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Effects of Maritime Illegal Oil Trading on Economic Growth in Nigeria

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Abstract
Illegal oil trading involves the theft of crude oil and its derivative products through a variety of different mechanisms with significant economic implications. This study therefore, investigates these implications covering the period of 1995-2012. Employing the e-views econometric software, the unit root, co-integration, and granger causality tests were carried out on the secondary data set to make it amenable to the application of the vector autoregressive (VAR) modeling of the ordinary least square multiple regression to reveal among others, that a significant relationship exists between the illegal oil trading and the economic growth in Nigeria. Other findings are that the volume of oil theft as an explanatory variable met the a priori expectation with its negative coefficient, but together with the one-year lagged variables of the dependent variables, was statistically significant in terms of contributions to the dependent variable. The study concludes that illegal oil trading has negative effects on the Nigerian economy, especially within the study period and should be checked by the law enforcement authorities. Prominent among the recommendations is the need to institute adequate and effective sanctions against offenders to serve as a deterrent.
Keywords: unit root, co-integration, granger causality, vector autoregressive

1. Introduction

This work provides an overview of oil theft problem in Nigeria maritime domain and distinguishes between local small scale oil theft for the domestic market and the larger scale oil theft involving transport by sea-going tankers to international destinations. It mentioned how much is stolen, associated effect and potential solutions. Oil displaced agriculture from its top revenue yielding position barely a decade after independence to the point of now accounting for over 85% of national revenue and 90% of foreign exchange earnings (Garuba, 2006 and 2010). This sudden descend of the country into the class of *rentier states*, dubbed as such by its virtual position as mere collector of rents from multinational companies, points to the linkage between oil and state and the basis for which the latter has become a contested terrain, as well as the chief mediator of the various social processes and clearages within the system. The observed leakages in Nigeria's case confirms the thesis by Chazan, et al (1992) that a state's capacity to secure full control over its people and resources is dependent on the reality of the concrete interests it reflects and manages. It is in this context that illegal oil trading (seeks an understanding) is premised on the constitutional provision that the ownership and control of all minerals and mineral oil, in, under and upon any land, and of rivers, streams and watercourses in Nigeria are vested in the Federal Government (see Section 44(3) of the 1999 Constitution of the Federal Republic of Nigeria as originated in the 1946 Mineral Ordinance).

The upsurge noticed in contemporary illegal oil trading started attracting public knowledge in1993 when crude oil and its refined products (specifically petrol) became the domain of senior military officers and their civilian cronies. From the initial opportunity provided by domestic subsidy and devaluation of the Nigeria Naira during which legally lifted products were diverted to more profitable markets of *Communaute financiere africaine* (CFA) Franc States under arrangement and cover of government officials, illegal oil trading in Nigeria took firm roots with the discrete cooperation of oil companies' workers who operated at oil wellheads or allowed access to them. The bunkerers tap directly into pipelines away from oil company facilities and connect from the pipelines to barges that are hidden in small creeks with mangrove forest cover. The scramble for illegal money accruable from this business grew alarmingly among top military brass who became increasingly preoccupied with bolstering their assets and securing perks for the middle ranks in anticipation of disengagement from service (Lewis, 1999 and 2007).

The business whose trans-border character soon expanded beyond Franc states of West Africa and Cameroon kept a rising tempo with operational sophistication and dexterity that make the competence of Nigeria's police and navy pale into insignificance; though they are often fingered as accomplices. The business of oil bunkering is as opaque and murky as the many gaps in analysts' knowledge of its operations (Asuni, 2009). However, Asuni (2009) also reveals three major ways oil theft is carried out:

(1) A minor and small-scale pilfering of condensate and petroleum product destined local market;
(2) Direct hacking into pipelines or tapping with a hose from wellhead through practical removal of the

'Christmas tree'

(3) Excess lifting of crude oil beyond the licensed amount, using forged bills of lading.

