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INSECURITY AND RATIONAL EXPECTATION OF OIL PRODUCTION IN NIGERIA (1998-2021): A TEST OF AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) PROCESS

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ABSTRACT

This paper investigated quantitatively, "Insecurity and Rational Expectations of Oil Production in Nigeria" (1998 - 2021); A Test of Autoregressive Integrated Moving Average (ARIMA), process, was adopted. For the achievement of these aims, we put forward and specified the models with variables such as: Production of oil, domestic Crude oil theft (Oil bunkering), supply (Export) of oil and the price of oil in the world market. These variables were extracted from the CBN statistical bulletin and from the NBS bulletin (Various issues). The econometric methods of autoregressive integrated moving average (ARIMA) process, popularized by G.P.E. Box and G.M. Jenkins of Time series Analysis for forecasting and control, otherwise known as the Box-Jenkins (BJ) methodology was used in the analysis. Given the empirical result, based on the ARIMA specification, 2 Autoregressive and 2 moving averages (2AR:2MA), were identified. The empirical result also, revealed that, the aprior expectation was constant in the estimation. The result showed that the expectation of oil production in Nigeria is a function of the lag values and those of the domestic crude oil theft (oil bunkering), supply (Export) of oil and the global oil prices. Furthermore, the coefficient of determination (R^2), shows that about 0.993701 (99.4%) of the total variation in Oil production is determined by the domestic crude oil theft, supply (Export) and oil price, current and lagged values. The paper identified insecurity as a major cause of domestic crude oil theft (Oil bunkering) in Nigeria, hence the cause of Nigeria's underdevelopment status. Consequently, based on the results, appropriate policy recommendations were made, which include amongst others, that adequate measures must be put in place to curb insecurity, hence preventing domestic crude oil theft (Oil bunkering) in the Niger- Delta region of Nigeria.

Keywords: Rational Expectation, Insecurity, Oil-Theft, Bunkering, ARIMA-Process, Oil Export, Box - Jenkins, insurgency.

BACKGROUND OF THE STUDY

The basic Rational Expectations Hypothesis (RATEX), according to Friedman (2005), holds that economic agenda form expectations of the future values of economic variables like prices, income etc., by using all the economic information available to them. Bryant (2016), enumerated these information to include, the relationships, governing economic variables,

particularly monetary and fiscal policies of the government. Rationale expectationists assume that economic agents have full accurate information about future economic events.

These expectations theory has come to nothing in Nigeria's quest to improve in its oil production. According to https://www.statista.com/nigeria (4th Sept., 2022), oil is contributing a lot to government revenue, but not to the economy as a whole, nearly 80% of the Nigeria's exports is accounted for by oil. That's why the economy is not growing. Thus, Nigeria recorded a decline of about 3.54% in Real GDR, in the 2nd quarter of 2022.

The reason for this is not far-fetched, for this reason , Campbell (2019), defined Insecurity as, "lack of confidence" continuing, he argued that insecurity, is the quality or state of being insecure: such as a state or feeling of anxiety, fear or self doubt, troubled by (feelings of insecurity, knowing that the citizens do not have confidence in the government.

Adagba et al (2020), has identified insecurity as the major course of underdevelopment of Nigeria. He want to list the current insecurity cases in Nigeria, as, persistent armed conflict by Boko Haram in the North East. These activities of Boko Haram, he noted has caused displacement of citizens, resulting to; poor infrastructure, water borne disease/ other communicable diseases, rape and abandonment. Others include; bandits attacks resulting to kidnapping for ransom as well as food insecurity and the cases of the activities of Unknown Gun men in the South East of Nigeria.

According to Dickson et al (2019), in a rationale expectations theory, if expansionary macroeconomic policy is to work in the short –run, a "policy surprise may be a "monetary surprise", a" fiscal surprise" or some combinations of the two. Dickson et al posited that a monetary surprise occurs when the actual rate of growth of the money supply differs from the expected rate of growth'. A fiscal surprise occurs when future levels of government expenditure and taxation differ from the expected levels.

