970	[.005]
dEXRDUMMY1	-.078097	.050524	-1.5457	[.125]
dINPT	4.3249	.48579	8.9028	[.000]
ecm(-1)	-1.1833	.096669	-12.2404	[.000]

****

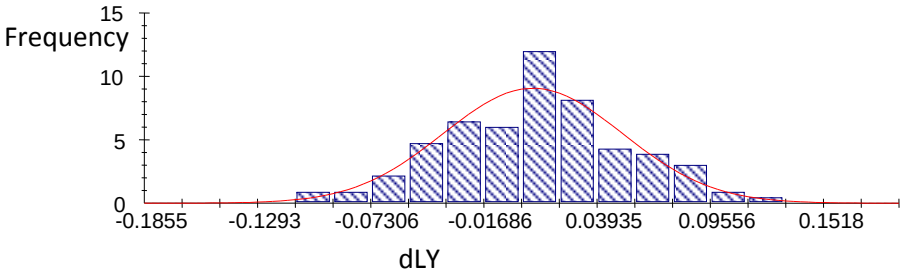
R-Squared .78173; R-Bar-Squared .74467
S.E. of Regression .047657; F-stat. F(12, 112) 31.6364[.000]
Mean of Dependent Variable .013393; S.D. of Dependent Variable .094313
Residual Sum of Squares .24075; Equation Log-likelihood 213.4031
Akaike Info. Criterion 194.4031; Schwarz Bayesian Criterion 167.5341
DW-statistic 1.6438

****

The overall fit of the parsimonious error-correction model is quite good since the R^2 has a value of 0.78. This shows that over 78% of the systematic variation in the rate of economic growth (proxied by the growth rate of real GDP) is explained by the regressors. The F-value of 31.64 is highly significant, easily passing the significance test at the 1% confidence level. This outcome shows that the hypothesis of a linear relationship between the logarithm of real GDP growth rate and the logs of the regressors cannot be rejected at the 1% confidence level. The coefficient of the error correction mechanism (ECM) is -1.18 and its t-value is -12.24. This t-statistic is highly significant, effortlessly passing the significance test at the 1% confidence level. The fact that the ECM is negative and highly significant means that the error correction mechanism will work properly to move the growth rate of real GDP towards equilibrium whenever the actual growth rate of real GDP deviates from its long-run equilibrium. The value of the coefficient portrays good dynamics since it is about unity in absolute value. Hence, the speed of adjustment is rapid.

The Durbin-Watson statistic of 1.64 indicates that there is no significant serial correlation. The observed d-statistic falls squarely in the so-called "gray" region since d_l=1.5 and d_u=1.71. All the regressors in the error correction representation (INVCONR, LM2, GEXPYR, LRQAGR, and EXRDUMMY1) are positively signed, as expected. Indeed, the coefficients of GEXPYR, RQAGR, and EXRDUMMY1 all pass the significance test at the 1% level, while the coefficient of LREER passes the significance test at the 5% level. The coefficient of INVCONR also passes the significance test but at the 10%. Among the 3 variables whose coefficients pass the significance test at the 1% confidence level, real agricultural output has the highest elasticity of approximately (0.6). This shows that a 10 percent increase in real agricultural output triggered a 6 percent growth in GDP growth during the period studied. The broad money supply has an elasticity of approximately 0.2, indicating that a 10 percent change in the money supply increased economic growth by 2 percent. The coefficient of the lagged value of the ratio of total government expenditure to GDP is .06, indicating that a 10 percent increase in government expenditure-GDP ratio will spur growth to approximately by 1 percent. The coefficient of the exchange rate regime dummy has an elasticity of approximately 0.9, implying that a 10 percent change in the exchange regime would enhance output about 1 percent. The elasticity of coefficient of the current value of the ratio of gross investment to total consumption is approximately .05. This means that a 10 percent change in the ratio of gross investment to total consumption changes output by almost 1 percent. The coefficient of real effective exchange rate has an elasticity of approximately 0.4 in absolute terms, indicating that a 10 percent depreciation of the real exchange rate boosts economic growth by 4 percent. Though the coefficient of the real effective exchange rate is significant, it is wrongly signed. This is not surprising as the short-run effect of depreciation of the real effective exchange rate dampens output and hence growth. However, the long-run effect of a depreciation of the real effective exchange rate would lead to economic growth in Nigeria. See Appendix 1 for more results on the autoregressive distributed lag estimates. The robustness of the results is also confirmed in Fig. 5 below which shows that the residuals are normally distributed.

Figure 5: **Histogram of Residuals and the Normal Density**



7.0 Summary and Policy Recommendations

In this study, an attempt has been made to investigate the nexus between economic growth and the real effective exchange rate in Nigeria by use of co-integration and error correction modeling. It was found that there is a long-run equilibrium relationship between economic growth, the real effective exchange rate, and some key macroeconomic variables like investment-consumption ratio, broad money stock, the ratio of government expenditure to income, real agricultural output, and exchange change regime. Real effective exchange rate and the other macroeconomic variables were found to be positively related to economic growth. Hence, real agricultural output, investment-consumption ratio, broad money stock, the ratio of government expenditure to income, and the exchange change regime are all drivers of economic growth in Nigeria. For the rapid and sustainable development of the economy, there is the need to implement robust policies which would contribute to macroeconomic stability, and facilitate the promotion of sound economic fundamentals that would lead to the maintenance of an equilibrium real effective exchange rate. In this regard, it is recommended that the monetary authorities continue with a managed floating exchange rate regime.

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APPENDIX 1: Autoregressive Distributed Lag Estimates

ARDL(2,1,2,1,2,2,2) selected based on R-BAR Squared Criterion

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Dependent variable is LY

125 observations used for estimation from 1981Q4 to 2012Q4

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Regressor	Coefficient	Standard Error	T-Ratio [Prob]
LY(-1)	.35077	.078582	4.4638 [.000]
LY(-2)	-.53405	.078505	-6.8027 [.000]
REER	-.4221E-3	.2065E-3	-2.0440 [.043]
REER(-1)	.8593E-3	.2725E-3	3.1539 [.002]
INVCONR	.0048674	.0029656	1.6413 [.104]
INVCONR(-1)	-.2838E-3	.0041494	-.068383 [.946]
INVCONR(-2)	.0038226	.0028159	1.3575 [.178]
LM2	.17297	.073533	2.3522 [.021]
LM2(-1)	-.12174	.073502	-1.6563[.101]
GEXPYR	-.0057772	.0017238	-3.3514[.001]
GEXPYR(-1)	.0080445	.0023893	3.3669[.001]
GEXPYR(-2)	-.0062251	.0018164	-3.4271[.001]
LRQAGR	.55113	.035667	15.4520[.000]
LRQAGR(-1)	-.072417	.047325	-1.5302[.129]
LRQAGR(-2)	.30700	.051204	5.9957[.000]
EXRDUMMY	.20432	.070529	2.8970[.005]
EXRDUMMY(-1)	-.046583	.068816	-.67692[.500]
EXRDUMMY(-2)	.078097	.050524	1.5457[.125]
INPT	4.3249	.48579	8.9028[.000]

****

R-Squared	.99180;	R-Bar-Squared	.99040
S.E. of Regression	.047657	F-stat. F(18, 106)	711.9973[.000]
Mean of Dependent Variable	11.3755;	S.D. of Dependent Variable	.48650
Residual Sum of Squares	.24075;	Equation Log-likelihood	213.4031
Akaike Info. Criterion	194.4031;	Schwarz Bayesian Criterion	167.5341
DW-statistic	1.6438		

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Diagnostic Tests

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Test Statistics	LM Version	F Version
A: Serial Correlation	CHSQ(4)= 31.5380[.000]	F(4, 102)= 8.6048[.000]
B: Functional Form	CHSQ(1)= 21.3077[.000]	F(1, 105)= 21.5765[.000]
C: Normality	CHSQ(2)= .010632[.995]	Not applicable
D: Heteroscedasticity	CHSQ(1)= .33542[.562]	F(1, 123)= .33094[.566]

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A: Lagrange multiplier test of residual serial correlation
B: Ramsey's RESET test using the square of the fitted values
C: Based on a test of skewness and kurtosis of residuals
D: Based on the regression of squared residuals on squared fitted values

IS ECOWAS RIPE FOR THE ADOPTION OF COMMON CURRENCY? CHECKING BY SYMMETRY AND SPEEDS OF ADJUSTMENT TO MACROECONOMIC SHOCKS

By: **Chuku A. Chuku**[1]

Abstract

This paper investigates the rationality of proceeding with a common currency in West Africa by testing for symmetry and speeds of adjustment to four underlying structural shocks among a pair of 66 ECOWAS economies. The findings reveal that there is relatively low degree of asymmetry in the responses of the economies to external disturbances, while about 85 percent of the correlations in supply, demand and monetary shocks among the countries indicate high asymmetry. The size of the shocks and speeds of adjustment among countries are also dissimilar, suggesting that ECOWAS should not yet proceed with the eco, since the costs will outweigh the benefits.

Keywords: Monetary union, Structural VAR, Optimal currency area, ECOWAS, West Africa

JEL Classification: F36; F42; E52

1. Introduction

Inspired by the relative success of the euro as a common currency of the European Monetary Union, The Economic Community of West African States (ECOWAS) proposed to launch a common currency for 'the community' called the eco with the postponed inception date being 2020 (ECOWAS, 2013). ECOWAS is a regional group of 15 West African countries[1] which already includes a monetary union of the former French colonies known as the West African Economic and Monetary Union (WAEMU)[2]. In April 2000, ECOWAS adopted a strategy of a two-track approach to the adoption of a common currency in the whole area. As a first track, the non-WAEMU members of ECOWAS were to form a second monetary union known as the West African Monetary Zone (WAMZ)[3] by July 2005, with the second track being the subsequent merging of WAEMU and WAMZ to form a single currency union in the region with a common currency- the eco.). The first phase of forming a WAMZ zone has been achieved and the focus is now on achieving the second.

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The feasibility of a wider monetary unification in ECOWAS poses several economic and institutional peculiarities as discussed in detail by Tsangarides and Qureshi (2008) and Masson and Pattillo (2005). First, it is unlikely that the French Treasury's guarantee of convertibility of WAEMU's currency (the CFA franc) to the euro at a fixed parity would continue for a monetary union of the expected size. Second, with politically dependent central banks, there is an incentive for monetary policy to be used to extract seigniorage which creates distortions and disincentives for countries to join the union since they are likely to lose the seigniorage privilege. Other issues include the membership of the relatively gigantic Nigerian economy and the implications of its fiscal activities, and more recently, the implications of the evolving global financial crises. Also, given the recent debt and financial crisis facing members of the European Monetary Union (EMU), a thorough appraisal of the feasibility of the proposed eco is desirable to ascertain the realizability and sustainability of the proposed union.

The standard framework used by economist to examine the desirability of a monetary union is the Optimal Currency Area (OCA) theory, pioneered by Mundell (1961) and McKinnon (1963) and elaborated by Krugman (1990) (see De Grauwe (2005) and Frank and Rose (1996) for an exposition). The theory places emphasis on four key criteria that would impinge on the benefits of adopting a common currency. They are: 1) the degree of openness and intra-regional trade, 2) the degree of labour and factor mobility, 3) the symmetry of shocks across countries and 4) the system of risk sharing. Depending on the extent to which these conditions are met, individual countries may enjoy benefits or suffer losses by joining a currency union. Some of the benefits accruable include: lower transaction costs, price stabilization, improved efficiency of resource allocation, enhanced trade and increased access to factor, labour and financial markets, among others. Costs include loss of seigniorage privilege and the sovereignty to maintain national monetary and exchange rate polices (Tsangarides and Qureshi, 2008; Karras, 2006; De Grauwe, 2005).Technically, the costs and benefits that may accrue to members of a monetary union can be measured by the symmetry (positive correlation) or asymmetry (negative correlation) of responses to exogenous disturbances affecting the members and the speed with which the economies adjust back to equilibrium after a shock. Costs tend to be lower if the disturbances are symmetric and markets are flexible i.e., factor, labour and financial markets are quick to adjust back to equilibrium, and higher conversely.

A few recent studies have investigated the costs and benefits of adopting a common currency in sub-Saharan Africa and specifically in West Africa. Most of them use a vector auto regressive (VAR) model to estimate the asymmetry of shocks accruing to different sub-regions in Africa. In different works, Bayoumi and Ostry (1997), Fielding and Shields (2001, 2003) and Hoffmaister et al. (1988) find a low degree of correlation between inflation shocks across countries and that terms of trade shocks have greater influences on macroeconomic fluctuations in CFA countries than in other sub-Saharan African countries. Focusing on the Southern African Development Community (SADC), Huizinga and Khamfula (2004) find a low degree of symmetry in real exchange rate shocks across countries. For East Africa, Buigut and Valev (2005) test the symmetry of underlying structural shocks in the region and find that supply and demand shocks are generally asymmetric, although their results show that the speed and magnitude of

adjustments to shocks is similar across the countries, they advocate further integration of the economies for an eventual monetary union in the future.

Coming back to the ECOWAS region, Addison et al. (2005) apply a VAR model to WAMZ countries and find very low cross country correlations of terms of trade shocks and real exchange rate shocks. Debrun et al. (2005) use a conjectured model about the fiscal-monetary policy mix in the region to assess the potential for monetary integration in ECOWAS. Their findings provide evidence of fiscal heterogeneity and abrogate Nigeria's membership of the union as non-beneficial unless it was accompanied by effective containment of Nigeria's financing needs. Benassy-Quere and Coupet (2005) use crisp cluster analysis to examine different monetary arrangements in sub-Saharan Africa. Their results again suggest that Nigeria should not form part of WAMZ, while the creation of the enlarged WAEMU and WAMZ zone in ECOWAS appear to be more economically viable without Nigeria. Tsangarides and Qureshi (2008) update the work of Benassy-Quere and Coupet (2005) by applying hard and soft clustering algorithms to examine the suitability of the proposed monetary union in West Africa. Their results reveal considerable dissimilarities in the economic characteristics of West African countries. Again, among the WAMZ countries, they particularly report a lack of homogeneity, with Nigeria and Ghana appearing as independent singletons. Lastly, Houssa (2008) use a dynamic factor model to examine the economic costs of a monetary arrangement in West Africa. His findings show negative and low positive correlations among supply disturbances across the countries, with greater similarity in the demand shocks among WAEMU countries. Other papers that have examined the feasibility of a monetary union in West Africa include Masson and Patillo (2001), Ogunkola (2005) and Yehoue (2005).

Given the studies conducted so far, this paper applies an extended method with updated information based on a multivariate structural VAR model to assess the feasibility and desirability of proceeding with a common currency union in ECOWAS. The objective of the study is to investigate the symmetry of shocks and speed of adjustment among countries to external shocks, domestic supply shocks, demand shocks and monetary shocks. This study brings a different contribution to the literature in many ways. First, rather than using the conventional two variable modelling approach consisting of only supply and demand shocks, the study used a four-variable structural autoregression model to capture the correlation of external shocks including the global financial crises and the correlation of domestic monetary shocks among the countries, which has hitherto been neglected in previous research. In addition, the paper also examines the extent to which the individual economies satisfy the other three criteria of forming an OCA i.e.: intra-regional trade and openness, labour and factor mobility and fiscal/ geo-political conditions.

The rest of the paper is presented as follows. Section 2 examines the economic profile of all the ECOWAS economies, with a view to identifying patterns and dissimilarities. Section 3 assesses the extent to which ECOWAS economies satisfy the conditions for an optimal currency area. Section 4 contains the methodology while Section 5 presents the results and Section 6 contains the conclusion.

2. Economic Profile of West African Economies

A similar profile of economic development is crucial in facilitating integration among potential members of a currency union. Similarities in economic structure, social structures and external relations make policy synchronization easier. Table 1 presents the economic profile of ECOWAS economies as at 2010. The table indicates that the range of economic growth among the countries is wide. With Benin growing at the slowest rate of 3 percent per annum and Burkina Faso growing at the fastest rate of 9.2 percent per annum, there is likely to be some dragging-effect within such a monetary union, with the slow growing economies dragging the fast growing ones down and vice-versa. However, the production structure for most of the economies seems to be similar, with an influential agricultural sector contributing an average of 33.4 percent to GDP and a weak manufacturing sector contributing an average of 8.1 percent of GDP.

The profile of each country's external balances is highly variegated with Sierra Leone having the highest current account deficit at 16.8 percent of GDP and an external debt stock of 133 percent of GNI. Burkina Faso has the highest external debt stock at 542 percent of GDP while Nigeria records the lowest at 12.5 percent of GDP. With an average external debt stock of 140 percent of GNI, most West African economies have a critical and unsustainable debt profile. Tax revenue as a percentage of GDP in the region seem to be similar in most of the countries with an average of 13 percent. Nigeria, however, is an exception as tax revenue is less than one percent of GDP. This may reflect the predominant oil-revenue base of the economy.

The structure and pattern of trade in the ECOWAS economies are generally similar. For most of the economies, the trade to GDP ratio appears to be significant, averaging 64.6 percent. Social indicators such as life expectancy (which is an indicator of health quality) and poverty headcount among the economies are highly consistent with the region's stage of development. However, the malnutrition and literacy rates in these economies are variegated. For example, literacy rate (which can be used as a crude estimator of the quality of the labour force) is as low as 15.1 percent of the population in Niger, while it is as high as 60.4 percent of the population in Ghana.

Table 1 Economic profile of ECOWAS countries (2010)

	BEN	BFA	CIV	GMB	GHA	GIN	GNB	MLI	NER	NGA	SEN	SLE	TGO	Avg
Economic structure														
GDP growth (annual %)	3	9.2	3	5	6.2	1.9	3.5	4.5	8.8	7.9	4.2	4.9	3.4	4.9
GDP per capita (constant 2000 US$)	1424	1127	1703.6	1265	1469	978.4	1064	955	653	2136	1732	742	895	1242
Inflation, consumer prices (annual %)	2.3	-0.8	1.7	5	10.7	15.5	2.5	1.1	0.8	13.7	1.3	16.6	1.8	5.6
Agriculture, value added (% of GDP)	32.2	33.3	22.9	26.9	30.2	13	57.3	36.5	39.6	32.7	16.7	49	43.5	33.4
Manufacturing, value added (% of GDP)	7.5	13.6	19.2	5	6.5	4.8	10.6	3.1	6.3	2.6	12.8	3.7	10.1	8.1
Industry, value added (% of GDP)	13.4	22.4	27.4	15.7	18.6	47.4	13.1	24.2	17.1	40.7	22.1	20.7	23.9	23.6
Services, etc., value added (% of GDP)	54.4	44.4	49.7	57.3	51.1	39.6	29.6	39.1	43.2	26.6	61.1	30.4	32.6	43
Real effective exchange rate index (2005 = 100)	n.a	n.a	99.7	101.1	97.8	n.a	n.a	n.a	n.a	118.1	n.a	99.8	98.2	102
Internal and External Balances														
Current account balance (% of GDP)	-8	-21	7.2	6.5	-7.2	-7.2	-3.3	-7.3	-12.1	1.3	-14.2	-16.8	-5.5	-2.7
External debt stocks (% of GNI)	55.3	542	100	158.1	72.3	212	n.a	80.1	99.1	12.5	84.7	133	135	140
Net ODA received (% of GNI)	10.3	13.5	10.7	18.5	6.1	5.8	17.8	11.5	9	1	8	24.3	17.7	11.9
Broad money (% of GDP)	37.5	26.3	34	56.2	27.1	16.4	25.8	26.5	19.1	36.7	37.5	25.8	42.7	31.7
Tax revenue (% of GDP)	16.1	12.9	16.6	18.2	12.5	11.1	n.a	14.7	11.3	0.3	16.1	11	15.4	13
Gross national expenditure (% of GDP)	114	115	95.4	119.4	113	104.4	121.4	109.4	109	n.a	119.5	112	117	113
Trade (% of GDP)	41.9	38.3	77.2	78	63.7	74.4	81	61.8	39.3	66	68.6	46.6	103	64.6

Social Indicators														
Life expectancy at birth, total (years)	53.4	53.5	53.1	56.7	62.5	51.6	45.9	49.5	53.4	50.2	57.6	46.4	54.8	53
Poverty headcount ratio at $2 a day (PPP) (% of pop.)	75.3	81.2	46.8	56.7	56.3	87.2	77.9	77.1	75.9	83.9	71.3	76.1	69.3	71.9
Malnutrition prevalence (% of children under 5)	20.2	37.4	16.7	15.8	13.9	22.5	17.4	27.9	39.9	26.7	14.5	28.3	22.3	23.3
Literacy rate, adult total (% of people ages 15 and above)	29	21.6	45.3	35.8	60.4	28.1	38	18.2	15.1	49.8	38.7	30.1	44.4	35

Source: World Development Indicators, World Bank 2011

Note: When figures for 2010 are not available, the most recent available figures are used.

Keys: N.A- not available, BEN-Benin, BFA- Burkina Faso, CIV- Cote d' Ivories, GMB- The Gambia, GHA-Ghana, GIN-Guinea, GNB-Guinea Bissau, MLI- Mali, NER-Niger, NGA-Nigeria, SEN- Senegal, SLE- Sierra Leon TGO- Togo.

3. Do ECOWAS Economies have the Necessary Conditions to form an Optimal Currency Area?

(a) Criterion 1: trade and openness

The literature on optimal currency area emphasizes trade as the main channel through which benefits from a common currency will be enjoyed. The more countries trade with each other, especially in a particular region, the more they will value regional exchange rate stability. In other words, the larger the volume of intra-regional trade, the greater the incentives for countries in a region to form a currency union. In this regard, currency unions are expected to be welfare enhancing because they reduce the potential disruptions to intra-regional trade brought about by relative price fluctuations and disharmonies in bi-lateral exchange rates. Moreover, Frankel and Rose (2000) provide empirical evidence to show that trade has positive impacts on growth and a common currency encourages trade in turn.

