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Searching for Appropriate Crude Oil Price Benchmarking Method in the Nigerian Budgeting Process

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Abstract
One of the fundamental challenges facing policymakers in Nigeria is the benchmarking of crude oil price in the budgeting process. Appropriate projection of future behavior of crude oil price is imperative in setting and achieving macroeconomic objectives of the government. This paper surveyed the various forecasting models and examined the current Moving Average benchmarking method to determine the best forecasting model for Nigeria. 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 was also 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.
Key words: Budget Process, Forecasting Models, Predictability and Macroeconomic Stability
JEL: C22, C53, E24, H3 & H6

1. Background

In the determination of domestic crude oil price benchmark for budgeting, there are varying degrees of endogenous and exogenous factors that influence the pegging of crude oil price benchmark in the Nigerian budgeting process. These include the social and economic objectives of the government, cost of oil production, Joint-Venture Agreement consideration, and production sharing contract, non-oil sector viability and the overall fiscal stance of the government. The interplay of these variables affects not only the benchmark of crude oil for budgeting but the government revenue stream projections in her fiscal planning.

Since 2005, the Nigeria budget framework has been anchored on pegging oil price benchmark to certain pricing mechanism in relation to expected but uncertain global economic outlook and conditions. Nigeria's policymakers use the Moving Average Method (MAM) for pegging oil price benchmarks (BOF, 2012). This has produced several implications based on the changing economic environment particularly long term economic projections framework of MAM as against the short-term crude oil price dynamic behaviour. Consequently, this has continued to trigger further challenge to systematically track the emerging challenges associated with short-run economic unexpected wide fluctuation that affect development planning circles.

In addition, the budget as an instrument of economic governance requires the inputs of all the relevant stakeholders including the National Assembly. Despite the critical role of the National Assembly in Budget planning, its ability to effectively control budget planning is limited by the information available to her. The MAM used by the executive in budget preparation has raised serious concern among public affair analyst on the factors and underlying assumption that informed the choice of this method. Major arguments against this method range from its public perception as an ad hoc way of benchmarking oil price to its inability to predict short-terms dynamics of oil price. Thus, legislators, economists and public affair analysts have argued that alternatives that could provide counterfactual facts should be explored to inform economic policy.

This paper therefore, seeks to examine the crude oil price benchmarking mechanism in Nigeria with a view to fashioning out an alternative method that could address the domestic and external market fundamentals which influence crude oil price behaviour. Additional effort in this study was the forecasting of crude oil price benchmark for 2013 fiscal year.

The rest of this paper is structure into six sections. The conceptual clarification about oil price regimes and benchmarking is the focus of section 2, while section 3 deals with the stylized facts about crude oil benchmark price in the Nigerian budgeting Process. Section 4 contains a robust discussion on Moving Average Method as operated in Nigeria as well as other alternative models of forecasting time series. The empirical result of the tested Autoregressive Integrated Moving Average model used for forecasting oil price benchmark was presented in section 5. The policy implications of the study are pursued in section 6 while section 7 concludes the study.

2. Conceptual Clarification about Oil Price Benchmarking

In economic literature, there is no unique dimension or conceptual perspective to the determination of crude oil price benchmark in both the international crude oil market and the domestic economic environment. However, pricing of crude oil or its administration has passed through phases of price regulations and structures. These are categorized into three price regimes. The posted price, the OPEC administered price and the market determined crude oil pricing structure (see, Fattouh, 2011). Within these frameworks, various kinds of crude oil price benchmark methods have emerged and adopted which we shall analyze subsequently.

The posted pricing framework is the first oil pricing system associated with the concession system used to calculate the stream of revenues accruing to host government by the multinational companies. This method which existed between 1950 and 1973 was based on contract agreement between the host government and her concessionaire (the multinational companies) over time, and does not reflect conventional price determination mechanism. Moreover, the emergence of OPEC in 1960 resulted into another pricing framework of crude oil in the international market known as the OPEC administered price. This pricing framework is centered on providing a stronger platform for oil exporting countries to maximize oil rent not below the posted price. Thus, long term contract price which involves supplying crude oil over an agreed price is a variant of the OPEC administered pricing regime that emerged from this school of thought. This pricing method, nevertheless, was challenged by the emergence of non-OPEC members' crude oil in the international market. Thus, oil producing countries began to sell oil at different prices: the posted prices, the official selling price and the buyback price. Perhaps, these were highly influenced by the quality and destination of crude oil which propelled the demise of OPEC administered price.

The collapse of the OPEC administered pricing system in 1986-1988 ushered in a new era in oil pricing in which the power to set oil prices shifted from OPEC to the so called market (Fattouh, 2011). This transition was propelled by the emergence of many suppliers with diverse quality of crude oil, outside the OPEC members during the mid 1980s global recession. A major strategy was the undercutting of the OPEC price against the spot price. This describes the ideal situation in which, crude oil pricing can be said to be determined by the forces between supply and demand. This market determined price of crude oil has become the standard benchmark for fixing or pegging crude oil price for oil exporting nations. In development planning, such mechanism translates significantly in the budget processes of exporting countries given that the vagaries of oil production and fluctuations in crude oil price affect the expected stream of revenue from the petroleum sector.