While the first is less significant in that it is conducted by local people who hide under the cover of violence in the Niger Delta region, the second category brings more technical sophistication into the business with the stolen product placed in small barges and taken straight into the sea where it is loaded into larger barges (mother ships) in return for money and weapons used to fuel violence, while the last category speaks solely about a spoilt system facilitated by official corruption in that it involves the use of forged bills of lading, issued by a carrier to a shipper, listing and acknowledging receipt of goods for transport and specifying terms of delivery (Asuni, 2009).

Oil theft has considerable economic, social, environmental, governance and security implications. This criminal act has contributed significantly to the poverty and degradation that exist in the Niger Delta region of Nigeria today. The issue of oil theft in the Niger Delta has been a problem for a long time but considered by many as tolerable. However, today there is a clear recognition from the Nigeria Government that this illegal practice is now having a direct negative impact on the entire economy (Garuba, 2010). Large-scale illegal oil bunkering has become an increasingly significant issue in recent years. The violence in Niger Delta is predicated on the activities of an illegal oil stolen syndicate that collaborates with foreigners to fuel the civil unrest with a view to creating opportunity to enable them to engage in their illicit oil deals in the creeks. Another negative impact of Illegal oil bunkering is environmental damage. The social and environmental costs of oil theft have been very extensive. They include destruction of wildlife and biodiversity, loss of fertile soil, pollution of and drinking water, degradation of farmland and damage to aquatic ecosystems, all of which have caused serious health problems for the inhabitants of areas surrounding illicit trade (Garuba, 2010). The objectives of this study are to determine the influence of maritime illegal oil trading on economic growth in Nigeria and to raise prediction models on the relationship between the maritime illegal oil trading and economic development in Nigeria.

2. Methodology

2.1 Sources of Data

Secondary data were used in the analysis and were sourced from the publications of the Central Bank of Nigeria, National Planning Office, National Bureau for Statistics, Nigeria National Petroleum Corporation (NNPC) and Nigerian maritime administration and safety agency (NIMASSA).

2.2 Methods of Data Analysis

The data set were analyzed using two approaches:

- Descriptive Statistics and
- Inferential Statistics

While the inferential statistics were employed to analyse the formulated hypothesis other objectives of the study were however, met with the use of descriptive statistics.

2.2.1 Test of Hypothesis

The formulated hypothesis was tested with a linear regression model with ordinary least square properties. Hence, a multiple regression approach was adopted. The economic analysis involved model specification and testing of the hypothesis. For the hypothesis, Gross Domestic Product (GDP) was made the dependent variable.

2.2.2 Test Statistics

The time series data for the period, 1995-2012, were fitted into the linear function. This was to enable us predict the level of the dependent variable GDP that can be achieved given known levels of the illegal oil trading explanatory variables. The test statistics therefore, include the Coefficient of Correlation (R), Coefficient of Determination (R^2), the analysis of variance (ANOVA/F-ratio) and the t-distribution (t-Test). While the ANOVA/F-test establishes the significance of the model as a whole, the coefficient of correlation seeks to test the magnitude of the relationship between the dependent variable and the components of maritime illegal oil trading as explanatory variables. The t-Test seeks to test the level of significance of the maritime illegal oil trading explanatory variables to the dependent variable.

2.2.3 Test of the Model Significance:

The first test carried out under the hypothesis testing was a test of the model significance. This seeks to test for the significance of the model as a whole. There are two ways to accomplish this; the analysis of variance or the coefficient of determination, R^2.

2.2.3.1 The Analysis of Variance Approach

This statistical tool aims to split the variations of a variable, for example, in the hypothesis, GDP regressand with its component parts, variations in the dependent variable GDP, that are accounted for by the explanatory variables (maritime illegal oil trading variables), regressors, that is, the different sources of growth in the GDP as produced by the maritime illegal oil trading components; are called the EXPLAINED VARIATIONS. Other

sources not thus explained are due to random or chance factors. These are estimates of the population disturbance variable 'u' and are represented by 'e', otherwise referred to as the RESIDUALS or error term.