Table 2 depicts the trade concentration and diversification indices of ECOWAS economies in 2009 and 2010. The pattern of concentration and diversification among the countries are variegated. Togo had the lowest trade concentration index in 2009 and maintained the status in 2010. While Guinea-Bissau had the highest concentration index at 0.89 followed by Guinea at 0.61, indicating that in 2009, these economies had high product and trade direction concentration. The diversification index for most of the economies in 2010 is relatively high, with Togo having the least at 69 percent and Mali with the highest at 87 percent. Following the diversification criterion, one can conclude that the ECOWAS region would likely benefit from adopting a common currency.

Table 2: **Trade concentration and diversification indices for ECOWAS economies 2009-2010**

	2009			2010		
Economy	Absolute Value	Concentration Index	Diversification Index	Absolute Value	Concentration Index	Diversification Index
Benin	140	0.35	0.75	138	0.37	0.75
Burkina Faso	93	0.52	0.81	118	0.50	0.82
Côte d'Ivoire	166	0.36	0.71	180	0.35	0.70
Gambia	18	0.35	0.72	23	0.32	0.69
Ghana	222	0.46	0.83	228	0.46	0.82
Guinea	92	0.61	0.80	92	0.44	0.81
Guinea-Bissau	12	0.89	0.75	12	0.89	0.75
Mali	167	0.57	0.83	137	0.63	0.87
Niger	84	0.43	0.86	100	0.38	0.80
Nigeria	250	0.83	0.84	185	0.77	0.80
Senegal	195	0.24	0.72	190	0.27	0.75
Sierra Leone	217	0.24	0.64	220	0.27	0.71
Togo	167	0.20	0.69	165	0.21	0.69

Source: UNCTAD, UNCTADstat

(b) Criterion 2: labour and factor mobility

Mundell (1961) argues that an optimal currency area is a group of countries in which labour and factor mobility is relatively high. If, for example, a member of an OCA is hit by negative asymmetric demand shocks, then labour and other factors of production will move from this country to other member countries, thereby restoring employment to its original level. With high labour and factor mobility, there will be movements in the region so as to equalize wages and factor prices from areas with excess supply to areas with deficit supplies.

Labour mobility varies across ECOWAS economies; however, there is unfortunately scant official data on labour mobility among West African economies. While labour mobility is relatively high between Nigeria and Benin[iv], there is very little mobility between most of the other economies. Ghana is relatively immobile because of some legal immigration and social security hurdles which are more relaxed in other economies.

Table 3: **Total labour force and agric labour force in ECOWAS economies 2005-2010 (thousands)**

YEAR		2005	2006	2007	2008	2009	2010
ECONOMY	SECTOR						
Benin	All sectors	3212	3334	3456	3580	3698	3825
	Agric	1556	1582	1607	1631	1653	1674
Burkina Faso	All sectors	6275	6488	6699	6908	7137	7366
	Agric	5677	5892	6120	6351	6589	6835
Côte d'Ivoire	All sectors	7522	7709	7911	8126	8367	8606
	Agric	3053	3052	3057	3062	3068	3074
Gambia	All sectors	681	701	722	743	765	788
	Agric	535	550	565	581	596	612
Ghana	All sectors	9851	10114	10379	10647	10944	11232
	Agric	5411	5516	5664	5790	5922	6058
Guinea	All sectors	4397	4500	4610	4720	4850	4988
	Agric	3606	3668	3731	3801	3879	3964
Guinea-Bissau	All sectors	605	617	631	645	660	676
	Agric	449	457	462	470	478	486
Mali	All sectors	3388	3480	3578	3672	3767	3869
	Agric	2420	2464	2511	2551	2592	2635
Niger	All sectors	4198	4326	4463	4592	4803	4973
	Agric	3639	3764	3895	4036	4183	4336
Nigeria	All sectors	44906	46110	47330	48613	49998	51349
	Agric	12376	12341	12312	12285	12257	12230
Senegal	All sectors	4769	4923	5078	5242	5408	5580
	Agric	3454	3541	3642	3742	3845	3952
Sierra Leone	All sectors	1952	2007	2055	2102	2141	2188
	Agric	1215	1241	1261	1281	1300	1320
Togo	All sectors	2594	2680	2772	2866	2962	3059
	Agric	1329	1352	1375	1399	1424	1449

Source: UNCTAD, UNCTADstat

Table 3 depicts the structure of the labour force in ECOWAS economies, showing clearly the thousand number of labour employed in all sectors and those employed in the agricultural sector between 2005 and 2010. An examination of the structure indicates that agriculture is the dominant employer of labour in all the economies accounting for between 53 and 95 percent of the employed labour in these economies. As a result of the high concentration of labour in the agricultural sector (which is a primary sector that does not necessarily require skilled labour),

one may not expect perfect labour and factor mobility in the near future because primary sectors are not skilled-labour intensive and they are not usually affected by domestic demand shocks; rather they are affected by exogenous and mostly climatic shocks which are likely to cut across the region. Nevertheless, the parties to the conference (i.e. ECOWAS governments) would need to install institutional frameworks that will remove hurdles to labour mobility, something similar to what is obtainable in the Euro zone.

(c) Criterion 3: fiscal transfers and geo-political factors

At present, no official fiscal transfer mechanisms exists in the region except for some form of official and military aid provided by Nigeria to some other countries in the region. This issue has to be addressed before the actual take-off of the common currency regime. While the economic criteria discussed above are essential for determining the suitability of a common currency regime in West Africa, the geo-political factors play an equally important role in this process. Two developments in the international environment make the prospects of a successful monetary union more challenging and at the same time propitious. First is the global financial crisis which has weakened the growth in the world economy, thereby adversely affecting the export performance of the region. Second, with the proliferation of regional economic blocs and growing protectionism in the developed and developing regions, West African countries may find it difficult to gain access to these markets. Given these trends, it will be beneficial for West African economies to focus on intra-regional trade. Again, this may not be adequate because of the primary product based nature of most of the economies in the region.

4. Methodology

(a) The model

As already mentioned, to ascertain the appropriateness of proceeding with a common currency in West Africa, The paper examines the symmetry and/or asymmetry of responses to macroeconomic shocks among countries in the region with a view to ascertaining whether the ECOWAS region meets the criteria for an optimal currency area (OCA). Blanchard and Quah (1989) provide the empirical foundation for this examination, and their model has consistently been refined in subsequent studies. For example, see Bayoumi (1992), Bayoumi and Eichengreen (1994), Saxena (2005), Buigut and Valev (2005), Huang and Guo (2006), Houssa (2008). The Blanchard-Quah model is premised on the AD-AS framework in which demand shocks have no effects on output in the long-run, while supply shocks can influence output and the price level both in the short and long run. The decision whether to adopt a common currency or not is determined by the symmetry or asymmetry of the correlation of shocks affecting the participating economies.

Following Mundell's (1961) arguments, countries facing positively correlated economic shocks will be better suited for a currency union because this will allow the use of union-wide policies to correct distortions. However, if the underlying shocks are highly idiosyncratic, it would not be ideal to proceed with a common currency since the costs are likely to be very large and policy synchronization will be ineffective.

Rather than the conventional two-shock (demand and supply) model which has been applied to study the appropriateness of a currency union in Africa(see Alagidede et al., 2011: Houssa, 2008; Buigut and Valev, 2005; Kose and Reizman, 2001; Huizinga and Khamfula, 2004), This study considers a four-shock model for ECOWAS analogous to the one used by Huang and Guo (2006) to study the appropriateness of a common currency in East Asia. The shocks consist of an external (global) shock, and three domestic shocks including; domestic demand shock, domestic supply shock and a monetary shock. The rationale for incorporating an external global shock into the model is to account for the primary export-oriented structure of West African economies. Including a monetary shock is important to permit estimating how ECOWAS economies respond to changes in their real effective exchange rate. Such an assessment is useful for the contemplation of the choice of an optimal exchange rate policy for the proposed eco.

The framework is as follows. Consider a structural moving average of a vector of variables X_t, and an equal number of shocks ε_t, so that

$$X_t = A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + \cdots = \sum_{i=0}^{\infty} A_i\varepsilon_{t-i} \qquad (1)$$

In matrix form, the model can be written as

$$X_t = \boldsymbol{A}(\dot{L})\varepsilon_t \qquad (2)$$

Where $X_t = [\Delta y_t^*,\ \Delta y_t,\ \Delta e_t,\ \Delta p_t]'$, comprising world real GDP denoted by y_t^*, domestic real GDP denoted by y_t, real exchange rate denoted by e_t and domestic price level denoted by p_t all in log difference forms. $\boldsymbol{A}$ is a 4 * 4 matrix that defines the impulse responses of endogenous variables to structural shocks $\varepsilon_t = [\varepsilon_t^{s*}, \varepsilon_t^s, \varepsilon_t^d, \varepsilon_t^m]'$ consisting of external world supply shock (ε_t^{s*}), domestic supply shock (ε_t^s), domestic demand shock (ε_t^d), and monetary shock (ε_t^m) respectively. It is assumed that they are serially uncorrelated and orthogonal, with a variance-covariance matrix normalized to the identity matrix.

(b) The Structural decomposition

By specifying four kinds of shocks: world real GDP, domestic real GDP, real exchange rate and inflation, decomposition of the series is done as follows:

$$\Delta y_t^* = A_{11}(L)\varepsilon_t^{s*} \qquad (3)$$

$$\Delta y_t = A_{21}(L)\varepsilon_t^{s*} + A_{22}(L)\varepsilon_t^s + A_{23}(L)\varepsilon_t^d + A_{24}(L)\varepsilon_t^m \qquad (4)$$

$$\Delta e_t = A_{31}(L)\varepsilon_t^{s*} + A_{32}(L)\varepsilon_t^s + A_{33}(L)\varepsilon_t^d + A_{34}(L)\varepsilon_t^m \qquad (5)$$

$$\Delta p_t = A_{41}(L)\varepsilon_t^{s*} + A_{42}(L)\varepsilon_t^s + A_{43}(L)\varepsilon_t^d + A_{44}(L)\varepsilon_t^m \qquad (6)$$

The decomposition presented in Equations (3) to (6) is simple and intuitive. They imply that world GDP is exogenous to country-specific domestic shocks, while all domestic variables are

affected by shocks to global output. To further refine the decomposition, we rely on underlying economic theory to make assumptions about the effects of domestic shocks on each of the other domestic variables.

(i) Global real GDP is posited to be strictly exogenous. This assumption is plausible because all the ECOWAS economies are relatively small and open economies, having no significant contribution to global output. This will probably not have been appropriate if a country like China were to be a participating member.

(ii) Domestic real GDP is affected only by shocks in global real GDP and shocks from itself in the long-run. However, it is not affected by monetary shocks ε_t^m nor demand shocks ε_t^d. This restriction is in line with Balnchard's natural rate hypothesis and it implies that $\sum_{i=0}^{\infty} A_{21i} \neq 0, \sum_{i=0}^{\infty} A_{22i} \neq 0, \sum_{i=0}^{\infty} A_{23i} = 0$ and $\sum_{i=0}^{\infty} A_{24i} = 0$.

(iii) The real effective exchange rate is assumed to be affected by shocks from the global economy, domestic supply shocks and domestic demand shocks, but it is not affected in the long-run by a monetary shock. This restriction implies that $\sum_{i=0}^{\infty} A_{34i} = 0$.

(iv) The domestic price level is assumed to be strictly endogenous, implying that the prices are affected by shocks in global GDP, domestic supply, demand shocks and monetary shocks too.

The entire model can be rewritten as a system of structural equations thus

$$\begin{bmatrix} \Delta y_t^* \\ \Delta y_t \\ \Delta e_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} A_{11}(L) & 0 & 0 & 0 \\ A_{21}(L) & A_{22}(L) & 0 & 0 \\ A_{31}(L) & A_{32}(L) & A_{33}(L) & 0 \\ A_{41}(L) & A_{42}(L) & A_{43}(L) & A_{44}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_t^{s*} \\ \varepsilon_t^{s} \\ \varepsilon_t^{d} \\ \varepsilon_t^{m} \end{bmatrix} \quad (7)$$

Following Amisano and Giannini (1997) and Huang and Guo (2005) estimates from the structural moving average model in Eq. (1) are not directly recovered, rather they are obtained by estimating a reduced form VAR model for the observed variables. In the structural VAR model, the external variable follows an autoregressive process, while the three domestic variables are modelled as functions of their own lags and lags of the external variable. Thus:

$$\Delta y_t^* = \tau + \sum_{i=1}^{n} \Gamma_i \Delta y_{t-i}^* + \mu_t^1 \quad (8)$$

and

$$X_t = \tau + \sum_{i=1}^{n} \Gamma_i X_{t-i} + \sum_{i=1}^{n} \Omega_i \Delta y_{t-i}^* + \mu_t \quad (9)$$

Where $X_t = [\Delta y_t,\ \Delta e_t,\ \Delta p_t]'$, Γ_i and Ω_i are coefficient matrixes, while μ_t^1 and $\mu_t = [\mu_t^2, \mu_t^3, \mu_t^4]$ are a mixture of structural innovations of reduced or observed residuals. Given that the first difference transformation will make the variables stationary, in order to obtain the relationships between reduced form innovations for the domestic variables and the corresponding structural stocks, we can write Eq. (9) as a MA representation of the form:

$$X_t = \theta + \sum_{i=1}^{n} G_i \mu_{t-i} \qquad (10)$$

Where

$$\theta = (I - \sum_{i=1}^{n} \Gamma_i)^{-1} (\tau + \sum_{i=1}^{n} \Omega_i \Delta y_{t-i}^{*}) \qquad (11)$$

The G_i is called impulse response and procured from:

$$\sum_{j=0}^{\infty} G^j L^j = (I - \sum_{i=1}^{n} \Gamma_i L^i)^{-1} \qquad (12)$$

Recovering structural shocks involves a special decomposition of reduced-form innovations, which is achieved by OLS estimation of Eq. (9). Since $G_0 \mu_t = A_0 \varepsilon_t$ and $G_0 = I$ (an identity matrix), it follows that $\mu_t = A_0 \varepsilon_t$. This represents a system of 16 equations. In accordance with the assumption that the structural shocks $\varepsilon_t = [\varepsilon_t^{s*}, \varepsilon_t^{s}, \varepsilon_t^{d}, \varepsilon_t^{m}]'$ are serially uncorrelated and orthogonal, we can get: $\Phi = E[\mu_1 \mu_t'] = A_0 A_0'$. These restrictions together with the other six restrictions imposed from economic theory imply that $A(L)$ is the unique Choleski lower triangle. Thus, it is sufficient to identify the structural A_i matrix and the time series of structural shocks $\varepsilon_t = [\varepsilon_t^{s*}, \varepsilon_t^{s}, \varepsilon_t^{d}, \varepsilon_t^{m}]'$ by using $\varepsilon_t = A_0^{-1} \mu_t$. In other words, structural shocks can be recovered as linear combinations of reduced-form innovations. By computing the correlation of the shocks in West African economies, we can evaluate the feasibility of a common currency union in West Africa. Positive and significant (above 50%) correlation coefficients signals that countries will require a synchronous policy response which is crucial for a centralized monetary policy management in the region.

(c) The data

The paper utilizes annual data for 12 ECOWAS economies[v], namely Benin (BEN), Burkina Faso (BFA), Cote d'Ivoire (CIV), Gambia (GMB), Ghana (GHA), Guinea-Bissau (GNB), Mali (MLI), Niger (NER), Nigeria (NGA), Senegal (SEN), Sierra Leone (SLE) and Togo (TGO). Liberia, Cape Verde and Guinea are excluded from the analysis. This is because Liberia initially declined to participate in the project although they have now included after expressing affirmative interest in 2010, Cape Verde has a currency that is directly linked to the Euro and for Guinea we did not obtain sufficient data series for the analysis. The sample covers the period between 1970 and 2010. This time frame gives us the benefit of also accounting for the effects of the 2007/08

global financial shocks (which is an example of an external global shock) on the domestic economies.

The data are extracted from two major sources: the International Financial Statistics IFS CD-ROM published by the IMF and World Development Indicators CD-ROM published by the World Bank. Domestic output is proxied by country GDP at 2000 constant US$. The real exchange rate series are obtained from IMF's IFS and it is computed based on unit labour cost for a basket of 26 advanced countries[vi] and the Euro area as a group. All the variables are logarithimized

5. The Results

(a) Preliminaries

Before implementing the multivariate structural VAR model, it is necessary to first scan the variables for integration properties. The ADF-GLS test is employed for unit root in which the datasets are detrended so that explanatory variables are taken out of the data prior to running the test regression. This test has the advantage of increased power gains associated with the detrending (Ng and Perron, 2001). The results of the unit root test for the natural logarithm of global GDP, domestic GDP, real effective exchange rate and price level indicate that these variables for each of the countries contain unit roots at levels. However, after taking the first differences of these variables, they all became stationary although this occurred at various levels of statistical significance. Following the results, it may be concluded that all the time series used in the model are integrated of order one, i.e. they are I(1) stationary.

In other to ensure that the estimates from the structural VAR are consistent, it is necessary to utilize the optimal lag length in the estimation. Lag order 2 is used in the estimation following the result of the lag order selection test using Hannan-Quinn Information Criterion, and this also helps to capture the dynamics of business cycles in the region.

(b) Correlation of structural shocks

As already specified, the paper examines the pairwise correlations of disturbances affecting ECOWAS economies. Along this line, it concentrates on the correlations of four underlying structural shocks: external shocks, supply shocks, demand shocks and monetary shocks. The decision criterion to assess the symmetry and/or asymmetry of the correlations of the structural shocks is as follows: If the correlation is positive, the shocks are categorized as symmetric or synchronous. On the other hand, if the correlation turns out to be negative or not statistically different from zero or less than 0.5, the shock is categorized as asymmetric. To test for the statistical significance of the correlation results, the Kendall and Stuart (1973) correlation statistic is used to test whether the correlation is statistically significant at 5% level. The statistic $(1/2)\ln\left[(1+r)/(1-r\right]$ has a distribution that approaches normality with a mean of $(1/2)\ln\left[(1+\rho)/(1-\rho\right]$ and a variance of $1/(N-3)$. Where r is the estimated correlation coefficient, ρ is the null value (i.e. 0) of the correlation coefficient and N is the number of observations. Hence, the null hypothesis is tested that the correlation coefficient is

equal to zero, that is, $(\rho = 0)$. In the following subsections, the results of the correlations of the four structural shocks among the ECOWAS economies are reported and discussed.

(i) Correlation of external shocks

Table 5 contains the correlations of external shocks to ECOWAS economies. The positive and statistically significant results are underlined. From the results, it is obvious that the correlations of external shocks are highly significant for many of the ECOWAS economies except for Burkina Faso, Gambia and Guinea-Bissau. The likely reason why external shocks to most of the countries are highly correlated could be as a result of the similarity in primary product oriented export base of most of the countries. Ceteris paribus, the higher the correlation of shocks from an external source, the greater will be the benefits for countries in the region to form a currency union. This is because under a single currency, the potential bilateral exchange rate distortions brought about by external disturbances are greatly reduced, if not totally eliminated. Following this criterion all the other economies but Burkina Faso, Gambia and Guinea-Bissau will be better-off adopting a common currency.

Table 5: **Correlation of external shocks**

	BEN	BFA	CIV	GHA	GMB	GNB	MLI	NER	NGA	SEN	SLE	TGO
BEN	1											
BFA	-0.59	1										
CIV	0.55	0.01	1									
GHA	0.82	-0.39	0.74	1								
GMB	-0.59	0.93	0.11	-0.2	1							
GNB	-0.15	0.78	0.35	0.22	0.88	1						
MLI	0.95	-0.59	0.5	0.91	-0.48	-0.02	1					
NER	0.89	-0.57	0.35	0.67	-0.58	-0.16	0.87	1				
NGA	0.76	-0.42	0.67	0.97	-0.2	0.21	0.89	0.7	1			
SEN	0.82	-0.12	0.86	0.9	-0.05	0.37	0.81	0.69	0.83	1		
SLE	0.75	-0.33	0.88	0.95	-0.15	0.19	0.78	0.53	0.9	0.89	1	
TGO	0.28	0.04	0.21	0.44	0.19	0.47	0.45	0.58	0.6	0.46	0.28	1

Red underlined numbers denote symmetry, i.e. positive correlations at the 5% level.

(ii) Correlation of domestic supply shocks

Symmetry of supply shocks are considered to be the most critical determining factor in forming a currency union since supply shocks are expected to have permanent effects and are more likely to be invariant to demand management policies (Bayoumi and Eichengreen, 1994; Buigut and Valev, 2005). Table 6 contains the correlation coefficients of the identified supply shocks among ECOWAS economies.

Table 6: **Correlation of domestic supply shocks**

	BEN	BFA	CIV	GHA	GMB	GNB	MLI	NER	NGA	SEN	SLE	TGO
BEN	1.00											
BFA	0.84	1.00										
CIV	0.01	-0.05	1.00									
GHA	-0.21	0.01	0.55	1.00								
GMB	-0.31	-0.52	-0.32	-0.72	1.00							
GNB	-0.14	0.07	-0.49	-0.18	-0.27	1.00						
MLI	0.10	-0.36	0.02	-0.06	0.35	-0.63	1.00					
NER	0.23	0.04	0.57	0.65	-0.69	-0.13	0.31	1.00				
NGA	-0.20	-0.28	-0.77	-0.47	0.67	-0.11	0.44	-0.59	1.00			
SEN	-0.56	-0.63	0.24	-0.35	0.74	-0.22	-0.03	-0.48	0.07	1.00		
SLE	-0.25	-0.26	-0.55	-0.47	0.13	0.88	-0.33	-0.22	0.10	0.07	1.00	
TGO	-0.25	-0.05	0.37	0.64	-0.08	-0.68	0.16	0.04	0.07	0.04	-0.83	1.00

Red underlined numbers denote symmetry, i.e. positive correlations at the 5% level.

