Determining Optimal Crude Oil Price Benchmark in Nigeria: An Empirical Approach

Saibu Olufemi Muibi [1]

This paper contributes to on-going empirical search for an appropriate crude oil price benchmark that ensures greater financial stability and efficient fiscal management in Nigeria. It adopted the seasonally adjusted ARIMA forecasting models using monthly data series from 2000m01 to 2012m12 to predict future movement in Nigeria crude oil prices. The paper derived a more robust and dynamic framework that accommodates fluctuation in crude oil price and also in government spending. The result shows that if the incessant withdrawal from the ECA fund and the increasing debt profile of government in recent times are factored into the benchmark, the real crude oil numerical fiscal rule is (US$82.3) for 2013 which is higher than the official benchmark of $75 used for 2013 and 2014 budget proposal. The paper argues that the current long run price rule based on 5-10 year moving average approach adopted by government is rigid and inflexible as a rule for managing Nigerian oil funds. The unrealistic assumption of the extant benchmark accounted for excessive depletion and lack of accountability of the excess crude oil account. The paper concludes that except the federal government can curtail its spending profligacy and adopts a more stringent fiscal discipline rules, the current benchmark is unrealistic and unsuitable for fiscal management of oil revenue in the context of Nigerian economic spending profile.

[1]**Saibu Olufemi Muibi,** Department of Economics, University of Lagos, Lagos, Nigeria, e-mail: osaibu@unilag.edu.ng

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1.Introduction

Synchronising revenue and expenditure has been a challenging experience for Nigeria and thus has been to the highly volatile commodity prices and the risk of 'Dutch disease', extraction from a finite resource and pressures to spend within a short-term horizon to improve infrastructure and quality institution. The resultant macroeconomic instability and fiscal misalignment complicate fiscal management revenue from crude oil resources (Budina and Van Wijnbergen, 2008, Hemming, 2013).

A number of studies have argued that establishment of special institutions to constrain the discretion of expenditure policies and promote fiscal discipline could help in mitigating such adverse effects oil revenue volatility and frugality of the government (Andrew, 2013, Sharma and Strauss, 2013, Allen 2012). Such fiscal institutions include fiscal rules, resource funds, fiscal responsibility laws, and fiscal advisory councils, (Sharma and Strauss 2013, IMF 2007). The most fundamental of these institutions is the fiscal rule which defines, in specific terms, the level of various indicators of overall fiscal performance that must be met (Kopits (2001), Kopits and Symansky, 1998). There are two distinct sets of fiscal rule: (1) restrictions or rules on the procedure by which fiscal decisions are made; and (2) quantitative constraints on fiscal policy. Many countries operate procedural and numerical rules in tandem and thus the attainment of one implies the other (Schaechter et al., 2012).

The first signal of Nigeria readiness to establish such fiscal institutions and rules commenced with creation of a special oil fund account called Excess Crude Oil Account (ECA) in 2004. This account accumulates oil revenue above a stipulated oil price bench mark. Therefore, what goes into the ECA account and the budget depends essentially on the oil price benchmark adopted. Currently, Nigeria has established the National Council of States and enacted the Fiscal Responsibility Act to serve as the advisory council and fiscal responsibility law respectively. However, Nigeria government's experiences with setting up of the oil price benchmark as a fiscal rule has not been satisfactory.

The government has been finding it increasingly difficult in terms of procedural and numerical rules[2] to adhere strictly to and accurately forecast revenue accruals based on the benchmark oil price rule for each fiscal year. It has consistently set a benchmark price that either overshoots or undershoots the level that is consistent with the expected revenue for that fiscal year or 3-year medium term expenditure framework, (Akomolafe and Danladi 2013). Since attainment of this fiscal rule is dependent on the consistency with which the benchmark mimic the volatile and exogenously determined international price of crude oil, an accurate forecast of this crude oil price is crucial to attainment of the predetermined overall fiscal performance for the Nigerian government. More so, adherence to these fiscal rules and entrenchment of standard fiscal institutions are a prerequisite for efficient spending from crude oil revenue and fiscal management of Sovereign Oil Wealth Fund established in 2013.

The purpose of this paper is to develop a simple framework for deriving an acceptable crude oil benchmark price, that consistently align the government spending with the desired sustainable level of savings from oil revenue. Defining such alternative approach to oil revenue spending fiscal rule removes partly the subjectivity inherent in the current approach to crude oil price benchmark in Nigeria. This also promotes understanding amongst the stakeholders in entrenching fiscal discipline and rules necessary for sustainable fiscal spending and savings into the Excess crude Account and Sovereign Wealth Fund.

[2] Procedural in terms of which government institution (Executive or legislative) should set the price

The rest of the paper is organised as follows. Section 2 reviews existing approach to oil price benchmark determination in Nigeria and other countries. Section 3 develops a new approach based on the Nigeria's economic risk specific factors and observed strength and weakness of existing framework. Section 4 presents the empirical estimate of the bench mark prices while section 5 concludes with policy significance of the framework.

2.Conventional Crude Oil Benchmark Approach

Economic literatures seem to be silent about the appropriate formula which must be applied to determine the level of savings required from oil revenue. While there is a specific rule with respect to debt management, there is no consensus on what is optimal benchmark for crude oil revenue savings. For instance, Basci et al (2004) among many others studies proposed two alternative fiscal policy rules in terms of their impact on debt sustainability: a rule that fixes the ratio of primary surplus to GDP ("fixed surplus rule") and one that sets the primary surplus as a linear function of debt to GDP ratio ("variable surplus rule") (Obinyeluaku 2006a &2006b).