Table 1. A Hypothetical ANOVA Table

Source of Variation	Sum of Squares	Degree of Freedom	Mean Square of Error	F-Statistic
Regression	$ESS = (R^2XTSS)$	**K-1**	$\frac{ESS}{K-1}$	**MS Σ_{ESS}** **MS Σ_{RSS}**
Residual	$RSS = \sum_{t=1}^{n}(e)^2$	**N-k**	$\frac{RSS}{N-K}$	**F-Tabulated**
Total Variation	$\sum_{t=1}^{n}(e)^2(GDP_{gt} - GDP_{gt})^2$	**N-1**		**Decision:** **if F_{cal}>F_{tab} reject Ho and Accept Ha**

For the hypothesis, the regression equation is presented thus;

$$GDP_t = \beta_0 + \beta_1 + VAS_t + VOS_t + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

2.2.3.2 The Coefficient of Determination, R^2 Approach

Another way to test for the model significance is through the coefficient of determination (R^2). The R^2 is calculated from the regression and it gives the proportion of the total variation in the dependent variable, actual cargo throughput factor that is explained by the independent variables, here the various maritime illegal oil trading components. R^2, from the sample is a statistical estimate of the population, e^2, (row squared). The value of R^2 ranges between 0 and 1;

In setting up the test the following hypothesis is tested;

HO_1:$\rho^2 = O$ i.e., the regressors, the growth in the maritime illegal oil trading components, or sources of growth in the cargo throughput factor, in a given year have no significant relationship with the actual growth of the cargo throughput factor for that year.

$HA_1\rho^2 > O$ (One-tailed test of significance) i.e., at least, there is a significant relationship between one of the independent variables and the actual growth of the cargo throughput factor.

2.2.3.3 Decision Rule

If F-ratio calculated is greater than the F-ratio tabulated or theoretical F, at alpha (α) – level of significance, and (K-1), (N-K), degrees of freedom, then we Reject H0 and Accept HA, and thus state that there is some truth in the estimated model (i.e. the regression model is significant since the regressors significantly account for the variation in the dependent variable (GDP_t)

$$\text{Here, F (calculated)} = \frac{R^2/K-1}{\frac{1-R^2}{N-K}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

2.2.4 Test of Significance of the Explanatory Variables, t-Test

Having established the significance of the estimated model as a whole next is to test the specific strengths of the various regressors in bringing about this result. This is carried out through the test on the estimated parameters of the regressors. The test-statistics or student t-test is calculated as follows;

$$\text{t- Test} = \frac{\beta_k}{Se(\beta_k)} \text{for K} = 1 - 6 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

Where;

β_k = Estimate of the population parameters for the regressors (i.e. maritime illegal oil trading components)

$Se(\beta_k)$ = Standard error of the estimate

2.2.4.1 Decision Rule

If absolute value or $\left|\frac{\beta_k}{Se(\beta_k)}\right| > tn - k$ at $\frac{\alpha}{2}$ level of significance, we Reject H0 and Accept HA: to conclude that the variable belongs significantly to the model.

2.3 Model Specification

The dependent variable represented by the symbol GDP_t is regressed on the various components of maritime illegal oil trading components figures for the corresponding period. These components of maritime illegal oil trading are hereby represented as follows:

VAS_t = Total value of stolen oil in year t;

VOS_t = Total volume of stolen oil in year t;

The dependent variable, however, is as specified: GDP_t = Level of cargo throughput in year t;

2.4 Data Estimation

Here, we note that the data set was estimated by carrying out the following tests; unit root, co-integration and granger causality tests. While the unit root test sought to test for the stationarity of the data set not to produce spurious results, the informational content of the model were confirmed by the use of the co-integration test which helped to establish the nature of the model, whether short- or long-run relationships existed among the variables of the model. Finally, with the granger causality test, the direction of the effects was thus established.

