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Oil Price Volatility and Stock Returns: A case of Listed Nigerian Firms

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Abstract

This paper provides empirical evidence to support the argument that oil prices impacts stock market performance in Nigeria. The major gaps observed in related studies were methodological: they employ models that do not properly analyse the dynamic process of how oil prices affect the performance of the stock market. Using daily data collected on daily basis for the Nigerian stock market and global crude oil price (the Brent) over the period November 2007 to July 2009, Autoregressive distributed lag (ADL) model was employed for the analysis. It was found that oil prices have a positive impact on the performance of the Nigerian stock market after a dynamic response lag of seven days. Contrary to the argument that oil prices do not affect stock market performance, the study concluded that stock markets are sensitive to oil prices in Nigeria. The major policy implication drawn from the study was that stabilizing oil prices in Nigeria and shielding the Nigerian stock market away from oil market shocks (by tightening regulation) would help to minimize the adverse effect that oil prices could have on stock prices. The major challenge however is that, while the stabilization of oil prices is important for overall macroeconomic management, oil prices are in turn driven by demand, supply and speculative factors across the globe.

Key Words: *Oil Price Volatility, Stock Returns, Listed Nigerian Firms*

Introduction

In the wake of the 2007 – 2009 global financial crises, stock markets in emerging economies experienced significant decline. While the cause of the poor performance have been attributed to the linkage of emerging stock markets to the developed stock market of western countries, the volatile trend observed in oil prices during these period is likely to be another attributing factor leading to the downward trend observed emerging stock markets in oil exporting economies like Nigeria (Abraham, 2009a). The debate in the literature concerning the impact of oil price volatility and its impact on stock market performance is very clear. While some authors (e.g. Mujahid *et al*, 2006; and Al-Fayoumi 2009) argue that oil prices do not influence stock market, others (e.g. Sari and Soytas, 2006; and Abraham, 2009b) argue that oil prices affect the performance of stock markets. Another point of divide is to say that oil prices only affects stock markets of oil exporting countries, while it does not affect the stock market of non-oil exporting countries (Adebiyi *et al*, 2009).

The objective of this study is to examine the impact of oil price on the performance of the Nigerian stock market. The study differs from other studies in two unique ways. First, most of the studies (e.g. Sari and Soytas, 2006; Aliyu, 2009; Adebiyi *et al* 2009) on this subject matter employ Vector Autoregressive (VAR) models to facilitate their estimations. While this technique is good in estimating the response of a dependent variable on the lagged values of an independent variable, the model leaves out the possibility of the current values of the dependent variable to influence the performance of the dependent variable. In the same vein, other studies (e.g. Mujahid *et al*, 2006) employed GARCH models to examine issues of volatility clustering in oil prices or the stock market, and do really estimate the dynamic time path that oil prices follows to impact on stock prices. To this extent, the study employs Autoregressive distributed lag (ADL) model to fill in the methodological gap identified in other studies. And secondly, the study uses daily data for both oil prices and the stock market to carryout its objective. Daily data are known to reveal the volatility inherent in a time series more than quarterly, monthly or yearly data, which were the kind of data used by most studies.

The study there sets out to test the hypothesis that, 'oil prices do not influence the performance of the Nigerian stock market'. This test of hypothesis will be used to answer the central research question of this study: do oil prices influence the performance of the Nigerian stock market? The study is organized into five sections. Section one presents the introduction, statement of problem, objective of the study, the research hypothesis and raises the research question. Section two reviews related literature and presents the theoretical framework for the study. The research methodology indicating the materials and methods employed for the study is presented in section three, while the results and discussion of the findings are presented in section four. Lastly, the conclusion and recommendation of the study, reflecting the policy implication of the study, are presented in section five.

Empirical Literature Review

Donald *et al* (2002) documented the recent developments in theoretical and empirical understanding of the macroeconomic consequences of oil price shocks. The first, theoretical and empirical analyses pointed to intersectoral reallocations of resources in response to external shocks generating asymmetric impacts. The second was a study on counterfactual monetary policies which concluded that monetary policy respondsto oil price shocks. Thirdly, a series of specifications of oil price changes was found to improve the statistical fit of regressions of GDP changes on oil price changes and other macroeconomic variables, but were only partially successful in generating a statistically stable oil price-GDP relationship. The study generally suggests that oil price volatility have certain impact on macroeconomic activities.