However, three approaches to oil saving fiscal rules have been mentioned in passive in the literature. Firstly, the accumulation of excess revenue resulting from a price above the target or benchmark price as in the case of Chile's copper stabilization fund (Fiess, 2001, Budina, & van Wijnbergen, 2008); secondly, revenue contingent sets a percentage of the commodity revenue as in the case of the Alaska's permanent fund (Kopits, 2001, Kopits & Symansky,1998) and thirdly, a mixture of both, a set percentage of commodity revenue and a reference price as in the case of Venezuela's stabilization fund are other example suggested in the literatures (Arbatli, 2012, , Sharma & Strauss 2013).

The general tendency among the oil rich countries[3] has always been toward adopting the first approach by using the a long run price calculated based on moving averages of past, spot or future prices or independent committee as the target or benchmark price, (Hemming, 2013, IMF 2007). However, such long run price rule especially in the case of Chile does not give much room for flexibility. For example the Chile's fiscal rule law does not have specific escape clauses that the authorities can apply in the case of shocks to the economy. As a result, the rule was suspended during the earthquake in 2010 (Sharma and Strauss, 2013). The failure of the long run price suggests fiscal rules (such oil price benchmark) is more likely to be successful if there is some form of flexibility in their design (Fiess, 2001, Andrew 2013). That is there should a trade-off between rigidity and flexibility and such trade-off allows for dealing with shocks and changes in fiscal policy (Drazen, 2002, Arbatli, 2012).

Crude Oil Benchmarking in Nigeria

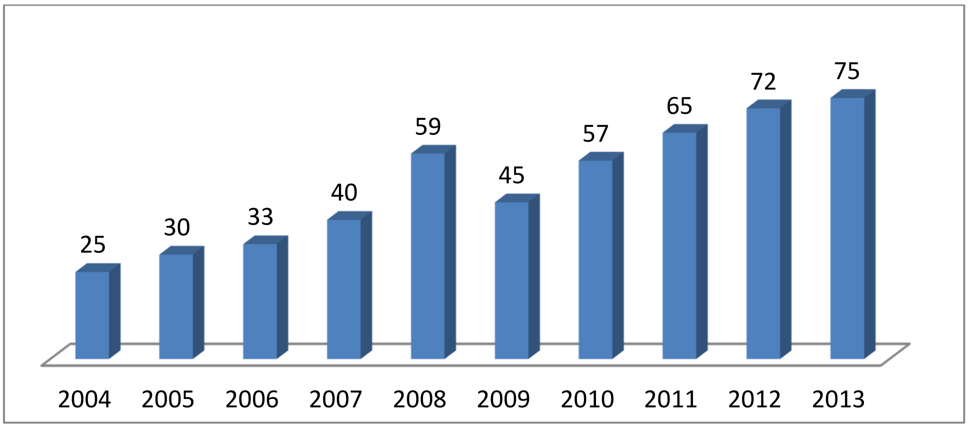
Figure 1 shows the trend in official crude oil price benchmark in Nigeria. The benchmark has always been the source of disagreement between the executive and legislative arms of government as the power to fix the benchmark is fused with the statutory functions of the Ministry of Finance. According to the Federal Government, Nigeria's crude oil price benchmark (see Figure 1) is anchored on a long run moving average of the international crude oil price. The Nigerian government price rule according to Ministry of Finance is based calculated based on 5-10 year moving average (MA) forecasting technique. Consequently, Nigeria also a possible victim of this long run price rules which has no adjustment mechanism for the flexibility and contingency in fiscal spending. The rationale as argued by the government is to capture the long-term period of cyclical economic

[3] These countries are Chile, Algeria, Russia, Mexico, Libya, Mongolia, Iran, Ghana, Colombia, Trinidad and Tobago Venezuela and Nigeria.

behaviour of crude oil price and to save some amount of money to smoothen government fiscal concerns in time of economic peril.

A major challenge with this method lies in the fact that forecasts from MA usually lag behind actual data and hence inappropriate for capturing the volatile oil price short-term cyclical fluctuations in associated with oil price movements which is the basis of the MTEF. Secondly, MA is weak in tracking or predicting future volatile oil price. It hardly reaches the peak or valley with actual data - rather it smoothens out the data (Woodridge, 2013). Third, for the essence of fiscal concern, the method could misdirect the principles of sharing crude oil proceeds among other things. Third, so for the essence of fiscal concern, because it does not say much about the future as it can only be used for one-step ahead forecast, the method could misdirect the principles of sharing crude oil proceeds among other things (Abiola and Okafor2013). Other arguments against this method ranged from its public perception as an ad hoc way of benchmarking oil price to its inability to predict short-terms dynamics of oil price.

Figure 1
Crude Oil Price Benchmark i 2004-2013



Sources: Yearly Budget Proposal Documents

Empirical Approach to Crude Oil Price Benchmarking in Nigeria

The weakness inherent in the extant approach and the continuous disagreement between legislature and the executive on the principles and rationality behind the benchmark figure and methodology adopted at arriving at such figure has also arose the interest of scholars ad policy analysts to re-examine the principles and assumption of using moving average method in pegging the crude oil price benchmark. Such an attempt made towards developing an alternative but appropriate method for projecting oil price benchmark must be anchored on short-term cyclical movements of crude oil price and other macroeconomic considerations (Abiola and Okafor 2013). Despite the high passions and emotions with which public commentators and policy analysts altercate about crude oil benchmark as an editorial issue in the news media, only few attempts have been made in the past at empirically determining crude oil price rule in Nigeria, among such attempts are Orok-Duke, Otonkue and Ekot, (2009), Akomolafe and Danladi (2013) and Abiola and Okafor (2013).