From, the above discussion, the spot[4] price (cash price), long term contract price[5] and arbitrarily market determined crude price were variants of the pricing structures that emerged from the seemingly international benchmarks of crude oil in the international market. However, within the market determined regime, different kinds of benchmarking system are also discernible. These international benchmarks are based on the physical component of the crude that influences the financial layer surrounding it. These classifications include Dubai Asia method, Dated Brent for Europe and Africa, West Texas Intermediate (WTI)-American market option, Argus Sour Crude (ASC)-SA, Kuwait and Iraq. For instance, Iraq uses Brent for its exports to Europe, a combination of Oman and Dubai for its exports to Asia, and until recently, WTI for its exports for the US. In 2010, Saudi Arabia, Kuwait and Iraq switched to the Argus Sour Crude Index (ASCI) for export destination. Nigeria uses Dated Brent to Europe and Brent to the US. BRAVE is the weighted average of all futures price quotations that arise for a given contract of the futures exchange during the trading day, with the weights being the shares of the relevant volume of transactions on that day. Major oil exporters such as Saudi Arabia, Kuwait and Iran use BRAVE as the basis of pricing crude exports to Europe. The various physical benchmarks are influenced by varying degrees of factors ranging from the quality of crude oil, location and timing to the destination of crude oil**.** Since physical benchmarks constitute the pricing basis of the large majority of physical transactions, some observers claim that derivatives such as futures, forwards, option and swaps derive their values from the price of these physical benchmarks (Fattouh, 2011).

Generally, oil prices are based on expectations on the behaviour and reactions of economic agents in the crude oil market**.** For oil exporting countries that bases' their revenue stream to domestic crude oil price projection, an inquiry into the anatomy of crude oil pricing system reveals that different countries and regions may have developed alternative crude oil benchmark prices for national economic policy and budget concerns. Nigeria as oil exporting country has adopted the Moving Average method for benchmarking crude oil price in budget planning.

3. Stylized Facts about Crude Oil Benchmark Price in the Nigerian Budgeting Process.

There is no doubt that the price and volume of crude oil sales bear an important nexus with the total revenue generated by the Federal Government of Nigeria (FGN). Table 1 indicates that oil revenue shared over 99 percent, 78 percent and 73 percent of the total federal government revenue generate in 2004, 2007 and 2011, respectively. The implication of this is that crude oil remains a critical variable in the fiscal operations and

[4] A spot transaction is often thought of as a transaction in which oil is bought or sold at a price negotiated at the time of agreement and for immediate delivery. It is the basis for buying and selling crude oil not covered by long term contractual agreement and applies often to one off transactions (fattouh, 2011).

[5] Long term contracts are negotiated bilaterally between buyers and sellers for the delivery of a series of oil shipment s over a specified period of time, usually one or two years.

concerns of the Nigerian government. The relationship between total government projected revenue and oil revenue is shown in Table 1.

Table 1: Government Revenue Profile: 2004-2012

Year	Total Revenue (N)'billion	Oil Revenue (N)'billion	Proportion of Oil revenue to Total Revenue.(%)
2004	1,059.66	1,059.00	99
2005	1,232.00	'955.00	77
2006	1,462.00	1,131.00	77
2007	1,765.00	1,364.00	78
2008	1,544.00	1,069.00	69
2009	3,191.8	3,114.8	98
2010	6,769.33	4,902.33	72
2011	7,914.70	5,760.39	73
2012	9,144.55	6,403.40	70

Source: **Various Issues of the Budget Office of the Federation Accompanying Documents**.

The volume of crude oil sold at the prevailing oil market price is a veritable platform to understanding the flow of totally collected oil revenue. However, the main issue of discourse here is to provide the relationship between the international price of crude oil and the domestic projection of crude oil price benchmark for economic policy. A look at the snapshots of Table 2 and Figure 1 show that domestic benchmark of crude oil price has been below the international crude oil. The price differential as shown in Figure 1 indicates that 2006 and 2008, and 2011 and 2012 witnessed the widest variations due to the high uncertainty in the external market environment. This provided platform for the establishment of the Excess Crude Account (ECA). A major puzzle is to seek answers to how these price differentials were set and the possible implications in developing and evaluating an accountable and efficient strategic budgeting model.

The principles and assumptions of the ECA portend some measure of complexities in the budgeting process despite the objective of smoothening government fiscal actions at periods of economic perils. The argument is that ECA has become a strategy to save for the future which formed the basis for establishing the Sovereign Wealth Fund (SWF) rather than predicting oil price and market dynamics in a transparent manner. Nonetheless, the Nigeria budget over the years have always accounted for budget deficits provisions while some proportion of revenue stream is kept as markup in the ECA.