It is disappointing to note that out of the 66 pairs of ECOWAS economies studied 58 of the correlations of domestic supply shocks are not statistically significant, meaning that they are asymmetric and this may reflect the major differences in the core export commodities of these economies, which ranges widely from crude oil in Nigeria to gold in Ghana and cashew nuts in Guinea-Bissau. Despite the overwhelming asymmetry in the correlation of supply shocks in the region, eight pairs of countries still have symmetrical (positive and significant) supply shocks. For example, Benin and Burkina Faso have a high correlation coefficient of 0.84. Others include Cote d'Ivoire and Ghana (0.55), Ghana and Niger (0.65), Ghana and Togo (0.64), Nigeria and Gambia (0.67), Gambia and Senegal (0.88) and finally, Guinea-Bissau and Senegal (0.74). This result implies that ECOWAS economies need different policy responses to adjust to supply shocks. At a given time, a group of countries in ECOWAS may need an expansionary monetary policy to respond to cyclical downturns while others might require contractionary monetary policy to respond to cyclical booms. Consequently it will be difficult for ECOWAS economies to operate the proposed eco if wages are rigid and or factor mobility is limited as we have already observed in the previous sections.

(iii) Correlation of domestic demand shocks

Table 7 presents the correlation of domestic demand shocks among ECOWAS economies. The correlation of domestic demand shocks and domestic supply shocks of ECOWAS economies are very similar in the sense that they are generally asymmetric, i.e. most of them are negative with a few positive and statistically significant correlation coefficients. Out of the 66 pairs of ECOWAS economies examined, only nine economies have significant symmetry in domestic demand shocks. They are: Benin and Cote d'Ivoire (0.58), Benin and Ghana (0.81), Benin and Senegal (0.90), Burkina Faso and Senegal (0.59), Cote d'Ivoire and Niger (0.87), Ghana and Gambia (0.56), Ghana and Senegal (0.79), and Nigeria and Mali (0.66). My result is different from

Houssa's (2008) result that only finds significant symmetry in domestic demand shocks between Cote d'Ivore and Benin. The insight from this result is the revelation of the weak inter-demand relationships among ECOWAS economies.

Table 7 Correlation of domestic demand shocks

	BEN	BFA	CIV	GHA	GMB	GNB	MLI	NER	NGA	SEN	SLE	TGO
BEN	1.00											
BFA	0.23	1.00										
CIV	0.58	-0.62	1.00									
GHA	0.81	0.14	0.48	1.00								
GMB	0.23	0.24	0.06	0.56	1.00							
GNB	-0.04	0.05	-0.01	-0.43	-0.76	1.00						
MLI	-0.14	0.48	-0.69	-0.06	-0.29	-0.03	1.00					
NER	0.32	-0.60	0.87	0.11	0.04	0.15	-0.92	1.00				
NGA	-0.67	0.25	-0.81	-0.78	-0.56	0.27	0.66	-0.66	1.00			
SEN	0.90	0.59	0.19	0.79	0.40	-0.19	0.14	-0.06	-0.46	1.00		
SLE	-0.02	-0.63	0.44	0.27	-0.23	0.08	-0.03	0.15	-0.32	-0.26	1.00	
TGO	-0.75	-0.41	-0.15	-0.83	-0.51	0.56	-0.28	0.20	0.41	-0.89	0.14	1.00

Red underlined numbers denote symmetry, i.e. positive correlations at the 5% level.

(iv) Correlation of monetary shocks

Table 8 contains the correlation of monetary shocks in ECOWAS economies. There seems to be more asymmetry in the correlation of monetary shocks for ECOWAS economies. Again, out of the 66 pairs of ECOWAS economies considered, only 10 pairs of economies have symmetric correlations in monetary shocks. Here, the results are not surprising because they intuitively follow from the asymmetric nature of demand shocks among the economies. In particular, the paper observes that the symmetric correlation of monetary shocks among ECOWAS economies is mostly among the WAEMU sub-set. Whereas, countries in the WAMZ sub-set have a divergent or asymmetric correlation of monetary shocks. The symmetry among the WAEMU sub-set can be explained by the already existing monetary arrangement in that region and the ties between their currency and the French franc and now the Euro. Specifically, symmetry can be observed in monetary shocks between Benin and Sierra Leone (0.55), Cote d'Ivoire and Guinea-Bissau (0.73), Mali (0.53) and Niger (0.51), Guinea-Bissau and Senegal (0.55) and Togo (0.62), Guinea-Bissau and Niger (0.62) and Mali and Senegal (0.55)

Table 8: **Correlation of monetary shocks**

	BEN	BFA	CIV	GHA	GMB	GNB	MLI	NER	NGA	SEN	SLE	TGO
BEN	1.00											
BFA	-0.14	1.00										
CIV	0.39	-0.86	1.00									
GHA	-0.53	0.59	-0.41	1.00								
GMB	-0.28	0.13	-0.37	0.19	1.00							
GNB	0.08	-0.91	0.73	-0.46	-0.14	1.00						
MLI	0.39	-0.38	0.53	-0.36	-0.92	0.47	1.00					
NER	0.16	-0.46	0.51	0.16	0.26	0.62	0.03	1.00				
NGA	0.22	-0.12	0.39	0.43	-0.15	0.34	0.31	0.82	1.00			
SEN	0.46	0.02	0.39	-0.13	-0.77	-0.23	0.55	-0.35	0.02	1.00		
SLE	0.55	0.25	-0.08	0.04	0.55	-0.32	-0.51	0.31	0.18	-0.08	1.00	
TGO	-0.32	-0.36	0.32	0.23	0.62	0.19	-0.59	0.48	0.11	-0.29	0.28	1.00

Red underlined numbers denote symmetry, i.e. positive correlations at the 5% level.

(c) The dynamics of the shocks: size of disturbances and speed of adjustment

It is instructive to examine the dynamic effects of the shocks in terms of the sizes of the disturbances and the speed of adjustment. The size of disturbances is an important economic characteristic because larger disturbances translate into higher volatility of the endogenous variables which undermines the effectiveness of a synchronous monetary policy. On the other hand, if the speed with which the economies adjust to disturbances is slow, then the cost of fixing the exchange rate and losing policy autonomy increases.

In order to assess the size of the disturbances, the impulse response coefficients are used which trace out the effect of a one-unit shock in each of the four endogenous variables. In the case of external shocks, the impulse responses are assumed not to be different.

Table 9**: Size of disturbances and speed of adjustment across regions**

Countries	**Supply disturbances**		**Demand disturbances**		**Monetary disturbances**	
	Size	Speed	Size	Speed	Size	Speed
ECOWAS						
Benin	0.029	0.006	0.392	0.057	0.117	0.020
Burkina Faso	0.038	0.004	0.459	0.080	0.050	0.005
Cote d'Ivoire	0.045	0.018	0.931	0.395	0.122	0.016
Gambia	0.032	0.006	0.729	0.260	0.159	0.029
Ghana	0.016	0.004	0.476	0.141	0.106	0.017

Guinea-Bissau	0.081	0.051	0.824	0.255	0.272	0.070
Mali	0.064	0.025	1.307	1.115	0.141	0.018
Niger	0.106	0.010	1.233	0.616	0.025	0.011
Nigeria	0.049	0.001	0.622	0.040	0.318	0.062
Senegal	0.038	0.011	0.608	0.328	0.075	0.012
Sierra Leone	0.076	0.015	0.209	0.098	0.338	0.066
Togo	0.059	0.019	0.637	0.097	0.056	0.027
Average	0.053	0.014	0.702	0.290	0.148	0.029
East Asia						
Australia	0.011	0.925	0.017	0.910		
Hong Kong	0.023	1.590	0.044	1.190	0.032	
Indonesia	0.013	1.239	0.071	1.335	0.050	
Japan	0.012	1.667	0.017	0.270	0.013	
Korea	0.029	0.886	0.038	0.115	0.030	
Malaysia	0.032	1.038	0.063	1.607	0.015	
New Zealand	0.060	0.648	0.031	0.291		
Philippines	0.089	0.587	0.081	1.475	0.040	
Singapore	0.032	1.353	0.028	1.072		
Taiwan	0.021	1.466	0.049	0.673		
Thailand	0.026	1.381	0.042	1.279	0.019	
Average	0.032	1.162	0.044	0.929	0.026	
SAARC						
Bangladesh	0.008	0.741	0.028	1.195		
Bhutan	0.023	0.727	0.033	1.532		
India	0.025	0.913	0.040	1.411		
Maldives	0.036	1.053	0.047	0.512		
Nepal	0.016	0.888	0.034	1.138		
Pakistan	0.028	0.612	0.040	0.990		
Sri Lanka	0.023	0.847	0.038	0.968		
Average	0.023	0.826	0.037	1.106		

Western Europe				
Austria	0.018	0.999	0.017	0.415
Belgium	0.028	0.668	0.028	0.508
Denmark	0.022	1.104	0.017	0.135
Finland	0.018	0.875	0.027	0.684
France	0.034	0.243	0.014	0.101
Germany	0.022	1.193	0.015	0.659
Ireland	0.021	1.222	0.038	0.382
Italy	0.030	0.427	0.036	0.380
Netherlands	0.033	0.692	0.019	0.511
Norway	0.031	0.651	0.034	0.704
Portugal	0.061	0.426	0.026	0.367
Spain	0.057	0.083	0.015	0.123
Sweden	0.030	0.261	0.012	0.419
Switzerland	0.031	0.997	0.016	0.858
United Kingdom	0.018	0.425	0.019	0.016
Average	0.030	0.684	0.022	0.417
The Americas				
Argentina	0.033	1.141	0.438	1.126
Bolivia	0.069	0.585	0.636	1.302
Brazil	0.084	0.706	0.068	0.983
Canada	0.020	1.052	0.028	0.703
Chile	0.064	1.214	0.251	0.548
Colombia	0.026	0.823	0.027	0.720
Ecuador	0.162	0.402	0.076	0.987
Mexico	0.059	0.775	0.072	0.865
Paraguay	0.094	0.459	0.064	0.719
Peru	0.050	1.169	0.062	0.452
United States	0.028	0.269	0.015	0.078
Uruguay	0.049	1.014	0.074	1.227

Venezuela	0.062	0.810	0.074	0.949
Average	0.062	0.801	0.145	0.820

Note: Figures for Western Europe, East Asia, and the Americas is from Bayoumi and Eichengreen (1994), SAARC figures are from Saxena (2005), size of monetary shocks for East Asia are from Huang and Guo (2006) and ECOWAS figures are author's computations.

Hence, the paper focuses on the other three structural disturbances. For supply shocks, it uses the average absolute value of the long-run (20-year horizon) of one unit shock on changes in real GDP as a measure of size since the supply disturbances are expected to have permanent effects on output. On the other hand, since the effects on demand and monetary disturbances are expected to be transitory, the demand and monetary shocks are proxied using the average absolute value of the short-run (2 year horizon) effect of one-unit shock consumer price index and real effective exchange rate respectively[vii]. For speed of adjustment, the study follows Bayoumi and Eichengreen (1994) by estimating the responses after 2 years as a share of the long run effect. To aid appreciation of the circumstances in ECOWAS economies, the results are compared to results that have been obtained in other geographical regions.

Table 9 displays the size of disturbances and speed of adjustment for supply, demand and monetary shocks for different geographic regions[viii]. Looking among the ECOWAS economies, the paper observes that Benin has the lowest size of supply shocks at 2.9 percent, while Niger has the highest at 10.6 percent. Demand shocks are relatively higher with Mali having the highest size of demand shock and the fastest speed of adjustment. For monetary disturbances, it also observes that Sierra Leone and Nigeria have the highest rates of monetary disturbance at 33 and 31 percent respectively. The speed of adjustment to monetary shocks are generally slow with that of Nigeria showing that only about 6% of the adjustment is completed within the first two years.

Comparing the average results for ECOWAS economies with the average from other regions, the study observes that the average size of supply shocks in West Africa (0.053) is only second to the America's (0.062). When put side-by-side with the results from other regions that have adopted or are about to adopt a common currency, for example Western Europe (0.03), East Asia (0.032), SAARC (0.023), the average size of the supply shocks in ECOWAS economies is comparatively too large, raising the red light on the proposed Eco! A similar pattern is also observed for demand shocks. Also, the large size of monetary shock and slow speed of adjustment to monetary disturbances for ECOWAS economies is an indication that a one-size-fits-all exchange rate policy across the region will not be ideal. A currency union in West Africa can only be effective if the size of monetary disturbances are low, and the speed of adjustments are high, and this does not seem to be the case.

6. Conclusion

In this paper, attempts have been made to investigate the symmetry and speeds of adjustments to macroeconomic shocks in ECOWAS economies for purposes of gauging the readiness of ECOWAS for a common currency. A multivariate structural VAR model is used to examine the symmetry of four kinds of disturbances affecting the region. They include external shocks, supply shocks, demand shocks and monetary shocks. The results indicate that there is a relatively low degree of asymmetry in the correlation of external shocks to countries in the region. The pattern of supply, demand and monetary shocks among the countries in the region is highly asymmetric, implying that it will be difficult for ECOWAS to operate the eco because the presence of asymmetric shocks indicates the need for different policy responses to adjust to supply, demand and monetary shocks in the region. In addition, the results reveal differing sizes and speeds of adjustment in monetary shocks. The implication is that the responses to real exchange rate shocks in the region do not converge, and therefore it will not be ideal to adopt a one-size-fits all exchange rate policy across the region.

In this light, policy makers in West Africa should consider delaying the introduction of the proposed eco and work further towards stronger integration of the ECOWAS economies in terms of intra-regional trade and factor and labour mobility within the region. Delaying the take off of the proposed eco will also afford policy makers the opportunity to learn from the prevailing debt and financial crisis being experienced in the Euro zone with a view to build in pre-emptive strategies.

Acknowledgements

I like to thank Professor Akpan Ekpo and conference participants at the WAIFEM/ECOWAS 2011 Regional Conference on Post Crisis Economic Reforms in Abuja, whose discussions motivated this study. The study greatly benefited from comments by Sebastien Walker, Janine Aron, Olayinka Idowu, Oluwatosin Adeniyi and other members of the Macro Policy Management Session at the conference on "Economic Development in Africa", organized by the Centre for the Studies of African Economies(CSAE), University of Oxford, U.K (18-20 March 2012).

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NOTES

[1] The list includes: Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.

[1] Members of WAEMU include Benin, Burkina Faso, Cote d'ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

[1] WAMZ countries include The Gambia, Guinea, Ghana, Nigeria and Sierra Leone

[1] This can partly be explained by the porous borders between the two counties and their relative proximity.

[1] Liberia, Cape Verde and Guinea are excluded from the analysis. This is because Liberia declined to participate in the project although they are now beginning to indicate interest, Cape Verde has a currency that is directly linked to the Euro and for Guinea we did not obtain sufficient data series for the analysis.

[1] These 26 advanced economies include: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Australia, Canada, Denmark, Hong Kong SAR, Israel, Japan, Korea, New Zealand, Norway, Singapore, Sweden, Switzerland, United Kingdom, and United States.

[1] The approach we adopted is similar to the approach adopted by Huang and Guo (2006) and Bayoumi and Eichengreen (1994). The advantage of this approach is that it enables us to compare results across regions and times.

[1] Figures for Western Europe, East Asia, and the Americas is from Bayoumi and Eichengreen (1994), SAARC figures are from Saxena (2005), size of monetary shocks for East Asia are from Huang and Guo (2006) and ECOWAS figures are author's computations.

[2]FDI AND THE ENVIRONMENT: EVIDENCE FROM THE FULLY MODIFIED AND DYNAMIC OLS APPROACHES IN WAMZ[3]

By: [4]**P.B. Eregha and N.I. Nwokoma**[5]

Abstract

Experts argue that high polluting industries in the North relocates to the South to take advantage of lax environmental regulations, leading to the emergence of "polluter haven" hypothesis and this invariably indicates that countries where such lax environmental regulations exist shows that their demand for quality life is low. This study revealed within the WAMZ region that the polluter haven hypothesis exits. It is therefore recommended that WAMZ countries encourage Multinationals to pay attention to the use of advanced and efficient technology to enhance their output which not only improves environmental quality but also lowers per unit cost.

Keywords: Polluter Haven Hypothesis, Fully Modified OLS, Dynamic OLS
JEL Codes: O13, O18, Q25, O53, R1, F23

1. Introduction

Foreign Direct Investment has been recognized as a panacea for growth and development as the inflow brings in necessary technology, expertise and financial resources to recipient countries. However, most of these countries often do not have the capacity to take advantage of liberalized trade and open markets and are unable to produce items for exports (Kumar and Pradhan, 2002; Eregha, 2012). Experts argue that FDI can provide such opportunities to facilitate their capacity. In this regard, however, increasing FDI inflow might also have deleterious effects for recipient country's ecosystem. In fact, in the literature FDI has the tendency to promote economic growth but it is also found to impact the environment negatively (Xing and Kolstad 2002, He 2006 and Shahbaz et. al 2011). Environmental regulations are essentially supposed to be means of internalizing the external environmental cost of firms' economic activity but in most cases this is not the case as a result of weak or unimplemented environmental regulations (Shahbaz et. al 2011). This is because in order to attract foreign investment, the governments of developing countries have a tendency to undermine environment concerns through relaxed or non-enforced regulations. Consequently, companies like to shift their operations to these developing countries to take advantage of lower production cost which is known as "pollution haven hypothesis". Similarly, a host country can

[2] *FDI is Foreign Direct Investment and Paper presented at the Department of Economics, University of Lagos staff seminar.*
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also loosen their regulatory requirements to attract investment, which is termed 'race to bottom hypothesis". Both of these hypotheses lead to excessive pollution and degradation in environmental standard of the host countries (Shahbaz et. al 2011). This happens because investors prefer to seek countries that have a less strict or non-existent environmental regulatory framework, or have low demand for good quality of life for their investment to reduce cost of production for the purpose maximizing abnormal profit.

Most FDI flows mainly into the natural resources sector of most African countries and specifically, in the WAMZ case (UNCTAD, 2009, 2010) and become uninternalized negative externality in these countries (Kumar and Pradhan, 2002). The surge of FDI basically flows to the extractive industry such as the agricultural sector, energy sector and recently to the communication sector of most WAMZ economies. It is a known fact that most of these WAMZ countries are characterized by weak institutions and poor governance framework (Diop et al, 2010) which might give room for the attraction of FDI flows that are detrimental to their environment, in sync with either the Pollution Haven Hypothesis or the race to Bottom Hypothesis.

It is against this backdrop that this study examines the relationship between the scale of foreign direct investment and environmental degradation in WAMZ countries. Although several studies have examined the relationship between foreign direct investment inflow and the environment, most of them have focused on the times-series data and few ones on panel without ascertaining the time series properties of their panel except the study by Tsai (2011). FDI and environment as captured by Co2 usually turn out to be non-stationary. In the unit root literature, it is argued that the widespread failure of hypothesis testing in relatively short series may be accounted for by the low power of conventional univariate unit root tests against persistent alternatives, typically for sample sizes that occur in practice. Furthermore, the traditional cointegration technique also has the problem of low power. This paper seeks to contribute to the debate on the FDI cum environment literature in three ways. First, it attempts to employ a series of homogeneous and heterogeneous panel unit root and cointegration tests. These methods avoid problems of low power associated with the traditional unit root and cointegration tests. The second contribution is the use of recent panel cointegration techniques which previous studies never considered and the literature entrenched that the methodology adopted has impact on the direction of relationship. Hence the long-run relationship is analyzed using the Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) estimators. These estimators correct the standard pooled OLS for serial correlation and endogeneity of regressors that are normally present in a long-run relationship. Third, most African economies are natural resources based inclusive of the WAMZ countries which FDI inflows are basically resources seeking FDI (UNCTAD, 2009, 2010; Eregha, 2012) and the tendencies for environmental degradation. Hence, a study of this sort is imperative and to the best of our knowledge there is little or no study on the FDI-environment connection in an Africa specific region. The present study bridges this gap by examining this connection in WAMZ. It is expected that if WAMZ environmental regulations are weak, FDI inflow in the region will tend to hamper the environment.

2. 0 Literature Review

2.1 Brief Theoretical Review

There exists strand of theoretical literatures tracing the environmental impacts from the entry and operations of foreign direct investment. Some of these theories that devised to demonstrate these impacts are: the pollution haven hypothesis, race to the bottom theory, race to the top theory and the regulatory chill theory (Gray, 2002; Temurshoev, 2006). The "Pollution Haven" hypothesis states that investors will seek other countries to locate their industries where it will be cheaper and more efficient in light of environmental regulatory requirements. The idea behind this hypothesis is that high polluting industries in the North will relocate to the South to take advantage of lax environmental regulations, leading to the emergence of "polluter haven" (Chichinisky, 1994; Gray, 2002; Eskeland and Harrison, 2003; Cole, 2004). Countries where such lax environmental regulations exist show their concern for human life and health. The next theory on the environmental impact of foreign direct investment which is a subset of the pollution haven hypothesis is the "Race to Bottom" theory. The race to bottom theory posits that government in their own deliberately lower environmental standards in other to attract foreign investment. That is, a deliberate effort by the government of any nation to reduce environmental regulations so as to attract foreign investor (Baumol and Oates, 1988; McConnell and Schwab, 1990; Friedman et al. 1992; Gray, 2002; Greaker, 2007). However, there exists a contrary theoretical argument against the previous theories (Pollution Haven and the Race to the Bottom theories). This opposing theory known as the "Race to the Top" theory expressed under the Porter Hypothesis postulates that stronger environmental regulations can facilitate competitiveness in the marketplace by fostering innovation and efficiency thereby attracting investors. This is also called the "Pollution Halo" theory (Gray, 2002; Copeland and Taylor, 2003). The other issue as entrenched in the literature is the "regulatory chill" whereby countries refrain from enacting stricter environmental standards in response to fears of losing a competitive edge against other countries in obtaining foreign investment (Gray, 2002).