Specifically, Orok-Duke et al(2009) uses a simple descriptive scheme based on historical trends of monthly prices of crude and the prevailing economic situation. Based on the monthly data series, the paper estimated two price equations for determining the benchmark oil price for Nigeria using data from 2000 to 2005.

$$P_b = (\frac{1}{N}\sum_{i=1}^{N} P_i) * SF \qquad 1$$

$$P_b = \frac{1}{2}(P_{max} + P_{min}) * SF \qquad 2$$

P_b is the benchmark Price of oil for the year. P_i is the spot oil price in each month while N is the number months. P_{max} and P_{min} stand for the maximum and minimum spot oil price for a given period respectively. The SF is the saving factors which lies between 0 and one (0<SF>1). The *SF* is the saving factors which lies between 0 and one

(0<SF>1). The paper used 0.6 & 0.65 and found US$33.4 and US$33.3 as most appropriate for 2005 crude oil benchmark as against US$ 35 per barrel adopted for the year.

Akomolafe and Danladi (2013) on the other hand estimated an ARIMA (2 1 0) model for the period 1993 January –2012.October. Based on the model estimated parameter, they argued that crude oil price level would stabilise around $100 in 2013 hence they suggested $80 per barrel as benchmark for crude oil price for 2013 budget. They premised the recommendation on the assumption that a benchmark lower than US$80 (say $60 or $70 per barrel) would be sub-optimal in the event that actual crude oil prices end up being higher than the forecasted price of $100 per barrel as idle resources would be left unutilized even in the face of rising poverty, unemployment, inadequate infrastructures and various economic hardships experienced in the country that the government would have otherwise deploy resources to ameliorate.

Abiola and Okafor (2013) surveyed the various forecasting models and argued that the current approach adopted by the federal government is defective and inadequate to adequately capture the dynamics of oil price movement and volatility. Abiola and Okafor (2013) observed that the current Moving Average benchmarking method used by the government to determine the best forecasting model for Nigeria extremely conservative and placed more emphasis on fiscal saving at the expenses of fiscal survival and sustainability. Using quarterly data from 2005Q1 to2012Q4 on oil price benchmark, the study finds that ARIMA model is the best forecasting model for projecting Nigeria's crude oil price benchmark. Based on this scenario, it found that $80 could be the appropriate crude oil price benchmark for 2013 fiscal year. The study suggests that benchmarking of crude oil should be based on the crude oil price fundamental to enhance predictability of policy and promote macroeconomic stability. A common trend in the three studies was that the government benchmark is far too low than required. In all the three papers the estimated benchmark is above the officially adopted benchmark by the government all through the years since 2005.

A careful assessment of the existing approached reviewed above clearly shows there is clear evidence of possible biases in the benchmark used by the government and those suggested by the three studies on Nigeria. For instance, how Orok-Duke et al (2009) arrived at the saving factor of 60% and 65% is not clear and what they meant by saving factor was not explicitly discussed. Secondly, the estimates are based on only the previous year's data and hence may suffer from small sample errors. While Akomolafe and Danladi(2013) estimates was based on a more rigorous ARIMA estimation technique and with a sufficient long data series and higher frequency(1993m01 to 2012m12), the choice of USD$80 based on the USD$100 forecast estimate from the model is subjective and arbitrary. Abiola and Okafor (2013) used relied on the benchmark determined from the MA methods adopted by government to project into 2013. Two issues arose from this approach. One, the reliance on the existing benchmark derived from MA approached which Abiola and Okafor had also criticized as inappropriate makes the projection from such estimates to suffer from same bias as the government previous estimates, Secondly, the use of the yearly determined benchmark as the quarterly data series do not accommodate the fluctuations in oil price movement.

3.Proposed Empirical Approach and Analytical Technique

3.1 Benchmark Price Setting Framework

The main essence of this paper is to suggest a simple mechanism that allows for trade-off between flexibility and rigidity. As a starting point, we assumed that the oil price benchmark in Nigeria follows the long run price rule setting but the framework must also allow for some discretion on the part of the government to revise the estimate and accommodate some contingencies year in year out. In essence, the attempt here is to derive a framework in line with Venezuela's stabilization fund which comprises a percentage of commodity revenue and a reference price. Therefore, the benchmark price is assumed to be determined by the process

$$P_b = \bar{P} + \beta(P_{t-1} - \bar{P}) + \varepsilon_t \qquad 3$$

Where 0< $\beta < 1$ $\varepsilon_t = government\ idiosyncracy$ P_{t-1} is the average yearly price of oil in the preceding period and $\bar{P}$ is mean long run oil price that the short run price converges. ε_t is the noise factor which captures the idiosyncrasy in preferences of the government. If the prevailing oil price equals the estimated long run price that is:

$$(P_{t-1} - \bar{P})=0 \qquad 4$$

Then irrespective of the value of β the budget benchmark equals the long run price plus the preferences adjustment by the government.

$$P_b = \bar{P} + \varepsilon_t \qquad 5$$

However if there is a constraint on the government to introduce their idiosyncrasy then Benchmark Oil Price becomes:

$$P_b = \left(\frac{1}{N}\sum_{i=1}^{N} P_i\right) + \beta\left(P_{t-1} - \left(\frac{1}{N}\sum_{i=1}^{N} P_i\right)\right) \qquad 6$$

which is equivalently to

$$P_{bt} = \bar{P} + \beta(P_{t-1} - \bar{P}) \qquad 7$$

Where $\bar{P} = \left(\frac{1}{N}\sum_{i=1}^{N} P_i\right)$ 8

Equation 7 implies that benchmark price for period t (P_{bt}) equals the mean value of the oil price in the previous years and a fraction) of the deviation of the immediate past period from the mean value. Therefore, there are two key parameters to be determined (the mean value $\bar{P}$ and the adjustment factor (β)) to calculate the benchmark Price.