Sari and Soytas (2006) investigated the impact of oil price shocks on the macroeconomy of a developing country using Turkey as case study. Employing VAR model, their result suggested that the oil price changes are important factors in explaining the variation in GDP, inflation, employment, and real stock returns Mujahid *et al* (2006) investigated the relationship between oil price and stock market Pakistan.

Granger Causality was applied to the daily data collected over the period March 1998 to December 2005 to determine the relationship between oil prices and stock returns. The empirical results indicate that no significant effect of oil prices was found on stock returns. The study also found no relation between news and stock returns and no day of the week effect.

In the 2009 Nigerian Economic Society (NES) Conference, the study by Abraham (2009) argued that oil policy adjustment are likely to correct the down ward swing experienced across stock markets. The argument was based on descriptive analysis on the performance of stock markets following daily policy adjustment to avert the global economic crisis. The study hypothesized that the Nigerian stock market responded more to oil policy adjustment than to countercyclical (monetary and fiscal) policies. Adebiyi *et al* (2009) estimated the effects of oil price shocks and exchange rate on the real stock returns in Nigeria over 1985:1-2008:4 using a multivariate VAR analysis. They found that real stock returns responds immediately and negatively to oil price shocks in Nigeria. The Granger causality result showed causation run from oil price shocks to stock returns, implying that variation in stock market is explained by oil price volatility. They concluded that economies are interwoven by way of increasing globalization of markets worldwide. Thus, establishing the linkages between oil price, exchange rate and stock markets is important for quite a number of reasons. For the multinationals, they can assess their exposure to foreign contracts. For the investor, it enables him assess his investment portfolio. For oil importers, fluctuations in oil price affect their trade balance and net foreign assets position. For the citenzry, it could reduce their disposable income and corporate profitability. Paramount among the reasons is that such knowledge can aid in the prevention of an economic crisis.

Aliyu (2009) assessed the impact of oil price shock and real exchange rate volatility on real economic growth in Nigeria using quarterly data collected from 1986 to 2007. The study employed the Johansen VAR-based cointegration technique to examine the sensitivity of real economic growth to changes in oil prices and real exchange rate volatility in the long-run while the short run dynamics was checked by using a vector error correction model. The Granger pairwise causality test revealed unidirectional causality from oil prices to real GDP and bidirectional causality from real exchange rate to real GDP and vice versa. Further findings showed that oil price shock and appreciation in the level of exchange rate exert positive impact on real economic growth in Nigeria. Al-Fayoumi (2009) examined the relationship between changes in oil prices and stock market returns in three oil importing countries, namely Turkey, Tunisia and Jordan. Monthly data of oil prices, interest rate, industrial production and stock market indices were modelled as a cointegrated system in a Vector Error Correction Model (VECM). Based on the data from December 1997 to March 2008, their empirical results do not support the hypothesis that oil prices lead to changes in stock market returns in these countries. However, the results bring evidence that the effect of the local macroeconomic variables on the changes in stock market returns is more important than that of oil prices. The policy implication was that policy makers and portfolio managers should focus on macroeconomic factors such as interest rate and industrial production rather than focusing on oil prices to be the main factor in predicting future stock returns.

Theoretical Literature and Framework

The impact of falling oil prices on stock market will differ from country to country depending on whether the country is an oil-exporter or oil-importer. In an oil- exporting country, a rise in world oil prices improves the trade balance, leading to a higher current account surplus and an improving net foreign asset position. At the same time, increase in oil prices tends to increase private disposable income in oil-exporting countries. This increases corporate profitability, raises domestic demand and stock prices thereby causing exchange rate to appreciate. In oil-importing countries, the process works broadly in reverse: trade deficit are offset by weaker growth and, over time, real exchange rate depreciates and stock prices decrease (Basher and Sadorsky, 2006).