The issue of insecurity in Nigeria, according to Egbefo et al (2014), on discussing on internal security crisis in Nigeria; causes, types, effects & solutions, agreed that the case of insecurity has made nonsense of the rationale expectations theory. In that, the expectations from oil production can no longer be realized as a result of oil theft[oil bunkering], insurgency, militancy in the Niger Delta region of the country. As well as kidnapping for ransom of oil workers expatriates.

To this and therefore, according to; https://www.reuters.com/energy, "Nigeria's highest crude and condensate output this year recorded in June, 2022 was 1.68 million b/p/d, though the country has the capability to export close to 2.5 million b/p/d, if not for the identified cases of oil theft, insurgency, militancy etc.

Furthermore, Akin et al (2018), writing on Nigeria's insecurity problems; tried to identify some of the causes as; illiteracy, unemployment/ joblessness, poor leadership amongst others while they identified; poverty, hunger, political thuggery, insurgency, drug abuse, militancy etc as some of its effects on the Nigeria society.

Finally, Egbefo et al (2014), in his journal article proffers some solutions towards this menace as; eliminating corruption, equipping the security personnel for rapid response, provision of adequate employment opportunities, as well as alleviating poverty.

OBJECTIVES OF THE RESEARCH

1. To evaluate the effect of insecurity on previous (lagged) values of oil production.
2. To examine the trend and pattern of insecurity measures on Rational expectations of oil production.

Theoretical Framework

Hubbert Production Theory

The Hubbert peak theory which was first proposed by Marion King Hubbert stipulates that the production curve is bell-shaped and symmetrical. In addition to understanding production behaviour, the production model is often used with the intent to forecast future production.

Hubbert (2004), peak oil theory predicts that the regional oil production and world oil production would follow a bell shaped curve. The theory predicts that the world oil production is presently in decline having reached and passed its peak, giving rise to various studies which aim to investigate and forecast production profiles and decline curves of regions and indeed the world.

Hotelling's Theory

Hotelling's (2012), research in which he proposes that oil production volume should move in response to oil price. In his study Hotelling theorizes to manipulate optimal price of an exhaustible resource in relation to its scarcity (production) and growth of interest rate. The theory states that the price of a depleting resource like conventional oil should rise over time at the same rate as interest rate because its value should increase as the reserves are exhausted. This rule, which forms the basis for economic theory of non-renewable resources, is based on the assumptions of an efficient market in which crude oil is regarded as exhaustible.

Devlin and Titman (2015) brought OPEC contribution to the world oil price market into the forefront. This is firstly, because all of its member countries are classed as developing economies by the UN, and secondly because they account for over 70 percent of oil that is traded in the world oil market, and the hold over 60 percent of the world oil reserves deposits and are therefore crucial to future world oil supply.

Hochman and Zilberman (2015) investigated the past effect country and regional oil production have had on oil prices, with particular focus on OPEC production and its behaviour with the global oil price market. The studies all agree that OPEC production has been instrumental in regulating the global oil market, though its current level of control seems to be going through some changes; its collective influence on the global market remains significant.

Determinants of Oil Production in Nigeria

Increased Oil Consumption

Oil demand increases as population increases. As the world's population grows, global oil demand increases accordingly. According to the U.S. Energy Information Administration's (2019) statistics, the U.S. led the world in global oil consumption with more than 18 million 42-gallon barrels consumed each day across the country.

Oil Reserves

Oil production in Nigeria is partly influenced by the proven reserves. Reflected as the available supply, oil reserves are most often expressed in terms of "proven reserves." Proven reserves are expected quantities of oil, determined through analysis performed by geologists and engineers that can be extracted with a high level of success using current methods. The potential of proven reserves can be increased through technological advances and further exploration of supply locations, as well as economic conditions that favor oil production.

Environmental Factors

The environment can have a strong effect on the production of oil in Nigeria. These environmental factors like the activities of the militants that usually blow off pipelines and other oil facilities, do reduce the flow of crude oil by the oil exploration firms.