3.2 Modelling the Time Series Properties of Crude Oil Price

Among several time series forecasting model (like ARIMA and ARCH GARCH and their variants like TGARCH, EGARCH) ARIMA) models have been acknowledged to be the most popular in the literature. ARMA models remained the classical models among them because of their mathematical tractability. They give a good approximation of general stationary processes and relatively simple to compute explicitly all the parameters. The estimation procedure itself is quite clear and well understood, (Gileva 2010). The general ARMA model consists of two parts: an autoregressive (AR) part and a moving average (MA) part(Ahmed (2012)):

The MA (q) and AR (p) processes are can be written equations 9 and 10 respectively:

MA(q) : $Y_t = \mu + \epsilon_t + \theta_1\varepsilon_{t-1} + \theta_1\varepsilon_{t-1} + \theta_2\varepsilon_{t-2} + \theta_3\varepsilon_{t-3} + \cdots \ldots\ldots\ldots. + \theta_q\varepsilon_{t-q}$ 9

AR(p) : $Y_t = \emptyset_0 + \emptyset_1 Y_{t-1} + \emptyset_2 Y_{t-2} + \emptyset_3 Y_{t-4} + \emptyset_1 Y_{t-4} + \cdots \ldots\ldots\ldots. + \emptyset_p Y_{t-p}$ 10

Mixed Autoregressive Moving Average processes:

ARMA(p, q) : $Y_t = \emptyset_0 + \emptyset_1 Y_{t-1} + \emptyset_2 Y_{t-2} + \emptyset_3 Y_{t-4} + \emptyset_1 Y_{t-4} + \cdots \ldots\ldots\ldots. + \emptyset_p Y_{t-p} - \left(\epsilon_t + \theta_1\varepsilon_{t-1} + \theta_1\varepsilon_{t-1} + \theta_2\varepsilon_{t-2} + \theta_3\varepsilon_{t-3} + \cdots \ldots\ldots\ldots. + \theta_q\varepsilon_{t-q}\right)$

$$= \emptyset_0 + \sum_{i=1}^{P} \emptyset_i Y_{t-i} - \sum_{j=1}^{q} \theta_j \varepsilon_{t-j} 11$$

where $\emptyset_i \; and \; \theta_j$ are real coefficients, ϵ_t is a white noise process i.e. $\{\epsilon_t\}$ is a sequence whose iid elements have mean zero and variance σ2 and are uncorrelated across time: E(ϵ_t) = 0,E($\epsilon_t^2 = \sigma^2$), E$\epsilon_t, \epsilon_s = 0$) = 0 for t = s.

The 1-step ahead-forecast of Y_{h+1} can be easily obtained from the model as

$$\hat{Y}_t(1) = E[Y_{h+1}|Y_h, \ldots\ldots] = \emptyset_0 + \sum_{i=1}^{P} \emptyset_i Y_{h+1-i} - \sum_{j=1}^{q} \theta_j \varepsilon_{h+1-j}$$

12

and the associated forecast error is $\varepsilon_h(1)\ Y_{h+1} - \hat{Y}_t(1)$, the variance of 1-step ahead forecast error is $Var\ \varepsilon_h(1)] = \sigma^2$ For the k-step ahead forecast, we have

$\hat{Y}_t(1) = E[Y_{h+k}|Y_h, Y_{h-1}, \dots \dots] = \emptyset_0 + \sum_{i=1}^{P} \emptyset_i \hat{Y}_{h(k-i)} - \sum_{j=1}^{q} \theta_j \varepsilon_{h(k-j)}$ □ 13

Where$\varepsilon_h(k-j)] = 0\ if\ k-i > 0\ and\ \varepsilon_h(k-j)] = \varepsilon_{h+k-i}$, $\hat{Y}_h(k-i) = Y_{h+k-i}$ If $k-i \le 0$, the multistep ahead forecast of an ARMA model can be computed recursively.

There are three stages involved in the estimation of the ARMA models. The first is the identification and selection of the appreciate order of the model. At this stage the values of p, d, and q must be determined. Finding appropriate values of p and q in the ARMA(p,q) model is usually done by plotting the partial autocorrelation functions for an estimate of p and likewise using the autocorrelation functions for an estimate of q. For moving average type models theoretical autocorrelation function becomes zero after some lag (q) (i.e. it cuts off) while theoretical partial autocorrelations tends to zero (i.e. dies down). On the other hand for autoregressive type models theoretical partial autocorrelations becomes zero after some lag say p while theoretical autocorrelations tends to zero after that lag. The criterion for the selection of ARIMA process is summarized in Table 1

Table 1

n-order Selection for ARMA Model

Model	AC function	PAC function
AR(p)	Dies down exponentially	Cuts off after lag p
MA(q)	Cuts off after lag q	Dies of exponentially
ARMA	Cuts off after lag q	Cuts off after lag p

The principle of parsimony model selection is usually adopted by using the either or both of Akaike Information Criterion (AIC) and Schwarz criterion (SC). The ARMA model with the least minimum AIK and or SC values is adopted. The second stage involves the estimation of the parameters usually by employing a least squares approximation to the maximum likelihood estimator (Bruce et al (2005). The third stages involve conducting diagnostic test on the model to ensure that all the assumptions of OLS are satisfied. The estimated model must be checked for its adequacy and revised if necessary, implying that this entire process may have to be repeated until a satisfactory model is found; and then forecasting can be made (Ahmed 2012 and Akomolafe and Danladi 2013).

