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Effect of Oil Price Movement on Stock Prices in the Nigerian Equity Market

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Disclaimer: The views expressed in this paper are those of the author alone and do not necessarily represent those of the Central Bank of Nigeria or CBN policy.

Abstract

This paper studies the relationship between oil prices and stock prices in the Nigerian equity market using a forecasting framework. The study was driven by the need to determine if the extreme volatility observed in oil prices has any significant impact on the stock price movement of a major oil exporting economy like the Nigeria. By establishing the presence of a significant relationship between these variables, investors and policymakers alike could use oil prices as a leading indicator in producing more accurate projections of stock prices. While the results of this study recorded no cointegration between stock prices and oil prices, the use of an ARIMA and a structural-ARIMA model showed that oil price is a significant exogenous variable which could improve the accuracy of stock price prediction in the Nigerian stock market by an extent.

Keywords: Oil prices, stock market predictability, Nigerian Stock Exchange.

1. Introduction

The documentation of the effects of oil prices on financial markets in developed economies like the United States and a number of oil importing European markets has led to a relatively high interest in the study of economic relationship between oil prices and the economic activities of these nations. One of such studies by Jones and Kaul (1996) showed that oil price movement had a negative relationship with stock market prices. The logic behind their conclusion could be explained by the fact that rising oil prices is associated with a rise in energy costs which is central to the cost of production. With a rising cost of production, investors tend to devalue firms due to lower expected returns in line with the concept of the weighted average cost of capital.

While there is a reasonably large and increasing literature on the impact of oil prices on stock prices for developed markets, the same cannot be said for emerging oil exporting economies that profit from high oil prices. This paper is aimed at deepening the study of the relationship between oil prices and movement of stock prices in the emerging stock market of Nigeria. While a significant number of studies used the framework of employing vector error correction models to model the impact of oil price shocks on stock market prices, this paper would make use of a forecasting framework according to Ikoku and Okany (2010), using an ARIMA and a Structural-ARIMA model to evaluate the impact of oil price movements on stock prices in Nigeria. My line of thought is that if a combination of an ARMA terms and oil prices produces more accurate out of sample forecasts than an ARIMA model, then it would be safe to conclude that oil price movements contains information which could significantly reduce the forecast error of stock prices.

The second section of this paper reviews existing literature on studies bordering the relationship between oil prices and stock market prices in both developed and emerging economies as well as oil importing and exporting economies. Following the review of literature is a section dedicated to a number of statistics tests as well as the modeling of stock prices followed by concluding sections detailing the findings and implications of the analysis.

2. Literature Review

In one of the studies of oil price movement's impact on stock prices and the economy, Barsky and Kilian (2002) explained that one of the impacts of oil price shocks on stock prices was noted in the 70's when a rise in oil prices brought about by a severe decrease in the supply of oil resulted in a shortage of finished goods; this led to a rise in the general price level of goods, and ultimately a global recession. While accepting the impact of oil prices on the economy and financial markets however, Barsky and Kilian (2002) explained that the events of the 70's which led to the various negative effects were more severe due to the economic climate of the period which kept the demand for oil at a high, thereby amplifying the effect of the oil supply shock on the economy.

Although Barsky and Kilian blamed the recession on the oil price shock experienced during this period, there have been other views which do not support the existence of a significant relationship between these two variables. Chen et.al (1986) studied the impact of oil prices on what they would term, "the over-reaction of stock market prices". Establishing that stock market prices reacted to a number of economic events and the expectation of such events, they point out that as a result of the portfolio diversification technique employed by financial investors worldwide, the impact of oil price shocks on prices was not as significant as it was made to look. They argued that factors more central to the determination of stock price movements were factors like discount rates, monetary supply and other state factors which had a more significant impact on the financial markets.

Paying greater attention to the method used in determining the relationship between stock market prices and certain macroeconomic variables including oil prices, Cheung and Lilian (1998) give less credit to conclusions based on the short term relationship between oil prices and stock markets, arguing that a long term relationship between these two variables provided more insight into stock price movement. Building the platform for their study on the Engel Granger cointegration technique, they attempt to determine if indeed there was a long term relationship and the dynamics of this relationship in five nations including Canada, Germany, Italy, Japan and the United States. Having determined this relationship, they progressed by developing an error correction model to improve their understanding of the impact of certain macroeconomic variables including oil prices on stock market prices. The result of their tests gave more support to the existence of a long term relationship between the two variables.

Adopting the same framework as Cheung and Lilian, Apergis and Miller (2008) employ the cointegration test along with an error correction model in a wider selection of countries which included the United Kingdom and France, they rejected the notion that there exists a very significant relationship between oil price shocks and stock prices, arguing that while there was relationship, it was not a very significant relationship thereby discrediting previous findings to the contrary.

So far, most of the reviewed studies on stock market returns and oil prices have been focused on developed economies; one of the few studies that focused on emerging stock markets, including South Africa and Venezuela, was by Basher and Sadorsky (2006) using data from a broad range of stock markets across emerging markets. Their finding was that oil prices did have a strong impact on stock market returns in general. Their method was based on the arbitrage pricing theory where oil price was used as a factor under investigation. Another study by Faff and Brailsford (1999) on the Australian economy also suggested a significant relationship between stock prices and oil prices while noting a negative relationship.