2.2 Brief Empirical Review

Unlike the existence of a plethora of studies on the environment-growth nexus, empirical studies on the FDI-environment nexus are still relatively few and far between in both developed and developing countries. For instance, in a study of the effect of US FDI on environmental quality in both developed and developing countries Xing and Kolstad (2002) aver that developing countries utilize lax environmental regulations as a strategy for attracting dirty industries from developed countries.

Peter and Jeffrey (2003) opine that heavy dependence on foreign direct investment contributes to the growth of carbon dioxide emissions in less developed economies of the globe. However, domestic investment was found to have insignificant effect on CO2 emissions. The study also reveals that foreign direct investment is more concentrated in industries which require more energy and as a result, energy emissions are increased and therefore, foreign investors prefer to invest in these industries in those countries where environmental laws are relatively flexible.

Hoffmann et al (2005) test the direction of causality between foreign direct investment and environmental pollution in low, middle and high income countries of the globe. The study used panel causality test to examine the relationship between foreign direct investment and CO2 emissions. The results of the test indicated that unidirectional causality run from foreign direct investment to energy emissions in middle income countries while CO2 emissions Granger cause foreign direct investment in low income economies and neutral hypothesis exists in high income countries which imply the rejection of pollution haven hypothesis in high income countries.

He (2006) employs a simultaneous system of five-equations to analyze the link between FDI-emission in China. The system incorporates the FDI location decision with respect to environmental regulation stringency and the impact of FDI on pollution through scale, composition and technique effects. The simultaneous system is estimated on a dynamic panel of 29 Chinese provinces for the period 1994 to 2001. The results shows that the total impact of FDI on industrial emissions is small and that a percentage increase in FDI capital stock contributes a 0.09 percentage increase in industrial emissions. Zeng and Eastin (2007) examined the effects of trade openness and FDI on industrial pollution levels across China provinces over the period 1996-2004. The study revealed that FDI is positively related with environmental protection in China.

Beak and Koo (2009) examine the relationship between foreign direct investment, economic growth and energy emissions in China and India. The study reveals that foreign direct investment has positive and significant impact on energy consumption in China. However for India, foreign direct investment was found to hamper the environment in the short-run while negative and insignificant effect of foreign direct investment on energy emissions is found in the long-run.

Cole et al. (2009) investigate the relationship between economic growth and industrial pollution emissions in China using data for 112 major cities for the period 2001-2004. Using disaggregated data the study separate FDI inflows from Hong Kong, Macao and Taiwan from those of other foreign economies. They examine four industrial water pollution indicators (wastewater, chemical oxygen demand, hexavalent chromium compounds, and petroleum-like matter) and four industrial air pollution indicators (waste gas, sulphur dioxide, soot and dust). The study showed that total industrial output has a strong positive effect on industrial emissions with this effect differing by country of ownership. Domestic firms were found to have the strongest detrimental effect on industrial emissions; Chinese-sourced affiliates from Hong Kong, Taiwan and Macao have a moderate detrimental effect on three of the four water pollution emissions but have an insignificant impact on air pollution; and foreign owned firms have a significant and beneficial effect but an hazardous effect on emissions of petroleum-like matter, with an insignificant effect in all other cases.

Ajide and Adeniyi (2010) examine the causal link between foreign direct investment and the environment in Nigeria for the period 1970-2006. The study employs the Autoregressive Distributed Lag (ARDL) modeling approach and it was revealed that a long run causal relationship exists between CO2 per capita (which is their measure of the environment) and foreign direct investment.

Tsai and Pao (2011) analyze the effect of economic growth and foreign direct investment on environmental degradation in BRIC[6] countries. The study employs panel cointegration technique. The results indicated the existence of long run relationship among the variables. The panel causality analysis indicated bidirectional causal relationship between foreign direct investment and energy pollutants which confirms the existence of pollution heaven and both halo and scale effects.

3. Data and Methodology

This empirical investigation probes the relationship between foreign direct investment and emissions (proxy for environment) using data for WAMZ countries over the period 1970-2010.

Based on the above theoretical review on the environmental impacts of foreign direct investment inflow and following the works of Cole and Elliot, 2005; Cole et al. 2005, 2009), this study specifies our empirical model thus:

$$Co2 = f(pcgdp, pcgdp^2, fdI) \quad \text{.....(1)}$$

$$Co2_{it} = \gamma_0 + \gamma_1 pcgdp_{it} + \gamma_2 pcgdp_{it}^2 + \gamma_3 fdI_{it} + \mu_{it} \quad \text{.....(2)}$$

Where, emissions=emissions per capita; pcgdp=per capita income; fdI= FDI as ratio of GDP; and μ =error term. Two green house gases emissions were used {Carbon emission (CO2) to capture the environment.

Data for the study was extracted from the World Development Indicator and IFS and analyzed by two recent panel cointegration techniques vis-a-vis: the Fully Modified and the Dynamic OLS approaches. These estimators correct the standard pooled OLS for serial correlation and endogeneity of regressors that are normally present in a long-run relationship Pedroni (1996, 2000). When applying cointegration tests to long-run hypotheses in aggregate panel data, a primary concern is to construct the estimators in a way that does not constrain the transitional dynamics to be similar among different countries of the panel. Instead, only the information concerning the long-run hypothesis of interest was pooled, and the short-run dynamics allowed to be potentially heterogeneous. This is a central theme for the panel fully modified and dynamic OLS approaches (Bangake and Eggoh, 2011). Present below are the FMOLS and DOLS models:

Consider the regression,

$$Co2_{it} = \alpha_i + \beta_i x_{it} + \mu_{it} \quad \text{.....(3)}$$

Where, $Co2_{it}$ is as defined; x_{it} is the vector of explanatory variables as previously defined.

$Co2_{it}$ and x_{it} are cointegrated with slopes β_i, which may or may not be homogeneous across $_i$;

Let $\xi_{it} = (\mu_{it,} \Delta x_{it})$ be a stationary vector consisting of the estimated residuals from the cointegrating regression and the differences in x and let

[6] BRIC: Brazil, Russia, India and China.

$\Omega_i = \lim T \to \infty E\left[T^{-1}(\sum_{t=1}^{T}\xi_{it})(\sum_{t=1}^{T}\xi_{it}^{'})\right]$ be the long-run covariance matrix for this vector process. This can be decomposed as $\Omega_i = \Omega_i' + \Gamma_i + \Gamma_i'$ where, Ω_i^0 is the contemporaneous covariance and Γ_i is a weighted sum of auto covariance.

Based on Pedroni (1996, 2000), the expression for the between-dimension, group mean panel FMOLS estimator is given as;

$$\hat{\beta}_{GFM}^{*} = N^{-1}\sum_{i=1}^{N}\left(\sum_{i=1}^{N}(x_{it}-\bar{x}_i)^2\right)^{-1} * \left(\sum_{i=1}^{N}(x_{it}-\bar{x}_i)Co2_{it}^{*} - T\hat{y}_i\right) \quad \text{.....(4)}$$

Where, $Co2_{it}^{*} = \left(Co2_{it} - \bar{Co2}_i\right) - \dfrac{\hat{\Omega}_{21i}}{\hat{\Omega}_{22i}}\Delta x_{it,}$

$$\hat{y} = \hat{\Gamma}_{21i} + \hat{\Omega}_{21i}^{0} - \frac{\hat{\Omega}_{21i}}{\hat{\Omega}_{22i}}\left(\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^{0}\right)$$

The Between-dimension estimator can be constructed as $\hat{\beta}_{GFM}^{*} = N^{-1}\sum_{i=1}^{N}\hat{\beta}_{FM_i}^{*}$ where, $\hat{\beta}_{FM_i}^{*}$ is the conventional FMOLS estimator applied to the ith member of the panel. The associated t-statistics for the Between dimension can be obtained as; $t_{\beta_{GFM}^{*}} = N^{-1/2}\sum_{t=1}^{N} t_{\hat{\beta}_{FMi}^{*}}$

where, $t_{\hat{\beta}_{FMi}^{*}} = \left(\hat{\beta}_{FM,i}^{*} - \beta_0\right)\left(\hat{\Omega}_{11i}^{-1}\sum_{t=1}^{T}(x_{it}-\bar{x}_i)^2\right)^{1/2}$.

Similarly, a Between-Dimension, Group Mean Panel DOLS estimator is as follows. However, we begin by augmenting the cointegrating regression with lead and lagged differences of the regressor to control for the endogenous feedback effect which plays similar role in the FMOLS procedure;

$$Co2_{it} = \alpha_i + \beta_i x_{it} + \sum_{k=-k_i}^{k_i}\gamma_{it}\Delta x_{it-k} + \mu_{it} \quad \text{.....(5)}$$

From the above, the group-mean panel DOLS estimator is;

$$\hat{\beta}_{GD}^{*} = \left[N^{-1}\sum_{i=1}^{N}\left(\sum_{t=1}^{T} z_{it}z_{it}^{'}\right)^{-1}\left(\sum_{t=1}^{T} z_{it}Co2_{it}\right)\right]_1$$ where, z_{it} is the 2(k+1)*1 vector of regressors $z_{it} = (x_{it}-\bar{x}_i), \Delta x_{it-k,\ldots,}\Delta x_{it+k}$; $Co2_{it} = Co2_{it} - \bar{Co2}_i$ and subscript 1 outside the

brackets indicates that we are taking only first element of the vector to obtain the pooled slope coefficient. The Between-Dimension estimator can be constructed as $\beta^*_{GD} = N^{-1}\sum_{i=1}^{N}\beta^*_{D,i}$ where, $\beta^*_{D,i}$ is the conventional DOLS estimator applied to the ith member of the panel. Similarly, if we denote $\delta_i^2 = \lim T \to \infty E\left[T^{-1}\left(\sum_{t=1}^{T}\hat{\mu}^*_{it}\right)^2\right]$ be the long-run variance of the residuals from the DOLS, the associated t-statistics for the Between-Dimension estimator can be obtained as:

$t_{\hat{\beta}^*_{GD}} = N^{-1/2}\sum_{i=1}^{N} t_{\hat{\beta}^*_{D,i}}$ where, $t_{\hat{\beta}^*_{D,i}} = \left(\hat{\beta}^*_{D,i} - \beta_0\right)\left(\hat{\delta}_i^{-2}\sum_{t=1}^{T}\left(x_{it} - \bar{x}_i\right)^2\right)^{1/2}$.

4. Empirical Analysis

4.1 Panel Unit Root Tests Result

Table 1 reports the outcome for both the homogenous panel unit root process tests (Levin et al. 2002 and Breitung, 2000) and heterogeneous panel unit root process tests (Im et al. 2003 and the ADF-Fisher) results. It can be deduced from the table that the null hypothesis of the unit roots for the panel data for the variables cannot be rejected when variables are taken in level.

Table 1: Panel Unit Root Result

	Homogeneous Unit Root Process				**Heterogeneous Unit Root Process**			
	Level		**1st Diff**		**Level**		**1st Diff**	
Variables	**LLC**	**Breitung**	**LLC**	**Breitung**	**IPS**	**ADF-Fisher**	**IPS**	**ADF-Fisher**
CO2	-0.89	-1.17	-8.13***	-5.22***	-1.30	19.55	-9.56***	91.66***
FDI	-1.06	-0.75	-6.71***	-3.65***	-1.21	16.04	-8.42***	76.92***
GDPPC	1.75	1.00	-6.60***	-4.54***	1.81	5.17	-6.11***	51.49***

Note: *** indicates significant at 1%; IPS=Im, Pesaran & Shin; LLC=Levin, Lin & Chu

These results strongly indicate that the variables are non-stationary in level and stationary in first differences. This finding is supported by both the homogenous and heterogeneous panel unit root tests. Similar results were found by Tsai (2011) on FDI inflow and Environment. However, this hypothesis was rejected when series are in first differences. Since the variables became stationary after first difference, the study proceeds to establish their long run relationship below.

4.2 Panel Cointegration Test Result.

Table 2 shows the outcomes of Pedroni's (1999) panel cointegration tests on the series that is between environment and the explanatory variables in the model. Four within dimension and three between-group dimension tests were used to check whether the panel data are cointegrated. The columns labeled within-dimension contain the computed value of the statistics based on estimators that pool the autoregressive coefficient across different countries for the unit root tests on the estimated residuals.

Table 2: Pedroni Residual Cointegration Test

Within-Dimension			**Between-Dimension**	
	Statistics	**Weighted Statistics**		**Statistics**
Panel v	-1.52	-0.42	Group rho	-1.13
Panel rho	-4.45***	-2.87**	Group PP	-2.68***
Panel PP	-5.02***	-3.61***	Group ADF	-1.37*
Panel ADF	-3.10**	-2.24**		

Note: ***; ** & * indicate 1%; 5% & 10% level of significance.

The columns labeled between-dimension report the computed value of the statistics based on estimators that average individually calculated coefficients for each country. Except for the v-statistic test, the results of the within-group tests and the between-group tests show that the null hypothesis of no cointegration can be rejected. This is also complemented by another residual based panel cointgration test shown in table 3.

Table 3: Kao Residual Cointegration Test

ADF	-3.63***

*** indicates 1% level of significance

The Kao residual cointegration test shown in table 3 indicates that the null hypothesis of no cointegration can be rejected of the series. Therefore, the environment and the included regressors are cointegrated for the panel of WAMZ countries. The presence of a long-run relationship between environment and the FDI inflow in the panel of WAMZ countries is economically meaningful in that it suggests that there is tendency of the resource seeking FDI hampering the environment suggesting loose environmental regulations giving room for such.

Having established that there exists a long run relationship, it is convenient that the coefficients of the model be estimated using a panel cointegrating estimator.

4.3 Panel Cointegration Estimations

The cointegrating vector was estimated using two methods: the Fully Modified OLS and the Dynamic OLS approaches. Tables 4 and 5 show the coefficients of the two methodologies for both each country and the panel together.

Table 4: Fully Modified OLS Estimation Result

Dependant Variable: Co2 per capita

Regressors	**Gambia**	**Ghana**	**Guinea**	**Nigeria**	**Sierra-Leone**	**Panel**
gdppc	-0.001*	0.07**	0.001	0.002***	0.05	0.02***
$(gdppc)^2$	0.008*	-0.005**	-0.002	-0.001***	-0.007	-0.001**
FDI	0.004	0.04***	0.004	-0.09***	0.08	0.01
C	0.81***	0.01	-0.08	0.61***	-6.46	-1.02***
Durbin-Watson	1.38	1.56	1.81	1.76	1.61	

Note: ***, **, & * indicate 1%; 5% & 10% level of significance

The FMOLS result on table 4 indicates that FDI inflow hampered the environment of most of the selected countries in WAMZ except Nigeria. For the panel of all the selected countries however it was found that FDI inflow facilitates environmental degradation in WAMZ. One profound finding of the result is the existence of Environmental Kuznets curve (EKC) in WAMZ as shown in the panel result, that is, at the beginning of growth the environment is hampered but at the long run the impact is reduced. This holds for each of the individual countries except Gambia which is the reverse of the case. This contradicts previous studies on the EKC hypothesis in either country specific or panel studies in Africa.

Table 5: Dynamic OLS Estimation Result

Dependant Variable: Co2 per capita

Regressors	**Gambia**	**Ghana**	**Guinea**	**Nigeria**	**Sierra-Leone**	**Panel**
gdppc	-0.003***	0.001**	-0.004	-0.003***	0.07	0.01
$(gdppc)^2$	0.002***	-0.04**	0.05	-0.02***	-0.001	-0.009
FDI	-0.02*	0.06***	-0.005	-0.10***	0.20	0.02
C	1.68***	-0.07	1.24	0.36	-10.19	-1.16***
Durbin-Watson	1.58	2.39	1.55	1.75	1.86	

Note: ***, **, & * indicate 1%; 5% & 10% level of significance; Lead(1)& Lag(-1)

The results obtained using the Dynamic OLS estimation as presented in table 5 are similar to those provided by the FMOLS estimation. These outcomes can therefore be seen as proving the strength of previous results though, the EKC hypothesis did not hold for Guinea and Gambia in the DOLS result. The reason might not be unconnected with the methodologies adopted in the previous studies which adopted either the error correction cointegration approach or fixed or random effects model for panel studies which might not correct for serial correlation and endogeneity of regressors that are normally present in a long-run relationship unlike these two methods.

5. Conclusion

The study examines the relationship between the inflow of Foreign Direct Investment and the environment in the WAMZ countries. Five WAMZ countries were selected based on data availability and the study covers the period 1970-2010 and the panel data approach was adopted for the analysis. Specifically, the time series properties of panel data were examined using both the homogeneous and heterogeneous panel unit root tests confirming the presence of both homogeneous and heterogeneous unit root problems associated with the panel data. The study therefore adopted the Pedroni and Kao residual based panel cointegration to establish long run relation among the series and the recent Fully Modified and Dynamic OLS cointegration approaches were used for the estimation. The study reveals that FDI inflow had positive and significant impact on most of the WAMZ countries both individually and as a group during the sample period. The finding suggests that FDI inflow in this region is detrimental to region's environment leading to environmental degradation. This is a confirmation for weak environmental regulation and implementation in the region alluding to low demand for good quality of life. It is therefore recommended that WAMZ countries set up tariff regulations to crouch environmental degradation and as well encourage environmental protection by technological transmission and know-how from developed countries to save the environmental quality and natural resources consumption. . WAMZ countries should also encourage Multinationals to pay attention to the use of advanced and efficient (greener) technology to enhance their output which not only improves environmental quality but also lowers per unit cost.

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DOES MONETARY EXPANSION HAMPER FOREIGN CAPITAL INFLOWS TO NIGERIA? EMPIRICAL REINVESTIGATION (1981-2012).

By: **Oziengbe Scott AIGHEYISI**

Abstract

The study employs cointegration and error correction methodology and Granger causality test to investigate the effect of monetary expansion and other relevant variables on the flow of foreign direct investment (FDI) to Nigeria's economy in the period 1981 – 2012 using annual time series data sourced from the Central Bank of Nigeria Statistical Bulletin. The paper finds no evidence of significant short run and long run effects of monetary expansion on FDI inflows. The Granger causality test results indicate that broad money is not a significant predictor of FDI inflows in the country. The paper however finds that high degree of external indebtedness reduces the attractiveness of the economy to FDI. Other factors identified to be detrimental to the flow of FDI into the economy include insecurity and infrastructural decay. There are also indications that greater integration of the economy with the global market, exchange rate depreciation and increase in commercial banks lending interest rates are positively related to FDI in the country. The paper however warns that excessive depreciation of the currency, unguarded liberalization of trade, and interest rates escalation could have adverse effect on the economy and these should be guarded against.

Keywords: Monetary Expansion, Foreign Direct Investment, Error Correction Model
JEL Classification: E51, E52, F21.

1. Introduction

Results of several empirical works suggest that monetary expansion in most developing countries is detrimental to the flow of foreign capital into them (Edo, 2007). The reasons for this have included decrease in interest rates, and the possibility of elevation of inflation rate consistent with the Quantity Theory (McPhail, 2010), amongst others. Low interest rate is believed to be unattractive to foreign investors seeking higher returns on their investments (and outlets to diversify their investment risks), as well as triggers capital outflows. The inflation effect of monetary expansion on foreign investment is attributed to the hike in input cost (cost of production), which reduces the competitiveness of firms' output in local and foreign markets, thereby impacting adversely on their returns. Though these are very tenable arguments, a major contention of this paper is that the effect of monetary expansion (defined in this context

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as increase in broad money) on foreign capital inflows, particularly foreign direct investment varies across countries and depends on country-specific conditions. The effect could be adverse if the expansion results from heavy reliance on seigniorage (which according to Oyejide (2013) is "caused by weak revenue base, inefficient tax collection system, lack of access to the option of financing budget deficits with long-term bonds sold to the non-bank domestic private sector, as well as overspending"), and poorly managed foreign aid and remittances which could induce inflationary pressures in the economy. However, if monetary expansion is engendered by increased capacity of the financial institutions to give credit to the private sector, which is an indication of financial sector development**,** its effect on foreign direct investment may not be adverse (Chea, 2011). Foreign investors' confidence in the prospects of a country's economy and expectation of impressive returns on investment therein may also render insignificant the effect of monetary expansion on FDI into the economy.

The objective of this paper is to empirically investigate the effect of monetary expansion on the flow of FDI into Nigeria's economy in the period 1981 to 2012, with a view to recommending policies that will enhance the attractiveness of the economy to FDI, while putting measures on ground to curtail the adverse effect excessive FDI inflows may have on the economy. The research hypothesis is that monetary expansion has no significant effect on the flow of FDI into Nigeria's economy.

The paper is structured into seven sections. Following the introduction, a critical analysis of the link between capital inflows and money supply, with brief review of the literature is done in Section 2. Section 3 contains some theoretical considerations on the nexus between monetary policy and capital flows. In Section 4, the empirical methodology is discussed. The estimation results are presented and discussed in Section 5. Policy options for attracting more FDI into the country are discussed in section 6. Section 7 concludes the paper.