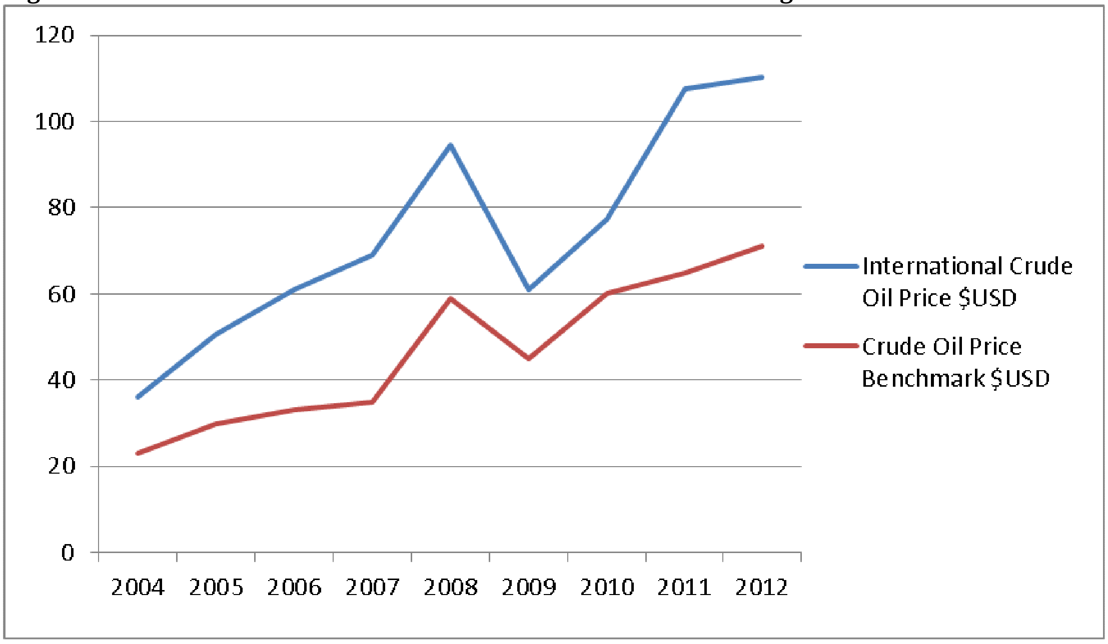
More fundamental is the assumptions underlying the pegging of crude oil price benchmark in the Nigerian budgeting process. A cursory observation of Table 2 reveals that crude oil price benchmark in Nigeria has considerably been based on Moving Average pricing framework among other concerns. This entails an average of a crude oil price series over a fairly long period of time. The continuously observed wide variations between the international crude oil price and the domestic oil price benchmark therefore invokes the need to re-examine the principles and assumption of using moving average method in pegging the crude oil price benchmark.

Table 2: International Oil Price and Domestic Projection of Oil Price Benchmark

Year	Average International Crude Oil Price $USD	Crude Oil Price Benchmark $USD	Excess Crude Account Component
2004	36.05	23	13.05
2005	50.64	30	21.1
2006	61.08	33	33.4
2007	69.08	35	34.08
2008	94.45	59	35.45
2009	61.06	45.0	16.06
2010	77.45	60.00	17.45
2011	107.46	65	42.65
2012	110.11	71	39.11

Source: OPEC (2012) and Various Issues of Budget Accompanying documents.

Figure 1: International Oil Price and Domestic Oil Benchmark in Nigeria.



Source: Author's Compilation.

5. Moving Average Method as Operated in Nigeria

Meaning

Moving Average (MA) method is one of the methods used in making forecasting and prediction on the behaviour of time series in applied economic analysis. The method involves taking the average of a long series over the years to make projection about the future behaviour of the series. It smoothens out short-term fluctuations and highlight longer-term trends or circles. The basic principle is to take into cognizance, changes in the error terms of the past and current value of the series to predict the future behavior of that series.

Moving Average is the dominant method used by the Federal Ministry of Finance/ Budget Office of the Federation in making projection on crude oil price benchmark for budget analysis. The rationale as argued by the BOF is to capture the long-term period of cyclical economic behaviours of crude oil price and to save some amount of money to smoothen government fiscal concerns in time of economic peril. Following the surplus' recorded in 2005 due to high unexpected rise in the price of crude oil, the Federal Government of Nigeria (FGN) created the Excess Crude Account (ECA). The ECA is the difference between the international crude oil price and the domestic benchmark of crude oil amongst other considerations.

Assumptions of MA Model

The assumptions of MA are;

1. It deals with fairly long term series for forecasting and prediction.
2. It considers the past error term of the series as basis of the future trend of the series.

The mechanics of this model is to use the average/mean behaviour of the series and its current period to test as against future projection of the series. The moving average model is specified as;

$$X_t = \mu + \varepsilon_t \sum_{i=1}^{q} \theta_i \varepsilon_{t-1} \quad \text{or} \qquad 1$$

$$X_t = \mu + \theta_0 u_t + \theta_1 u_{t-1}$$

Where, X_t is the domestic projection of crude oil price over time and u_t is the average mean of the series. The parameters $\theta_1,...,\theta_q$ are used to explain the behaviour of the past residuals in relation to the mean value of oil price in the model, while $\varepsilon_t, \varepsilon_{t-1}$, $\varepsilon_t \approx (0, \sigma^2)$ and u_{t-1} are the white noise error term.

The Nigeria budgeting framework which draws from this model is predicated on generalizing the average mean of past crude oil price for a fairly long period of 10years. This is expected to smoothening cyclical behaviours of the oil price and other macroeconomic variables that could influence crude price for the next fiscal year.

Challenges and Implications of Moving Average Method

A major challenge with this method lies in its inability to capture short-term cyclical fluctuations associated with oil price movements which is the basis of the MTEF. Secondly, MA is weak in tracking or predicting future volatile oil price. Third, for the essence of fiscal concern, the method could misdirect the principles of sharing crude oil proceeds among other things. Thus, this attempt is made towards developing an alternative but appropriate method for projecting oil price benchmark anchored on short-term cyclical movements of crude oil price and other macroeconomic considerations.

