IMPACTOFNIGERIANPETROLEUMOILPRODUCTIONONNIGERIANECONOMY:COINTEGRATIONANDERRORCORRECTIONMODEL ANALYSIS

ABSTRACT

This study was done to investigate the effect of Nigerian crudeoilproductionagainst Nigerianeconomy. Johansen's co-integration concept is employed on thirty-three years (1981-2013) data about annual Gross national income, petroleum production along with petroleum oil exchange. Augumented Dickey-fuller (ADF) test was carried out in level as well as first difference of every sequence. ADFtestindicatedexistenceofunitrootatthelevelotherwise at first differencetheseries werestationary.ThetraceandeigenvaluesofJohansenco-integrationindicatedsingleco-integratingequationinthesystem,hencepresenceoflong-termrelationshipbetween the variable. However, since the series are co-integrated, vector-error-correction-modelwas applied to estimate the long-term coefficient. Crude oil production has a negative coefficient andsignificant,whilecrudeoilexportissignificantinpredictingdifferencein Gross national income on the long-term. Contrary to the long-term result there was no short-run causationbetween Gross national income, petroleum oil production and crude oil exportation inNigeria. The revealed result of the study attracted recommendation that export of theproduct should be given keen attention and proper management, that will bringdevelopmentofothersectorsthroughtheincomefromcrudeoilexportationwhichwillbringabout great growthineconomy.

Keywords: Economy, Petroleum, Production, Co-integration, gross domestic product (GDP), export Unit Root Test, Stationary, Trace, Eigen values.

1. Introduction

Oil is the main source of power in Nigeria and the globe at large.Oilplaymajorrolein determiningthe commercial as well aspolitical fateof Nigeria. Notwithstanding,Nigeriancrude oillindustrywas establishedfrom inceptionofthecentury, itwasinactive till the completionofNigerian insurrection (1967-1970) before theoilindustry commencetotake important functionin commercial lifeof Nigeria.

Nigerian may be classifiedas nation which is basically provincial that rely uponmain production exports(particularly crude oil produce) after the realization of freedom by 1960ithad background of tribal, religious as well as aboregionalpressure, enlarged by the significancedifferenceby economic,educational as well asecological evolutionin the North and theSouth.These can be partiallyaccreditedintogreatexplorationof crude oilinthecountrywhichimpactsandis impactedbyeconomicalongsocialunits. Petroleumoil discoverycontributed to the development of Nigerianeconomyboth favourablyand unfavorably, on the unfavorable part, it can be weighedin terms of degradation of host community, where oil is exploited.Most of these communities bear ecological degradation that lead to reduction of ways of live hoodas well as othereconomic and social factors. Though, broad earnings are garnered from the nationaland international sales of crude oil products has consequence on the improvement of the Nigerianeconomy in respects to gains and productivity is still aquestion to answer. Hence, the demand to analyzethesimilar impactof petroleumoilontheeconomy.The majorobjective of this study istoanalyzethesignificanceofpetroleumoilproduction against Nigerianeconomy. Giventhe realitythatthesectoris highlyimportant area inNigerianeconomythereisserious demand for an proper and useful production as well as export strategy for the sector. Although,crudeoilhas contributed immenselyusedincognizance of thefactthatsurplus earning made out of the oil sector can be invested in them to multiply and also improved the overallGrossdomestic productoftheeconomy.Theinitialt trialtoexploreoil startedinthedecade,thisbeganwithexplorationactivitiesunderGermanBitumenco-operation.Theywerecertifiedandwere liableforexploringBitumendiscoveredinsomepartsofthecountry.The period before Independence from 1914 to 1960 was identified by colonialentrepreneurshipforlawfuleconomicactivitieswhich wereimpliedtoreplacethe oppression and earlier era of nineteen centuries.

Notwithstanding, after independence period witness various exploration activities in crude oilexploration. On securing her independence, the oil market in Nigeria was wide open toaccomodatecountriesotherthanBritainandUnitedStatesofAmerica (USA) to takeincrude oil exploration activities with the emergence of about nine Internationalcompaniesrunninginnigeria.

TheseareShellBPwhichwasgrantedlicensesin1973.Texaco/Mobil/Tennessee Nigeria incorporated (TENNECO), Gulf oil, SAFRAB (ELF)Nigeria Agip oil company (NAOC), Philips petroleum and Esso exploration. Othercompanies like Japan petroleum, Union oil American occidental were satisfactoryexplorers.Thisis due to the fact thatthesehavebeenstudiedondevelopingoil-exportingcountries".