2. Monetary Expansion and Capital Inflows: A Critical Analysis and Brief Review of Relevant Literature

Empirical works such as those of Edo(2007), Bini Smaghi (1982), Cumby and Obstfeld (1983) (as cited in Edo, 2007), etc. have shown that expansionary monetary policies in developing countries of Africa, Asia and other developing regions of the world contributed significantly to the decline in capital inflows into the countries within the period covered by their studies. One of the researchers suggested that "efforts need to be intensified to attract more foreign capital, instead of undue emphasis on monetary expansion" (Edo, 2007, abstract). This suggestion obviously implies that foreign capital inflows is desirable and facilitates rapid economic growth. Also implied is that foreign capital inflows is preferred to monetary expansion, and that monetary expansion could be detrimental to capital inflows. While these may not be disputed, it should be noted that excessive flow of foreign capital into an economy if left uncontrolled (as it could be controlled either by increase in residence capital outflows, accumulation of reserves or large current account deficit (International Monetary Fund, 2013)), could result in the expansion of money supply and excess liquidity in the economy overtime (Vujcic, n.d; Kim and Yang,

2008; Hashmi, et al, 2011). Monetary expansion could engender increase in inflation rate which, beyond some threshold, could be detrimental to economic growth and development (Lee, 1997; Salami and Kelikume, 2010; Bassey and Onwioduokit, 2011). In fact, inflation in China has been attributed to the huge inflow of foreign capital to the country. Jian, Shaoyi and Yanzhi (2011) also observe that large capital inflows to China force the country into a dilemma on making a choice between achieving monetary independence and exchange rate stability. Structural imbalance in the country's BOP has also been blamed partly on large long-standing inflows of FDI which, combined with other factors pose serious challenge to the People's Bank of China to dampen appreciation of the national currency which could have adverse effect on the country's export trade (Glick and Hutchison, 2008). International trade and finance literature acknowledges that excessive flow of foreign capital into an economy could cause an appreciation of the domestic currency (Okpanachi, 2013), and overvaluation or appreciation of the national currency is acknowledged to reduce the international competitiveness of a country's export commodities in the global market with the result that the country's export earnings will significantly nosedive. (This, however, is the case where the demand for the country's export commodities is elastic in the global market). The literature also notes that the overvaluation of the local/domestic currency, apart from reducing the international competitiveness of a country's export sector in the global market, also has the tendency to reduce the inflow of foreign capital into the economy. This is the rationale for the deliberate maintenance of relatively high exchange rate for the domestic currency of some countries by their monetary authorities. It has been argued that the local currency of China (the Yuan or Renminbi) is undervalued, and the country has consistently used this exchange rate policy to maintain and strengthen its competitiveness in international trade, and as a result, she has consistently achieved surpluses in her balance of trade/current accounts in recent times (Lardy, 2005; Morrison and Labonte, 2011).

It could be inferred from the foregoing that while the developing or underdeveloped countries are making frantic effort to attract foreign capital into their economies (through tight monetary policy and other policies) to supplement the low level of domestic investment, engendered by the low savings rate, high interest rate, infrastructural decay etc., they are simultaneously attracting what will result in the situation they assiduously try to avoid – high and rising inflation and appreciation of their national currencies resulting from excessive and poorly managed capital inflows followed by abrupt reversals and the possibility of financial (banking and currency) crisis (Vujcic, n.d), which could keep them perpetually underdeveloped unless measures are taken to curtail such adverse effects (Powell, 2013).

3. Monetary Policy and Capital Flows: Some Theoretical Considerations.

Monetary policy refers to central bank action to influence short-term interest rate, nominal exchange rate and particularly, the money stock (Rasche and Williams, 2007). Policies aimed at expanding the money stock in the economy are known as easy or expansionary monetary policies, while those targeted at reducing the supply of money in the economy are known as tight or contractionary monetary policies.

Within the IS-LM framework, assuming prices are rigid, an increase in money supply (or monetary expansion) depicted by a right ward shift of the LM curve (with no corresponding shift of the IS curve), brings about decrease in interest rate, resulting in increase in domestic investment which ultimately results in increase in aggregate income or output where the savings, investment and liquidity preference functions are responsive to changes in interest rate. The framework suggests that if the savings and investment functions are perfectly inelastic with respect to interest rate, then monetary expansion has no effect on income and that where the liquidity preference curve is perfectly interest rate-elastic (i.e. when the economy is in a so called liquidity trap which has been argued to be unrealistic), an increase in money supply will have no effect on the interest rate. Except under these conditions (i.e. rigid prices, inelastic savings and investment functions and perfectly elastic liquidity preference function), monetary expansion inevitably leads to decrease in interest rate and increase in income. If monetary expansion contributes significantly to the decline in the inflow of foreign capital to an economy, it follows logically that the decline in capital inflow could have resulted (partly) from income and interest rate effects of monetary expansion. This is to say that, assuming prices do not strongly respond to monetary expansion, the increase in income and the decrease in interest rate associated with monetary expansion could have been partly responsible for the decline in capital flows into the economies studied by the researchers. However, in reality, prices are highly responsive to increase in money supply, except where there is price control mechanism. Monetary expansion engenders increase in prices, which reinforces increase in demand for money, driving up the interest rate, engendering decline in domestic investment (and domestic output), creating an investment gap which should be filled, thus necessitating inflow of FDI to an economy.

Assume a policy of tight money, i.e. contractionary monetary policy. Ceteris paribus, this engenders an increase in interest rate (particularly in situations of high inflation uncertainty) and the rise in interest rate has been demonstrated by Mackinnon (1973) and Shaw (1973) to bring about increase in savings or loanable funds, in a deregulated financial system. However, the increase in interest rate could act as a disincentive to local investors and could lower domestic investment, particularly in the LDCs. On the contrary, increase in interest rate has been hypothesized to attract foreign direct investment into a country (Anna et al 2012). For the LDCs, increase in interest rate may not be a guarantee for increase in the inflow of foreign investment. As a matter of fact, in a study of the Zimbabwean economy, Anna et al (2012) found no significant relationship between interest rate and foreign direct investment in the period February 2009 to June 2011.

The flow of FDI into an economy where interest rate is high could be attributed to the decline in domestic investment occasioned by the rise in domestic interest rate. FDI flows into the economy to fill the gap thus created. This however is dependent on investor's expectation of satisfactory returns and/or strong confidence in the prospects of the economy.

No doubt, the amount of FDI that flows into African countries is quite meager compared to what goes to countries such as China and some other Asian economies. The FDI that flows into African economies head straight for those sectors that promise high returns on investment, such as the extractive sector (oil and gas, etc.) and telecommunications sectors (UNCTAD, 2013),

while very little goes to the main (productive) sectors, such as manufacturing, energy, agriculture and education sectors. Thus foreign investors are described as nomads who move their cattle to places where there are green(er) pastures. Unarguably, the difference in the amount of foreign capital that goes into various sectors of an economy cannot be attributed to monetary expansion. Monetary expansion does not reduce the attractiveness of some sectors of the economy to foreign investors and enhance the attractiveness of others.

4. Empirical Methodology

Annual time series data (covering the period 1981 to 2012 sourced from the Central Bank of Nigeria Statistical Bulletin) on relevant variables have been utilized for the investigations. The key variables of interest are foreign direct investment (FDI) and broad money supply (M2). Other variables of interest include exchange rate (EXRT), trade openness (TOPEN), financial openness (FOPEN), External Debt ratio of GDP (EXDT_GDP), domestic investment ratio of GDP (DINV_GDP) and domestic lending interest rate of commercial banks (LINTR). Trade openness is defined as the ratio of total trade (export plus import) to GDP, financial openness is defined as the ratio of foreign (or external) assets plus foreign liabilities to the GDP (Lane and Milesi-Ferretti (2001), and gross domestic investment (also referred to as gross capital formation) is measured as the sum of gross fixed capital formation and increase in capital stock. To proceed with the empirical investigation, the paper specifies a model of the basic functional form:

FDI = f (M2, EXRT, TOPEN, FOPEN, LEXDT_GDP, LDINV_GDP, LLINTR)……. (1).

The method of cointegration and error correction modeling has been employed for the investigations. This involves testing the variables for unit root (using the Phillip-Perron test), the cointegration test (using the Johansen test for cointegration), and if the variables are found to be cointegrated, we shall proceed to estimate an error correction model to represent the short-run dynamic relationship, using the Engle and Granger (1987) two-step procedure. The standard error correction model (ECM) is specified as:

$$\Delta LFDI_t = a_0 + a_1 \Delta LFDI_{t-1} + \sum_{i=0}^{m} (\beta_i \Delta LM2_{t-i}) + \sum_{w=0}^{s} (\theta_w \Delta LEXRT_{t-w}) + \sum_{l=0}^{q} (\phi_l \Delta LTOPEN_{t-l}) + \sum_{v=0}^{r} (\pi_v \Delta LFOPEN_{t-v}) + \sum_{j=0}^{n} (\gamma_j \Delta LEXDT\_GDP_{t-j}) + \sum_{k=0}^{p} (\partial_k \Delta LDINV\_GDP_{t-k}) + \sum_{x=0}^{u} (\text{Ч}_x \Delta LLINTR_{t-x}) + \Omega ECT_{t-1} + \xi_t$$

……..……. (2)

The variables are as earlier defined. L is natural logarithm, ECT_{t-1} is one-period lagged values of residuals from the static model (equation 3), which is included in the model as the error correction term. m, n, p, q, r, s, u are appropriate number of lags of the respective variables.
The associated long-run (static) model is specified in its empirical form as:

$$LFDI_t = \lambda_0 + \lambda_1 LM2_t + \lambda_2 LEXRT_t + \lambda_3 LTOPEN_t + \lambda_4 LFOPEN_t + \lambda_5 LEXDT\_GDP_t + \lambda_6 LDINV\_GDP_t + \lambda_7 LLINTR_t + \varepsilon_t \quad \ldots\ldots (3)$$

The a priori expectations are: $(\theta_w, \phi_l, \pi_v, Ч_x, \partial_k) > 0$, $\chi_j < 0$, $\theta_i <> 0$, $\Omega < 0$; $(\lambda_2, \lambda_3, \lambda_4, \lambda_6, \lambda_7) > 0$, $\lambda_5 < 0$, $\lambda_1 < > 0$.

As noted in the introductory section, effect of broad money expansion on FDI inflows is an empirical issue, and depends on the source of the expansion i.e. whether it results from seigniorage, poorly managed foreign aid and remittances, or increased capacity of the financial system to give credit to the private sector. It may also be rendered insignificant by investor's confidence in the prospect of the economy or from expectation of impressive returns from investment therein. The depreciation of the national currency (increase in exchange rate) is envisaged to boost the competitiveness of a country's export in the global market as the country's export commodities are relatively cheaper in foreign markets. This transpires if the exported commodities are of good quality, the demand for them is elastic and there are no restrictions to their entrance into foreign markets. This no doubt attracts investors (local and foreign) to the productive sectors of the economy to take advantage of the enhanced competitiveness of the country's export commodities engendered by the depreciated currency. Considering that investors often times need to import a portion of inputs needed for production, and export part of their output in a bid to expand or diversify the market for their output, trade openness defined as export plus import over the GDP, is expected to be positively related to FDI inflows. Less control of capital flows also increases the chance for flow of FDI to an economy. Thus a positive relationship is expected between financial openness and FDI inflows. The level of a country's external indebtedness compared to its size (or GDP) also sends some signals to foreign investors. High level of external debt relative to the GDP of a country issues a red alert to foreign investors as this may prompt the government of the country to formulate policies that are not investment-friendly, e.g. faulty tax policies. Domestic investment is a key determinant of the size and growth of an economy. Economies with impressive growth rate or with high prospect for growth, ceteris paribus attract foreign investment. Thus a positive relationship exists between domestic investment relative to economy size and FDI inflows. High commercial banks' lending interest rates act as a disincentive to domestic investors, creating an investment gap which foreign investors will have to fill. On the strength of foreign investors' faith/confidence in the economy, the rise in interest rate could stimulate more FDI inflows to supplement existing investment and fill or narrow the investment gap therein. To play the role of error correction, i.e. restoring FDI to its long run (equilibrium) path, in the event of short run deviation from it, Ω (the coefficient of the error correction term, ECT_{t-1}) is expected to be negatively signed and statistically significant, and for asymptotic convergence to equilibrium, its value should be between -1 and zero; its absolute value indicates the speed of adjustment to equilibrium.

5. Estimation Results and Discussions

Unit Root Test for Variables

The results of the unit root test for the variables (in logs.) are presented in Table 5.1.

Table 5.1: Phillip-Perron (PP) Unit Root Test for Variables.
(Regression includes an intercept and a linear trend).

Variables	Level			Difference			Order of integration
	PP-stat	5% critical value	Inference	PP-stat	5% critical value	Inference	
LFDI	-2.2297	-3.5629	Non-stationary	-9.2504	-3.5684	Stationary	1
LEXRT	-1.0095	-3.5629	Non-stationary	-5.9721	-3.5684	Stationary	1
LM2	-2.9660	-3.5629	Non-stationary	-13.6704	-3.5684	Stationary	2
LTOPEN	-3.5842	-3.5629	Stationary	-8.3087	-3.5684	Stationary	0
LFOPEN	-3.0277	-3.5629	Non-stationary	-7.1644	-3.5684	Stationary	1
LEXDT_GDP	-2.5056	-3.5629	Non-stationary	-4.3005	-3.5684	Stationary	1
LDINV_GDP	-1.4682	-3.5629	Non-stationary	-8.9937	-3.5684	Stationary	1
LLINTR	-2.5720	-3.5629	Non-stationary	-7.5824	-3.5684	Stationary	1

Source: Authors estimations using EVIEWS 7

The unit root test results reveal that the trade openness series is stationary in levels, thus it is integrated of order zero (0), while broad money series is stationary in second difference, i.e. it is integrated of order 2. The remaining variables are stationary in first differences and are therefore integrated of order 1. Although most of the series are individually non-stationary in levels, there is a possibility that a linear combination of the variables is stationary. If this is this case, then the variables will be said to be cointegrated, this is to say a long run (equilibrium) relationship exists between them.

Cointegration Test

The Philip-Perron test is employed to test for cointegrating relationships between the variables. The results of the test are presented below in Table 5.2.

Table 5.2 Philip-Perron Cointegration Test

Sample (adjusted): 1983 2012
Included observations: 30 after adjustments
Trend assumption: Linear deterministic trend
Series: LFDI LM2 LEXRT LTOPEN LFOPEN LEXDT_GDP LDINV_GDP LLINTR
Lags interval (in first differences): 1 to 1

(A) Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.955288	254.0838	159.5297	0.0000
At most 1 *	0.820618	160.8583	125.6154	0.0001
At most 2 *	0.748610	109.3113	95.75366	0.0042
At most 3	0.707684	67.88880	69.81889	0.0706
At most 4	0.411286	30.99123	47.85613	0.6670
At most 5	0.203796	15.09681	29.79707	0.7738
At most 6	0.141677	8.259821	15.49471	0.4380
At most 7	0.115341	3.676590	3.841466	0.0552

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

(B) Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.955288	93.22546	52.36261	0.0000
At most 1 *	0.820618	51.54709	46.23142	0.0124
At most 2 *	0.748610	41.42246	40.07757	0.0351
At most 3 *	0.707684	36.89756	33.87687	0.0211
At most 4	0.411286	15.89443	27.58434	0.6747
At most 5	0.203796	6.836985	21.13162	0.9600
At most 6	0.141677	4.583231	14.26460	0.7932
At most 7	0.115341	3.676590	3.841466	0.0552

Max-eigenvalue 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
Source: Author's computation using EVIEWS 7

The Trace test indicates 3 cointegrating equations, while the Maximum Eigenvalue test indicates existence of 4 cointegrating equations between the variables. These tests indicate existence of cointegrating relationships between the variables.

Short Run (Error Correction) Representation

Considering that the existence of equilibrium relationship(s) between the variables is a condition for error correction representation, according to the Granger Representation Theorem, we proceed to represent the short run (dynamic) relationship with the standard error correction model using the Engle-Granger two-step procedure. The result of the estimation is presented in Table 5.3. The model is estimated using the variables in the forms in which they are stationary.

Table 5.3 Short Run (Dynamic Error Correction) Estimation Results

Dependent Variable: D(LFDI)
Method: Least Squares
Sample (adjusted): 1983 2012
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.098103	0.114125	0.859616	0.4002
D(LFDI(-1))	-0.214289	0.157190	-1.363249	0.1880
D(LM2,2)	-0.952240	0.743253	-1.281178	0.2148
D(LEXRT)	0.818513	0.368656	2.220265	0.0381
D(LTOPEN)	0.740392	0.310747	2.382617	0.0272
D(LFOPEN)	0.010843	0.186193	0.058234	0.9541
D(LEXDT_GDP)	-0.572709	0.188763	-3.034010	0.0066
D(LDINV_GDP)	-0.156004	0.159257	-0.979570	0.3390
D(LLINTR)	0.911839	0.427786	2.131531	0.0456
ECT(-1)	-0.763760	0.253846	-3.008756	0.0069

R-squared	0.713542	Mean dependent var	0.275105
Adjusted R-squared	0.584636	S.D. dependent var	0.591292
S.E. of regression	0.381080	Akaike info criterion	1.169588
Sum squared residual	2.904442	Schwarz criterion	1.636654
Log likelihood	-7.543816	Hannan-Quinn criterion.	1.319006
F-statistic	5.535368	Durbin-Watson stat	1.760049
Prob(F-statistic)	0.000711		

Source: Author's estimation using EVIEWS 7

The signs on the coefficients of LEXRT, LTOPEN, LFOPEN, LEXDT_GDP and LLINTR conform to a priori expectations, while that on LDINV_GDP does not. There is no a priori expectation on the sign on broad money variable. The result shows no evidence of significant short-run impact of broad money expansion on inflow foreign direct investment in Nigeria. This is attributable to foreign investors' confidence in the prospect of the economy and to expectation of impressive returns from the sector (s) of the economy to which they channel their investments. Furthermore, the results reveal that nominal exchange rate depreciation has significant positive impact on FDI in the country. The impact is highly significant at the 2 percent level. This implies that the depreciation of the Naira contributes significantly to the flow of FDI into Nigeria during the review period. A 10 percent depreciation of the Naira (i.e. a 10 percent increase in the

exchange rate) is associated with about 8.2 percent increase in FDI inflows. Openness of the economy to international trade also positively, significantly impacts on the flow of FDI into the country in the short-run, the impact being significant at the 2 percent level. This suggests that greater integration of Nigeria's economy with the global market engenders significant inflow of FDI into the economy in the short-run. Financial openness is, however, observed to have no significant relationship with the flow of FDI into the country. The results also show that the size of Nigeria's external debt relative to its GDP is negatively and significantly related to the amount of FDI that flows into the country. This relationship is highly significant at the 1 percent level. A 10 percent rise in the external debt-GDP ratio is associated with about 5.73 percent decrease in the amount of FDI that flows into the country. This suggests that unsustainable external debt levels adversely affect the inflow of FDI into the economy as it reduces its attractiveness to foreign investors. The relationship between domestic investment relative to GDP and FDI inflows is highly insignificant. This suggests that the amount of domestic investment in the country has no bearing on the amount of FDI that flows into it. The impact of commercial banks lending interest rate on FDI inflows is positive and significant at the 2.5 percent level. A 10 percent increase in the lending interest rate is associated with 9.11 percent increase in the flow of FDI to Nigeria's economy. A plausible interpretation of this observation is that the increase in lending interest rate acted as a disincentive to domestic investors, and Ajakaiye (as cited in Obida and Abu, 2010), holds that it also affected the internal rate of return of domestic investors negatively, engendering reduction in domestic investment and creating a gap that needs to be filled. This necessitates foreign investment inflows. The inflow of FDI in the face of rising interest rate is based on foreign investors' confidence in the prospects of the country's economy, as well as expectations of favourable returns from the sector of the economy to which the investment is channeled. This suggests the need for the monetary authority to put up a framework to curtail escalation of commercial banks' lending interest rates to avoid foreign dominance which may not augur well for the economy in the long-run.

The coefficient of the error correction term is correctly signed, and is also statistically significant at the 1 percent level. The coefficient suggests that over 76 percent of the short-run deviation of FDI from its equilibrium path is offset annually to maintain the long-run equilibrium. This is an indication of a very high speed of adjustment of FDI to its equilibrium path in the event of short-run deviation there from.

The coefficient of determination (R^2) indicates that the model has a good fit, as over 72 percent of the variation in the dependent variable is explained by the regressors. The unexplained portion is attributable to other factors affecting FDI inflows not included in the model, such as state of infrastructure, insecurity, etc. The F statistic is highly significant at the 1% level and indicates that the variables are jointly significant in the determination of FDI inflows. The DW-statistic indicates absence of first order positive autocorrelation. This is further confirmed by the results of the Breusch-Godfrey (B-G) test for serial correlation (Table 5.4). The results indicate acceptance of the assumption of absence of serial correlation of the residuals. Furthermore, the Breusch-Pagan-Godfrey (B-G-P) test result (Table 5.5), suggests that the assumption of homoskedasticity cannot be rejected. Thus the model is appropriately specified, and could be relied upon for policy.

Table 5.4. B-G Test for Serial Correlation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.887563	Prob. F(2,18)	0.4289
Obs*R-squared	2.692969	Prob. Chi-Square(2)	0.2602

Source: Author's computation using EVIEWS 7

Table 5.5: B-P-G Test for Heteroskedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey

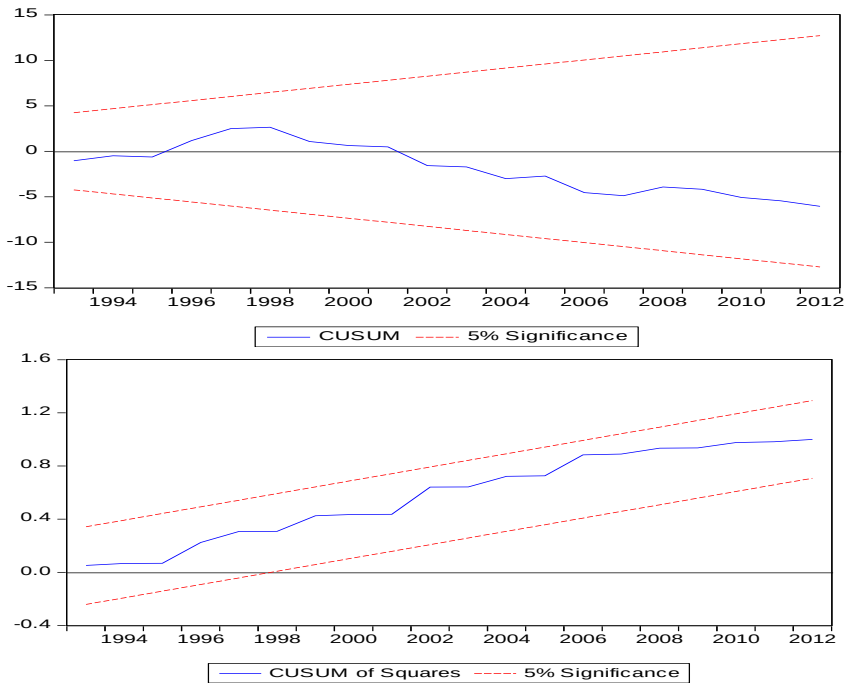
F-statistic	1.858325	Prob. F(9,20)	0.1191
Obs*R-squared	13.66232	Prob. Chi-Square(9)	0.1349
Scaled explained SS	3.918900	Prob. Chi-Square(9)	0.9167

Source: Author's computation using EVIEWS 7

Test of structural stability.