Insecurity factors

Whenever a major oil producing country is affected by insecurity crisis, that nation's ability to continue production will be affected. For example, where insurgency, militancy, oil theft (bunkering), kidnapping and pipeline vandalisation, arm proliferation reigns, these makes oil production unattractive. It also discourages potential business investment as well as foreign direct investment (FDI) in the oil sectors. To raise oil production, increased standard of living is advocated as well as fortification of the armed / security forces

World Demand for Oil (Supply)

In its latest Oil Market Report, the IEA (2019) said crude oil demand had grown by 2.3 percent on an annual basis in the second quarter, which prompted an upward revision of the overall growth rate for 2017 to 1.6 million bpd. The revision boosted oil prices, with Brent once again above US$55 a barrel for the first time in about five months.

MODEL SPECIFICATION

Modeling oil production in Nigeria

In line with the RATEX hypothesis, production of oil at period t is actually determined by its own lagged values, and the lagged values of Crude oil theft (oil bunkering), supply (Export) for oil, and the price of oil in the world market in accordance with the following process.

$$X_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 Y_{t-1} + \beta_3 Z_{t-1} + \beta_4 K_{t-1} \quad (1)$$

Where, β_0, β_1, β_2,β_3 and β_4 are coefficients

X_t = Oil production at period t

X_{t-1} = Oil production period at lag 1

Y_{t-1} =Crude oil theft (oil bunkering)

Z_{t-1} = Supply for oil (export) at lag 1

K_{t-1} = price of oil at lag 1

The rational expectation of oil price formed at period t-1 is the mathematical expectation of oil price conditional on oil theft, supply for oil and price of oil.
Thus, we have $E_{t-1}X_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 Y_{t-1} + \beta_3 Z_{t-1} + \beta_4 K_{t-1}$ (2)

METHOD OF DATA ANALYSIS

An Autoregressive Integrated Moving Average (ARIMA) Process

The ARIMA was popularized by G.P.E Box and G.M. Jenkins of time series Analysis; forecasting control.

ARIMA model, unlike the regression models, it is explained by P-regressors $x_1 x_2$, x_3.....xp. the ARIMA methodology time series allow to be explained by previous or lagged values of itself and stochastic error terms.

It is necessary to put here also that most economic time series are non –stationary (Johasen&Juselius, 2013). If a time series is integrated of order 1 (i.e it is 1(1), its first difference are integrated e.g 1 (0) (i.e stationary). Again, if a time series is 1 (2), its 2nd difference is 1(0). Generally, it should be noted that, if in a time series, we get an integration 1(0) series.

This follows that, if we differenced a times "F" to make it stationary and apply the ARIMA (P.K) model to it, then our original time series is ARIMA (P,F,K) (ie.autogressive integrated moving average time series).

Here, P equals the number of autoregressive terms. K equals the number of moving average and F, the number of times, the series has to be differenced to become stationary.

Method of Analysis

The incorporation of lag values in a model is one of the basic features and assumptions of the autoregressive integrated moving average (ARIMA). Hence the ARIMA was used to analyze the Model.

Method; ARIMA
Date; 03/29/22
Sample (adjusted): 1998 2021
Included observations: 22 after adjustments
Maximum dependent lags: 3 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (3 lags, automatic): DOMCONS EXPORT PRICE
Fixed repressors: C
Number of models evaluated: 192
Selected Model: ARDL(3, 2, 3, 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
PROD(-1)	0.344623	0.185812	1.854682	0.1060
PROD(-2)	-0.101611	0.230054	-0.441683	0.6720