Furthermore, research on organization of petroleum exporting countries also constrained, these study due to their importanttothisresearchworkinNigeria,willconsquentlyneedtobe examined.Doing sowillbringforththetimepositionoftheimpacttopetroleumIndustryontheNigerianeconomy as it has been identified by different researchers either generally or relatingspecificallyto Nigeria.

2. Material and Methods

This study is limited to the period of 1981 – 2013 of the annual data collected from Nigeria National Petroleum Cooperation (NNPC) and Central Bank of Nigeria (CBN).

LITERATURE REVIEW

2.1 TimeSeriesAnalysis

Time series analysis is a numerical methodology used to evaluate behavioral ways in datagatheredovertime.Itisusedto ascertain natureofchangeinstatisticalinformationover periodic intervalsoftime.Thesepatternsareusedto arriveat predictionforthefuture. Thus,timeseriesanalysis assiststoconfrontdoubtsaboutthefuture.

2.3 Jarque-Bera(JB)TestofNormality

Jarque-Bera test of normality is an approximation and exact test or large-sample test. It is principally based on OLS residuals.Thetest evaluatethe measure of asymmetry andmeasuresof taildness of the distribution of ordinaryleastsquareresiduals. The following statistic is applicable:

$$JB = n\left(\frac{S^2}{6} + \frac{(k-3)}{24}\right) \quad \text{--------------- (1)}$$

Wheren=size of the sample

S= Coefficient of skewness and

K=Kurtosiscoefficient.

Under normallydistributedvariables,S=0andK=3.Hence,theJBtestofnormalityisatestofthejointlyhypothesisthatSandKarezero (0)and three (3) in that order.Inthissituationthevalueofthe JBstatisticis expectedto be zero (0).

Under the null hypothesis that the residuals are normally distributed, Jarque-Berashowedthatasymptotically(i.e when the samples large)theJBstatisticfollowsthechi-squaredistribution with 2 degree of freedom. If the computed p-value of the JB statistic in anapplication is sufficiently low, which will happen, if the value of the statistic is verydifferentfrom0,onecanrejectthehypothesisthattheresidualsarenormallydistributed.But,ifthep-valueisreasonablyhigh,whichwillhappenifthevalueofthestatisticisclosetozero, wedon't reject thenormalityassumption.

2.4 TestsforStationary

Intimeseriesanalysis, it isfirstassumethattheseriesarestationary. When stationary exist in time series it implies that the series are normally distributed with it's mean and variance been constant over along time period. Before appropriate time series model can be used for forecasting andcontrol measure,itisessential tocheckitssuitabilityindifferentways.Theultimate famousdistinct methods are based on analysis of the residual. In this case, the residualsshouldbe a white noise process if the model is sufficient. A times this can be analyzedfrom the graph of the residual. In this study we measured the unit root test due tothe significancedevoted toit.

2.5 TheAugmentedDickey-Fuller(ADF)TestforUnitRoot

As the error term may not be white noise, Dickey and Fuller expand their testprocedure intimating an augmented form of the test which involves additional laggedtermsofthedependentvariableto enableelimination of autocorrelation.Thelaglengthon these additional terms can either determined by the Akaike Information Criterion (AIC) orSchwart Information Criterion (SIC), or more usefully by the lag length necessary towhitenthe residuals.

ThethreepossibleformsoftheAugumented Dickey-Fullertestaregivenbythefollowingequations:

$$\Delta y_t = \alpha y_{t-1} + \sum_{i-1}^{p} \beta_i \Delta y_{t-i} + u_t \qquad (2)$$

$$\Delta y_t = \alpha_0 + \alpha y_{t-1} + \sum_{i-1}^{p} \beta_i \Delta y_{t-i} + u_t \qquad (3)$$

$$\Delta y_t = \alpha_0 + \alpha y_{t-1} + a_2 t + \sum_{i-1}^{p} \beta_i \Delta y_{t-i} + u_t \qquad (4)$$

Thedifferencebetweenthethreeregressionsconcernsthepresenceofthedeterministicelements α_0 and $a_2 t$.

2.6 JohansenCo-integrationTest

Themultivariatemaximumlikelihoodco-integrationtestingprocedurewasdevelopedbyJohansen(1998)andStockandWatson(1988)andJohansenandJuselius(1990).