The mechanisms through which oil price shocks affect the macroeconomy have been demonstrated in the literature from the perspective of the supply-and demand-side effects. Oil is considered as an input to production and, thus, an increase in oil price give rise to increased production costs which causes productivity to decline. Oil price increases reduces the purchasing power of consumers and motivate producers to substitute less energy intensive capital for more energy intensive capital. It is predicted that the enormity of this effect depends on whether the shock is temporary or permanent in nature. As a result, the different authors have allotted weights to the supply and demand channels (Rasche and Tatom, 1977, and Kim and Loungani, 1992). Other channels, which have been identified in the literature, include the real balance effect, and the transfer of income effect (Mork, 1989). This transfer of wealth from oil importing countries to oil exporting countries leads to a decrease in global demand in the oil-importing countries which outweighs the increase in the oil- exporting countries because of the assumed low propensity to consume in the latter.

Three models of oil price have been identified in the literature. The linear measure of oil price; asymmetric oil price and the net oil price increase. The linear or symmetric measure of oil price assumes that effects of oil price movements (increases or decreases) are equal such that a rise in oil price is expected to have a negative impact on the level of economic activity and oil price declines have a positive impact (Afshar *et al*, 2008).

Asymmetric oil price shocks refer to an oil price measure that differentiates between the positive and negative oil price volatility. In other words, a variable represents a positive percentage changes in oil price and another variable represents the negative percentage change (Mork, 1989; Lee *et al*., 1995). Net oil price increase model has been defined as the quantity by which oil prices exceed its maximum value over the previous periods. Thus, if by example, the current price of oil is higher than the maximum oil price of previous periods, then the percentage change between the two is computed. This measure of oil price assumes that when oil price is merely increasing to attain its maximum level in the previous period, it would have no impact. However, when the current price of oil is increase to a level above its maximum value in the previous periods, it is expected to have an impact (Hamilton, 1996).

Other econometric models for examining the impact of oil price volatility on the stock market performance are the vector autoregressive (VAR) model and the auto distributed lag (ADL) model. The VAR system rests on the general proposition that economic variables tend to move together over time and are also autocorrelated (Johnston and DiNardo, 1997). The VAR is commonly used for forecasting systems of interrelated time series and analyzing the dynamic impact of random disturbances on the system of variables. The VAR approach side steps the need for structural modeling by modeling every endogenous variable in the system as a function of the lagged values of all the endogenous variables in the system.

To take the volatility clustering into account, Mujahid *et al* (2006) used the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model which is developed by Bollerslev (1986) with some variations. The GARCH (1,1) was argued to be a model that works well for stock returns in Pakistan with capturing the ARCH effect. However, the GARCH model basically aims at finding out whether there is volatility clustering in a trend or not, with the aim of forecasting the future values of the series with minimal errors. The model like the VAR, is not sufficient in establishing the dynamic process it takes for an independent variable to impact on the dependent. The ADL model focuses on the relation of a dependent variable y_t on its lagged values and current and lagged values of one or more explanatory variables (Greene, 1997). Thus the current value of y depends on the current and all previous values of x and ε. Alternatively, this relation shows that the current value of x has an effect on the current and future values of y. The lags in the ADL model imply a set of dynamic responses of the dependent variable to any given change in the independent variable(s). To model the impact of oil price volatility on the Nigerian stock market therefore, the ADL model will be employed because of its strength of examining the dynamic process of oil price volatility on stock market performance. This model is adapted from Abraham (2009a), who used the ADL framework to examine the impact of the global financial crisis on selected stock markets in Africa.

Research Methodology

The data for this study were collected online from www.africanfinancialmarkets.com and are also available for download from the site. The data were collected on a five day weekly basis from Mondays to Fridays. The choice of Mondays to Fridays is to harmonize the oil price data with the Nigerian stock market data (which are available on a five day weekly basis). Due to its closeness with the Nigerian crude oil, the daily data on oil prices were collected for the Brent in US dollar per barrel. On the other hand, all share index data were used to capture the performance of the Nigerian stock market. Both time series data were collected from November 2007 to July 2009. The choice of this scope in data collection is to capture the movement in oil prices as well as the performance of the stock market within the context of the 2007 – 2009 global economic crises.

