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The Role of Speculation in the Determination of Energy Prices

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ABSTRACT: This paper seeks to evaluate the role of speculation in the determination of global energy prices. Designed as a case study, five major oil producing countries are the focus of this positivistic study: Nigeria, Mexico, Iran, Saudi Arabia and Russia. Data is collected through secondary sources. One-tailed and two-tailed tests carried out on the relationship between speculation and oil prices for each of the five countries yield critical values lower than the alpha. Thus, the null hypothesis is rejected in favor of the alternate hypothesis that 'there is a significant and positive correlation between commodity derivatives (oil futures) and oil prices'. The study found that while there is a positive relationship between speculation in the commodity derivatives market and oil prices, such a relationship is at best weak and attributes the high prices to several factors, including political instability, high and rising demand from overheating economies such as China, and falling production levels, among others. The paper emphasized the need to enhance the physical and financial transparency of the energy market, as well as the operation of the supply and demand fundamentals, including regulating against insider trading and market manipulation practices, strengthening the reporting requirements of the dealers in the market, and strengthening capital adequacy and margin requirements.

Keywords: Oil Futures; Derivatives; Markets Supply and Demand; Oil Producing Countries.
JEL Classifications: Q31; Q02; Q41; Q47

1. Introduction

The global energy market has in recent years witnessed sharp price increases hitherto unprecedented in history. For example, oil prices increased from an annual average of just $16 in 1998, to an average of $95 by 2008 (Doukas, et al., 2011).Over the same period, net incremental supply of oil had increased faster than demand, as had global inventories (Fan and Xu, 2011); raising strong suspicions that the increase in global energy prices has been driven by excessive speculative activity rather than sound market fundamentals. While many studies have been carried out in a bid to ascertain the role of speculative activity in these price increases, findings remain inconclusive.

This paper evaluated the recent trends in energy (and specifically oil) prices, with the aim of empirically ascertaining the role of speculative activity on energy prices. The introduction is the first section. The literature review section evaluated studies which have been carried out in this area, and in so doing identifies gaps which the study attempted to fill. The next section is the methodology which spells out the research philosophy, research strategy, data sources, data collection methods, and data analysis procedures and processes adopted by the study. The findings and results section comes immediately after the methodology. Here, the data collected from the various sources is presented and subsequently analyzed within the same section. The conclusion section summarized the main findings of the study, as well as its implications, on the basis of which steps that need to be taken are outlined in the recommendations section which follows.

2. Literature Review

The role of speculation in the determination of energy prices remains far from being resolved. Gilbert's (2010) study focuses on nine commodity markets within the energy, agricultural and metal sectors. Focusing on the period from 2006 to 2008, he applies the Granger causality test and found 'limited but significant' correlation between speculative activity and energy prices. Irwin and Sanders (2010a) have however rejected Gilbert's assumption that the trader positions within the energy or metal sectors are identical to those in the agricultural sector. They also rejected Gilbert's conclusions on the grounds that correlation does not necessarily imply causation.

Einloth's study (2009) focuses on the period between 2007 and 2008. He examines the link between convenience yields and commodity derivative markets. His approach assumes that in the absence of speculative activity, commodity prices and convenience yields would increase as commodity inventories decline. However, an inverse relationship between commodity prices and convenience yield would suggest the presence of speculative activity in the market. Applying this methodological approach to the same period (between 2007 and 2008), Dema (2009) found evidence for the existence of speculative activity and thus, like Gilbert (2010) found support for the speculative bubble theory. However, Dema's methodological approach has been criticized by Irwin and Sanders (2011) as not being 'sufficiently robust' while Rossi (2011) pointed out Einloth's (2009) failure or inability to ascertain the effect of trade in commodity indices on energy prices, if at all there was such an effect.

Routledge et al., (2000) have demonstrated the existence of an inverse correlation between commodity spot prices and convenience yields, but their study falls short in the determination of whether this relationship is as a consequence of speculative activity or not. In their study, Tang and Xiong (2010) have hypothesized that in the absence of commodity indices, the correlation between the financial market and the commodity market can at best be weak. Their study establishes that the correlation between these two markets became only strong in 2005, when there was a dramatic growth in the commodity index. To isolate other extraneous factor from the observed growth, Tang and Xiong (2010) break down and classify their sample into two groups: one consists of commodities which are part of the index, while the other consists of the commodities which are not. They further hypothesize that a higher correlation between commodities in the index with other financial investments relative to the correlation between those commodities which are not part of the index and the same financial investments would indicate speculative activity. Their results are statistically significant, but weak (Tang and Xiong, 2010).

Phillips and Yu (2007) have also found support that speculative activity has an impact on energy prices. Using a series of Dickey Fuller tests, Fan and Xu (2011) demonstrate the existence of price anomalies over the period 2005 to 2010, which give strong indications of bubbles that spread from the subprime mortgage market to the oil market. However, their study found no support for the existence of bubbles in the agricultural commodities markets. A major strength of this study is its empirical rigor. Eckaus (2008) maintains that the high oil price levels witnessed between 2007 and 2008 were the result of excessive speculative activity. Based on summary data, he argues that the high prices could not be attributed to other factors such as the high demand for energy from China, the weakening of the dollar, and political instability in various oil-rich nations.