There are two basic test statistics involved in Johansen and Juseliuss maximumlikelihoodtest.Thefirstteststatisticisthetracetestwhilethesecondisthemaximaleigenvalue test. The Johansen co-integration test is full information maximumlikelihoodapproach;itisbasedonthefollowingvectorautoregressive(VAR)modeloforderp:

$$Y_t = A_1 Y_{t-1} + --- + A_p Y_{t-p} + BX_{t+e_t} \qquad (5)$$

Where Yt is a k — vector of non — stationary I(1) variables; Xt is a d-vector ofdeterministicvariables;andetisavectorofinnovations.OnecanrewritethisVARasfollows:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i-1}^{p-1} \Gamma_t \Delta Y_{t-i} + BX_t + e_t \qquad (6)$$

Where: $\Pi = \sum_{i-1}^{p} A_i - I, \Gamma_i = -\sum_{j=i+1}^{p} A_j$ (7)

The Grangers representation theorem asserts that if the coefficient matrix Π

hasreducedrank

r<k,thenthereexists $k \times r$ matrices α and β,eachwithrankrsuchthat $\Pi = \alpha\beta'$ and $\beta' Y_t$ isI(0); r is the number of co-integrating relations (i.e the rank) and each column βis the co-integrating vector. The elements of α are known as the adjustment parameters in the vector error correction model. The Johansen's approach is to estimate the Π matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Π.

2.7 VectorErrorCorrectionModel

A vector error correction (VEC) model is a restricted VAR designed for use withnon-stationaryseriesthatareknowntobeco-integrated. Onemaytestforco-integrationusing an estimated VAR object, Equation object estimated using non-stationaryregressionmethods, or usingaGroup.

The VEC has co-integration relations built into the specification so that it restricts thelong-run behavior of the endogenous variables to converge to their co-integratingrelationshipswhileallowingforshort-runadjustmentdynamics.Theco-integrationtermis known as the error correction term since the deviation from long-run equilibrium iscorrectedgraduallythroughaseriesofpartialshort-runadjustments.

Totakethesimplestpossibleexample,consideratwovariablesystemwithone co-integratingequationandnolaggeddifferenceterms.Theco-integratingequationis:

$$y_{2,t} = \beta y_{1,t} \tag{8}$$

ThecorrespondingVECmodelis:

$$\Delta y_{1,t} = \alpha_1 (y_{2,t-1} - \beta y_{1,t-1}) + \varepsilon_{1,t} \tag{9}$$

$$\Delta y_{2,t} = \alpha_2 (y_{2,t-1} - \beta y_{1,t-1}) + \varepsilon_{2,t} \tag{10}$$

Inthissimplemodel,theonlyright-handsidevariableistheerrorcorrectionterm.Inlongrun equilibrium, this term is zero. However, if y_1 and y_2 deviate from the long runequilibrium,theerrorcorrectiontermwillbenonzeroandeachvariableadjuststopartiallyrestoretheequilibriumrelation.Thecoefficient α_i measuresthespeedofadjustmentofthei-thendogenousvariabletowardstheequilibrium.

2.8 GrangerCausalityTest

When timeseriesisstationary,thetestiscarried outusingthelevelvaluesoftwoormorevariables.Ifthevariablesarenon-stationary,thenthetestisdoneusingfirst(orhigher)differences.Information criterion usuallyadopted for when chosen number of lags, suchastheAkaikeinformationcriterionortheSchwarzinformationcriterion.Anypeculiarlaggedvalueofoneofthevariablesiswithholdintheregressionif(1)itissignificantaccordance witht-test,and(2),theotherlaggedvaluesofthevariablecollectivelyaddexplanatorypowertothemodelaccordingtoanFisher exact test.ThenthenullhypothesisofnoGrangercausalityisnotrejectedifandonlyifnolaggedvaluesofanexplanatoryvariablehavebeenretainedintheregression.

2.9 MathematicalstatementofGrangerCausality

Let Y and X be stationary time series. To test the null hypothesis that x does notGranger-cause Y,onefirstfindtheproperlaggedvaluesof Ytoincludeinaunivariate auto regressionof Y:

$$y_t = a_0 + a_1 y_{t-1} + a_1 y_{t-2} + \ldots\ldots + a_m y_{t-m} + \varepsilon_t \quad (11)$$

Next,theauto regressionisaugmentedbyincludinglaggedvaluesofx:

$$y_t = a_o + a_1 y_{t-1} + a_2 y_{t-2} + \ldots + a_m y_{t-m} + b_1 x_{t-1} + \ldots + b_q x_{t-q} + \varepsilon_t \quad (12)$$

One retains in this regression all lagged values of x that are individually significantaccordingtotheirt-statistics,providedthatcollectivelytheyaddexplanatorypowertotheregressionaccordingtoanF-test. In the notation of the above augmented regression, p is the shortest,andqisthelongest,laglengthforwhichthelaggedvalueofxissignificant.