Also, Arouri and Rault (2010) studied the relationship oil price movements on stock prices of Gulf Corporation Countries (GCC) to determine what causes what. They employed the granger causality test to determine the causal effects between stock prices and oil prices. For the Saudi Arabian market, they found out that there was a consistent bi-directional causality between the two variables, while for the other GCC countries there was a unidirectional causality from oil prices to stock prices.

3. Data and Methodology

Data on the Nigerian stock market index (All-Share Index) was obtained from the Nigerian Stock Exchange database. Taking end of month values of the index (ASI), which is value weighted and constitutes all traded securities, the author used data from January 2004 to June 2014 making for 126 observations. I also obtained monthly prices for Brent Crude from the Bloomberg database ranging from January 2004 to June 2014 making for an equal 126 observations. Please refer to figures 1, 2 and 3 for graphs of the data over this time period. Also, Figures 5 and 6 shows the descriptive statics of the time series. A set of diagnostics is carried out on both variables including tests for stationarity, causal effects and cointegration.

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Figure 1. Historical movement of the Nigerian All-Share Index

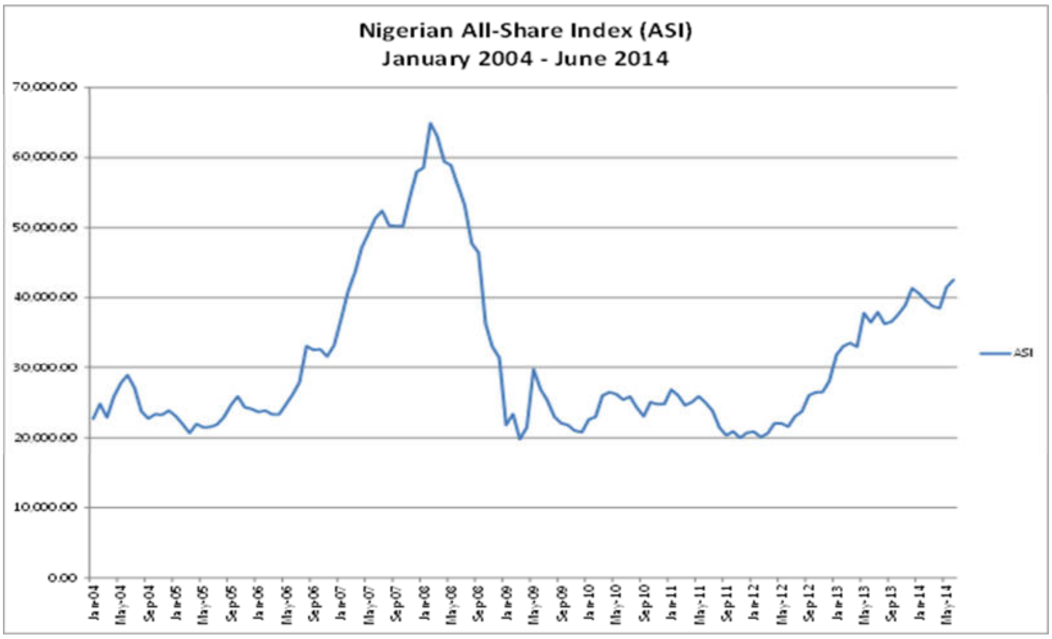


Figure 2. Historical movement of Oil Prices

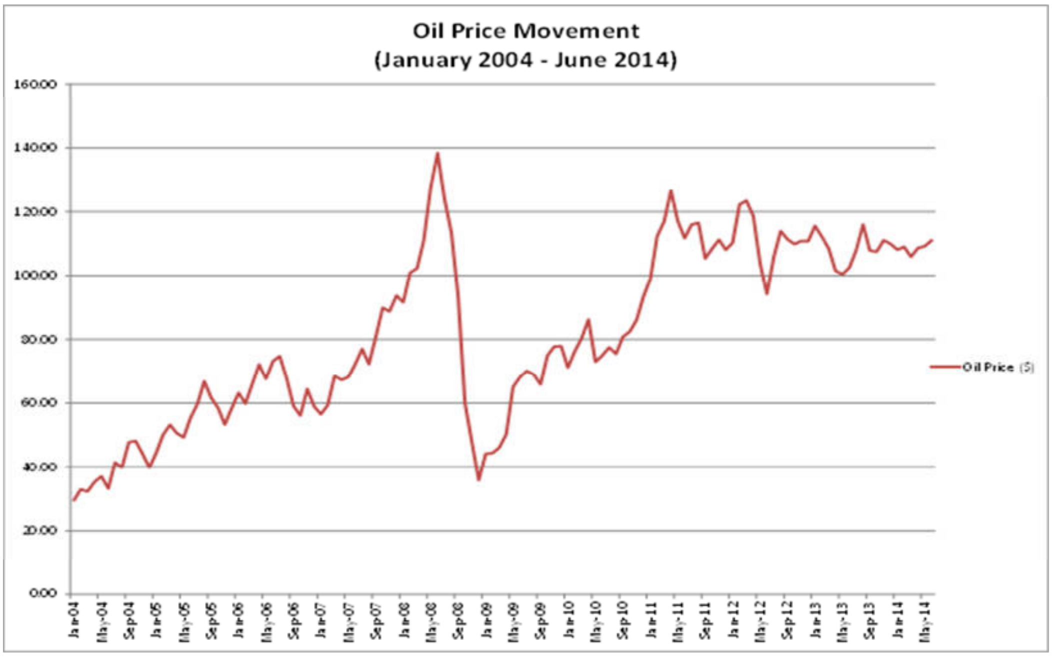


Figure 3. Historical movement of the Nigerian All-Share Index and Oil Prices

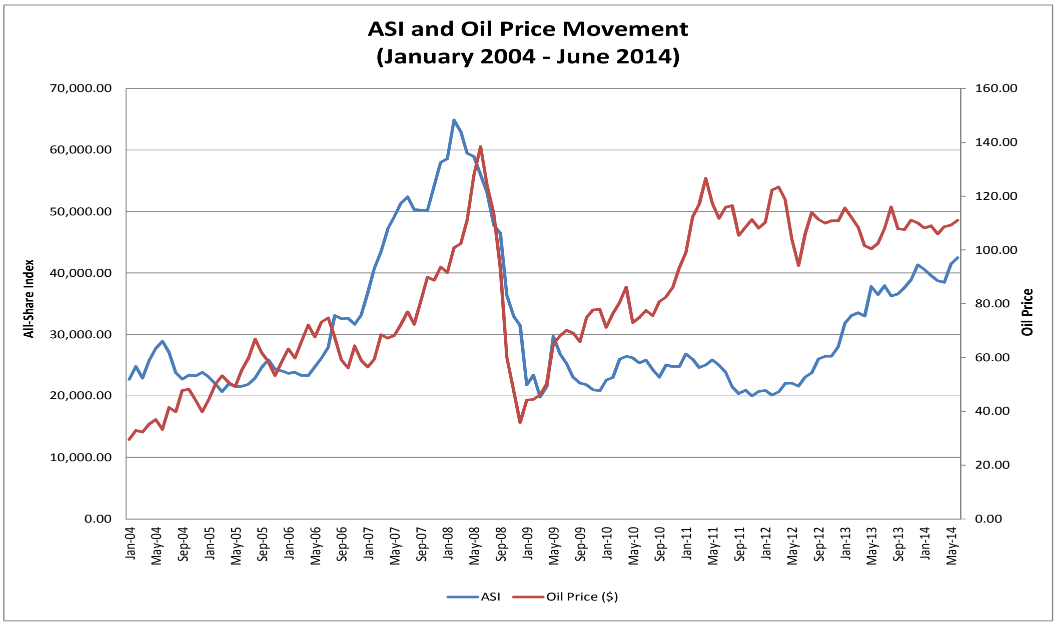
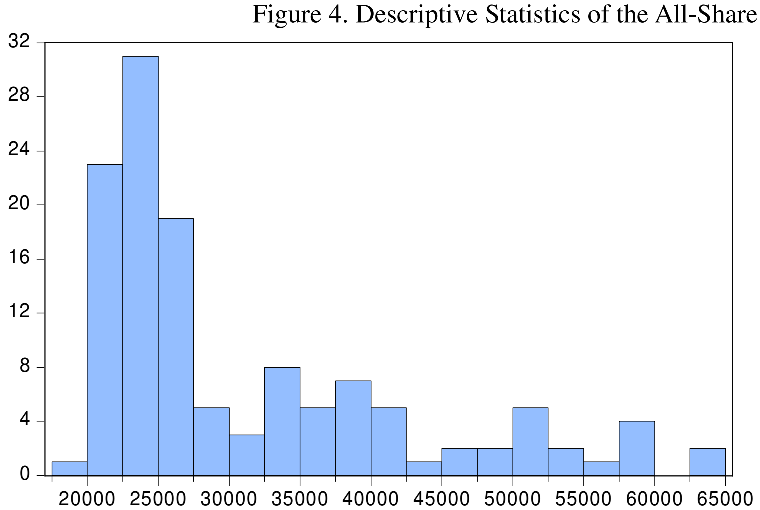