Other Alternative Approaches

In macro-econometric analysis, there are other methods/models used for forecasting and measuring volatility in time series. These include Trend Series/Regression, ARIMA, ARCH, GARCH and E-GARCH. Some of these methods are suited for different kinds of series and analysis as discussed below.

Trend Regression

This is one of the methods used in determining what will happen to future economic time series based on the history of the series. It is based on a regression analysis which helps to determine the linear trend factor that can be used to make future prediction about the series. First, the mechanic of trend regression is applied to ascertain whether a trend factor exist in the series. Second, such trend can be used to predict the future behaviour of the series. The trend regression equation is specified as;

$$X_t = \alpha_0 + \alpha_1 trend + \varepsilon_t \qquad 2$$

Where X_t , is the series to be predicted while α_0 and α_1 are the coefficients. ε_t , is the error term with an assumption that it follows a white noise process as $\varepsilon_t \approx (0, \sigma^2)$. The time or trend regression is mostly suited to show the trend movement of the series. However, the trend regression may be better only for series that are less volatile.

ARCH

Autoregressive Conditional Heteroschedasticity (ARCH) model developed by Engle (1982) is one of the econometric models used for determining series behaviour over time. The ARCH model is specifically utilized to measure volatility in economic and financial time series like stock prices, exchange tare and inflation rate. The rationale is to capture the conditional variances of the error term. The main assumption of the ARCH model is that most time series posses varying variance. This implies that volatile series possesses random walk which poses challenge to forecasting or predicting the future behaviour of such series. Thus, ARCH model helps to determine whether there is ARCH effect by first obtaining the mean of the equation as;

$$X_t = \beta_1 + \beta_2 X_2 + ..., \beta_k X_{kt} + u_t \qquad 3$$

Assuming that conditional on available information at time (t-1), the disturbance term is distributed as; $u_t =\approx N[0,(\alpha_0 + \alpha_1 u_{t-1}^2)]$

Where X_t is the series, and β_1, β_2 and β_k are the parameters. The error term $u_t \approx N(0,\delta_t^2)$ is the white noise which satisfies's the normal assumption.

Thus, modeling volatility in series may be necessary to determining the future behaviour of that series. However, a major shortcoming with the ARCH model is its limitation to determining whether the series is volatile (ARCH effect) or not. Thus, ARCH models cannot simply predict the future of the series on its own.

GARCH

Generalized Autoregressive Conditional Heteroschedasticity (GARCH) model is an extended ARCH model due to Bollerslev (1986). GARCH is also an econometric model used to predict volatility in economic and financial time series. The approach requires a joint estimation of the mean and variance of the equation. The mechanics of GARCH requires that the current conditional variance depends on the past squared residuals of the process and on the past conditional variances. The GARCH model can be specified as;

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_t^2 + \alpha_{t-1}^2 \qquad 4$$

The main application of GARCH model is for measuring volatility in high frequency data. GARCH like ARCH cannot be used for forecasting the future behaviour of a series. Although the discussed models can be applied in testing different series, none of the models appear to be appropriate for forecasting the crude oil price. Thus, analysis is extended to evaluate the popular ARIMA[6] model advanced by Box and Jenkins (1970).

ARIMA Model

The Autoregressive Integrated Moving Average **(**ARIMA) model is one of the macro-econometric modeling and forecasting methods used in econometric analysis. The method deals specifically with forecasting non-stationary or weakly stationary series. Many economic time series are nonstationary such that they do not have a constant mean and posses' time varying covariances. Thus, parameter estimates or forecast of a series with this kind of Data Generating Process (DGP) may not only be inefficient but could also yield misleading inferences. Although

[6] The ARIMA method produces dynamic forecasts by including the lags of the variables and its error terms. It can also be used for In-sample and Out-sample forecasts.

there are other predictive models, the ARIMA model involves forecasting or predicting a non-stationary series like crude oil price over time.

It considers both the past values (autoregressive) and the mean residuals of the error term (moving average) characteristic of the series. Its major improvement over MA is that it considers both the past and future cyclical behaviours of economic variables in setting appropriate structure for forecasting and predicting time series like crude oil price over time. The ARIMA model is also better when projecting for fairly short-term behaviours of variables that are of concern to the Medium Term Expenditure Framework (MTEF) in Nigeria.

Classical Assumptions of the ARIMA Model

The ARIMA model is anchored on the following assumptions:

a. The model deals with very high time-varying series. Oil price assumes high level of volatility which requires ARIMA model for forecasting.

b. ARIMA model posses the ability to track changes of the time series. The MTEF is based on making projection and considerations about the broad macroeconomic aggregates within a short term period.

c. The ARIMA model is also better when projecting for short-term behaviours of time series.

Operational Mechanics of the ARIMA Model

In order to correct the shortcomings of the moving average method in budget analysis, the ARIMA model developed by Box and Jenkins (BJ) is adopted in this study as an appropriate framework for forecasting crude oil price. ARIMA model has two components: The Auto-Regressive and the Moving Average. The Moving Average component captures the behaviours of the past residuals while the AR component deals with the past values of the series.