ThenullhypothesisthatxdoesnotGranger-causeyisacceptedifandonlyifnolaggedvalues ofxareretainedintheregression.

2. STATISTICAL ANALYSIS

Thischapteriscenteredontheanalysisofdata.Thetimeplots,descriptivestatistics,testof normality and all other analysis used in this work were done with computer usingEviews 7.2Econometricpackage.

3.1 TimePlot

Thetimeplotatlevelandforthefirstdifferencefrom1981-2013(i.e.33years)

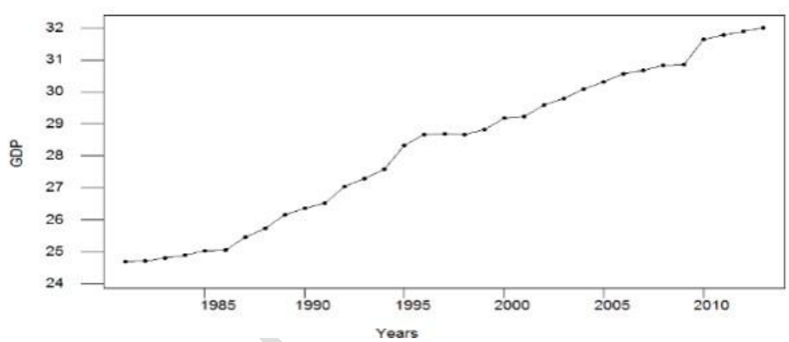

Figure1: TimeplotofGrossDomesticProduct(GDP)atlevelforNigeriafrom1981 to 2013

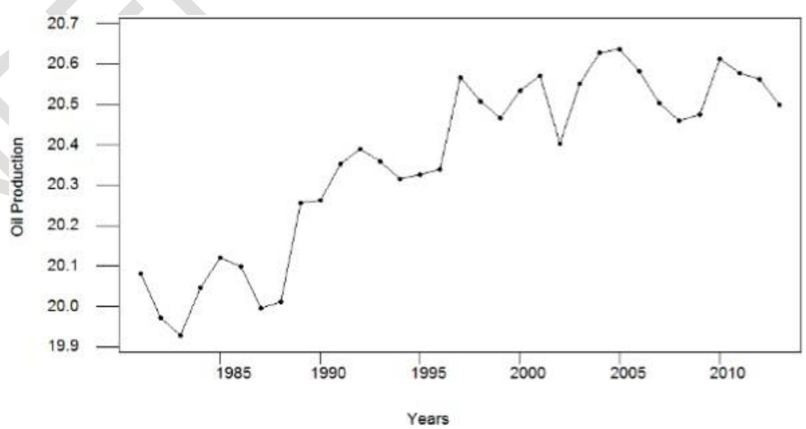

Figure2:TimeplotoftotaloilproductionatlevelforNigeriafrom1981to2013

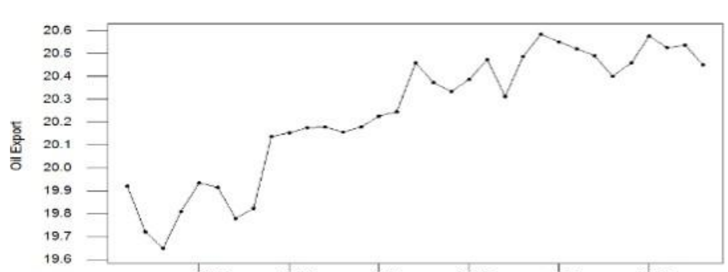

Figure3:TimeplotoftotaloilexportatlevelforNigeriafrom1981to2013

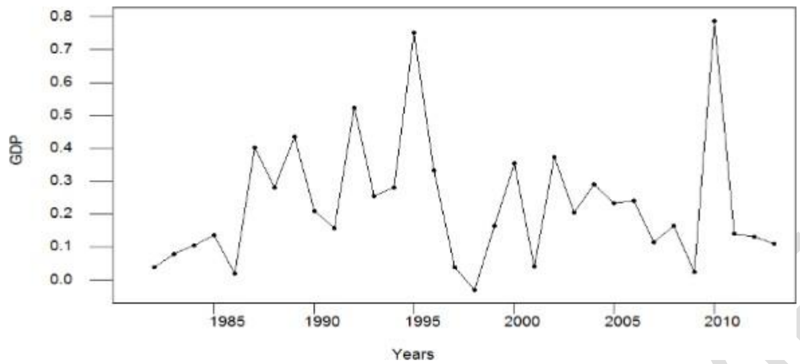

Figure4:TimeplotofGrossDomesticProduct(GDP)atfirstdifferenceforNigeria from 1981 to 2013

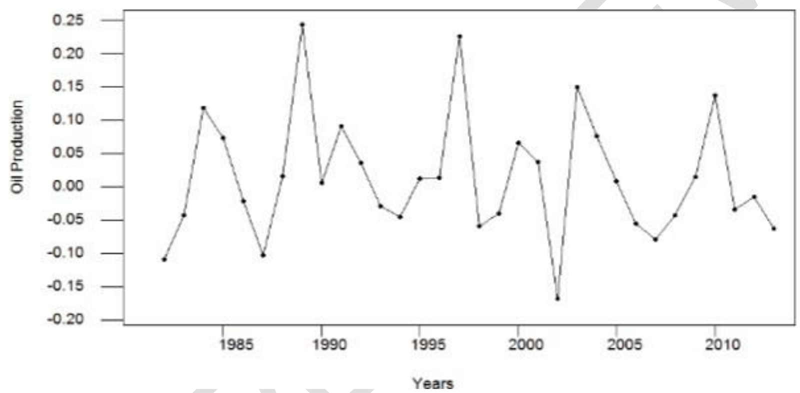

Figure5:TimeplotoftotaloilproductionatlevelforNigeriafrom1981to2013

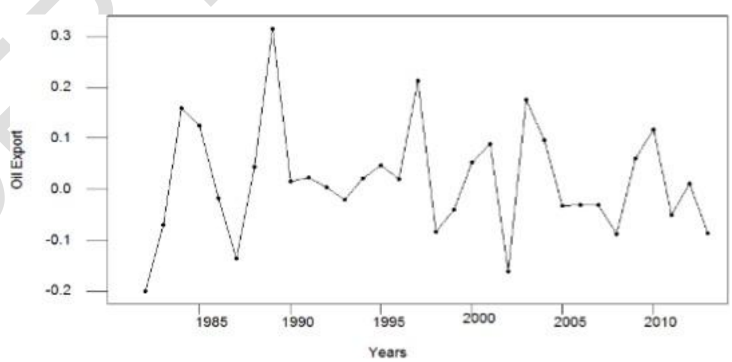

Figure6:TimeplotoftotaloilexportatfirstdifferenceforNigeriafrom1981to2013

Fromfigures1,2,and3,itcanbeobservedfromtheirtimeplotthattheseriesaretrended indicating no stationarity at level of Gross Domestic Product (GDP), oil exportandoilproductioninNigeria.However,figure4,5and6indicateapatternthatcanbefitted;hence theseriesarestationaryatfirst difference.