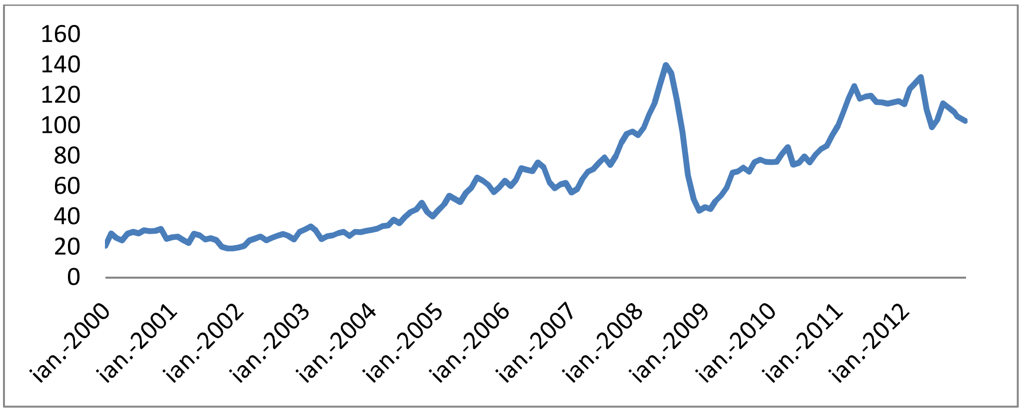
4.Data Description and Model Estimation:

4.1 Data Description

The monthly time series data used for the analysis covers a period of 13 years from 2000M01 to 2012M12 thus comprising a time series of 156 observations. In Nigeria, year 2020 has been adopted as an economic planning horizon. The development planning document tagged Vision 202020 detailed some programmes to be executed for Nigeria to join the top 20 economies in the world by year 2020. Also the government has a 3- year medium term planning framework called Medium Term Expenditure Framework. The 2014 to 2016 is currently being considered for approval in the National Assembly. In the MTEF, the government has fixed the benchmark crude oil price at US$74 per barrel which is lower than 2013 US$75 benchmark. The document also envisaged a drop in oil production from 2.5 million barrel per day to 2.3barrel per day. Therefore to capture this planning horizon of the government, the out-of-sample period is set for 2013 to 2020. This allows a comparison of the estimated model parameters with the projection by government for the medium and long term

planning framework. The crude oil monthly data set was collected from US Energy Information and Administration (EIA) website[4].
A common observation in macroeconomic time series is the present of unit root and a tendency for the series to be explosive and non-converging to the mean value. To avoid spurious regression and biased estimates, the trend plot of the time series properties was examined. Figure 5, clearly indicates that the series is actually not stationary in the current form and there might be a non-stationary trend and structural changes in the level of the series. Table 4 present the time series properties tests of series and there is sufficient evidence to assume that the variable became stationary when both intercept and time trend variable are included. To identify the nth-order appropriate for the ARMA model, the auto correlogram of the detrended crude oil prices series was plot and examined in Figure 3, based on the criteria in Table 2. The plot in Figure 2 shows that the AC died off exponentially while PAC cut off after lag 2 apparently suggesting a model of ARIMA(2 0 0).

Figure 2
Monthly Crude Price 2000-2012



[4] http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=INI0000004&f=M

Because of the uncertainty of the exact process and the general ambiguous nature of interpretation of the correlogram, it is necessary to identify several tentative models, and then perform diagnostic checks to determine the most appropriate. The conventional approach is to estimate parameters in ARIMA models and choose the model with minimum regression errors based on the AIC and SC value as the most appreciate model. As shown in Table 3 ARMA (2 0 0) model is found to have the best fit and most appropriate model for the crude oil price time series forecasting . To further confirm the suitability of ARIMA (2 0 0) model sensitivity and robustness tests were carried on the model estimates. Table 6 presents the estimated of the ARMA (2,0 0) with the least minimized error term as indicated by AIC and SC. The estimated results show that convergence was achieved after 7 iterations and ARMA(2 0 0) roots were inevitable. The plot of the residual histogram was found to be negatively skewed but normally distributed around the mean value. Jarque-Bera statistics further confirms that the residual is normally distributed. The Breusch-Pagan-Godfrey's heteroskedasticity and serial correlation tests also support the robustness and statistical fitness of the model.

4.2 Forecasting the Crude Oil Price with the ARMA Model

Having established the fitness of the ARIMA model, the next step is to examine the forecasting power of the model for both in sample and out-of sample. The in sample was done for the period of 2000 to 2012 corresponding to entire sample period. Clearly, the plots in Figure 8 show that the model fits the data and substantially mimic the actual data series. The bias and variance proportions were significant small which suggest the proportion of bias and variation between the forecasted and actual series is insignificant.

Based on equation 13 the out of sample forecasted was estimated and Figure 8 plots the out of sample forecast for the period 2013 to 2020. From Figures 5 plot it is observed that oil price is likely to rise steadily from the current US$112 in 2012 to US$131.2 in 2014 and US$140 in 2015. Bearing an unforeseeable circumstance and also if the current oil market fundamentals remain positive, it is optimistic that the oil price could rise to as high as US$168 and US$186 respectively in 2018 and 2020 respectively. The estimates from the model compare favourably with the US IEA forecasts which suggest that could oil price would rove around US$130 and could rise to as much as US$186 in 2020.

4.3 Deriving the Benchmark Oil Price Based of the Forecast

The starting point is the determination of the values of the parameters $\bar{P}$ and β. Based on equation 7, $\bar{P}$, the mean values of crude oil price was calculated to be US$ 61.2 and Table 7 presents the estimates of equation 7 with monthly data series for the period 2004 to 2012. β was estimated to be 0.49 (50%) which suggests that the variation in oil price is shared equally between saving and consumption. It is assumed that government is likely to maintain such pattern of spending from oil resources hence a value of 0.5 is adopted for the parameter β.

Table 5

Derivation of Marginal Propensity to Consume Oil per unit price (β)

Dependent Variable: P_{bt}

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$P_{t-1} - \bar{P}$	0.489	0.033	14.690	0.0000
C	38.292	1.093	35.020	0.0000
Adjusted R-squared	0.667	F-statistic 215.81(0.0000)		

Table 6 presents the estimates of crude oil benchmark calculated based on the forecasted price movement. Three scenarios were presented namely the highest, lowest and mean benchmark price. It shows that for the Nigerian government to maintain fiscal stability and avoid excess withdrawal from the excess crude oil account, the benchmark oil price should have been around USD79 in 2013 and USD82 for 2014. The model suggests an a gradual upward review of the benchmark from US$79 in 2013 to US$ 91 by 2016 and/or on the average a benchmark of US$82 per barrel as against the US$ 74 per barrel adopted for the Medium Term Expenditure Framework for the year 2014 to 2016.