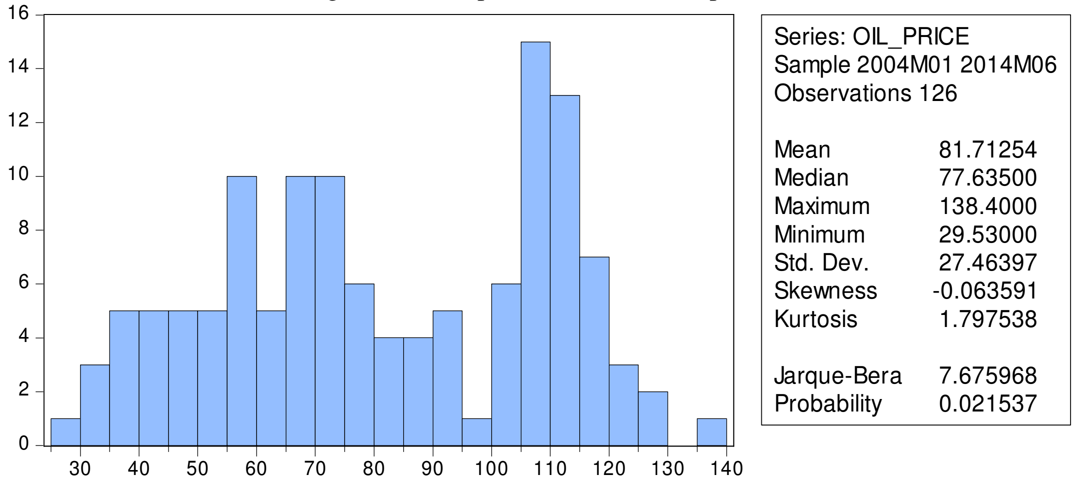
Figure 4. Descriptive Statistics of the All-Share Index



Series: ASI
Sample 2004M01 2014M06
Observations 126

Mean	31049.12
Median	25920.03
Maximum	64848.70
Minimum	19825.08
Std. Dev.	11222.23
Skewness	1.280039
Kurtosis	3.636166
Jarque-Bera	36.53320
Probability	0.000000

Figure 5. Descriptive Statistics of Oil prices



To determine the impact of oil prices on ASI, the author adopted a forecasting framework by building an optimized Autoregressive Integrated Moving Average (ARIMA) model of ASI based on the model with the lowest Akaike and Schwarz Information Criterions. Subsequently, I built a structural-ARIMA model by adding the appropriate lag of Oil Prices to the optimized ARIMA model. The data is divided into two periods for the purpose of forecast evaluation, from 2004M1 to 2013M12 (model estimation sample) and from 2014M1 to 2010M6 as the forecast evaluation sample. Out of sample forecasts are produced to evaluate the models built with the idea that if the structural model outperforms the ARIMA model then I can conclude that Oil Prices could be watched as a leading indicator of stock prices in Nigeria. Since there was no evidence of cointegration between Oil prices and the ASI, a vector error correction model was not built.

4. Diagnostic Tests

4.1 Unit Root Test

Due to the spurious results given by regression estimations done on variables which are non-stationary, Dickey (1976) and Fuller (1976) noted the presence of a downward bias in least squares estimation and attributed this bias to the presence of a unit root in the variables. As a result of this downward bias noted by Dickey and Fuller which could lead to inaccurate forecast results, I tested for the presence of a unit root in my variables employing both the Augmented Dickey-Fuller (ADF) test by Dickey and Fuller (1981), and the Phillips-Perron (PP) test as designed by Phillips and Perron (1988) which uses the OLS but accounts for both auto-correlation and heteroskedasticity in the standard errors. Describing an autoregressive process as shown by Bierens (2003), equation (1) can be transformed by recursively replacing the AR terms with differenced terms of a variable giving equation (2).

$$y_t = \beta_0 = \sum_{j=1}^{k} \beta_j y_{t-j} + U_t, \qquad (1)$$

$$U_t \sim iidN(0, \sigma^2)$$

$$\Delta y_t = \alpha_0 + \sum_{j=1}^{k} \alpha_j \Delta y_{t-j} + \alpha_k y_{t-k} + U_t \qquad (2)$$

$$U_t \sim iidN(0, \sigma^2)$$

where $\alpha_0 = \beta_0, \alpha_j = \sum_{j=1}^{k} \beta_j - 1, j = 1, \ldots, k.$

I apply the ADF and PP test to the ASI and Oil Prices where the presence of a unit root is indicated when $\alpha_j = 0$ as the null hypothesis (H_0), against an alternative hypothesis (H_1) when $\alpha_k < 0$, which indicates the absence of a unit root.

In general, the results of the unit root tests on the two times series, ASI and Oil prices, indicated the presence of a unit root in the two financial time series. I conducted the tests with and without assumptions of a linear trend in the series since I could not determine visually whether the series had a linear trend. The ADF test revealed that ASI and Oil prices had a unit root on the levels without trend, while testing with assumptions of a linear trend showed that there was a unit root in the ASI and none in the Oil Prices, with a prob. value of 0.0379 rejecting the presence of a unit root in the Oil prices assuming a linear trend. However, the results differed with the PP test which showed the presence of a unit root in the two variables both with and without a trend for both the ASI and Oil prices on the levels.

In order to clean up the unit roots noted in the variables on the levels, I ran the tests on the first differences of the series; the results from both the ADF and PP tests strongly rejected the presence of unit roots in the first differences with and without trend as depicted in table 1 and 2 respectively.