Since oil prices are available in US dollar per barrel and the stock market index is not, the data will be log transformed be estimations are carried out. The data will also be tested for stationarity using the augmented dickey fuller test (ADF). The aim of this test is ensure that both series are stationary before the ADL model is estimated in an ordinary least squares (OLS) context. The ADL model was adapted from Abraham (2009a), who used the model to examine the impact of the global financial crisis on selected stock markets in Africa. The model was specified as follows:

$$\Delta\log(\ddot{Y}_{Africa})_t = \beta_o + \beta_1\Delta Log\ddot{Y}_{Africa(t-i)} + \beta_2\Delta Log\ (X_{US,UK})_t + \ldots + \beta_n\Delta Log(X_{US,UK})_{t-I} \quad (1)$$

Replacing the $\ddot{Y}_{Africa}$ with the Nigerian stock market ***(NSM),*** and the subscript $X_{US,UK}$ with oil prices ***(P)*** yields:

$$\Delta logNSM_t = \beta_o + \beta_1\Delta LogNSM_{t-I} + \beta_2\Delta LogP_t + \ldots + \beta_n\Delta LogP_{t-I} \quad (2)$$

Where the length of t-i and n will be determined by the Akaike Information Criterion and the strength of their adjusted R squared. The difference symbol **(Δ)** is assigned to the model to show that series are transformed to ensure stationarity, while the log operation is also included in the model to show that the series are log transformed to harmonize the units of measurements. The coefficients $\beta_o\ \beta_2 \ldots \beta_n$ will be tested using both the t and f statistics however, for the test of hypothesis; the f-statistic is used. The decision rule is that if the f-calculated value is greater than its 5% critical value, the null hypothesis of oil prices do not influence the performance of the Nigerian stock market will be rejected, else, reverse is the case. Thus the model to be estimated for this study is equation **(2)**, where the Nigerian stock market **(NSM)** is the dependent variable and oil prices **(P)** is the independent variable.

Results and Discussion

The time series data were tested for stationarity using the ADF test. The result showed that Oil price (P) and the Nigerian Stock Market (NSM) were both stationary at levels

i.e. *I*(0). When differenced by one i.e. *I*(1), the series became stationary. This implies that the series have large up and down swings. The stationarity test results are presented in table 1 of the appendix.

Model Estimation

The ADL model was fitted with up to twenty lags determined by the Aikaike info criteria (AIC). The model was found to have significant parameters for the NSM at lags 1, 2, 9 and 14. For oil prices, the only significant lags were at 7 and 14 (this result is shown in table 3 in the appendix). The model was then re-estimated using only the significant lags. At this point, the significant lag value of 14 for the impact of oil prices on stock market performance became insignificant. Since the focus of the study is to measure the impact of oil prices on stock market performance, all the values for the Nigerian stock market specified as independent variables (which were however significant) were dropped and the model fitted using only the significant lag length of 7 for oil prices. The result in equation form is presented below (please refer to table 2 in the appendix for the Eviews output):

NSM_t = - 0.00067 + 0.0507Oil Price $_{t-7}$ --------------------------- estimated equation (2) t-stat (-2.06) (2.29)

P-value (0.0397) (0.0226)

R-squared = 0.0125, DW = 1.07, F-stat = 5.24 (p-value = 0.0226)

Model Interpretation

The model shows that oil prices have a positive impact on stock market performance and that 1.25% of the present performance of the Nigerian stock market is influenced by dynamic adjustment in oil prices of one week ago (both from domestic and external sources)[2]. Though the size of impact oil prices has on stock market performance is small as shown by the R-square value, the model can be interpreted as thus: a one unit increase in oil prices in the global economy, will lead to a 0.0507unit increase in the Nigerian stock market index. Likewise, a one unit fall in the global oil price, will lead to a 0.0507 drop of the Nigerian stock market all share index. This can even be spotted on the trend presented in figure 1. It can be observed that, during the global economic crisis, when oil prices fell steeply, the Nigerian stock market slide down slowly (see figure 1). The major implication of this study therefore would be on how to ensure stable oil prices in Nigeria. Since oil is a global commodity, affected by supply, demand and speculative factors, the challenge should be; how to ensure that oil prices are stable in the domestic market, and how to shield the stock market away from the volatility that oil prices are known for.