The structure of the model is shown below.

The AR component of ARIMA is specified as;

$$X_t = c + \sum_{i=1}^{p} \varphi_i X_{t-1} + \varepsilon_t \quad \text{or}$$

$$X_t = \varphi_1 X_{t-1} + \varepsilon_t \qquad 5$$

Where, X is the lagged values of domestic crude oil price benchmark over the years. However, the Moving Average component of the ARIMA model is captured in equation 1. Thus, integrating equation 1 and equation 5 gives the full specification of the ARIMA model as;

$$X_t = c + \varepsilon_t + \sum_{i=1}^{p} \varphi_i X_{t-1} + \sum_{i=1}^{q} \theta_i \varepsilon_{t-1} \quad \text{or} \qquad 6$$

$$X_t = \mu + \varphi_1 X_{t-1} + \theta_0 u_t + \theta_1 u_{t-1}$$

Equation 3 in the form of ARIMA (p, q) shows that the series is integrated of order AR (P) and MA (q). The order of integration (I), represents the number of times, the series can be differenced to make it stationary.

Data Consideration

The model requires a fairly long time series. In econometric analysis, data range of about 30 points is required to obtain an efficient estimate that could be used for better policy inferences. Our domestic crude oil price benchmark is 8 years, hence, we employed the CEAR method to disaggregate the data into four quarter each to forecast for the future (CEAR, 2010). Thus, more data points were generated for the analysis.

Testing the ARIMA Model

The BJ methodology has four steps in testing the ARIMA model. These are identification, estimation of the model, diagnostic checking and forecasting.

1. The identification process starts by testing for the stationary properties of the series. This is done by analyzing the correlogram of the time series or carrying out a unit root test of the Augmented Dickey-Fuller Test and Philip-Peron to determine the order of integration. Thus, crude oil price benchmark over the years would be subjected to stationarity tests.

2. Estimation of the ARIMA model is then conducted using Ordinary Least Squares Method.

3. Diagnostic checking of the model is performed to determine the nature of fitness of the results using iterative process.

4. Forecasting of the future series based on the outcome of the estimated model is then carried out. This is expected to provide robust, efficient and appropriate basis for pegging oil price benchmark.

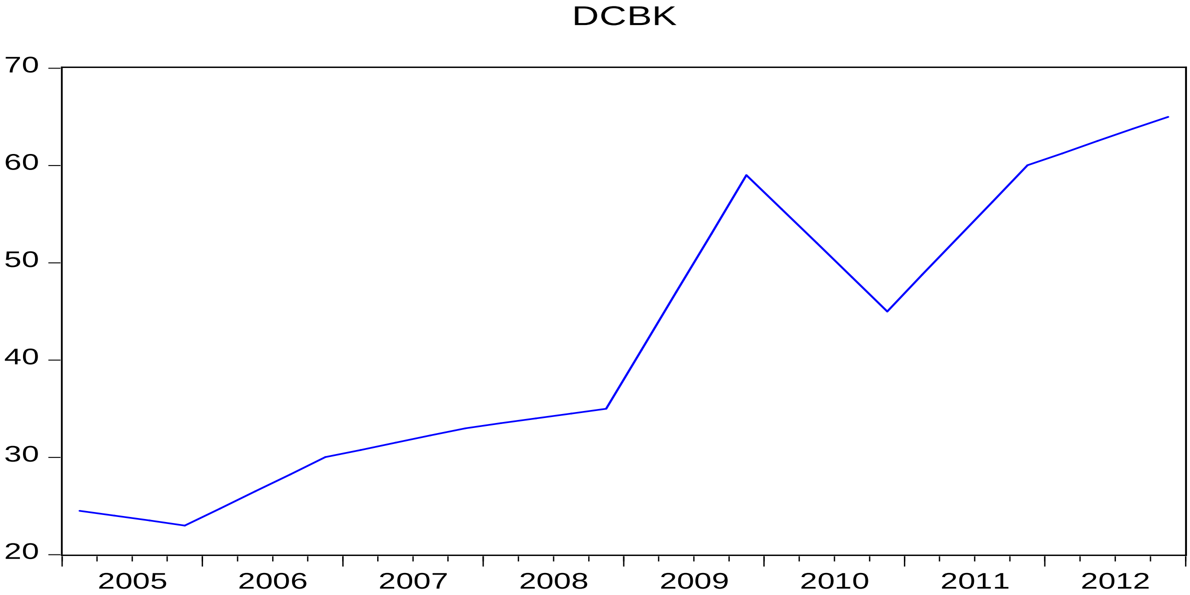
5. Empirical Analyses.

Based on the procedures enumerated in the previous section, the results of the ARIMA model are presented and discussed below.

Step 1: Unit Root Test

Three methods of checking the presence of unit roots in the domestic crude oil price benchmark were employed for the analysis. These are the graphical analysis, the correlogram which deals with the simple Auto-Correlation Function (ACF) and the Partial Autocorrelation Function (PACF), and the Augmented Dickey Fuller (ADF) test. The results are presented below.

Figure2: The Trend of Domestic Crude Oil Price Benchmark



Source: Author's computation.