Table 1. Unit Root Tests (Augmented Dickey-Fuller)

ADF Tests - Levels

Null Hypothesis: ASI has a unit root

		Without Trend		With Trend	
		ASI	**Oil**	**ASI**	**Oil**
ADF test statistic		-2.1288	-2.3168	-2.1229	-3.5561
Test critical values:	1% level	-3.4847	-3.4838	-4.0350	-4.0337
	5% level	-2.8852	-2.8849	-3.4471	-3.4465
	10% level	-2.5795	-2.5793	-3.1486	-3.1482
*MacKinnon (1996) prob values.		0.2339	0.1684	0.5276	0.0379

ADF Tests - First Differences

Null Hypothesis: ASI has a unit root

		Without Trend		With Trend	
		D(ASI)	**D(Oil)**	**D(ASI)**	**D(Oil)**
ADF test statistic		-5.3151	-7.9140	-5.2952	-7.8889
Test critical values:	1% level	-3.4842	-3.4838	-4.0344	-4.0337
	5% level	-2.8851	-2.8849	-3.4468	-3.4465
	10% level	-2.5794	-2.5793	-3.1484	-3.1482
*MacKinnon (1996) prob values.		0.0000	0.0000	0.0001	0.0000

Table 2. Unit Root Tests (Phillips-Perron)

PP Tests - Levels

Null Hypothesis: ASI has a unit root		Without Trend		With Trend	
		ASI	Oil	ASI	Oil
PP test statistic		-1.6976	-2.1685	-1.6997	-3.1070
Test critical values:	1% level	-3.4833	-3.4833	-4.0331	-4.0331
	5% level	-2.8847	-2.8847	-3.4462	-3.4462
	10% level	-2.5792	-2.5792	-3.1480	-3.1480
*MacKinnon (1996) prob values.		0.4300	0.2189	0.7458	0.1093

PP Tests - First Differences

Null Hypothesis: ASI has a unit root		Without Trend		With Trend	
		D(ASI)	D(Oil)	D(ASI)	D(Oil)
PP test statistic		-8.9347	-7.9194	-8.9076	-7.8945
Test critical values:	1% level	-3.4838	-3.4838	-4.0337	-4.0337
	5% level	-2.8849	-2.8849	-3.4465	-3.4465
	10% level	-2.5793	-2.5793	-3.1482	-3.1482
*MacKinnon (1996) prob values.		0.0000	0.0000	0.0000	0.0000

4.2 Granger Causality Tests

In order to determine any causal effects between the ASI and Oil Prices, I refer to the test proposed by Granger (1969) using bi-variate regressions as described in equation (3) and (4) investigating from 1 to 12 monthly lags, l. This test would be conducted on both the levels and the first differences of my variables.

$$ASI_t = \alpha_0 + \alpha_1 ASI_{t-1} + \ldots + \alpha_l ASI_{t-l} + \beta_1 Oil_{t-1} + \ldots + \beta_l Oil_{t-l} + \mathcal{E}_t \quad (3)$$

$$Oil_t = \alpha_0 + \alpha_1 Oil_{t-1} + \ldots + \alpha_l Oil_{t-l} + \beta_1 ASI_{t-1} + \ldots + \beta_l ASI_{t-l} + U_t \quad (4)$$

The results of the Granger-Causality test as described in the equations above is shown in table 3 with the Null Hypothesis being that ASI does not cause Oil for ASI to Oil, and Oil does not cause ASI from Oil to ASI. It revealed that there was no causality between the variables for the first 7 lags on the levels, while changes in Oil prices caused changes in the ASI from 8 to 12 lags. Running the test on the first differences of the variables revealed that the first difference of Oil prices caused changes in D(ASI) in 1, 7, 9, 10, 11 and 12 lags, while there was no causality in the test results from 2 to 6 lags. The results indicated presence of bi-directional causality between the first differences of the variables in the 8^{th} lag. See tables 3 and 4.

Table 3. Granger Causality Tests (Levels)

ASI VS OIL			
No. of Lags	ASI to OIL /1	OIL to ASI /2	Test Result
1	0.9071	0.9992	No Causality
2	0.6854	0.0994	No Causality
3	0.6136	0.2677	No Causality
4	0.1404	0.3253	No Causality
5	0.2001	0.2895	No Causality
6	0.2021	0.1701	No Causality
7	0.1215	0.1684	No Causality
8	0.0908	0.0278	Oil Causes ASI
9	0.0759	0.0251	Oil Causes ASI
10	0.1018	0.0195	Oil Causes ASI
11	0.1431	0.0058	Oil Causes ASI
12	0.0920	0.0154	Oil Causes ASI

Table 4. Granger Causality Tests (First Differences)

D(ASI) VS D(OIL)			
No. of Lags	D(ASI) to D(OIL) /3	D(OIL) to D(ASI) /4	Test Result
1	0.4087	0.0303	D(Oil) Causes D(ASI)
2	0.4306	0.1371	No Causality
3	0.1040	0.1992	No Causality
4	0.1269	0.1561	No Causality
5	0.1437	0.0868	No Causality
6	0.1230	0.0915	No Causality
7	0.0791	0.0193	D(Oil) Causes D(ASI)
8	0.0478	0.0306	Bi-directional Causality
9	0.0758	0.0416	D(Oil) Causes D(ASI)
10	0.1165	0.0443	D(Oil) Causes D(ASI)
11	0.0547	0.0836	D(ASI) Causes D(Oil)
12	0.0341	0.0986	D(ASI) Causes D(Oil)

1/ p-values for the null hypothesis "ASI does not cause Oil."
2/ p-values for the null hypothesis "Oil does not cause ASI."
3/ p-values for the null hypothesis "D(ASI) does not cause D(Oil)."
4/ p-values for the null hypothesis "D(Oil) does not cause D(ASI)."