3.2 DescriptiveStatisticsandTestofNormality

Intestingfornormality,Jarque—Beratestforthetimeseriesdataisemployed.

Thehypothesistobetestedis:H

o:JB=0(normallydistributed)

H1:JB $\neq 0$ (notnormallydistributed)

$\alpha = 0.05$

Test statistic=JBwhereJBisJarque-Beratest

Criticalregion:RejectH0ifp-value< α value of0.05 p-value< α valueof0.1

Table1:ResultsofDescriptiveStatisticandTestofNormality

	GDP	PROD	EXPORT
Mean	28.27005	20.36380	20.24059
Median	28.66648	20.40287	20.31278
Maximum	32.02559	20.63877	20.58548
Minimum	24.66934	19.92692	19.64845
Std.Dev.	2.427058	0.218835	0.280427
Skewness	-0.086799	-0.618627	-0.624807
Kurtosis	1.697128	2.079433	2.163027
Jarque-Bera	2.375465	3.270079	3.110330
Probability	0.304912	0.194945	0.211155

The descriptive statistics reveal that during the period under study, the Gross domesticproducthadthehighestmeanandstandarddeviation;thisimpliesthatGDPisthemosterraticamongthevariablesunderstudy.Inthecaseofnormalitytest,Itcanbeobservedthat the Jarque-Bera test indicated the retention of Ho, hence the time seriesobservationsarenormallydistributedat5%levelofsignificance.