The structural stability of the model is tested using the cumulative sum of residuals (CUSUM) the cumulative sum of squared residual (CUSUMSQ). The plots are shown in Figure 1.

Figure 1: Plots of CUSUM and CUSUM of squares.



The plots of both CUSUM and CUSUMSQ lie between the 5% critical bounds. This indicates that the parameters of the model are structurally stable, and this augurs well for policy.

Long run estimates

The Engle and Granger two step procedure employed for the estimation of the short-run (dynamic) error correction model resolves that estimating the static model specified in equation 3 gives the long run effects. The result of estimation of equation 3 is presented in Table 5.6.

Table 5.6. Estimated Static (Long Run) Model

Dependent Variable: LFDI
Method: Least Squares
Sample: 1981 2012
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.439744	3.223889	-0.446586	0.6592
LM2	0.097492	0.318645	0.305958	0.7623
LEXRT	0.850477	0.420758	2.021295	0.0545
LTOPEN	0.795214	0.371902	2.138236	0.0429
LFOPEN	-0.204393	0.224606	-0.910006	0.3719
LEXDT_GDP	-0.416903	0.210861	-1.977149	0.0596
LDINV_GDP	-0.227975	0.161337	-1.413032	0.1705
LLINTR	1.014990	0.470001	2.159550	0.0410

R-squared	0.983510	Mean dependent var	10.47962
Adjusted R-squared	0.978701	S.D. dependent var	2.862199
S.E. of regression	0.417718	Akaike info criterion	1.304299
Sum squared residual	4.187726	Schwarz criterion	1.670733
Log likelihood	-12.86879	Hannan-Quinn criterion.	1.425762
F-statistic	204.4914	Durbin-Watson stat	1.799999
Prob(F-statistic)	0.000000		

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.522547	Prob. F(2,22)	0.6002
Obs*R-squared	1.451199	Prob. Chi-Square(2)	0.4840

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.788494	Prob. F(7,24)	0.6038
Obs*R-squared	5.983261	Prob. Chi-Square(7)	0.5417
Scaled explained SS	3.626989	Prob. Chi-Square(7)	0.8216

Source: Author's estimation using EVIEWS 7.

Again it is observed that the long run (static) effect of broad money expansion on FDI inflows in Nigeria is also statistically insignificant. This suggests that broad money expansion is not a significant factor explaining the amount of FDI that flows into the country. Exchange rate depreciation and greater integration of Nigeria's economy with the global market increase the attractiveness of the economy to foreign direct investment, all things being equal. There is no significant long run relationship between financial openness and FDI inflows. Increase in external debt-GDP ratio has statistically significant negative long run effect on the inflow of FDI, while the long run effect of domestic investment-GDP ratio is statistically insignificant. The long run effect of commercial banks lending interest rate on FDI inflows is significantly positive. The model has high goodness of fit as indicated by the coefficient of determination of over 98%. The highly significant F statistic indicates that the variables are jointly significant in explaining the amount of FDI that flows into the country. The DW and the B-G tests for serial correlation indicate absence of the problem of autocorrelation in the model, while the B-G-P test result indicates acceptance of the assumption of homoskedasticity. The model is therefore appropriately specified and could be relied upon for policy.

Granger Causality (G-C) Test

To further investigate the relationship between monetary expansion and inflow of FDI in Nigeria, the pair-wise Granger causality test introduced by Granger (1969) is conducted to determine whether or not history of broad money helps to predict (current) inflow of FDI in the country, and vice versa in the period under consideration. In mainstream econometric investigations, the G-C test is applied to variables that are stationary in levels. It is observed in the unit root test for stationarity that M2 is stationary in second difference, while FDI is stationary in first difference (Table 5.1). Therefore the causal relationship between M2 and FDI is investigated using the variables in the forms in which they are stationary. The G-C test involves estimating the following (pairs of) vector autoregressive (VAR) models:

$$\Delta \mathrm{LFDI}_t = h_0 + \sum_{f=1}^{p} \acute{\Gamma}_f \Delta \mathrm{LFDI}_{t-f} + \sum_{g=1}^{p} \left(Đ_g \, \Delta(\mathrm{LM2,2})_{t-g} \right) + U_t$$

$$\Delta(\mathrm{LM2,2})_t = z_0 + \sum_{ç=1}^{p} \acute{y}_ç \Delta(\mathrm{LM2,2})_{t-ç} + \sum_{\varpi=1}^{p} \left(\bar{A}_\varpi \, \Delta \mathrm{LFDI}_{t-\varpi} \right) + V_t \qquad (4)$$

Testing the null hypothesis (H0): $Đ_1 = Đ_2 = \ldots = Đ_p = 0$, against the alternative hypothesis (H1): $Đ_1 \neq Đ_2 \neq \ldots \neq Đ_p \neq 0$ is a test that M2 does not Granger-cause FDI. Similarly, testing the null

hypothesis (H0): $\bar{A}_1 = \bar{A}_2 = \ldots \bar{A}_p = 0$, against the alternative hypothesis $\bar{A}_1 \neq \bar{A}_2 \neq \bar{A}_p \neq 0$ is a test that FDI does not Granger-cause M2. The Wald's F-statistic shall be employed for the test. The null hypotheses are tested at the 5% level of statistical significance.

In pair-wise Granger-causality test, rejecting a null hypothesis, and accepting the other suggests that that there is unidirectional Granger causality between the two variables in the pair of VAR models, with causality running from the first variable that appears in the rejected null hypothesis to the other variable. In the event that both null hypotheses are rejected, the implication is that there is two-way causation (that is bi-directional causality). This is to say that both variables involved in the pair-wise Granger-causality test Granger-cause each other. Where both null hypotheses are accepted, the implication is that there is no Granger-causality between both variables. The results of the pair-wise Granger-causality tests are presented in Table 5.7.

Table 5.7: Pairwise Granger Causality (G-C) Test Results

Null Hypotheses	Lag	Obs	F-Stat.	Prob.	Decision	Inference
D(LFDI) does not Granger Cause D(LM2,2)	1	29	0.00347	0.9534	Accept	No-causation
D(LM2,2) does not Granger Cause D(LFDI)			1.36471	0.2533	Accept	
D(LFDI) does not Granger Cause D(LM2,2)	2	28	0.01351	0.9866	Accept	No-causation
D(LM2,2) does not Granger Cause D(LFDI)			1.34300	0.2808	Accept	
D(LFDI) does not Granger Cause D(LM2,2)	3	27	0.01674	0.9970	Accept	No-causation
D(LM2,2) does not Granger Cause D(LFDI)			0.81416	0.5011	Accept	
D(LFDI) does not Granger Cause D(LM2,2)	4	26	0.04395	0.9960	Accept	No-causation
D(LM2,2) does not Granger Cause D(LFDI)			0.59103	0.6737	Accept	

Source: Author's estimations using EVIEWS 7.

It can be observed that estimating the VAR model using 1, 2, 3, 4 lagged values of each variable gives no indication of a causal relationship between the two variables as the null hypotheses are both accepted at the 5% significance level. Considering that causal relationship(s) exists between cointegrated variables (Gujarati, 2009), the G-C test results further confirms the absence of long run relationship between M2 and FDI. Thus, history of M2 does not help to predict the amount of FDI that flows into Nigeria's economy. The observation that FDI does not predict M2 suggests that the amount of FDI that flows into Nigeria's economy does not significantly influence the level of broad money supply.

6. Policy Recommendations

In the light of the totality of the findings, the following policy options are recommended to enhance the attractiveness of Nigeria's economy to foreign direct investment.

Considering that exchange rate depreciation is favourable to inflow of FDI into Nigeria's economy, the monetary authority should put in place measures to avoid over appreciation and overvaluation of the Naira. However, measures should also be taken to avoid excessive depreciation of the Naira as this could have detrimental effects on the nation's export, and could trigger high inflation in the economy since the country is highly important dependent.

I. The observed positive and statistically significant impact of trade openness on FDI inflows is an indication that greater integration of the nation's economy with the global market will pave way for increased inflow of FDI into the economy. To this end, barriers to cross-border trade in goods and services should be eliminated, albeit selectively, not full scale, to protect some sectors of the economy which are not strong enough to compete at the global level, and may be further weakened as a result of full scale trade liberalization.

II. The level of external indebtedness of the country (relative to its GDP) was observed to have detrimental effects on the inflow of FDI into the economy. The need to reduce the external indebtedness of the country to sustainable levels cannot be overemphasized.

III. The observed relationship between the weighted average lending interest rates of commercial banks and FDI inflows suggests that increase in the interest rate was associated with increased inflow of FDI. However, beyond some threshold, this could act as a disincentive to domestic investors. There is therefore the need to target a range of interest rate favourable to both domestic/indigenous and foreign investors so as to avoid foreign dominance of the productive sectors, which may not augur well for the economy in the long run.

IV. Considering that excessive inflow of FDI to an economy with poorly developed financial sector could engender high inflation rates as a result of expansion in money supply as seen in the Granger causality test, and could as well cause severe financial crisis as witnessed in Asia, and engender appreciation of the domestic currency, which could affect the country's export performance, while striving to attract more FDI, Nigeria's government should also put up a framework to mitigate its adverse effects.

7. Conclusion

The objective of the paper has been to investigate the impact of monetary expansion on the inflow of FDI into Nigeria's economy, with a view to identifying other factors affecting FDI inflows and recommending policy options which could enhance the attractiveness of the economy to FDI. The methods of cointegration and error correction modeling and Granger causality tests were employed for the investigations. The analysis finds no evidence of significant short and long run effects of monetary expansion on inflow of FDI to Nigeria's economy. It also finds that broad money is not a predictor of FDI inflows in Nigeria. These findings uphold the null hypothesis formulated at the introduction of the paper. The analysis,

however, finds that trade openness, exchange rate depreciation and commercial bank lending interest rate are positively and significantly related to FDI inflows. External indebtedness has significant adverse effect on FDI inflows, while the effects of domestic investment and financial openness on FDI inflows are negative, though statistically insignificant. Furthermore, the Granger-causality test result indicates that no causal relationship exists between broad money expansion and foreign direct investment in Nigeria. Reducing the level of external debt, greater openness of the economy to international trade, depreciation of the domestic currency, (not excessive depreciation as this could have detrimental effect on the country's export as well as engender high inflation as the country is highly import dependent), etc. may enhance the attractiveness of the economy to FDI.

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IMPACT OF OIL PRICE SHOCKS ON THE MACROECONOMY: EVIDENCE FROM NIGERIA

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Abstract

The role of oil price shocks in the movements of key macroeconomic fundamentals such as output and inflation has been the focal point of many empirical enquiries. However, earlier studies on the oil price- output-inflation relationship in Nigeria hardly took an explicit account of potential non-linearities. This study, therefore, investigated the impact of oil price shocks on output and inflation in Nigeria between 1970 and 2006. A macroeconometric model which captured both the direct and indirect relationships between oil price shocks, output and inflation, was employed. Three alternative measures of oil price shocks namely linear, asymmetric and volatility were considered. The behavioural equations were estimated using the three-stage-least-squares technique and a general-to-specific procedure was used to minimise the loss of valuable information. The linear benchmark model showed that the effect of oil price shocks on inflation was moderately important, while the effect on output was not significant. Specifically, in response to a doubling of oil price, output rose by 0.20% and it resulted in a 0.25% decline in inflation. The results of the asymmetric model indicated that a 100% increase in oil price would cause output to rise by 0.57%, but it would decline by only 0.13% following an oil price reduction of the same order of magnitude. The volatility measure showed that doubling the oil price would raise output by 0.45% and inflation would increase by 0.15%. The estimated results suggested that oil price shocks had trifling impact on output, while it appeared to have slight effect on inflation. This implied that the enclave nature of the oil sector and its weak linkages with the rest of the economy as well as better management via sterilisation may have moderated the effect of oil price shocks on both output and inflation respectively.

Key words: Oil price shocks, Macroeconometric model, Output, Inflation.

JEL codes:
G12; E32;
Q43; O53

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1 Introduction

Oil plays a significant role in the Nigerian economy as evidenced not only by being the largest contributor in terms of total government revenue but also the overall leader in her exports composition. It accounted for 82.1% of total government revenue

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during the oil boom in 1974 before reducing to a share of 64.3% by 1986 which was a consequence of the rapid decline in world market price of crude oil. The share of oil revenue in total government revenue still remains substantial owing to the attainment of 85.6% and 86.1% in 2004 and 2005, respectively (Adeniyi, 2010). Thus, in the case of Nigeria, persistent oil shocks could have severe macroeconomic implications which may induce challenges with respect to policy making. Furthermore, there appears to be a clear link between international oil price movements and the performance of key macroeconomic indicators, such as real output and the level of domestic prices, in the Nigerian economy. The first half of the 1970s, which coincides with the period of the first major oil price shock in the global markets, was characterised by high level of growth in real output. The price of oil which merely stood at $ 1.8 per barrel in 1970 rose rapidly to $ 11.6 by 1975 with Nigeria's average growth of real output standing at 7.5 per cent. The steady decline era, with regard to oil prices, of the early 1980s also fits the low and negative realisation of the growth of GDP as an unimpressive GDP growth rate of -6.35 per cent was recorded over the period spanning 1981-1985. The experience with inflation also illustrates, quite insightfully, the association between oil price developments and the dynamics of key macroeconomic variables. While the price of oil in the period 1976-1980 was $ 24.4 on the average, inflation averaged 16.6 per cent. The converse , plausibly , is true as the sustained rise in oil prices experienced over the 2002-2006 period appears to be a major, albeit not the only, explanation for the rise in inflation from the previous period average of 10.2 per cent (i.e. in 1997-2001) to 13.6 per cent. Thus, a pattern seems to emerge where higher oil prices are linked with improvements with regard to output growth on the one hand and higher domestic prices on the other.

The foregoing problems make raising the following questions a necessary exercise: What are the effects of oil price shocks on the real sector of the Nigerian economy? Are there non-linearities in the oil price- macroeconomy nexus in the case of Nigeria?. Addressing these and related issues constitute the primary thrust of this paper.

The key objectives of this empirical exercise are clear namely; to examine the impact of oil price shocks on output and the general price level as well as to ascertain the importance or otherwise of non-linearities in the relationship between oil prices and these key macroeconomic fundamentals.

Although a plethora of extant enquiries have forayed into unearthing the nexus between oil prices and the macroeconomy, the present study makes inventive attempts on at least four counts. First, there appears to be an empirical puzzle on the relationship between oil prices and macroeconomic aggregates in Nigeria. A review of earlier studies has revealed the existence of only a few thorough ones, have found little or no significant effect of oil prices on macroeconomic activities (See Ayadi et al 2000; Ayadi 2005 and Olomola and Adejumo 2006). This is out of consonance with received wisdom particularly against the backdrop of the dominance of the oil sector in the Nigerian economy. Hence, there is a need to re-investigate empirically the oil price- macroeconomy relationship in order to further probe this conundrum. Second, the preponderance of existing studies has employed Vector

Autoregressive (VAR) models. In particular, most of the studies in the literature have dwelled on issues as they concern net oil importing developed countries using VARs. Although a few studies are available for net oil exporting developing countries, there has not been much emphasis on identifying the likely channels via which oil price shocks exert influence on these economies.

Olomola and Adejumo (2006) construct a VAR model of the Nigerian[7] economy but do not explicitly consider both the long run linkages between oil price shocks and macroeconomic aggregates and the details of the transmission mechanism of the shocks. Hence, methodology-wise, this study differs considerably from most other studies by seeking to develop a small macroeconometric model of the Nigerian economy using stochastic equations. Since the variables of interest can be modelled with respect to their theoretical determinants, patterns in structural relationships are tractable. Third, the issue of asymmetric responses of macroeconomic variables to oil price shocks has occupied the attention of researchers since the thought provoking study by Mork (1989). The present study thus seeks to extend this notion to the case of an open net oil exporting developing economy such as Nigeria. Finally, the breakdown in the oil price-macroeconomy relationship identified in the literature (See Hamilton 1996) as a result of functional misspecification of oil prices is an important factor to consider in a study of this nature. While there had been some ample attempts to examine the impact of oil shocks on the macroeconomy, there seems to be less attention on issues of non-linearities and asymmetry simultaneously with specific reference to Nigeria. The thrust of this study is to not only use both positive and negative oil price changes as separate variables but also incorporate non-linearities by deploying a number of literature compliant oil price transformations.

The rest of the paper is organized in the following order. A brief stylized discussion indicative of the connectedness between each of the key macroeconomic aggregates (inflation and output) and oil price trends is the subject of section two. Section three tersely touches on both the theoretical and empirical literature on the effects of oil price shocks on the macroeconomy. The details of the theoretical framework and methodology are bared in section four, while the specifications of the various equations of the macromodel and estimation procedures are also discussed. In section five, the findings from the estimated equations of the model, their interpretations and model validation exercises are presented. The section also looks at the results for the non-linear models while the sixth and final section contains the summary, conclusions and policy lessons.

2. Trends in Crude Oil Prices and Macroeconomic Aggregates in Nigeria

The experience with inflation, as revealed in Figure 1, is somewhat different. In this case there appears to be no clear pattern with regard to movements in oil prices vis-à-vis domestic inflation. Between 1979 and 1980, an oil price increase resulted in a decline in inflation from 11.8 per cent to about 10 per cent. On the flip side, inflation dropped

[7] See also Nnanna and Masha (2003).

precipitously from a peak of about 40.0 per cent in 1984 to single digits (5.5 per cent) in 1985 as a consequence of a relatively smaller, compared with the 1979-80 increase, oil price decrease. During the period from 1997 to 2000, inflation was mostly single digit with the highest recorded at a little less than 10.0 per cent. The striking feature of this period, on the contrary, was that both sharp price increase (in 1998-99) and a substantial price reversal (in 1999-2000) were experienced. Thus, Nigeria's experience with inflation seems to be characterised by no systematic pattern with respect to the influence of crude oil price fluctuations on the global markets.

Figure 1: Oil Prices and Domestic Prices in Nigeria

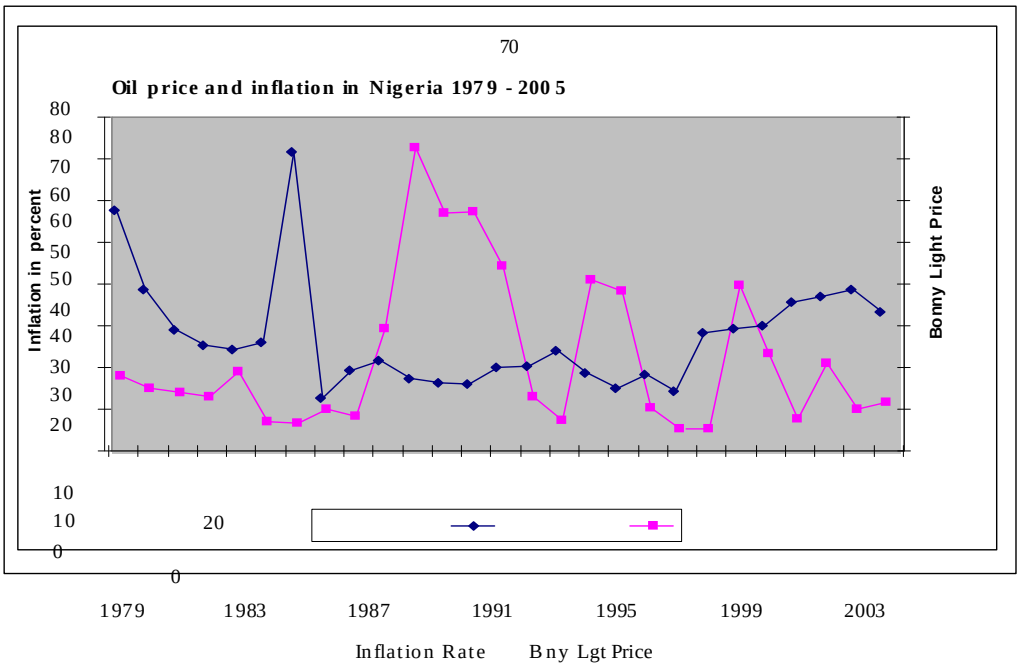
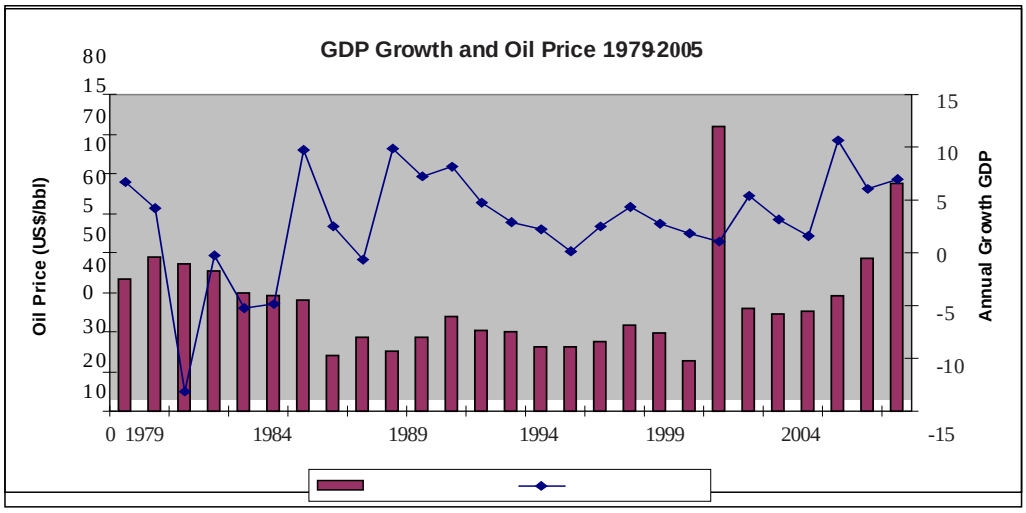


Figure 2 shows the plot of annual growth rate of gross domestic product against oil prices. A close visual inspection shows that the periods of higher oil prices are not necessarily consistent with better economic growth rates. For example, the price of oil moved upwards from $ 15.1 in 1988 to $ 18.6 in the subsequent year but the growth prospects of the economy appeared weaker as evidenced by the decline in GDP growth rate from 9.9 per cent to 7.2 per cent in 1988 and 1989 respectively. Also, the period 1984-85 was one during which a price decline corresponded to higher growth rate in GDP. Specifically, the price of oil reduced from $ 29.2 to $ 28.2 but the growth rate of the economy stood at about 9.7 per cent in 1985 on the heels of an unsatisfactory -4.8 per cent recorded in the previous year. Although the price of oil was increasing over the period 2002-2005, there appears to be a far from commensurate increase in the growth rate of the economy as the growth rate (though positive) still declined from 10.7 per cent in 2003 to just under 7.0 percent in 2005.