4.3 Cointegration Tests

Referring to Engel and Granger (1987), if two variables are integrated of the same order, a linear combination of the two variables would normally result in a variable that is also $I(1)$. They however explain that if the linear combination of the two variables produces a variable which is stationary on the levels, $I(0)$, then one can say that the two variables are cointegrated, i.e. have a long term relationship. Therefore, if a linear combination of ASI, $I(1)$, and Oil, $I(1)$, is $I(0)$, then ASI is cointegrated with Oil as shown in regression equation (5)

$$z_t = ASI_t - Oil_t - \alpha \quad (5)$$

Where Z_t is the disturbance term (also a linear combination of ASI and Oil prices) of the regression equation. Hence, if both ASI and Oil prices are cointegrated, Z_t would be $I(0)$ and they would be cointegrated of the order (1,1), also known as the cointegrating vector. Also, I make use of the Johansen technique implemented by

Johansen (1991) using VAR systems which requires the two variables in the linear combination to be integrated of the same order. For fairness in testing for cointegration between ASI and oil prices, I tested the two variables for a cointegration relationship using the Phillips-Ouliaris cointegration test as applied by Bernard and Durlauf (1995).

Table 5 shows the results of my test using the Johansen technique which revealed that there was no long run relationship between ASI and Oil prices. The test was conducted with no restrictions on the cointegrating equation, assuming an intercept and no linear trend in the CE. The trace test failed to reject the null hypothesis of no cointegration equation at the 5 percent level with a prob value of 0.4899. The maximum-Eigenvalue also failed to reject the absence of a long run relationship between the two variables in the long run with a prob. value of 0.6492. Also, in table 6, the two step Engel-Granger test revealed that there was no cointegration between ASI and Oil prices with a prob. value of 0.8778 on the tau-statistics, and 0.8935 on the z-statistic accepting the null hypothesis of no cointegration between the two. The Phillips-Ouliaris test also shown in table 7 goes on to confirm that there was no long run relationship between ASI and Oil prices.

Table 5. Johansen Cointegration Test

Johansen Test

Trace tests

Hypothesized # of C.E	Statistic	0.5 Critical Value	Prob**
None	7.7736	15.4947	0.4899
At Most 1	2.0518	3.8415	0.1520

Maximum Eigenvalue

Hypothesized # of C.E	Statistic	0.5 Critical Value	Prob**
None	5.7218	14.2646	0.6492
At Most 1	2.0518	3.8415	0.1520

Trace/Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 6. Engle-Granger Cointegration Test

Engel-Granger Test

Null hypothesis: Series are not cointegrated	Value	Prob.*
Engle-Granger tau-statistic	-1.1196	0.8778
Engle-Granger z-statistic	-2.7325	0.8935

*MacKinnon (1996) p-values.

Table 7. Phillip-Ouliaris Cointegration

Phillips-Ouliaris Test

Null hypothesis: Series are not cointegrated	Value	Prob.*
Phillips-Ouliaris tau-statistic	-1.4238	0.7914
Phillips-Ouliaris z-statistic	-4.2983	0.7845

*MacKinnon (1996) p-values.

5.0 Forecast Models and Performance

Maintaining the choice of a forecasting framework, the author built an ARIMA model as proposed by Box and Jenkins (1976) by selecting the model with the lowest AIC from a total of 64 models of D(ASI), using AR and MA terms as shown in table 8. The best ARIMA model obtained was an ARIMA (2, 1, 2) with an SIC of 18.4087 and Adjusted R-Square of 17.68 percent. Using this as my bench mark model, I developed a structural ARIMA, using the first difference of Oil prices as an explanatory variable of the All-Share index. The structural model which recorded an Adjusted R-Square of 24.91 percent showed that D(Oil(-1)) was significant in the model with a coefficient of 64.5228 and a t-statistic of 2.5893. The correlogram of residuals for ARIMA and the structural model (SARIMA) are shown in tables 10 and 11 respectively. Due to the lack of cointegration between the two variables, the use of an Error Correction Model to capture any long run dynamics between the variables is ruled out. Both models are presented in table 9.

With these two models, I produce an out of sample forecast with different time horizons, 2 months, 4 months and 6 months. The results of the two models were evaluated using the mean absolute percent error (MAPE) as shown in equation 6

$$MAPE = 100 \sum_{t=T+1}^{T+h} \left| \frac{\widehat{ASI_t} - ASI_t}{ASI_t} \right| \qquad (6)$$

where ASI_t-hat at time-t is the forecast and ASI_t is the actual.