3.0 Data Presentation and Analysis

Table 2. Volume of Stolen Oil, Value of Stolen Oil and GDP

S/N	YEAR	VOS	VAS	GDP
1	1995	229565000	91.76	1933211.6
2	1996	230031800	111.74	2702719.1
3	1997	257947000	107.56	2801972.6
4	1998	249207600	76.26	2708430.9
5	1999	257791600	105.13	3194015
6	2000	242350000	357.68	4582127.3
7	2001	337322415	821.7	4725086
8	2002	390463495	1079.1	6912381.3
9	2003	237250000	786.6	8487031.6
10	2004	193450000	812.8	11411067
11	2005	156950000	1161.6	14572239
12	2006	255500000	2240.6	18564595
13	2007	255500000	2304	20657318
14	2008	292000000	4056	24296329
15	2009	694925910	6655.5	24794239
16	2010	283078530	3525	33984754
17	2011	386091290	6975	37543655
18	2012	179514150	3239.5	39650864

Source: NIMASSA, CBN, Various Years

3.1 Data Estimation

In this section, our objective is to establish the stationarity of the entire data set employed in the estimation. When a particular data set is found to be stationary, it then suffices that the data set can be relied upon for the estimation, having eliminated the possibility of spurious results.

Table 3. Unit Root Test for the Variables Employed.

	Augmented Dickey-Fuller Unit Root Test			
Variable	**T-statistic.**	**Critical value**	**Order of Integration**	**Significance**
VOS	-3.527962	-3.052169	1(0)	5%
VAS	-8.649341	-3.920350	1(1)	5%
GDP	-3.287799	-3.065585	1(1)	5%

Source: E-views 6.0 Econometric Package

3.2 Unit Root Test Result

The unit root test was carried out using the Augmented Dickey Fuller test in order to determine whether the data set was stationary and the order of integration. It could be observed from Table 3 that only the volume of oil was stationary at level. Other variables turned out to be stationary at first difference. Generally, the data set can be relied upon for analysis as it shows no evidence of producing spurious results.

3.3 The Co-integration Result

Having established the stationarity of the data set, the Johansen co-integration test was applied, which adopts no exogenous variables as it is based on the vector auto regression (VAR) modeling. Here, we try to establish the presence of a short or long-run equilibrium existing between the variables and hence the estimated regression equation results. This result is as presented in Table 4.

Table 4. Co-integration and Test Results

	Johanssen Co-integration Test		
Model		**Number of Co-integrating Equations**	**Nature of Equilibrium**
1	Maritime Illegal Oil Trading and Cargo Throughput	1	Long-run

Source: E views 6.0 Econometric Package

In Table 4, model 1 shows evidence no co-integrating equation and a short-run relationship

3.4 The Granger Causality Result

The result here does indicate that most of the pair of variables has not, in fact, produced significant causal effects. In other words, the pair of variables failed to produce any noticeable significant causal effects.

3.5 Hypothesis Testing

3.5.1 The Influence Of Illegal Oil Trading On Economic Growth

Here, one lead equation is to be estimated and the hypothesis states as follows:

HO: There is no significant relationship between the level of Maritime Illegal Oil Trading and Economic Growth in Nigeria.

The sub-hypotheses from HO are as follows;

HO_a: The value of Maritime Illegal Oil Trading has no significant effect on the level of Economic Growth in Nigeria.

HO_b: The volume of Maritime Illegal Oil Trading has no significant effect on the level of Economic Growth in Nigeria.

Table 5. Results of the Global Statistics for the Influence of Illegal Oil Trading On Nigeria Economic Growth

Test-Statistic	Model Least Square
R-square	0.902
Adjusted R-square	0.889
S.E of Regression	4269296
Sum of squared residual	2.73E+14
Log likelihood	-298.7053
Durbin-Watson stat	2.457565
Mean dependent Variable	14640113
S.D. dependent Variable	12827473
Akaike info criterion	33.52
Schwarz criterion	33.67
Hannan-Quinn criterion	33.54
F-statistic	69.23413
Prob(F-statistic)	0.00000

NB:*** = significant at 1%; ** = significant at 5%; * = Not significant. F-ratio tabulated DF (2, 15); 1% = 6.36, 5% = 3.68, t-ratio DF (15); 1% = 2.95, 5% = 2.13.

Source: Eviews 6. Statistical Package

3.5.2 Test of Model Significance – ANOVA.

In order to confirm the specification status of our model, we employed the ANOVA.