Hypothesis Testing

From the estimated equation (2), the computed t-statistics value is 2.29. At 5% critical value with degrees of freedom greater than 120, the tabulated t-statistic value from the student t-distribution table is 1.96. Since the Computed t-statistics value (2.29) is greater than the tabulated t-statistics value (1.96), the null hypothesis is rejected while the alternative is accepted implying that oil prices (positively) influences the performance of the Nigerian stock market, at a significant lag length of seven. In terms of the research question which is: do oil prices influence the performance of the Nigerian stock market? The answer is yes, but after a dynamic response period of seven days, when daily data is used for the analysis.

Conclusion and Recommendation

The paper established that stock market performance can be influenced by oil prices. The stock market houses both individual and institutional wealth/investment. Thus, the stock market authorities should be careful about its regulations concerning quoted oil stocks and their activities in the exchange. Since oil prices are volatile, the craze for banks to invest in oil businesses across the globe using capital mobilized from the Nigerian capital market, should also be cautioned, as this could have adverse effect for the stock market and the economy at large.

Conflict of Interest

No potential conflict of interest was recorded by the author

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APPENDICES[3]

Table 1(a): Stationarity Result For Oil Price At Levels *I*(0)

ADF Test Statistic	-0.721233	1% Critical Value*	-3.4479
5% Critical Value			-2.8686
10% Critical Value			-2.5705

*MacKinnon critical values for rejection of hypothesis of a unit root.

Source: Eviews 3.1 Output, Researchers Estimation

Table 1(b): Stationarity Result For Oil Price At First Difference *I*(1)

ADF Test Statistic	-21.70237	1% Critical Value*	-3.4480
5% Critical Value			-2.8686
10% Critical Value			-2.5705

*MacKinnon critical values for rejection of hypothesis of a unit root.

Source: Eviews 3.1 Output, Researchers Estimation

Table 1(c): Stationarity Result For The NSM At Levels *I*(0)

ADF Statistic	Test0.065997	1% Critical Value*	-3.4480
		5% Critical Value	-2.8687
		10% Critical Value	-2.5705

*MacKinnon critical values for rejection of hypothesis of a unit root.

Source: Eviews 3.1 Output, Researchers Estimation

Table 1(d): Stationarity Result For NSM At First Difference *I*(1)

ADF Test Statistic	-13.66916	1% Critical Value*	-3.4481
5% Critical Value			-2.8687
10% Critical Value			-2.5706

*MacKinnon critical values for rejection of hypothesis of a unit root.

Source: Eviews 3.1 Output, Researchers Estimation

Table 2 (a): Model Estimation for Equation 2

Dependent Variable: NSM Method: Least Squares Sample(adjusted): 22 424

Included observations: 381

Excluded observations: 22 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000392	0.000315	-1.243065	0.2147
NSM(-1)	0.412310	0.054230	7.602986	0.0000
NSM(-2)	0.199054	0.058860	3.381819	0.0008
NSM(-3)	-0.102690	0.059878	-1.714970	0.0873
NSM(-4)	-0.004552	0.060111	-0.075723	0.9397
NSM(-5)	0.035220	0.059779	0.589173	0.5561
NSM(-6)	-0.080485	0.059500	-1.352686	0.1771
NSM(-7)	0.016935	0.058876	0.287636	0.7738
NSM(-8)	0.048687	0.058891	0.826727	0.4090
NSM(-9)	-0.125155	0.058882	-2.125509	0.0343
NSM(-10)	0.043015	0.059223	0.726316	0.4681
NSM(-11)	0.047288	0.059729	0.791698	0.4291
NSM(-12)	-0.027585	0.059680	-0.462221	0.6442
NSM(-13)	0.054076	0.059293	0.912015	0.3624
NSM(-14)	0.143642	0.058796	2.443058	0.0151
NSM(-15)	-0.100088	0.059083	-1.694031	0.0912
NSM(-16)	-0.081371	0.059212	-1.374220	0.1703
NSM(-17)	-0.010113	0.059760	-0.169226	0.8657
NSM(-18)	-0.018067	0.061461	-0.293963	0.7690
NSM(-19)	0.056978	0.061385	0.928211	0.3540