The results of the forecast shown in table 12 showed that the structural model with Oil prices as an additional exogenous variable outperformed the ARIMA model in the 2 and 4 months forecast horizon. In the 2 months forecast, the structural model with Oil prices had an MAPE of 6.687 percent against the ARIMA's 7.036 percent, while in the 4 month forecasts, the structural model had 11.3902 percent against the ARIMA's 11.6369 percent. In the longest forecast horizon adopted (6 months), the structural model recorded an MAPE of 10.0698 percent against the ARIMA's 9.8442 percent. Noticeable is that as the horizon becomes longer, the forecast accuracy reduced which could be attributed to the lack of cointegration between the two from the tests conducted.

Table 8. ARIMA Selection by SIC

AR / MA	0	1	2	3	4	5	6	7
0	18.4694	18.4684	18.4335	18.4356	18.4457	18.4551	18.4893	18.5142
1	18.4541	18.4399	18.4571	18.4269	18.4631	18.4994	18.4631	18.5000
2	18.4351	18.4678	18.4087	18.4574	18.4488	18.4465	18.5477	18.5862
3	18.4443	18.4358	18.4670	18.4737	18.5354	18.4676	18.4992	18.5401
4	18.4510	18.4720	18.4507	18.4903	18.5511	18.5110	18.5517	18.5361
5	18.4786	18.5142	18.5358	18.5594	18.5565	18.5620	18.5362	18.5775
6	18.5041	18.5372	18.5255	18.5595	18.5744	18.6047	18.5798	18.6148
7	18.5444	18.5865	18.5609	18.6005	18.5890	18.6258	18.6634	18.6623

Table 9. Forecast Models

Dependent Variable: D(ASI)
Method: Least Squares
Sample : 2004M01 2013M12

	ARIMA		Structural ARIMA	
	Coefficient	Prob.	Coefficient	Prob.
D(Oil(-1))	-	-	64.5228	0.0110
AR1	1.2963	0.0000	0.7271	0.0000
AR2	-0.8074	0.0000	-0.6540	0.0000
MA1	-1.2548	0.0000	-0.5639	0.0001
MA2	0.9684	0.0000	0.8604	0.0000
MA3	-	-	0.3464	0.0115
MA4	-	-	0.0200	0.8532
MA5	-	-	0.4888	0.0000
Constant	167.0072	0.5616	158.7881	0.7328
Adj. R-squared	0.1768		0.2491	
F-Statistic	7.2265		5.6863	
AIC	18.2907		18.2414	
SIC	18.4087		18.4574	
Durbin-Watson	1.8242		2.0619	

6.0 Conclusion

The results from my analysis shows that while there was no long run relationship between the ASI and Oil prices, there appeared to be a short run relationship between the two variables. Going by the forecasting framework adopted, the results show that Oil prices when used to model stock prices in the Nigerian stock market, did marginally reduce forecast errors in two of the three adopted forecast horizons, and could be said to have some predictive ability as a result. This might not be unconnected with the fact that Oil is the main source of revenue for the Nigerian economy; hence changes in oil prices could have an effect on stock prices. The findings in this study have significant implications in that it gives investors and policymakers alike, an important perspective on the oil price risk inherent in the Nigerian stock market. However, upon the conclusion of this study, I believe that a better predictor of stock prices in the Nigerian stock market might be revenue from oil sales. Because this is the main source of revenue for the economy, it might have a more significant relationship with stock market prices as a result. More research could be carried on this area to enrich existing literature on the subject.

Table 10. Correlogram (ARIMA)

Date: 03/27/11 Time: 08:51
Sample: 2004M01 2013M12
Included observations: 108
Q-statistic probabilities adjusted for 7 ARMA term(s)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|* |	.|* |	1	0.084	0.084	0.8413	
.|* |	.|. |	2	0.074	0.068	1.5097	
.|* |	.|* |	3	0.108	0.098	2.94	
*|. |	*|. |	4	-0.13	-0.153	5.0103	
.|** |	.|** |	5	0.245	0.266	12.502	0.000
.|* |	.|. |	6	0.11	0.073	14.018	0.001
.|. |	.|. |	7	0.053	0.037	14.37	0.002
.|. |	*|. |	8	0.006	-0.097	14.375	0.006
.|. |	.|* |	9	0.01	0.085	14.388	0.013
.|* |	.|* |	10	0.116	0.08	16.15	0.013
*|. |	*|. |	11	-0.083	-0.15	17.062	0.017
.|. |	.|. |	12	0.025	-0.018	17.145	0.029
*|. |	*|. |	13	-0.132	-0.129	19.461	0.022
.|. |	.|. |	14	-0.045	0.038	19.731	0.032
.|. |	.|. |	15	0.068	-0.016	20.37	0.041
*|. |	.|. |	16	-0.079	-0.031	21.219	0.047
.|. |	.|. |	17	-0.024	-0.056	21.302	0.067
*|. |	.|. |	18	-0.098	-0.019	22.667	0.066
*|. |	*|. |	19	-0.135	-0.087	25.265	0.046
.|. |	.|. |	20	-0.055	-0.059	25.699	0.058
*|. |	*|. |	21	-0.15	-0.116	28.966	0.035
.|. |	.|. |	22	-0.05	-0.001	29.337	0.044
.|. |	.|. |	23	-0.024	0.052	29.425	0.060
*|. |	*|. |	24	-0.088	-0.066	30.594	0.061
.|. |	.|. |	25	0.033	0.066	30.762	0.078
.|. |	.|. |	26	-0.048	0.013	31.115	0.094
*|. |	.|. |	27	-0.081	-0.025	32.142	0.097
.|. |	.|. |	28	0.011	0.018	32.159	0.123
*|. |	.|. |	29	-0.078	-0.042	33.118	0.128
*|. |	*|. |	30	-0.082	-0.104	34.185	0.130
.|. |	.|. |	31	-0.013	-0.004	34.211	0.160
.|. |	.|* |	32	0.055	0.085	34.711	0.178
.|. |	.|. |	33	0.064	0.05	35.384	0.192
.|. |	.|. |	34	0.063	0.03	36.059	0.206
.|. |	.|. |	35	0.041	0.029	36.35	0.233
.|. |	.|. |	36	-0.054	-0.001	36.85	0.254