Figure 2: Oil Prices and Output Growth in Nigeria



3. Review of the Empirical Literature

Oil Price Shocks and the Macroeconomy in Developing Countries

Although emphasis with respect to research has been on net oil importing and industrial economies a few recent studies have focused on the effects of oil price changes on the macroeconomy of developing countries.[8] Semboja (1994) calibrates a Computable General Equilibrium (CGE) model to examine the effect of oil price changes on the Kenyan economy. The impact responses suggest that increasing oil prices lead to deterioration in both the terms of trade and trade balance. The consequence of this a decline in output and the price index. Eltony and Al-Awadi (2001) found evidence that linear oil price shocks were important explanations for fluctuations in macroeconomic variables in Kuwait. Their results showed that government expenditure which is the major determinant of economic activity in the country was significantly influenced by shocks to oil prices. De Santis (2003) using a CGE model for Saudi Arabia attempts an explanation of the fluctuations in oil prices, via crude oil demand and supply shocks, and their impact on overall prices, output, profits and welfare. His results support the view that there is an overshooting effect on prices while output converges steadily to its long run equilibrium level. The welfare effects on Saudi Arabia were found to be, compared to results in the CGE literature, very large suggesting that supply shocks to the oil market through increased production quotas will be avoided by the Saudi authorities.

Wakeford (2006) employs a political economy orientation which relies on historical analysis of the impact of oil price shocks on the South African economy. He concludes that the

[8] Some of these studies include Ayadi(2005), Ayadi et al. (2000), Adenikinju and Falobi (2006), Semboja (1994) and Nkomo (2006)

effects of recent shocks were only beginning to manifest in rising inflation and interest rates as well as slowing of economic growth. Swanepoel (2006) uses a VAR model to investigate the impact of external (oil price) shocks on the imports prices, producer prices and consumer inflation rates in South Africa. He finds a negative response of non-oil import prices to oil price shocks. For producer prices and consumer prices, the shock had significant positive (at least on impact) and insignificant positive (irrespective of the number of lags considered) effects respectively. Raguindin and Reyes (2005) examine the effects of oil price shocks on the Philippine economy. Their impulse response functions for a linear specification of oil prices revealed that oil price shocks lead to prolonged declines in real GDP. In the non-linear VAR however oil price decreases play a greater role in fluctuations of model variables than oil price increases. They use data covering the period 1981-2003. Chang and Wong (2003) using quarterly data from 1978:1-2000:3, within a vector error correction model (VECM), on oil prices, GDP, consumer price index and unemployment rate find a marginal impact of oil price shocks on the Singapore economy. Both impulse response and variance decomposition analysis provide reasonable basis for their conclusion that the adverse effect of oil prices on GDP, inflation and unemployment rates in Singapore was minimal. They however conclude that this impact, though small, should not be interpreted as negligible.

Anshasy et al (2005) investigate the effects of oil price shocks on Venezuela's economic performance from 1950-2001 employing general to specific modelling (VAR and VECM). They examine the relationship between oil prices, government revenues, government spending on consumption, investment and GDP and found two long run associations consistent with economic growth and fiscal balance. These relationships were important for both long run performance and shorter term fluctuations.

Ayadi et al (2000) examine the effects of oil production shocks on a net oil exporting country, Nigeria. Using a standard VAR which includes oil production, output, the real exchange rate and inflation over the 1975-1992 period, the impact responses show that a positive oil production shock was followed by rise in output, reduction in inflation and a depreciation of the domestic currency. With the same methodology and set of variables (except that oil price replaces its level of production), Ayadi (2005) finds negligible responses of output, inflation and the real exchange rate following an oil price shock. Olomola and Adejumo (2006) examine the effects of oil price shocks on output, inflation, real exchange rate and money supply in Nigeria within a VAR framework. They find no substantial role for oil price shocks in explaining movements in output and inflation. Only the long run money supply and the real exchange rate are significantly affected following a shock to oil prices.

Farzanegan and Markwardt (2009) analyse the dynamic relationship between oil price shocks and major macroeconomic variables of the Iranian economy by applying a VAR approach. Their study points out the asymmetric effects of oil price shocks; for instance, positive as well as negative oil price shocks significantly increase inflation. They also find a strong positive relationship between positive oil price changes and industrial output growth. However, they surprisingly find only a marginal impact of oil price fluctuations on

real government expenditures. Furthermore, the Dutch Disease syndrome through significant real effective exchange rate appreciation appears to be supported by the relevant data for Iran. Jbir and Zouari-Ghorbel (2009) study the oil prices–macroeconomy relationship by analysing the role of subsidy policy in Tunisia. The vector autoregression (VAR) methodology was employed to analyze the data over the period 1993 Q1 to 2007 Q3. The results of the model using both linear and non-linear specifications indicate that there is no direct impact of oil price shock on economic activity. The shocks to oil prices affect economic activity indirectly. The major channel via which the effects of the shock are transmitted is the government's spending.

4. The Macroeconometric Model

4.1 The Structure of the Macroeconomic Model

The ensuing discussion thus centres on the specifications of the equations of the macroeconomic model, the linkages in the macro model as well as the estimation techniques.

Income Determination

The traditional income determination identity posits that income (Y) is demand driven and determined by its components i.e consumption (C), investment (I) and net exports (X-M). That is;

$$\boldsymbol{Y = C + I + G + X - M} \qquad (1)$$

Where X is exports and M is imports.

In what follows is the modelling of the individual components of aggregate demand.

Consumption

Consumers always face an inter-temporal decision problem as they need to choose the amount of available resources to consume in the current period. This implies a simultaneous consumption decision for future periods. Hence, the private consumption function relies on the inter-temporal optimizing model of consumption. However, the impact of interest rate on consumption is theoretically indeterminate since the relative weights of the substitution and income effects for a net saver informs the outcome. An increase in interest rate on the one hand leads to a rise in the rate of return on saving which produces s substitution effect in favour of saving thus implying lower consumption. On the other hand, increased interest rate implies that it is easier to accumulate a given amount of cash holdings. This acts as a disincentive to saving and thus consumption in the current period rises with the net (final) effect both in terms of magnitude and direction indeterminate. The price level has implications for private consumption, and is added as an explanatory variable, as it affects the real value of consumers liquid assets such as demand deposits and also reduces consumption via a lowering of money's purchasing power. Thus the private consumption function is given as;

$$rpcons_t = \beta_0 + \beta_1 rgdp_t + \beta_2 prc_t + \beta_3 rgdp_{t-1} + \beta_4 rir_t + \varepsilon_1 \qquad (2)$$

Where rpcons is private consumption, rgdp is Gross Domestic Product, prc is the general price level and rir is the real interest rate.

Aggregate Investment

The modelling of investment relies on the accelerator principle which explicitly underscores the importance of output in investment decisions. Thus in a developing economy with a relatively less sophisticated capital market, the growth of the economy could serve as an indicator of how profitable investments are expected to be.

The above implies a direct and proportional relationship between net investment and output growth. Thus, for net investment to be positive an accelerator in the growth of output is required. This theoretical principle, although convincing, leaves out the role of the opportunity cost of capital and its effect on investment outcomes. Thus, the interest rate is included as a regressor since higher capital user cost raises the opportunity cost of capital use (since the capital could be sold and the returns saved) with a resultant decline in investment. Also, taking a cue from the debt-overhang literature, high external debt is viewed by investors as a signal to higher future taxes on investment and thus discourage private capital accumulation. Therefore, the effect of debt servicing (quite substantial over most of this study's sample period) on investment is captured through the inclusion of an external debt stock-GDP variable. The price level affects investments through expectations about future prices. A higher price level is interpreted as a signal to macroeconomic distortions since even higher price levels are envisaged in the future. Such expectations lead to a reduction in investment. Also, saving and therefore investment is reduced through a decline in the real interest rate occasioned by the aforementioned price level expectations. The aggregate investment function is hence written as;

$$rinv_t = \delta_0 + \delta_1 rgdp_t + \delta_2 rir_t + \delta_3 prc_t + \delta_4 edgdp_t + \varepsilon_2 \qquad (3)$$

Where rinv is aggregate investment and edgdp is the debt stock-GDP ratio. The other variables in the expression retain their earlier definitions.

Government Expenditure

Government Expenditure is postulated to be a function of government revenue which derives mainly from oil exports. Increased export earnings imply an increase in revenue to the government and ceteris paribus higher spending especially on recurrent items such as wages, pension obligations, subsidies and so on. Due to the ubiquity of the fiscal dominance phenomenon in developing countries, the money supply is included as a regressor. It is commonplace for fiscal demands to be met through money creation emanating from political pressures which the absence of autonomous monetary authorities helps aggravate. This has far reaching implications prominent of which is the Dutch Disease spending effect and the attendant appreciation of the real exchange rate and the decline in competitiveness for adversely affected sectors of the economy. The government (recurrent) expenditure function is given as;

$$rg\exp_t = \alpha_0 + \alpha_1 rgvrev_t + \alpha_2 mny_t + \alpha_3 rg\exp_{t-1} + \varepsilon_3 \qquad (4)$$

Where rgexp is government recurrent expenditure and mny is the money supply (broadly defined). It is noteworthy that the lagged expenditure term is added to capture persistence in government behaviour since it is usually difficult to scale down spending in developing countries. All other variables are as earlier defined.

Export Function

Nigeria, being essentially a monocultural economy, derives well over 90% of her export revenue from crude oil. Due to the above fact that aggregate export is thus partitioned into oil exports and non-oil exports (mainly agricultural commodities).
Hence;

$$X = oilX + NoilX \qquad (5)$$

Where oilX is crude oil exports and NoilX represents other exports.

Non-oil export is conventionally modelled using the export demand and supply framework.

On the demand side, a measure of On the demand side, a measure of foreign income is an important

explanation. This variable is usually a trade-weighted average of the incomes of a country's major

trading partners. Export demand is also affected by the real exchange rate.

A rise in foreign income is expected to boost export volume via higher export demand while a depreciation of the domestic currency implies that domestic goods are cheaper to foreigners resulting also in increased exports.

On the supply side, the price of exports (pexp) in relation to domestic goods prices is the determinant of real non-oil exports viz; This, non-oil export function, can be expressed in the form;

$$rnoilx_t = \tau_0 + \tau_1 finc + \tau_2 p\exp_t + \tau_3 reer_t + \varepsilon_4 \qquad (6)$$

Where rnoilX is non-oil exports, finc is the foreign income which is the trade-weighted average of incomes for Nigeria's major trading partners. Pexp is export price while other variables remain as defined earlier.

Oil export is modelled in a similar fashion except that in addition to the earlier explanatory variables, leaving out the relative price of export to domestic price level, a variable capturing oil price fluctuations is included as a regressor. This is expedient as shocks to the price of oil in the international market have a clear and direct impact on the export earnings of Nigeria and hence real output. The oil export function is thus expressed in the for

$$roilx_t = ?_0 + ?_1 roilp_t + ?_2 roilx_{t-1} + \varepsilon_5 \qquad (7)$$

Where roilX is oil exports and roilP is a measure of oil price changes.

We now turn to the import demand function with income and the real exchange rate as the conventional determinants. The traditional import demand function posits that a rise in income leads to an increase in import demand while a real depreciation of the real exchange rate reduces import demand by switching spending from imports towards domestic goods. Hence, the import demand function is given as;

$$rimp_t = \varphi_0 + \varphi_1 rgdp_t + \varphi_2 reer_t + \varepsilon_6 \quad (8)$$

Where rimp is imports and other variables retain their earlier definitions.

The Price Level

A key macroeconomic objective is price stability. Thus, it is imperative to investigate the linkage between oil price changes and domestic prices. This can be done theoretically using a model with a weighted average of prices of tradeable and non-tradeable commodities (see Rutasitara, 2004 for Tanzania; Ubide, 1997 for Mozambique; Korsu, 2008 for Sierra Leone among others). The price level in this model is expressed as follows;

Hence, the price equation is given as follows

$$prc_t = \lambda_0 + \lambda_1 mny_t + \lambda_2 rgdp_t + \lambda_3 neer + \lambda_4 rir_t + \lambda_5 roilp + \varepsilon_7 \quad (9)$$

Where neer is the nominal effective exchange rate and other variables remain as defined earlier.

4.2 Methodology and Data Issues

Econometric estimation proceeds in the conventional fashion in the literature. Since it is common knowledge that the use of non-stationary time series data for analysis produces spurious results, the starting point is a formal test of stationarity applying both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. For non-stationary series, the tests for cointegration are conducted to ascertain the likelihood of the existence of stationary linear combinations referred to as cointegrating vectors. Where cointegration is established there is an equilibrium (long-run) association between the I(1) variables. However, the existence of simultaneity precludes the use of the Ordinary Least Squares (OLS) for estimation as the coefficients obtained will be biased and inconsistent. Hence, Three Stage Least Squares (3SLS) which accounts for simultaneous equation bias was employed in estimation following the tests for unit root and cointegration. The foregoing are the vital building blocks of the estimation procedure for the macroeconomic model specified in this study

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Aggregate data at an annual frequency were obtained from BP Statistical Review of World Energy 2008, International Financial Statistics CD-ROM, World Development Indicators

CD-ROM and some issues of the Central Bank of Nigeria Statistical Bulletin. Data spanning the period 1970 to 2006 were collected from these sources.

The components of the income determination identity namely income, private consumption, government consumption, aggregate investment, imports and exports are deflated by the consumer price index to arrive at the real values used for estimation. Except for variables with some negative values and rates, other variables in the stochastic equations were included in logarithmic functional form such that the coefficients are interpretable as elasticities. The foreign income series is calculated as the weighted average of the real incomes of the ten major trading partners of Nigeria. The real exchange rate was computed from the trade weighted average of the bilateral real exchange rate between Nigeria and each of the major trading partners. Three oil price shock series were constructed based on transformations of the linear oil price measure. The first measure is a linear measure which is the log of the difference of the nominal oil price. Our second (asymmetric) measure treats oil price increases and decreases as separate variables. The third series was obtained from a GARCH (1, 1) model of oil prices arising from the intuition about the importance of such shocks in macroeconomic environments were volatility has historically been minimal (see the Appendix for the narrative on the precise definition of these alternative oil price shock measures).

5. Empirical Results

This section is slanted towards the investigation of the time series properties of the model variables, presentation of the estimated model results as well as validation of the macroeconomic model to ascertain its suitability for forecasting and policy analysis.

5.1 Stationarity Tests

It is the rule, rather than the exception, in time series analysis to investigate the stationarity of macroeconomic variables before they are used in regressions. This reflects the fact that estimation with non-stationary variables results in bias and inconsistency of the estimates of coefficient standard errors thus increasing the likelihood of drawing false inferences. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were employed in investigating stationarity. The results of both tests are consistent and show that trade balance, real interest rate, real exchange rate, debt-GDP ratio and nominal exchange rate are stationary. All the other variables only become stationary on differencing once. It is also noteworthy that all the oil price variables, both the linear measure as well as the non-linear transformations, are stationary with the exception of the volatility adjusted measure (sopi). The scaled oil price increase series (sopi) is I(1).

5.2 Test for Cointegrating Relationships

It is possible, under some set of conditions about the behaviour of random errors, to have a linear combination of non-stationary variables that is unit free. If such linear approximation exists, then a long- run (equilibrium) relationship exists among the cointegrated variables. Since the earlier stationarity test revealed that most of the variables

were non-stationary, there is need to conduct cointegration tests. Here, both the Engle-Granger Two Step (EGTS) approach and the Johansen Maximum Likelihood procedure are applied in testing for long-run association. The two methods are employed with a view to ensuring that predictions are mutually reinforcing since the weaknesses of one method can be augmented via the use of the other.

The EGTS approach proceeds in two steps. First, the static regression was estimated for all of the stochastic equations. The residuals from this step one regression were then saved and tested for stationarity on an equation-by-equation basis. Stationary residuals imply that the process generating the residuals is cointegrated. The Johansen Maximum Likelihood procedure, on the other hand, uses estimates from a linked Vector Autoregression (VAR). VARs are sensitive to the specified lag length. In order to arrive at the optimal lag length various criteria were used. These include Schwarz Information Criterion (SIC), Hannan-Quinn test, Final Prediction Error test, Akaike Information Criterion and a Likelihood Ratio test. The lag length suggested by the majority of these tests was three. However, to save degrees of freedom, lower lags were used in some of the equations. Generally, the cointegration tests
reveal that both the EGTS approach and the Johansen procedure[9] yield similar results for all the behavioural equations in the macroeconomic model. Hence, the conclusion that cointegration exists among the variables of each of the stochastic equations.

5.3 Macroeconomic Model Results and Interpretation

The results from the estimated system are displayed in Tables 1. The diagnostics of the estimated system indicate an R^2 ranging from about 33% in the private consumption function to 99% in the price level function. It is noteworthy, however, that the R^2 is applicable with regard to the adequacy of specific equations but is a poor predictor of the overall goodness-of-fit within this system of equations. The ability of the model to replicate observed variations in the historical series is a more reliable measure of equation system adequacy.

The Private Consumption Function

The results of the estimated private consumption function in Table 1 shows that the effect of current year's income on private consumption is positive with an elasticity of 0.157. The coefficient on the lagged income variable was however insignificant and was dropped from the estimation procedure. This seems to point to lack of support for the permanent income hypothesis for Nigeria. To this extent, current consumption is driven by movements in current income since the average propensity to consume remains unchanged as income rises. The real interest rate is significant in the private consumption function. Although the degree of interest rate sensitivity of private consumption is low in Nigeria, 0.003, the inter-temporal substitution principle holds at the aggregate level.[10] Thus, the influence of the interest rate is evident in consumption smoothing as agents can lend or borrow through

[9] The results for the unit root and cointegration tests conducted are excluded here for want of space.
[10] Raut and Virmani (1990) found a similar positive relationship for some selected developing countries.

financial intermediaries especially commercial banks. Despite the less than sophisticated structure of the Nigerian financial system and the low income earnings of most people, borrowing constraints do not appear binding particularly with respect to consumption decisions. This suggests the availability of less formal sources of credit. The lagged private consumption term is positive and significant implying a reasonable degree of habit persistence.

The Aggregate Investment Function

The result of the aggregate investment function is presented in Column 3 of Table 1. The results seem to support the accelerator principle as output has a positive effect on the level of investment. This is similar to the finding of Jayamaran (1996) in his study of South Pacific countries. More importantly, the rate of change, 2.864, is more than proportionate. The results also conform with received wisdom on the effect of the general price level on aggregate investment. Inflation is posited to reduce investments via acting as a signal to potential investors of some degree of macroeconomic instability in the host (destination) country. Therefore, there is an option value associated with delaying investments when sunk costs and the attendant irreversibilities are considered. The responsiveness of aggregate investment to price level change is a negative and statistically significant -0.131.