PROD(-3)	0.495237	0.143794	3.444074	0.0108
DOMCOTF	2.308383	0.662847	3.482529	0.0102
DOMCOTF(-1)	-1.044220	0.605524	-1.724490	0.1283
DOMCOFT(-2)	2.314814	0.576487	4.015378	0.0051
EXPORT	0.461803	0.079969	5.774765	0.0007
EXPORT(-1)	-0.052021	0.119977	-0.433593	0.6776
EXPORT(-2)	0.141308	0.164439	0.859333	0.4186
EXPORT(-3)	-0.686499	0.158507	-4.331030	0.0034
PRICE	3.484976	1.138249	3.061699	0.0183
PRICE(-1)	-0.406850	1.350414	-0.301278	0.7720
PRICE(-2)	3.829749	1.734641	2.207805	0.0630
PRICE(-3)	-5.678814	1.850132	-3.069411	0.0181
C	-218.4505	298.4653	-0.731912	0.4880

R-squared	0.993701	Mean dependent var	2225.591
Adjusted R-squared	0.981104	S.D. dependent var	220.3961
S.E. of regression	30.29595	Akaike info criterion	9.878409
Sum squared resid	6424.911	Schwarz criterion	10.62230
Log likelihood	-93.66250	Hannan-Quinn criter.	10.05365
F-statistic	78.88346	Durbin-Watson stat	2.899505
Prob(F-statistic)	0.000003		

*Note: p-values and any subsequent tests do not account for model selection.
The ARIMA process (3,2,3,3)≡2AR;2MA
Source: Authors computation

The result above shows that the expectation of oil production in Nigeria is a function of its lag values and those of the domestic Crude oil (oil bunkering), supply (export) of oil, and the global oil price. The coefficient of determination shows that about 99.4% of the total variation in oil production is determined by the level of oil theft, supply and oil price current and lag values. Domestic oil theft at current value and lag 2 value are positive relative to the current production level. This implies that oil production decreases as the crude oil theft increases. This is in line with EIA (2009) who inferred that insecurity increase propels increase in oil theft via increased militancy, insurgency etc. Domestic oil theft at lag 1 is negative relative to the production level. This is as a result of the increase in activities of militants in the Niger Delta Region. Oil export (supply) at current value and lag 2 value are positive relative to oil production. This is because oil is Nigeria's chief income earner and the increasing demand of Nigeria's oil at the world market must be match with increase in production. Supply of oil at lags 1 and 2 are negative. This is as a result of increase activities of pipeline vandalization and disruption of exploration activities which led to lower production for domestic consumption. Oil price is also found to be positively related with oil production at current level and lag 2 levels. This is in line with the general economic theory that the higher the price, the higher the quantity supplied. The negative lag 1 and 3 of world oil price is as a result of a decline in oil price at the world market which forces suppliers to supply less. It also agreed with Harold

Hotelling's (2012), theory which he proposes that oil production volume should move in response to oil price. The overall regression is significant, at 1%.

SUMMARY/ RECOMMENDATIONS

Summary

In summary therefore, it can be seen that the rational expectations is the applications of the principles of true mathematical expectations of the future variables conditional on all variables in the model which are known to the public at time t.

To this extent therefore, the study is of the view that, rational expectations of oil production in Nigeria depends on the level of oil theft (bunkering) occasioned by the insecurity in the country, since higher oil production raises the level of oil theft. It also depends on supply of oil (oil export) in the world market (since the higher the oil production, the higher the supply of oil to the rest of the world. This as well depends on the price of oil at the world market, (this is since, price determines supply and invariably the level of production).

The study agreed that insecurity is the major cause of domestic oil theft, like the activities of militants, insecurity, oil bunkering, kidnapping for ransom, vandalism amongst others. All these lowers the production of oil in the country, thus have a negative impact on economic development of the country.

RECOMMENDATIONS

The study after thorough investigations came out with the following recommendations.

- The need for government to study the trend of oil production in Nigeria for processing of information, as postulated by the rational expectations theory.
- To put adequate measures in place to avoid/ prevent domestic crude oil theft.
- The government should arm and fortify the armed forces to curb the spate of insecurity in the Niger-Delta region in particular and the nation at large.
- The root causes of insecurity and its effects such as; marginalization, fear, joblessness, inequality, poverty and youth restiveness should be looked into by the government.

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