Table 6

Estimates of Forecasted Benchmark for Crude Oil Price

		P_{t-1}		$0.5(P_{t-1} - \bar{P})$		P_{bt}		
Years	$\bar{P}$	Highest	Lowest	Highest	Lowest	Highest	Lowest	$P*_{bt}$
2013	61	113	82	25	10	87	71	79
2014	61	122	87	30	13	91	74	82
2015	61	131	96	34	17	95	78	87
2016	61	140	105	39	21	100	83	91
2017	61	149	113	43	25	104	87	95
2018	61	158	122	48	30	109	91	100
2019	61	168	130	52	34	113	95	104
2020	61	177	139	56	38	118	99	108

Sources: Author's Calculation

Reliance on this method had created more challenges than envisaged and further made mess of the excess crude oil account in term of failure to meet up with the target savings expected from the crude oil benchmark. A simple arithmetic of the withdrawal further confirms the real benchmark is could be higher than official declared benchmark. In a recent report by the Federal Ministry of Finance, published in a Nigerian daily (Daily Trust on September 02 2013), the Government has withdrawn a sum of US$5.1billion from the account within just 6 months in 2013. If this withdrawal is quantified in terms of unit per barrel of oil sold, the estimated real benchmark calculated in Table 7 clearly indicates that the real oil benchmark used post-mortemly is above USD 80.

Table7
Quantifying the Withdrawal from ECA in Unit Crude Oil Price

	Amount withdrawn	Output/ year[5]	Withdrawal in Unit price per barrel	Official Price	Real Benchmark Price
2013 withdrawal	US$5.1b	876m	US$5.8 per barrel	US$ 75	US$80.1

Sources: Author Calculation

The adoption of lower benchmark for the budgets might account for the excess withdrawal from the Excess Crude account. The account that had over US$20 billion in 2006 got depleted to as low as US$3.9 as at the end 2012 (Figure 6a). The current benchmark is counter intuitive and negates the primary objective for the ECA as the balance in the ECA account decline progressively year in year out. The establishment of Sovereign Wealth fund which is the investment component of the ECA requires a steady flow of fund and a well-structured and planned withdrawal. The Sovereign Wealth fund was formally funded in early 2013 with seed money of US$1.0billion of which only US$200million has been invested. Up now 12 months after the initial deposit, no single addition has been made to the fund yet the oil price has been on the upward movement and the benchmark has been kept so low such that on average a USD 35 per barrel presumed added to the ECA fund monthly. Perhaps if the benchmark had been high enough to account for the greater flexibility required in funding the budget whatever savings in the ECA could easily be transferred to the Sovereign Wealth funds.

The great danger of insistence on the conservative benchmark like the proposed USD74 for 2014 budget is the growing level of Nigerian government indebtedness and high cost of debt servicing. As depicted in table 6b, total national debt currently exceeds $50bn (with a double-

[5] (2.4mpd*365days in year gives output per year)

digit interest rates, and service charges alone to gulp over N700bn, about 15 per cent of budgeted revenue, in 2014. More worrisome is the fact that most of these debts in recent years were incurred to fund huge deficits, which became necessary as a result of the clearly inappropriately low crude price budget benchmarks. As Henry Boro in December 16, 2013 edition of the Punch Newspaper rightly noted,

"it makes no sense to borrow to fund a deficit that is ultimately non-existent. The state government in several occasions had queried the management of excess crude oil account and alleged that the Federal Government had mismanaged the fund"

5. Conclusion

This paper has demonstrated that the oil price benchmark in Nigeria can be determined empirically. Adherence to the proposed flexible and robust framework to determine the crude oil benchmark helps in reducing the conflict that usually occurs at every year budget presentation and approval. It also ensures stable net saving into the Excess Crude oil account. Using the proposed framework, it was found that the current benchmark is conservatively low and thus put pressure on the saving in the excess crude oil account. Because this benchmark is too low relative to high expenditure profile of the government, the excess crude oil account could not serve the purpose it was meant. In contrast to the US$74 per barrel proposed in the 2014 to 2016 Medium term Expenditure framework, this paper suggests a bench mark above US$80 (between US$82 and US$91) given the optimistic and positive outlook of oil price in the international market. The oil price is expected to rove above US$110 from 2014 based on the forecast and in tandem with the US EIA forecast of Nigeria crude oil price movement.

The incessant withdrawal from the account clearly vindicates the legislative and also supports the proposition in this paper. Therefore the model estimates seem realistic and clearly can help douse the usual tension and altercations between the executive and legislative every year about the benchmark price the budget should be based. Similarly the three previous studies (Orok-Duke, Otonkue and Ekot, 2009 and Akomolafe and Danladi 2013) on the oil price benchmark in Nigeria had also advocated a higher than the official benchmark, this further indicates that the current official oil price benchmark is sub-optimal for the current expenditure profile of the government.

This paper therefore argues that except the federal government curtails its spending profligacy and adopts a more stringent fiscal discipline rules, the current benchmark is unrealistic and unsuitable in the context of Nigerian economic reality. The government needs to adopt a price rule that is more flexible and sustainable. The government as constraint on ts incessant withdrawal from ECA due to pressure could scrap the ECA and transfer directly to SWF investment funds and also establishment of an independent commission to determine the benchmark based on international best practices. Considering the legal and cost as well as the international image consequence of breaking the SWF investment incessantly will put a check on the government high appetite for spending. More so establishment of independent body will remove the rancour between the legislature and executive. This also has the advantage of making the process more transparent and ensures that the yearly budget routine is fast-tracked eliminates the attendant distraction and delay in budget passage which impacts negatively on budget performance in Nigeria.