Table 11. Correlogram (Structural-ARIMA)

Date: 03/27/11 Time: 08:55
Sample: 2004M01 2013M12
Included observations: 107
Q-statistic probabilities adjusted for 7 ARMA term(s)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|. |	.|. |	1	-0.032	-0.032	0.1233	
.|. |	.|. |	2	-0.027	-0.028	0.2096	
.|. |	.|. |	3	-0.06	-0.062	0.6346	
*|. |	*|. |	4	-0.092	-0.097	1.6482	
.|. |	.|. |	5	0.033	0.023	1.7793	
*|. |	*|. |	6	-0.069	-0.078	2.3629	
.|. |	.|. |	7	0.065	0.051	2.8904	
.|* |	.|* |	8	0.103	0.099	4.2153	0.040
.|. |	.|. |	9	0	0.008	4.2153	0.122
.|* |	.|* |	10	0.137	0.142	6.5986	0.086
*|. |	.|. |	11	-0.086	-0.05	7.5503	0.110
.|. |	.|. |	12	0.034	0.053	7.7031	0.173
*|. |	*|. |	13	-0.113	-0.101	9.3814	0.153
.|. |	.|. |	14	-0.035	-0.015	9.5446	0.216
.|. |	.|. |	15	0.069	0.033	10.178	0.253
.|. |	.|. |	16	-0.061	-0.062	10.678	0.298
.|. |	.|. |	17	0.025	-0.022	10.762	0.376
.|. |	.|. |	18	0.008	-0.005	10.772	0.463
.|. |	.|. |	19	-0.055	-0.06	11.186	0.513
.|. |	*|. |	20	-0.049	-0.086	11.527	0.567
*|. |	*|. |	21	-0.124	-0.088	13.7	0.472
*|. |	*|. |	22	-0.103	-0.158	15.213	0.436
.|. |	.|. |	23	0.017	0.01	15.256	0.506
.|. |	.|. |	24	-0.011	-0.049	15.273	0.576
.|* |	.|* |	25	0.124	0.093	17.569	0.484
.|. |	.|. |	26	-0.018	-0.012	17.619	0.548
.|. |	.|. |	27	-0.056	-0.051	18.091	0.581
.|. |	.|* |	28	0.037	0.08	18.299	0.630
*|. |	.|. |	29	-0.085	-0.037	19.433	0.618
*|. |	*|. |	30	-0.099	-0.091	20.964	0.583
.|. |	.|. |	31	-0.024	0.004	21.059	0.635
.|. |	.|. |	32	0.046	0.045	21.405	0.670
.|* |	.|. |	33	0.096	0.029	22.895	0.639
.|. |	.|. |	34	0.042	0.066	23.188	0.675
.|. |	.|. |	35	0.067	0.025	23.93	0.685
.|. |	.|. |	36	-0.037	-0.005	24.157	0.721

Table 12. Forecast Performance

	Two Months (2014M1 - 2014M2)	Four Months (2014M1 - 2014M4)	Six Months (2014M1 - 2014M6)
ARIMA Model			
Root Mean Squared Error	3,040.2610	4,933.4070	4,326.5700
Mean Absolute Percent Error	7.0356	11.6369	9.8442
Theil Inequality Coefficient	0.0366	0.0592	0.0513
Bias Proportion	0.8503	0.8455	0.8112
Variance Proportion	0.0029	0.0040	0.0106
Covariance Proportion	0.1468	0.1504	0.1782
Structural-ARIMA Model			
Root Mean Squared Error	2,947.7490	4,866.7950	4,374.2980
Mean Absolute Percent Error	6.6870	11.3902	10.0698
Theil Inequality Coefficient	0.0356	0.0585	0.0518
Bias Proportion	0.8159	0.8317	0.8344
Variance Proportion	0.0073	0.0058	0.0044
Covariance Proportion	0.1767	0.1625	0.1611

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