Table 1: Macroeconomic Model Results using 3SLS

Variable	Private Consumption	Aggregate Investment	Government Expenditure	Non-Oil Exports	Oil Exports	Import	Price Level
Constant	4.087 (3.746)	-2.877 (-7.647)	1.239 (2.171)	-7.621 (-6.728)	-0.172 (-0.764)	-2.205 (-5.75)	1.835 (2.273)
Rir							-0.017 (-3.558)
Reer				0.036 (2.149)			
roilp					0.002 (0.506)		-0.002 (-2.358)
edgdp		-0.008 (-0.391)					
ΔLnrgdp	0.157 (1.886)	2.864 (10.866)				2.411 (7.538)	
ΔLnprc						0.517 (4.087)	
ΔLngvrev			-1.588 (-2.144)				
ΔLnfinc				1.993 (6.81)		0.699 (3.734)	
ΔLnpexp				2.817 (3.241)			
ΔLnmny							-0.199 (-2.134)
ΔLnrpcons (-1)	0.425 (4.614)	-0.131 (-4.716)					

ΔRir(-1)	0.003 (2.757)						
ΔLnrgexp (-1)			0.707 (5.268)				
ΔLnroilx (-1)					1.003 (3.604)		
ΔLnprc (-1)							1.039 (8.693)
R2	0.334	0.589	0.786	0.755	0.989	0.785	0.995
Adj R2	0.267	0.549	0.772	0.731	0.988	0.764	0.994
DW	1.426	1.592	2.122	1.925	1.816	1.825	2.197
Jarque- Bera Test	0.54 (0.52)	0.06 (0.79)	0.89 (0.61)	1.23 (0.43)	0.89 (0.43)	0.88 (0.64)	1.75 (0.19)
ARCH- LM Test	0.75 (0.35)	0.65 (0.32)	0.36 (0.83)	1.03 (0.32)	3.12 (0.10)	0.42 (0.69)	0.65 (0.53)
Ramsey Test	0.63 (0.25)	1.34 (0.22)	0.42 (0.53)	1.05 (0.37)	1.02 (0.32)	0.89 (0.35)	0.87 (0.62)

The external debt-GDP ratio has a negative effect on aggregate investment. These results hinge on the fact that it is aggregate investment, rather than its private and public components, which is modelled here. There are two parts to the theoretical argument. First, a rise in external debt lowers private investment since potential investors envisage higher future taxes. Second, more funds for investment by the government following a receipt of external financing. Hence, the impact of external debt on aggregate investment depends on which of the two effects is dominant. A negative effect, in this instance, suggests that the latter positive public investment effect is outweighed by the former negative debt-overhang effect. Overall, aggregate investment is considerably inelastic to the external debt-GDP ratio (-0.008).

The Government Expenditure Function

The results in column 4 are for the government recurrent expenditure equation. The results show that government revenue is significant and positively related to government recurrent expenditure. The elasticity is –1.588. This appears surprising as higher revenue accruing to government is expected to result in increased public sector spending. A plausible explanation is that as government revenue rises more resources become available to satisfy expenditure which in some way implies a crowding out of or reduction in government recurrent expenditure. This explains the observed negative relationship between the current level of government revenue and contemporaneous fiscal expenditure. Finally, previous government recurrent expenditure has a positive effect on the current level of government expenditure.

The Non-Oil Export Function

The non-oil export function results as seen in column 5 of Table 1 show that the real exchange rate has positive effect on non-mineral exports. The elasticity of non-oil exports to the real

effective exchange rate is 0.036. Thus, depreciation in the real exchange rate renders domestic goods more affordable as the relatively higher prices of foreign goods boosts domestic production. This implies a surge in non-oil exports while the converse holds in the case of a real exchange rate appreciation. Foreign income is a positive and significant contributor to the level of non-oil exports. These exports are basically primary agricultural products. The foreign income is constructed as the trade weighted average of the incomes of Nigeria's ten largest trading partners. Although these countries are industrialised economies with a broad spectrum of options, from many other developing countries, as regard primary commodity exports, an increase in their income still has significant positive effect on non-oil products in Nigeria. This may be due to the fact that an increase in the price of exports relative to domestic goods raises exports as investment in export oriented sectors become more profitable than is the case for domestic (non-tradable) goods. This effect is not only positive, 2.817, but is also statistically significant.

The Oil Export Function

The results in column 6 are for the oil export function. The result shows that oil price shock has a positive but insignificant effect on oil exports and the magnitude is small at 0.002.This result is in line with Hamilton (1996) that which oil posits that an oil price shock usually has a negative impact on output growth in oil-importing economies with the reverse operating in oil-exporting nations. This effect plausibly works through the positive influence of oil price shocks on oil exports with the attendant rise in net exports, assuming unchanged import levels, resulting in higher output levels. However, the positive impact of oil price shocks is insignificant. Lagged oil exports have a positive and significant impact on the current level of oil exports. The elasticity of 1.003 is very close to unity.

The Import Function

The results for the import demand function are presented in column 7. The import demand function shows that income has positive effects on import. The income elasticity of imports, of about 2.41, implies that a 1% increase in income for instance will result in a 2.4% surge in imports. The coefficient of foreign income is positive, with an elasticity of 0.699. A rise in foreign income can be viewed as a consequence of the expansion of economic activities in the major trading partners. The scaling up of production abroad has a linkage with the demand for imports in Nigeria. This seems true, from anecdotal evidence, since the marginal propensity to consume imported goods is high.

The price level has a positive and statistically significant effect on the demand for imports. Intuitively, higher prices of domestically produced goods tilt the balance in favour of foreign products which now appear cheaper to purchase. The consequence of these relative price movements is an increase in import demand. The elasticity of import demand to the price level is about one-half (0.517).

The Price Level Function

In the last column of the table, the results show that the price level is negatively influenced by the money supply, real interest rate and the oil price shock while the impact of

lagged prices is both positive and significant. A strict interpretation of the foregoing is counterintuitive but some plausible explanations are attempted with a view to understanding the results. This is against the background that the oil price shock was significant despite the small, -0.002, coefficient. Inflation in Nigeria, from the results, appears to be a self-fulfilling prophecy. Thus, previous year's price movements in a particular direction reinforce movements in prices in the current year. This has implications with respect to the commitment of the monetary authorities to stabilizing the path of domestic prices.

5.4 Validation of the Macroeconometric Model

The forecasting performance of a macroeconometric model is traditionally done using the historical simulation approach. We follow the standard procedure which includes a visual inspection of the graphs of both the actual and model-generated values of the dependent variables. Also, summary statistics such as Theil's inequality coefficient and its decomposition into its bias, variance and covariance components was used. Root mean squared error (RMSE) and the correlation coefficient between these actual and simulated values are also examined. Figure 3 displays the graphs of the historical and model-based values of some endogenous variables in our benchmark/linear model.[11]

From the figure, the paths in time of the historical and simulated series are close and turning points of the actual series appear to be well tracked by the simulated values. Table 2 also displays the summary statistics used for model validation. Therefore, based on the different evaluation criteria discussed above, our model appears suitable for policy simulation, since it has low bias and variance proportions and a high covariance proportion. Moreover, the low RMSE and high correlation coefficient both further confirm the suitability of the model.

[11] *A similar approach was followed in the cases of the asymmetric and volatility-adjusted models. In sum, both models also display comparable tracking ability with regard the endogenous variables and more importantly turning points in the actual series were mimicked to a reasonable degree by the model-driven series.*

Figure 3: Graphs showing Actual and Simulated Values of Some Endogenous Variables

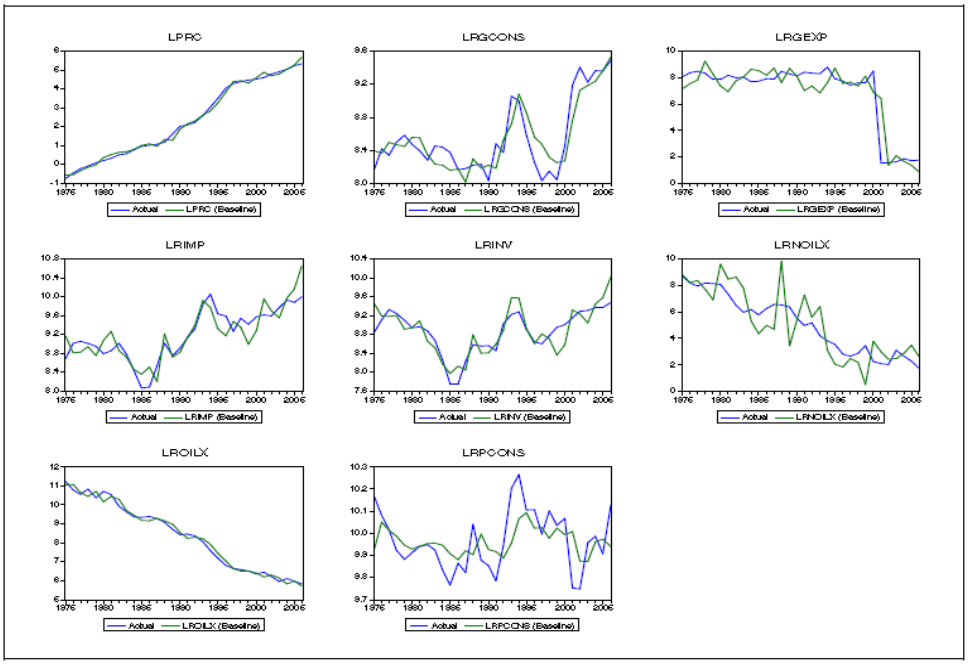

Table 2: Summary Statistics of Validation of the Macroeconomic Model

	Theil's Inequality Coefficient	Decomposition of Theil's Inequality Coefficient			Root Mean Squared Error	Correlation Coefficient
		Bias Proportion	Variance Proportion	Covariance Proportion		
Price Level	0.025	0.000	0.001	0.998	0.149	0.997
Government Expenditure	0.076	0.000	0.058	0.942	0.113	0.890
Imports	0.014	0.000	0.059	0.941	0.256	0.889
Investment	0.012	0.000	0.077	0.923	0.218	0.857
Non-Oil Exports	0.107	0.000	0.078	0.922	0.231	0.855
Oil Exports	0.012	0.000	0.003	0.997	0.212	0.993
Private Consumption	0.006	0.000	0.321	0.678	0.112	0.513

5.5 Interpretation of Results for the Asymmetric Model of Oil Price Shocks[viii]

The results for the asymmetric model are displayed in Table 3. It is worth noting that, in this model, the oil price series is decomposed into oil price increases and decreases with both included as separate variables (see Mork, 1989). As the results reveal, there appears to be no marked difference in both the magnitude and signs of coefficients in most of the equations of this model as compared to the earlier linear specification. For instance, private consumption is still positively influenced by its previous realisation thus lending support to habit persistence with regard consumption decisions. Interestingly, current income and the real interest rate are both insignificant at the conventional levels and hence do not feature in the model. The government consumption function has its lagged value and current income as positive and significant determinants of the path of public sector consumption. The elasticity of government consumption with respect to income changes is 1.22. Hence, it seems plausible that improvements in growth result in expanded public sector activity in the line with Wagner's law. Habit persistence in government consumption is, however, only sparingly supported as the coefficient on the lagged term is just significant at the 10 per cent level.

For aggregate investment, the positive influence of output on investment supports the accelerator principle. Here, 10 per cent increase in output leads to almost 30 per cent rise in the level of investment. The price level, which signals macroeconomic instability, has the expected negative effect on investment as a 1 per cent increase in the level of domestic prices lowers aggregate investment by about 0.1 per cent. The debt overhang effect, though rightly signed, is insignificant in this model. Government expenditures responds more than proportionately to changes in fiscal revenues as evidenced by an elasticity of 1.49 while better growth performance in trading partner countries exerts a positive and significant influence on the non-oil exports sector. Higher domestic economic growth rates have the expected positive effect on the demand for imports. For example, a 1 per cent increase in domestic income leads to a 2.5 percent surge in imports.

Table 3: **3SLS Results for Asymmetric Model**

	Private consumption	Aggregate Investment	Government Expenditure	Non-oil Exports	Oil Exports	Aggregate imports	Domestic Prices
Constant	5.87 (5.863)*	-21.698 (-7.926)*	14.688 (1.935)*	-7.307 (-6.534)*	0.045 (-0.184)	-23.036 (-5.963)*	2.003 (1.774)***
rpcons(-1)	0.411 (4.084)*						
Rgdp		2.942 (11.127)*				2.482 (7.797)*	
Prc		-0.126 (-4.553)*				0.52 (4.008)*	
Edgdp		-0.008 (-0.344)					
Rgvrev			-1.491 (-2.009)**				
rgexp(-1)			0.801 (5.580)*				
Finc				1.956 (11.701)*		0.71 (3.698)*	
Reer				0.039 (-2.289)			
Pexp				2.914 (3.311)*			
roilx(-1)					0.968 (7.729)*		

Mny							-0.214 (-1.662)***
prc(-1)							1.038 (9.978)*
Rir							-0.014 (-2.313)**
Roilpi					0.005 (-1.029)		-0.002 (-1.353)
Roilpd					0.001 (-0.331)		0.0001 (-0.856)
R-Squared	0.241	0.562	0.782	0.741	0.982	0.773	0.975
Adj R-Squared	0.217	0.52	0.768	0.717	0.971	0.75	0.938
Durbin-Watson statistic	1.587	1.886	2.266	1.968	2.298	1.912	2.327

Notes: The symbols *, ** and *** indicate that the variable is significant at 1%, 5% and 10% respectively. Also, the t-statistics are indicated in parentheses.

At this juncture, the paper turns to the equations which serve as the means through which international oil prices enter into our small macroeconometric model of the Nigerian economy. An oil price increase has a positive impact on oil exports and by implication real output.[viii] This result is consistent with both a priori expectation and empirical evidence from other oil-exporting countries (see Al-Awadi, 2001; Abesinghe, 2001 and Eltony, 2001). However, this positive impact is found to be statistically insignificant. Earlier studies on Nigeria, Ayadi et al, 2000; Ayadi, 2005 and Olomola and Adejumo, 2006, also arrived at a similar conclusion. Even in terms of magnitude, the effects appear negligible as a 100 per cent increase in oil prices yields only about 0.5 percentage points rise in oil exports. Also, oil exports are not significantly lowered in response to declining global oil prices as a reduction of about 50 per cent in oil prices would result in 0.1 per cent lowering of oil exports. From the foregoing, the notion of asymmetry which posits that oil price increases leads to shrinking output while oil price decreases of a similar order of magnitude do not seem to spur economic activity appears unimportant in the case of Nigeria. This is implied since both the positive impact of an oil price rise as well as the negative effect of a decline in

oil prices have negligible coefficient which are also statistically insignificant. Finally, a similar outcome emerges from the price equation in our model. Asymmetry, as in the case of output, is also not statistically important as revealed by the low values of the t-statistics. Thus, oil price increases and decreases have marginal (and low) effects on the growth of both real output and domestic prices in Nigeria.

5.6 Interpretation of Results for the Volatility Model of Oil Price Shocks

The result of the model which includes a measure of oil price volatility is presented in Table 4. Following Lee et.al (1995), an oil price volatility variable is included. The intuition behind this is simply that oil price changes are likely to have more pronounced effects in an environment where prices have been historically stable than in cases where price movements have previously been erratic. As the results reveal, the adjusted R-squared ranges from about 22 per cent in the private consumption function to 98 per cent in the oil exports function. It is pertinent to note that these values are almost identical to the ones obtained in the asymmetric model. Also, in the majority of equations in the macroeconometric model with volatile oil prices both the order of magnitudes of coefficients and the signs are similar to those in the model with asymmetry. There are, however, a few striking distinguishing features. First, in the domestic price equation the magnitude of the money aggregate coefficient is 0.027 as compared with 0.214 in the asymmetric model. Although both coefficients have a negative sign, this coefficient is statistically insignificant in the volatility model. Second and even more importantly, oil price volatility has a dampening effect on oil exports and by implication real output. Here, a 10 per cent increase in the volatility of oil prices appears to lower oil exports by about 0.09 percentage points. This impact though seemingly negligible is also found to have no statistical significance in the model. Oil price volatility, notwithstanding, has a positive influence on domestic prices. This is due plausibly to the fact that heightened uncertainties about oil prices also raise uncertainty about the future paths of inflation and inflation expectations. The consequence of the foregoing is a gradual but upward movement of prices within the domestic economy. The elasticity of domestic prices to oil price changes in the model is about 0.015.

In sum, the results from the oil price volatility model are similar to the earlier asymmetric model except for the statistically significant effect of oil prices on domestic inflation in the former model. Hence, the results from both models in Tables 3 and 4 seem to lend credence to the non-existence of important asymmetries and non linearities in the impact of oil price shocks on key macroeconomic indicators for Nigeria

Table 4: 3SLS Results for Volatility Model

	Private consumption	Aggregate Investment	Government Expenditure	Non-oil Exports	Oil Exports	Aggregate imports	Domestic Prices
Constant	5.707 (5.695)*	-19.781 (-7.551)*	18.161 (2.454)*	-7.289 (-6.596)*	-0.109 (-0.547)	-16.941 (-5.111)*	0.377 (-0.887)
rpcons(-1)	0.427 (4.243)*						
Rgdp		2.756 (10.888)*				2.037 (7.584)*	
rgcons(-1)						0.434	
Prc		-0.112 (-4.147)*					
edgdp		-0.008 (-0.382)					
rgvrev			-1.819 (-2.512)**				
rgexp(-1)			0.730 (5.228)*				
Finc				1.991 (8.327)*		0.535 (3.158)*	
reer				0.046 (3.175)*			
Pexp				0.497 (4.743)*			
roilx(-1)					0.994 (4.286)*		

Mny							-0.027 (-0.544)
prc(-1)							1.017 (7.252)*
rir							-0.007 (-1.693)***
Rsopi					-0.009 (-0.502)		0.015 (2.233)**
R-Squared	0.244	0.623	0.777	0.659	0.985	0.839	0.787
Adj R-squared	0.22	0.587	0.763	0.627	0.953	0.813	0.754
Durbin-Watson Statistic	1.615	1.608	2.144	2.011	1.945	2.164	2.318

Notes: The symbols *, ** and *** indicate that the variable is significant at 1%, 5% and 10% respectively. Also, the t-statistics are indicated in parentheses.

6. Conclusion and policy implications

The performances of some key macroeconomic indicators for Nigeria seem to be hinged to a reasonable degree on global oil price dynamics. This pro-cyclical behaviour has constituted a critical challenge to proper macroeconomic management within the Nigerian economy with severe macroeconomic implications which induce challenges with respect to policy making. Three Stage Least Squares (3SLS) approach was employed in the estimation. A number of alternative models were used, capturing diverse aspects of the oil price-macroeconomy relationship. These models ranged from linear to two non-linear specifications. In the linear model, the results showed that oil price shocks had a small positive but insignificant effect on output in Nigeria. This is consistent with some of the results of other studies on oil exporting countries in the literature. Also, oil shocks had a significant, albeit small, effect on the path of domestic prices as a doubling of oil prices resulted in a decline of about 0.2 percentage points in the level of domestic prices.

There are a number of policy lessons arising from the results of the study. First, oil prices appear to have a muted impact on output via the oil exports component of net exports. The implication of this for commercial policy is such that trade liberalization measures should be promoted with a view to improving the competitiveness of the economy vis-à-vis the rest of the world. Second, since the impact of oil prices on domestic price level is minimal, concerns about the tendency for endogenous monetary policy reaction to exacerbate

undesirable economic consequences may not be viewed as crucial. Hence, the monetary authorities may, to a reasonable degree, conduct policy in an effective manner even when oil prices become more or less volatile than expected. Finally, regarding oil revenue management in Nigeria, the government can effectively use domestic demand management policy especially fiscal policy to cushion the possible adverse effects of oil price shocks on the economy. The data on some key variables in the small macroeconometric model developed in this study are not available at higher frequency. This has implications for the results as some of the impact of oil price shocks may prove to be more palpable only after a few quarters or months. Thus, further studies could explore the use of quarterly or monthly data as soon as they become obtainable. Also, the model here considers only aggregate demand and its components without any explicit modelling of the supply side. A plausible direction for future research is a sectoral analysis together with due consideration for not only output effects, as treated in our instance, but also potential employment impacts of oil price shocks. Finally, based on the objectives of the study we have identified, estimated and solved the macroeconometric model together with a validation of the model's ability to mimic observed movements in the actual data on the basis of various criteria. However, simulations/experiments to quantify the effects of changes in some policy variables on the model under different assumptions remain an area which requires attention. The foregoing will help in enriching policy makers' understanding of the effects of shocks to global oil prices on Nigeria's macroeconomic performance.

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Appendix

Alternative Definitions and Measurement of Oil Price Shocks

The traditional, also linear, measure of oil price shocks in the literature as popularised by Hamilton (1983) is the quarterly changes in real oil prices which is constructed as the first log differences of the oil price variable viz;

$$\Delta o_t = \ln o_t - \ln o_{t-1} \qquad \text{(A1)}$$

Where: O_t is the real oil price in period t and ln represents the logarithm of the same variable.

Evidence of non-linearity between GDP growth and oil price changes from the literature informed further investigation with the general consensus being that positive oil price changes affect the macroeconomy by lowering real output growth while the effect of oil price decreases on economic activity may at best be minimal. This asymmetry, as a phenomenon, has been well documented in the literature (see Mork 1989, Jimenez-Rodriguez and the references therein). Mork (1989) concludes that oil price decreases are insignificant using a non-linear specification in which only positive changes are considered as follows;

$$\Delta o_t^{+} = \begin{cases} \Delta o_t \ if \ \Delta o_t > o \\ o \end{cases} \qquad \text{(A2)}$$

In this instance, oil price rises and declines are given separate treatment. He argued that there was little experience with declining oil prices prior to 1980 with the subsequently observed large oil price decreases eroding both the magnitude and statistical significance of the estimated effect of oil on the macroeconomy.

The macroeconomic environment also matters for an objective assessment of the impact of oil price shocks. Lee et al. (1995) show that oil price increases in the aftermath of long periods of price stability have more dramatic implications than those changes which merely correct for large price declines in the immediate ,recent past periods. Thus, it is not only the 'importance' of an oil price increase, as in Hamilton's suggestion, that matters but also the volatility of the oil price series. Lee et al's Scaled Oil Price Increase (SOPI) is calculated based on a Generalized Autoregressive Conditional Heteroscedasticity, GARCH(1,1), model as follows;

$$\beta_i o_{t-i} + \varepsilon_t ; \varepsilon_t \ / \ I_t \ \rightarrow \ N(0, h_t) \qquad \text{(A3)}$$

$$h_t = \gamma_0 + \gamma_1 \varepsilon_{t-i}^{\ 2} + \gamma_2 h_{t-i} \qquad \text{(A4)}$$

$$SOPI = \max\left(0, \varepsilon_t / \sqrt{h_t}\right) \qquad \text{(A5)}$$