3.3 UnitRootTestResults

InordertoperformJohansenco-integrationtest,theserieshavetobetestedforstationarity.Toinvestigatewhetheraseriesisstationaryornot,unitroottestofAugmentedDickey-Fuller(ADF)isconductedwithlevelsandfirstdifferencesofeachseriesontheconditionthatthenullhypothesisisnon-stationary,sorejectionoftheunitroothypothesissupportsstationarity.

Thehypothesistobetestedis:

Ho: $\gamma = 0$
(unitrootisnotpresent)H1: $\gamma \neq 0$
(unitrootispresent)

$\alpha = 0.05$
Teststatistic=ADFteststatistic

Criticalregion:RejectH0if,ADFteststatistic>Mickinnoncriticalvalueforrejectionofhypothesisofaunit root at5%significancelevel

Table2:ResultsofAugmentedDickey-FullerTestatLevelandFirstDifference

Observation	AtLevel	5% Mickinnon critical Value	P-Value	1st Difference	5% Mickinnoncritical Value	P-Value
GDP	6.03E-05	-2.95711	0.9518	-5.513917	-2.96041	0.0001
Oilproduction	-1.266792	-2.95711	0.6326	-5.922493	-2.96041	0.0001
Oilexport	-1.478413	-2.95711	0.5315	-5.787184	-2.96041	0.0001

The result of Augmented Dickey-Fuller test of table 2 indicates that at 5% significantlevelofMickinnoncriticaltestthevariablesconsideredarenotstationaryatlevelbuttheyallbecomestationaryafter1st difference.

3.3 JohansenCo-integrationTest

After conforming that Gross Domestic Product (GDP), oil production and oil exportobservation were stationary at first order or I(1), then the next step is to estimate theVectorErrorCorrectionModel(VECM).Firstly,weneedtoselectanoptimumlagofVECMmodelbeforeperformingtheJohansenco-integrationtest.

Table3OptimumLagSelectionbasedonSchwarzInformationCriterion

LagLength	GDP	OilProduction	OilExport	SystemEquaton
1	-0.0472	-1.7143	-1.4405	-5.6612
2	0.1620	-1.4880	-1.3246	-5.3252
3	0.2827	-1.3211	-1.2205	-4.7752
4	0.5441	-0.9836	-0.9394	-3.9410
5	0.7154	-0.0577	-0.6052	-3.2442
6	0.6177	-0.4962	-0.5359	-3.6444

Optimum lag selection based on the Schwarz Information Criterion on table 3 aboveindicatelag1aslaglengthappropriateforthesystemofequations,therefore,Johansenco-integrationtest canbeperform usinglagof1.

$$\Delta Y_t = \theta_1 (Y + \alpha_0 + \alpha_2 P + \alpha_3 X) + \alpha_4 \Delta Y)_{t-1} + \gamma(\Delta y + \Delta P + \Delta X + \varepsilon)_{t-1}$$

TheJohansen'sco-integrationtestbasedontwotests,thefirstisthetracetest,whilethesecondisthemaximaleigenvaluetest.Indeterminethenumberofcointegratingvectorsasegmentalprocedureisadopted.

1. Firstandforemost,testHo(ro=o)againstH_1(ro>o).Ifthenullhypothesisisnotrejected, then it is concludedthattherearenocointegratingvectorsamongthenvariablesinYt.

2. If Ho (ro=o) is rejected, then it is concluded that there is at least one co integratingvectorandproceedtotestHo(ro=1)againstHi(ro>1).Ifthenullhypothesisisnotrejected, thenit'sconcludedthatthereisatleasttwocointegratingvectors.

Table 4: Trace and Max-Eigen Co-integration test for Gross Domestic Product (GDP), OilProduction,and Oil Export (1981-2013)

Numberof cointegrating vectors	TraceTest			MaximumEigenvalueTest		
	Statistic	Critical-Value(5%)	P-Value	Statistic	Critical-Value (5%)	P-Value
R=0	63.61409	47.5613	0.0009	38.51065	27.58434	0.0014
R<=1	25.10344	29.79707	0.1578	17.90964	21.13162	0.1333
R<=2	7.193792	15.49471	0.5552	6.595283	14.26460	0.5381
R<=3	0.598509	3.847466	0.4391	0.598509	3.841466	0.4391

Theco-integrationtestonthetable4aboveindicatestherejectionofnoneco-integrationat 5% significant level for both trace and eigenvalue test but indicates a co-integratingequation.