NSM(-20)	-0.084316	0.056702	-1.487013	0.1379
P	0.034019	0.021165	1.607353	0.1089
P(-1)	0.008087	0.021268	0.380269	0.7040
P(-2)	0.009520	0.021248	0.448021	0.6544
P(-3)	-0.018373	0.021341	-0.860917	0.3899
P(-4)	-0.008581	0.021369	-0.401576	0.6882
P(-5)	0.006276	0.021208	0.295904	0.7675
P(-6)	0.037429	0.021312	1.756232	0.0800
P(-7)	0.041973	0.021336	1.967220	0.0500
P(-8)	0.000979	0.021293	0.045993	0.9633
P(-9)	0.017403	0.021215	0.820310	0.4126
P(-10)	0.016287	0.021120	0.771190	0.4411
P(-11)	0.009646	0.021121	0.456717	0.6482
P(-12)	0.038460	0.021104	1.822416	0.0693
P(-13)	-0.009607	0.021195	-0.453261	0.6507
P(-14)	-0.042923	0.021167	-2.027855	0.0434
P(-15)	0.031059	0.021232	1.462859	0.1444
P(-16)	-0.017476	0.021510	-0.812448	0.4171
P(-17)	0.007830	0.021555	0.363265	0.7166
P(-18)	-0.022881	0.021441	-1.067156	0.2867
P(-19)	0.005490	0.021380	0.256802	0.7975
P(-20)	-0.006636	0.021340	-0.310962	0.7560

R-squared	0.336259	Mean dependent var	-0.000860
Adjusted R-squared	0.255984	S.D. dependent var	0.006773
S.E. of regression	0.005842	Akaike info criterion	-7.343658

Sum squared resid	0.011572	Schwarz criterion	-6.909019
Log likelihood	1440.967	F-statistic	4.188817
Durbin-Watson stat	1.991570	Prob(F-statistic)	0.000000

Source: Eviews 3.1 Output, Researchers Estimation

Table 2(b): First Re-estimation of Equation (2)

Dependent Variable: NSM Method: Least Squares Sample(adjusted): 16 424

Included observations: 401

Excluded observations: 8 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000297	0.000294	-1.012315	0.3120
NSM(-1)	0.376432	0.049347	7.628305	0.0000
NSM(-2)	0.160435	0.049570	3.236554	0.0013
NSM(-9)	-0.056896	0.044148	-1.288768	0.1982
NSM(-14)	0.099316	0.044889	2.212490	0.0275
P(-7)	0.039786	0.019668	2.022850	0.0438
P(-14)	-0.033268	0.019783	-1.681662	0.0934

R-squared	0.256779	Mean dependent var	-0.000787
Adjusted R-squared	0.245461	S.D. dependent var	0.006641
S.E. of regression	0.005769	Akaike info criterion	-7.455374
Sum squared resid	0.013112	Schwarz criterion	-7.385654
Log likelihood	1501.802	F-statistic	22.68748
Durbin-Watson stat	1.939304	Prob(F-statistic)	0.000000

Table 2(c): Second Re-estimation of Equation (2)

Dependent Variable: NSM Method: Least Squares Date: 02/08/10 Time: 22:50 Sample(adjusted): 16 424

Included observations: 407

Excluded observations: 2 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000750	0.000326	-2.302464	0.0218
P(-7)	0.051032	0.022217	2.297011	0.0221
P(-5)	-0.017636	0.022229	-0.793368	0.4280

R-squared	0.013900	Mean dependent var	-0.000766
Adjusted R-squared	0.009019	S.D. dependent var	0.006595
S.E. of regression	0.006564	Akaike info criterion	-7.206814
Sum squared resid	0.017412	Schwarz criterion	-7.177265
Log likelihood	1469.587	F-statistic	2.847457
Durbin-Watson stat	1.075891	Prob(F-statistic)	0.059156

Table 2(d): Third Re-estimation of Equation (2)

Dependent Variable: NSM Method: Least Squares Date: 02/08/10 Time: 22:51 Sample(adjusted): 9 424