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Table 2
Augmented Dickey-Fuller test statistics

		t-Statistic	Prob.*
Null Hypothesis: NCOP has a unit root			
Lag Length: 1 (Automatic - based on SIC, maxlag=13)			
Exogenous: Constant		-1.711688	0.4234
Test critical values:	1% level	-3.473096	
	5% level	-2.880211	
	10% level	-2.576805	
Exogenous: Constant, Linear Trend		-4.101461	0.0077
Test critical values:	1% level	-4.018748	
	5% level	-3.439267	
	10% level	-3.143999	
*MacKinnon (1996) one-sided p-values.			

Figure 3
Correlogram for the level and First Difference for Crude oil Price

<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>.|*******</td><td>.|*******</td><td>1</td><td>0.952</td><td>0.952</td><td>100.64</td><td>0.000</td></tr>
<tr><td>.|****** |</td><td>***|. |</td><td>2</td><td>0.874</td><td>-0.352</td><td>186.15</td><td>0.000</td></tr>
<tr><td>.|****** |</td><td>.|. |</td><td>3</td><td>0.786</td><td>-0.036</td><td>256.10</td><td>0.000</td></tr>
<tr><td>.|***** |</td><td>.|. |</td><td>4</td><td>0.698</td><td>-0.034</td><td>311.76</td><td>0.000</td></tr>
<tr><td>.|**** |</td><td>.|. |</td><td>5</td><td>0.616</td><td>0.015</td><td>355.46</td><td>0.000</td></tr>
<tr><td>.|**** |</td><td>.|. |</td><td>6</td><td>0.542</td><td>0.019</td><td>389.71</td><td>0.000</td></tr>
<tr><td>.|*** |</td><td>.|. |</td><td>7</td><td>0.483</td><td>0.068</td><td>417.20</td><td>0.000</td></tr>
<tr><td>.|*** |</td><td>.|. |</td><td>8</td><td>0.432</td><td>-0.043</td><td>439.37</td><td>0.000</td></tr>
<tr><td>.|*** |</td><td>.|. |</td><td>9</td><td>0.384</td><td>-0.034</td><td>457.04</td><td>0.000</td></tr>
</table>

.|** |	.|* |	10	0.346	0.089	471.59	0.000

Table 3
Model Selection Parameters

Models	AIC	SC
ARIMA(1 0 0)	6.448	6.510
ARIMA(2 0 0)	*6.125**	*6.209**
ARIMA(0 0 1)	7.401	7.459
ARIMA(0 0 2)	6.789	6.868
ARIMA(1 0 1)	6.190	6.293
ARIMA(2 0 1)	6.152	6.276
ARIMA(2 0 2)	6.146	6.292

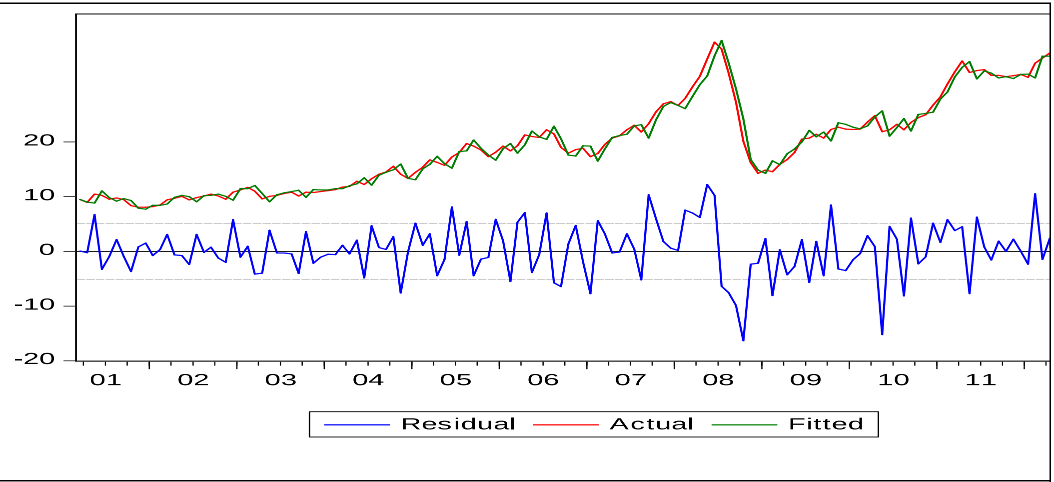
(*) signifies the model that minimized the error term

Table 4
Estimated AR(2) Model(Dependent Variable: NCOP)[6]

Variable	Coefficient	Std. Error	t-Statistic	Prob.
@TREND	0.756073	0.050941	14.84220	0.0000
AR(1)	1.444096	0.071658	20.15253	0.0000
AR(2)	-0.548815	0.071666	-7.657916	0.0000
SAR(12)	0.189284	0.092891	2.037701	0.0435
R-squared	0.976735	Mean dependent var		66.21514
Adjusted R-squared	0.976230	S.D. dependent var		33.10673
S.E. of regression	5.104265	Akaike info criterion		6.125795
Sum squared resid	3595.387	Schwarz criterion		6.209058
Log likelihood	-430.9314	Hannan-Quinn criter.		6.159629
Durbin-Watson stat	1.969567			
Inverted AR Roots	.87	.75+.44i	.75-.44i	.72+.17i
	.72-.17i	.44+.75i	.44-.75i	.00-.87i
	-.00+.87i	-.44+.75i	-.44-.75i	-.75+.44i
	-.75-.44i	-.87		

Figure 4
Plot of Actual and In Sample Forecast of Crude Oil Price

[6] The estimated was done base on seasonally detrended adjusted sample with 142 observations (2001M03 2012M12) after adjustments