The graphical analysis in Figure 2 above shows that domestic crude oil price benchmark moved in a staggering upward trajectory. This clearly indicates that the series is not stationary which suggest the presence of unit root in the series. It is therefore concluded that the series is not stationary and can be utilized to carry out forecasting using ARIMA.

Similarly, the result of the unit root test in domestic crude oil price benchmark based on the correlogram approach with a pattern of 29 lag is shown in Table 3. The autocorrelation (ACF) started with a high value and declined slowly, indicating that the series is not-stationary. More also, the Q-statistics at lag 29 has a probability value of 0.000 which is smaller than 0.05%. This confirms that the series is non-stationary and must be differenced for stationarity to occur in the series. Overall, the autocorrelation functions (ACF) of the residuals which can also be used to test fitness of the regression suggest that the critical value of the probability is close to one. In the nut shell, it is observed that none of the terms (spikes) is exterior to the confidence intervals and the Q-statistics has a critical probability close to one. A classical import of these results is that the ARIMA model performed well as an alternative method of forecasting a non-stationary series like the ad hoc domestic crude oil price benchmark.

Furthermore, the unit root result of the Augmented Dickey-Fuller (ADF) test is shown in Table 4. The result shows that the domestic crude oil price benchmark series is not statioanty at level. Thus, the series was differenced and stationarity was achieved after the first difference. This further reinforces the fact that the series possesses a unit root and can only be stationary after the first difference transformation. The overall economic import of these is that the Domestic Crude Oil Price Benchmark (DCBK) possesses the feature of a series that can be used for ARIMA forecasting.

Table 3. Result of the DCBK Correlogram

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.009	0.009	0.0025	
. | . |	. | . |	2	0.007	0.007	0.0041	
. | . |	. | . |	3	0.008	0.008	0.0061	0.938
*****| . |	*****| . |	4	-0.706	-0.706	18.389	0.000
. | . |	. | . |	5	0.006	0.043	18.391	0.000
. | . |	. | . |	6	0.005	0.033	18.392	0.001
. | . |	. | . |	7	0.002	0.030	18.392	0.002
. |**. |	****| . |	8	0.232	-0.536	20.749	0.002
. | . |	. |* . |	9	-0.009	0.080	20.753	0.004
. | . |	. | . |	10	-0.010	0.053	20.757	0.008
. | . |	. | . |	11	-0.015	0.033	20.768	0.014
. | . |	.**| . |	12	0.056	-0.209	20.934	0.022
. | . |	. | . |	13	-0.003	0.039	20.934	0.034
. | . |	. | . |	14	-0.004	0.009	20.935	0.051
. | . |	. | . |	15	0.021	0.041	20.963	0.074
. | . |	. |* . |	16	-0.062	0.109	21.225	0.096
. | . |	. | . |	17	0.009	-0.033	21.231	0.130
. | . |	. | . |	18	0.009	-0.054	21.238	0.170
. | . |	. | . |	19	-0.016	0.006	21.261	0.215
. | . |	. |**. |	20	0.009	0.224	21.269	0.266
. | . |	. *| . |	21	-0.017	-0.100	21.301	0.320
. | . |	. *| . |	22	-0.018	-0.104	21.339	0.377
. | . |	. | . |	23	-0.004	-0.043	21.342	0.438
. | . |	. |* . |	24	-0.002	0.141	21.342	0.500
. | . |	. *| . |	25	-0.002	-0.111	21.343	0.560
. | . |	. *| . |	26	-0.001	-0.104	21.343	0.618
. | . |	. *| . |	27	-0.001	-0.073	21.344	0.673
. | . |	. | . |	28	-0.002	-0.012	21.345	0.724
. | . |	. | . |	29	-0.001	-0.062	21.345	0.770

Source: Author's computation

Table 4: Augmented Dickey-Fuller Test result

Null Hypothesis: D(DCBK) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.937943	0.0055
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

Source: Author's computation

Step 2: Result of the ARIMA Model

The result of the ARIMA test is presented in Table 5**.** The regression result indicates that the coefficients of the model are statistically significant as revealed by the t-statistics and the probability values. The result indicates that the coefficient of determination R^2 of 64% well explain the goodness of the fit. The D.W. and F-statistics provide evidence that the ARIMA test is well fitted. Table 5 suggests that crude oil price benchmarking in

Nigeria can be predicted based on ARIMA (1,1,4). This simply means autoregressive order AR (1) and MA (4). The result below provides a classical and appropriate platform to perform forecasting of the future of price benchmark.

Table 5: Result of the ARIMA Model

Dependent Variable: DDCBKSA
Method: Least Squares
Date: 09/24/12 Time: 17:39
Sample (adjusted): 2005Q3 2012Q4
Included observations: 30 after adjustments
Convergence achieved after 3 iterations
MA Backcast: 2004Q3 2005Q2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(1)	0.925456	0.086621	10.95521	0.0000
MA(4)	-0.904682	0.146677	-6.266708	0.0000

R-squared	0.641012	Mean dependent var	1.382125
Adjusted R-squared	0.628191	S.D. dependent var	2.746889
S.E. of regression	1.674948	Akaike info criterion	3.933782
Sum squared resid	78.55262	Schwarz criterion	4.027195
Log likelihood	-57.00673	Hannan-Quinn criter.	3.963665
Durbin-Watson stat	2.141790		

Inverted AR Roots	.95			
Inverted MA Roots	.98	.00+.98i	-.00-.98i	-.98

Source:Author'sComputation

Step 3: **Diagnostic Checking**

The procedure used in this ARIMA analysis follows the classical method of data smoothening through the seasonalization of the data. Thus, various iteration processes was conducted to test for the adequacy and reliability of the result. First, after stationarising the data, an appropriate ARMA (p, q) process was identified using the correlogram Q-Statistics. Estimated models which fulfilled the criteria of p + q = 5 were considered and compared. The model's order of integration whose parameters were not significant at 5% confidence level were rejected and dropped from the model.