Included observations: 414

Excluded observations: 2 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000667	0.000323	-2.062952	0.0397
P(-7)	0.050651	0.022136	2.288203	0.0226

R-squared	0.012549	Mean dependent var	-0.000684
Adjusted R-squared	0.010152	S.D. dependent var	0.006611

S.E. of regression	0.006578	Akaike info criterion	-7.205406
Sum squared resid	0.017826	Schwarz criterion	-7.185957
Log likelihood	1493.519	F-statistic	5.235872
Durbin-Watson stat	1.076406	Prob(F-statistic)	0.022631

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APPENDICES[3]

Table 1(a): Stationarity Result For Oil Price At Levels *I*(0)

ADF Test Statistic	-0.721233	1% Critical Value*	-3.4479
		5% Critical Value	-2.8686
		10% Critical Value	-2.5705

*MacKinnon critical values for rejection of hypothesis of a unit root.

Source: Eviews 3.1 Output, Researchers Estimation

Table 1(b): Stationarity Result For Oil Price At First Difference *I*(1)

ADF Test Statistic	-21.70237	1% Critical Value*	-3.4480
		5% Critical Value	-2.8686
		10% Critical Value	-2.5705

*MacKinnon critical values for rejection of hypothesis of a unit root.

Source: Eviews 3.1 Output, Researchers Estimation

Table 1(c): Stationarity Result For The NSM At Levels *I*(0)

ADF Test Statistic	0.065997	1% Critical Value*	-3.4480
		5% Critical Value	-2.8687
		10% Critical Value	-2.5705

*MacKinnon critical values for rejection of hypothesis of a unit root.

Source: Eviews 3.1 Output, Researchers Estimation

Table 1(d): Stationarity Result For NSM At First Difference *I*(1)

ADF Test Statistic	-13.66916	1% Critical Value*	-3.4481

5%	Critical Value	-2.8687
10%	Critical Value	-2.5706

*MacKinnon critical values for rejection of hypothesis of a unit root.

Source: Eviews 3.1 Output, Researchers Estimation

Table 2 (a): Model Estimation for Equation 2

Dependent Variable: NSM Method: Least Squares
Sample(adjusted): 22 424

Included observations: 381

Excluded observations: 22 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000392	0.000315	-1.243065	0.2147
NSM(-1)	0.412310	0.054230	7.602986	0.0000
NSM(-2)	0.199054	0.058860	3.381819	0.0008
NSM(-3)	-0.102690	0.059878	-1.714970	0.0873
NSM(-4)	-0.004552	0.060111	-0.075723	0.9397
NSM(-5)	0.035220	0.059779	0.589173	0.5561
NSM(-6)	-0.080485	0.059500	-1.352686	0.1771

NSM(-7)	0.016935	0.058876	0.287636	0.7738
NSM(-8)	0.048687	0.058891	0.826727	0.4090
NSM(-9)	-0.125155	0.058882	-2.125509	0.0343
NSM(-10)	0.043015	0.059223	0.726316	0.4681
NSM(-11)	0.047288	0.059729	0.791698	0.4291
NSM(-12)	-0.027585	0.059680	-0.462221	0.6442
NSM(-13)	0.054076	0.059293	0.912015	0.3624
NSM(-14)	0.143642	0.058796	2.443058	0.0151
NSM(-15)	-0.100088	0.059083	-1.694031	0.0912
NSM(-16)	-0.081371	0.059212	-1.374220	0.1703
NSM(-17)	-0.010113	0.059760	-0.169226	0.8657
NSM(-18)	-0.018067	0.061461	-0.293963	0.7690
NSM(-19)	0.056978	0.061385	0.928211	0.3540
NSM(-20)	-0.084316	0.056702	-1.487013	0.1379
P	0.034019	0.021165	1.607353	0.1089