20
10
0
-10
-20
01
02
03
04
05
06
07
08
09
10
11
Residual
Actual
Fitted

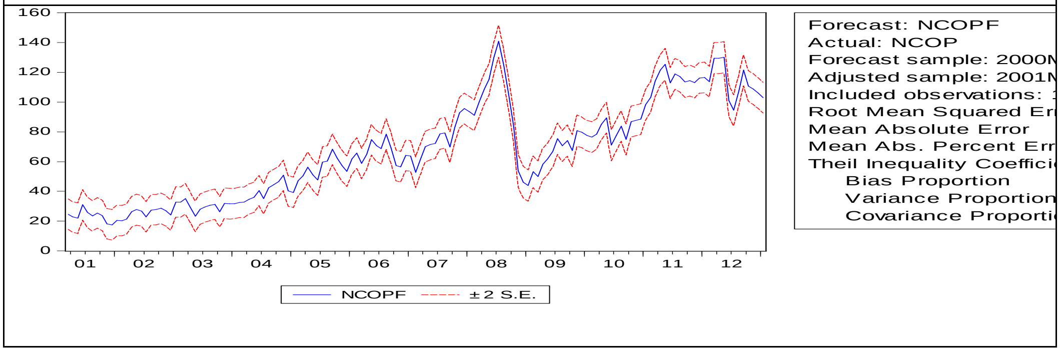
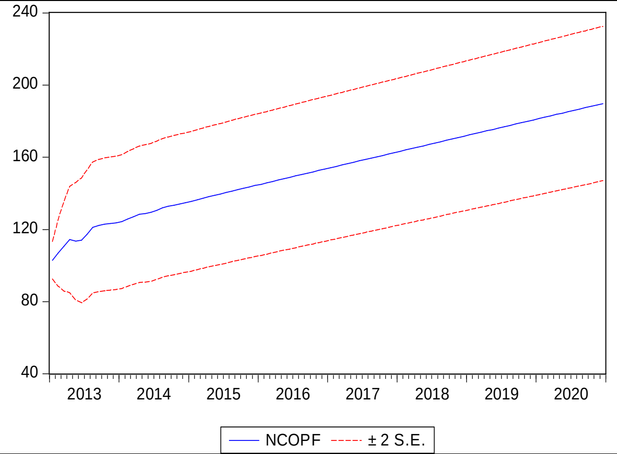
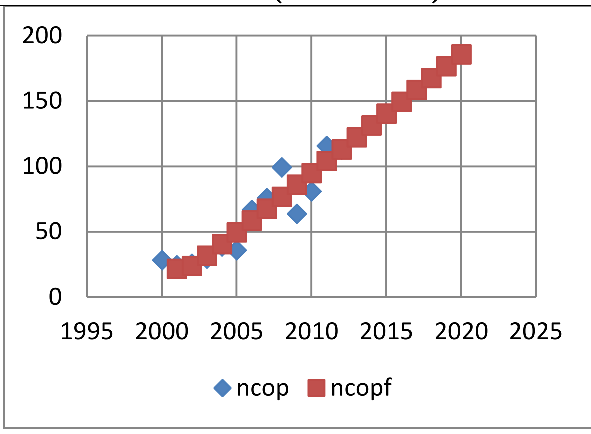

160
140
120
100
80
60
40
20
0
01
02
03
04
05
06
07
08
09
10
11
12
NCOPF
±2 S.E.
Forecast: NCOPF
Actual: NCOP
Forecast sample: 2000M
Adjusted sample: 2001M
Included observations: 1
Root Mean Squared Er
Mean Absolute Error
Mean Abs. Percent Err
Theil Inequality Coeffici
Bias Proportion
Variance Proportion
Covariance Proporti

Figure 5
Out of Sample Forecast of Oil Price Movement (2013-2020)





	Reference Case	2015	2020
2010 U.S. EIA AEO	Highest Lowest	\$144.72 \$51.48	\$185.51 \$51.90
OUR ARMA MDEL ESTIMATE	Highest Lowest	\$140.3 \$96	\$186.6 \$139

Source: U.S. Energy Information and Natural Resources Canada

Figure 6a
Excess Crude Oil Account Balance

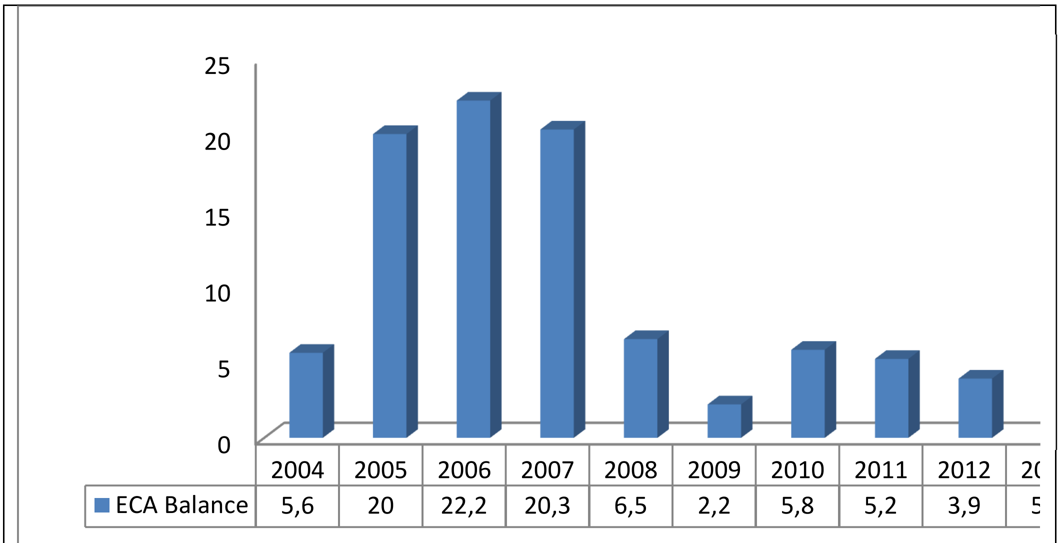


Figure 3b: Nigeria's Total Debt Stock (US$)