The estimation technique began by modeling the conditional mean process through an autoregressive AR (1) and moving average MA(1) to various orders with the validitity of the model been determined by the behaviour of the correlegramm of residual. Thus, the order of the model with the lowest value of Akaike Information Criterion (AIC) and the Schwartz Information Criterion (SIC), appropriate Durbin Watson value is selected as the best fit. The result revealed that AR(1) and MA(4), i.e. ARIMA (1,1, 4) could be the best forecasting standard for domestic crude oil price benchmarking in the Nigerian budgeting process. Intuitively, AR (1) and MA (4) fall into the MTEF and Fiscal Policy Strategy Paper of the Federal government.

Step 4: Forecasting

The result presented in Table 5 was further extended to forecast for the future crude oil price benchmark. This is based on the procedures developed by Box and Jenkins for forecasting non- stationary time series using with the ARIMA model. The 2012 fourth quarter of the seasonalized data was used as baseline for the 2013, while the scaling factor was determined by the residuals generated from the regression result. The BJ ARIMA model forecast shows that the 2013 domestic crude oil price benchmark is US$80 at the end of the fourth quarter. This projection takes into consideration, the impacts of stochastic variables as well as the historical trend of the series in the estimation. The result is shown in Table 6 while the procedure[7] is presented in appendix 1.

Table 4: ARIMA Forecast Values of DCBK for 2013.

Year/Quarter	**Future Value**
2013 Q1	**80.409**
2013 Q2	**81.850**
2013 Q3	**81.884**
2013 Q4	**80.945**
Average Value	**81.272**

Source: Author's Computation

Step 5: Counter-factual Evidence and Sensitivity Analysis

The Federal Ministry of Finance/BOF pegged the 2013 oil price benchmark at US$75 per barrel using 5-10 years moving average method. This study carried out a counter-factual analysis to determine the validity of the Moving Average Method against the ARIMA predictive model. The result is showed in Table 5. From the table, the result indicates that using a 10-years moving average, crude oil benchmark would be US$70pb while a 9-years moving average puts domestic crude oil price benchmark at US$75. However, when a moving average of 5–years was applied, domestic crude oil price benchmark would be US$90.

Table 5: Oil Price benchmark using MAM

Year/ MA Period	**Future Value US$'**
2013 5 years	**US$ 90**
2013 9 years	**US$74.65**
2013 10 years	**US$70**

Source: Author's Computation

Analytical Procedure of the Moving Average Method

MA(t) = Y(1)+ Y(2)+ Y(3)+ Y(4)+ Y(5)+ Y(6)+ Y(7) +Y(8)+Y(9) +(10)⁄10

MA (10) = 29.04+ 36.05+50.64+61.08+69.08+94.45+61.06+77.45+107.46+110.11 / 10

MA (10) = 696.42/10 = 69.64

MA (9) = 36.05+50.64+61.08+69.08+94.45+61.06+77.45+107.46+110.11 / 9

MA (9) = 467.38 / 9

MA (9) = 74.15

MA (5) = 94.45+61.06+77.45+107.46+110.11 / 5

[7] There are different ways of carrying out ARIMA forecast. Gujarati and Porter used the method below to forecast US GDP as; $Y_{2008-I} - Y_{2007-IV} = \mu + \beta_{1u2007-IV} + \beta_{2u2007-III} +_{u2008-I}$. This method does not take care of seasonality in data.

$$MA\ (5) = 450/\ 5$$

$$MA\ (5) = 90.$$

From the evidence above, the 9-year moving average appears to be the value used to arrive at the 2013 budget. This time horizon is close to the 10 years MA reported by the BOF. Nevertheless, the timing may not be able to track the short-term cyclical behaviour of crude oil price dynamics. The 5-years moving average result which is fairly within the 3-5year MTEF is conspicuously higher than the value predicted by the ARIMA model. Although the BOF may have taken into consideration of the behaviour of exchange rate as well as other macroeconomic and international developments in the oil market, MA is not a good forecasting method for tracking short-term cyclical behaviour of crude oil price.

The principle of benchmarking crude oil price and the establishment of the ECA could be drawn from the typical Milton Friedman Price Based Fiscal Rule which is aimed at smoothening future consumption may be a step in the right direction but must be anchored in a transparent framework.

This paper argues that even though the US$75 per barrel is cautious, the process of arriving at it is faulty in one hand while raising it to US$80 could generate more revenue to the government needed for capital expenditure financing as well as reduce fiscal deficit in the 2013 budget on the other hand.