P(-1)	0.008087	0.021268	0.380269	0.7040
P(-2)	0.009520	0.021248	0.448021	0.6544
P(-3)	-0.018373	0.021341	-0.860917	0.3899
P(-4)	-0.008581	0.021369	-0.401576	0.6882
P(-5)	0.006276	0.021208	0.295904	0.7675
P(-6)	0.037429	0.021312	1.756232	0.0800
P(-7)	0.041973	0.021336	1.967220	0.0500
P(-8)	0.000979	0.021293	0.045993	0.9633
P(-9)	0.017403	0.021215	0.820310	0.4126
P(-10)	0.016287	0.021120	0.771190	0.4411
P(-11)	0.009646	0.021121	0.456717	0.6482
P(-12)	0.038460	0.021104	1.822416	0.0693
P(-13)	-0.009607	0.021195	-0.453261	0.6507
P(-14)	-0.042923	0.021167	-2.027855	0.0434
P(-15)	0.031059	0.021232	1.462859	0.1444
P(-16)	-0.017476	0.02151	-	0.4171

		0	0.812448	
P(-17)	0.007830	0.021555	0.363265	0.7166
P(-18)	-0.022881	0.021441	-1.067156	0.2867
P(-19)	0.005490	0.021380	0.256802	0.7975
P(-20)	-0.006636	0.021340	-0.310962	0.7560

R-squared	0.336259	Mean dependent var	-0.000860
Adjusted R-squared	0.255984	S.D. dependent var	0.006773
S.E. of regression	0.005842	Akaike info criterion	-7.343658
Sum squared resid	0.011572	Schwarz criterion	-6.909019
Log likelihood	1440.967	F-statistic	4.188817
Durbin-Watson stat	1.991570	Prob(F-statistic)	0.000000

Source: Eviews 3.1 Output, Researchers Estimation

Table 2(b): First Re-estimation of Equation (2)

Dependent Variable:

NSM Method: Least Squares

Sample(adjusted): 16 424

Included observations: 401

Excluded observations: 8 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000297	0.000294	-1.012315	0.3120
NSM(-1)	0.376432	0.049347	7.628305	0.0000
NSM(-2)	0.160435	0.049570	3.236554	0.0013
NSM(-9)	-0.056896	0.044148	-1.288768	0.1982
NSM(-14)	0.099316	0.044889	2.212490	0.0275
P(-7)	-0.039786	0.019668	-2.022850	0.0438
P(-14)	-0.033268	0.019783	-1.681662	0.0934

R-squared	0.256779	Mean dependent var	-0.000787
Adjusted R-squared	0.245461	S.D. dependent var	0.006641
S.E. of regression	0.005769	Akaike info criterion	-7.455374
Sum squared resid	0.013112	Schwarz criterion	-7.385654
Log likelihood	1501.802	F-statistic	22.68748

P(-7)	0.051032	0.022217	2.297011	0.0221
Durbin-Watson stat	1.939304	Prob(F-statistic)		0.000000
P(-14)	-0.017636	0.022229	-0.793368	0.4280

Table 2(c): Second Re-estimation of Equation (2)

Dependent Variable: NSM Method: Least Squares Date: 02/08/10 Time: 22:50
Sample(adjusted): 16 424

Included observations: 407

Excluded observations: 2 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000750	0.000326	-2.302464	0.0218

R-squared	0.013900	Mean dependent var	-0.000766
Adjusted R-squared	0.009019	S.D. dependent var	0.006595
S.E. of regression	0.006565	Akaike info criterion	-7.206814
Sum squared resid	0.017412	Schwarz criterion	-7.177265

Log likelihood	1469.587	F-statistic	2.847457
Durbin-Watson stat	1.075891	Prob(F-statistic)	0.059156

Table 2(d): Third Re-estimation of Equation (2)

Dependent Variable: NSM Method: Least Squares Date: 02/08/10 Time: 22:51
Sample(adjusted): 9 424

Included observations: 414

Excluded observations: 2 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000667 0.000323		-2.062952	0.0397
P(-7)	0.050651	0.022136	2.288203	0.0226
R-squared	0.012549	Mean dependent var		-0.000684
Adjusted R-squared	0.010152	S.D. dependent var		0.006611
S.E. of regression	0.006578	Akaike info criterion		-7.205406
Sum squared resid	0.017826	Schwarz criterion		-7.185957
Log likelihood	1493.519	F-statistic		5.235872

Durbin-Watson stat	1.076406	Prob(F-statistic)	0.022631

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