3.4: VectorErrorCorrectionModel

Havingestablishedthatthereisoneco-integratingequationinthesystem,thevectorerrorcorrectionmodelandlong-runcoefficientcanbeestimated

Where Y_t =GrossDomesticproduct(GDP), P_t =crudeoilproduction(PROD)and X_t =crudeoilexport(EXPORT)respectively.

Table 5: Estimated Long-run Coefficient

Co-integrating Eq:	Co-integrating Eq1
GDP(-1)	1.000000
PROD(-1)	28.00619
	(4.89738)
	[5.71861]
EXPORT(-1)	-30.37707
	(3.81869)

$$Y_{t-1} = -16.24712 - 28.00619 P_{t-1} + 30.37707 X_{t-1}$$

	[-7.95483]
C	16.24712

S.E (4.89738)(3.81869)

t-statistic (5.71861)(-7.95483)

Thevaluesofthelongrunresultusingvectorerrorcorrectionmodelindicatedthatcrudeoil production has negative coefficient and also significant at 5% on economic growth,whilecrudeoilexportissignificantinpredictingeconomicgrowth.

3.4.1 GrangerCausalitytest

Thegrangercausalitytestapproachusedtoestimatethecoefficientoftheshort-rundynamicof thevariable.

Table6:ResultsoftheVECGrangerCausality/BlockErogeneityWaldTests

Dependentvariable:D(GDP)

Excluded	Chi-sq	Df	Prob.
D(PROD)	2.299066	1	0.1295
D(EXPORT)	1.623744	1	0.2026
All	2.471126	2	0.2907

Dependentvariable:D(PROD)

Excluded	Chi-sq	Df	Prob.
D(GDP)	0.543835	1	0.4608

D(EXPORT)	0.202968	1	0.6523
All	0.778629	2	0.6775

Dependentvariable:D(EXPORT)

Excluded	Chi-sq	Df	Prob.
D(GDP)	0.811143	1	0.3678
D(PROD)	1.583052	1	0.2083
All	2.352839	2	0.3084

Theresultofshort-rungrangercausalityofthevectorerrorcorrectionmodelindicatenonecausationbetweenthevariablesunderconsiderations.Asitcanbeobserved,oilproduction and GDP are independent (that is, they cannot cause each other) likewise,exporttoGDPandfinallyproductiontoexport.

4. CONCLUSION

ThisstudyexaminedtheimpactofNigeriapetroleumoilproductiononNigeriaeconomy Itcoversaperiodfrom1981to2013. Toevaluatetheimpactofpetroleumoilproduction ongrossdomesticproduct.

Jarque-Bera test for normality showed that the variables involved were normallydistributed. Augmented Dickey Fuller test results shows that the time series variablesincorporatedinthestudyexhibitincreasingconsistenttrendovertheperiod,andtheydonotrejectthenullhypothesisofnon-stationaryinthelevels.Thenullhypothesisatfirstdifference is rejected and revealed that all the variables became stationary. Havingconfirmed the stationary status of the time series employed with the aim of determinelevelofintegrationbyusingtheunitroottest,thestudyproceededbyusingJohansen'smethodo fcointegratingandthevariablesarecointegratedandhencethereexistalongrunofrelationshipbetweenthem.

4.1 RECOMENDATION

1. Basedonthefindingsofthisresearchwork,itisinevitabletoprovideasetofpolicyrecommendationthatwouldbeapplicabletotheNigerianeconomy.
2. TheNigerianationalpetroleumcorporation(NNPC)shoulddiversityitsexportthroughdownstreamproductionthiswillenhancetherefinedpetroleumforexports.
3. Thegovernmentshouldencouragemorecompanyparticipationsothatbetterequippedrefineries canbebuilt.
4. Securityshouldbeboostedonthehighseawherecrudeoilproductsarebeingsmuggled.
5. Governmentshouldgiveattentiontonon-oilsectortoboosttheeconomy.
6. Government should fight corruption by establishing institutions that will arrestedprosecutepublicofficeholders.ThereisurgentneedforNigeriatodiversitythereexport market especiallytheoilmarket.

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