3.5.3 Decision Rule

Employing the E-views software, since the F–ratio calculated (69.23413) > F–ratio critical (6.36, 3.68), at both 1% and 5% levels of significance respectively, we reject H0 and conclude that there is a significant relationship between the level of maritime illegal oil trading and economic growth in Nigeria. The estimated regression result is presented thus;

$$\text{GDP}_t = 17991587 + 7067.458VAS_t - 0.059312VOS_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

3.6 The Impact of Maritime Illegal Oil Trading On Economic Growth in Nigeria (Test of Sub-Hypotheses)

The sub-hypotheses from HO are as follows;

HO_a: The value of Maritime Illegal Oil Trading has no significant effect on the level of Economic Growth in Nigeria.

HO_b: The volume of Maritime Illegal Oil Trading has no significant effect on the level of Economic Growth in Nigeria.

Having tested the significance of the model, we go a step further to test the significance of the maritime illegal oil trading in contributing to the total variation in the level of economic growth in Nigeria. This is achieved through the student t-test. We refer to the regression result in Table 6 wherein, both the value and volume of illegal oil trading were statistically significant since the t-ratio calculated (11.45, 5.26) > t-ratio critical (2.95, 2.13) at both 1% and 5% levels of significance, respectively.

Table 6. T-Statistic Table-Effect on Economic Growth

VARIABLE Test Statistic	X_1,Value of Oil Theft, VAS_t	X_2,Volume of Oil Theft, VOS
Coefficient of the Variable	7067.458	-0.059312
Standard Error	617.1261	0.011282
T-Statistic Calculated	11.45221 NS	-5.257127 NS
T-Statistic Tabulated 1%	2.95	2.95
T-Statistic Tabulated 5%	2.13	2.13
Significance	0.0000	0.0001

NB:***=significant at 1%;**=significant at 5%;*=Not significant. T-ratio DF (15); 1%=2.95, 5% =2.13

Source: E-views 6.0 Statistical Package.

4.0 The Maritime Illegal Oil Trading and Economic Growth

This section is on the relationship between maritime illegal oil trading and the level of economic growth. This result revealed that a significant relationship actually exists between maritime illegal oil trading and level of economic growth in Nigeria. In addition, both the value and volumes of maritime illegal oil trading were to be statistically significant even at 1% level of significance. However, only the volume of maritime illegal oil trading carried the correct sign. In the same vein, the model, with an R-squared of 90% has shown that the changes in the explanatory variables taken together have been able to explain at least, 77% of the total variations in the dependent variable, port revenue, thus, leaving only about 23% to chance occurrence. The estimated regression result is presented thus;

$$\mathrm{GDP}_t = 17991587 + 7067.458VAS_t + 0.059312VOS_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

From equation 4, while the volume of cargoes pilfered, with its negative coefficient, met the a priori expectation, the number of global and local attacks on ships failed to meet the a priori expectation, bearing positive coefficients.

5. Summary of Findings

From the objective standpoint, the study made the following findings;

1. That a significant relationship exists between the maritime illegal oil trading and economic growth in Nigeria.
2. That only the volume of maritime illegal oil trading met the a priori expectation with its negative coefficient and effect on economic growth in Nigeria.
3. That only the one-year lagged variable of the gross domestic product exerted a significant effect on the level of economic growth in Nigeria.

5.1 Conclusion

On the basis of our findings, the study therefore concludes that generally, maritime illegal oil trading has affected the economy negatively and that the volume of illegal oil trading is high and as such deals a devastating effect on the economy in general.

5.2 Recommendations

There is need for the maritime authorities to step up the fight against illegal oil trading in the country. In effect, there should be adequate and effective sanctions for offenders to serve as a deterrent. Following from this recommendation, the study still recommends that there should be proper legal framework to persecute culprits involved in illegal oil trading. The practice of selective treatment for offenders should be stopped since our constitution states that all individuals are equal before the law. Also, the authorities should as well learn to adopt some of the modern ways of tracking the stolen oil like the finger printing method and satellite imaging. With this, it will be possible to track any stolen oil by forensic experts.

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