6.0 Policy Implication

Budget deficit and its financing has become a prominent feature of the Nigerian budgeting system. Deficit arises due to short falls in the expected flow of revenue against government expenditure. Although the pegging of crude oil price benchmark has also become a fiscal instrument of ensuring that government saves money against uncertainties in the dynamic international crude oil market, benchmarking could have varying implications for the economy. This argument relates to incurring budget deficit when revenue sources are not optimally patterned or planned. Given that revenue projections are made based on the domestic benchmark of oil price, development planning could be structured to take into account of flexible ways of improving revenue stream of the government while efficient implementation could be a sufficient condition to ensuring that fiscal objectives are realized.

The Moving Average method as operated in Nigeria seems not to be a systematic method of benchmarking. This is because of the long term framework it assumes against the short-term dynamics of crude oil price movements. Effective budgeting system must recognize or programme the short-term changes in oil price movement with appropriate and reliable framework. The ARIMA model is one of the classical methods of forecasting short term behaviours of random walk series like crude oil price. This method takes into account of the stochastic behaviour of oil price to predict the future behaviour of the series as shown above.

The US$80 forecasted for the 2013 fiscal year illicit some implications. First, it could help the government to generate more revenue and reduce fiscal deficit. Second, it could assist government in making realizable targets for crude oil production. The leakages in the oil production or rather the short falls in projected oil production have monumental impact on the economy. Government can target realistic price and modest projection of crude oil production rather than being overly cautious in benchmark with unrealistic projected crude oil production. Third, oil price is assuming some modest stability as the global economy growth is likely to continue its improvement in the next fiscal year. Fourth, oil price changes follows a short term cycles in which the current cycle may not end until 2014. Although the US$80 pb is fairly high, the scenarios above are likely sustain the international crude oil price over and above this projected benchmark.

7.0 Conclusion and Recommendation

This study has endeavoured to examine the domestic crude oil price benchmarking method in the Nigerian economic environment. The Budget Office of the Federation (BOF) applies Moving Average method as a model for projecting or fixing domestic benchmark in budgeting. This method involves taking moving average of long crude oil price series to fix for the next fiscal year amidst other considerations. However, crude oil price follows a short term dynamics which makes the MA inappropriate for benchmarking oil price. This study reviewed the MA and other forecasting methods with a view to determining the appropriate benchmarking model as well as predicting the 2013 oil price benchmark.

The Autoregressive Integrated Moving Average (ARIMA) method was found appropriate for forecasting the non-stationary crude oil price benchmark in Nigeria. ARIMA (1,1,4) model offered the best order of integration for predicting crude oil benchmark in Nigeria. The timing of the prediction is tune with the policy space of the government MTEF and FSP. The result equally suggests US$80 per barrel (average) for the 2013 oil price benchmark. The implication of this forecast is that government could generate more revenue and reduce fiscal deficit with a modest projection of crude oil production. This study recommends that benchmarking of crude oil should be based on the crude oil price fundamental to enhance predictability and promote macroeconomic stability.

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Procedures for Conducting ARIMA Forecasting

The steps used in conducting the ARMA forecast are stated below;

1. The disaggregation of annual domestic crude oil price benchmarks in to quarterly data.
2. Seasonalization of the data to account for the seasonal behaviour of the data and obtain seasonal scale.
3. Estimation of the ARIMA model to obtain
4. Forecasting using the 2012 fourth quarter as baseline. The scales of the seasonal coefficients are used to generate the AR while the residuals of the preceding four quarters of the baseline year are used as the MA for the forecast period. This is shown as;

   Quarter 1:

   DCBK = 0.925472* AR(1) – 0.904689*MA(4)

   DCBK = 0.925472*1.36181 - 0.904689*(-0.88434) = 2.0604

   = 2.0604+78.21299 =80.273

   Multiplying 80.273 by the SC (1.001695) = **80.409** the forecasted first quarter.

   Quarter 2:

   DCBK = 0.925472* AR (1) – 0.904689*MA(4)

   DCBK = 0.925472*2.0603 - 0.904689*(0.47912) = 1.4733

   = 1.4733 + 80.280 = 81.7013 (81.8823)

= Multiplying 81.7013 by SC 0.999607 = **81.850** the second quarter forecast.

Quarter 3:

DCBK = 0.925472* AR (1) – 0.904689*MA(4)

DCBK = 0.925472*1.4733 - 0.904689*1.59726 = -0.0815

= - 0.0815 + 81.669 = 81.5875 81.768

= Multiplying 81.5875 by SC 1.001427 = **81.884** the third quarter forecast

Quarter 4:

DCBK = 0.925472* AR(1) – 0.904689*MA(4)

DCBK = 0.925472*-0.0815- 0.904689* 0.70983 = -0.7176

= - 0.7176 + 81.703= 80.985 81.166

= Multiplying 80.985 by SC 0.997277 = **80.945** the fourth quarter forecast

Average Value: Q1 +Q2 + Q3+ Q4
= 80.409+81.850 +81.884 +80.945 = 325.088

Average Oil Price Benchmark for 2013 = 325.088/4= 81.272

Table 4: Forecast Values of DCBK for 2013.

Year/Quarter	**Future Value**
2013 Q1	80.280
2013 Q2	80.669
2013 Q3	80.735
2013 Q4	80.252
Average Value	80.484

Source: Author's Computation

80.280+ 81.669+81.703+80.764 = 324.416/4 = 81.104