Jensen (2011) concludes that the high oil and natural gas prices witnessed between 2000 and 2010 were the result of excessive speculation in the commodity derivatives markets. Acknowledging that oil prices had increased from an average of between \$25-\$30 in 2000 to an average of between \$90-\$105 in 2008, and that natural gas prices had increased from an average of \$2 -\$3 BTU to \$6 -\$8 BTU over the same period. The US Permanent Subcommittee (2009) found that market fundamentals alone cannot account for the price increases given that over the same period the incremental supply of oil to the global markets exceeded the incremental demand for oil. Moreover, they find a sharp increase in global oil inventories over that period, with US inventories soaring to eight-year highs and those of the OECD to twenty-year highs (Fan and Xu, 2011). Equally, the Permanent Subcommittee (2009) found that the risk premium arising from political instability (Dema, 2009) cannot adequately explain the high price increments over that period. Instead, they attribute the high energy prices to billions of dollars poured by investment, hedge, and pension funds as well as by other large financial players into the oil futures markets. According to the Permanent Subcommittee (2009:23), the massive purchase of the energy commodity derivatives has "created an additional demand for oil, driving up the price of oil to be delivered in the future in the same manner that additional demand for the immediate delivery of a physical barrel of oil drives up the price on the spot market". While their study acknowledges the difficulty of quantifying the impact of speculative activity on oil prices, and does not attempt to do so, it cites other studies like Phillips and Yu (2007) and Doukas et al., (2011) which demonstrate that speculative activity has increased oil prices by between $20 and $25 per barrel.

Like Eckaus (2008), the major weakness of the Permanent Subcommittee's study (2009) is that its findings are based on simple summary data rather than on a well-grounded empirical analysis. This is a weakness which the studies of Hamilton (2009), Singleton (2011) and Kilian (2009) set out to address. They all conclude that speculative activity is a major driver of rising oil prices. Banks (2009) found that the impact of speculative activity has not only applied upward pressure on oil prices at some point in 2008, but that it has also driven the prices lower at some other points in 2008. Thus, he found that the relationship between speculation and energy prices may either be positive or inverse, depending on a number of factors. Banks's (2009) study admits that the direct measurement of speculation is an inherently difficult proposition. His attempt to infer the existence of speculative activity based on simple correlation between movements in oil and gold prices has been criticized as "ignoring the issue that simple correlation does not signify any meaningful structural relationship supporting oil speculation" (Rossi, 2011:5).

Masters and White (2008) also support the proposition that speculative activity has been behind the recent high oil price increases. They hold that the massive growth in commodity index funds trade has led to the artificial increase in the demand for commodity prices, which has in turn led to artificial price increments for a number of commodities (refer to table 1 and figure 1). Using summary data covering the period 1970-2008, they base their findings on an apparent positive correlation between the rise in the commodity index over the period and the accompanying rise in oil prices (Masters and White, 2008). Their study has been criticized for arriving at that conclusion based on mere correlation, given that correlation does not necessarily imply causation (Rossi, 2011; Irwin and Sanders, 2011). Furthermore, Masters and White (2008) did not directly factor in the role of market fundamentals in their study. In their study, Masters and White (2008) have also asserted that any impact on the price of oil by speculative activity is further amplified through the 'Goldman roll effect'. Table 1 can also be shown by means of a line graph, which is captured in figure 1.

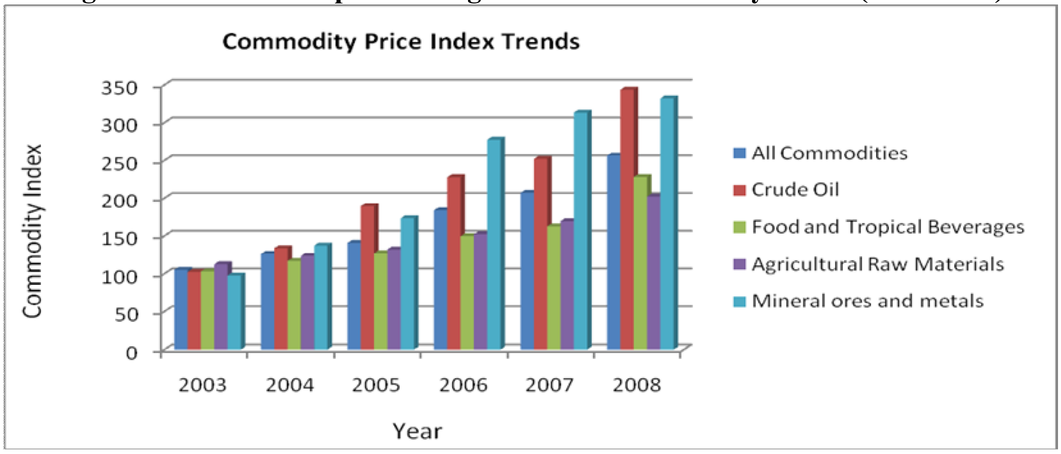
Table 1. Movement in the Commodity Price Index (2003-2008)

Commodity	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
All Commodities	105.1	126.1	140.8	183.6	207.2	256.6
Crude Oil	102.4	133.8	189.1	227.8	252.1	343.8
Food and Tropical Beverages	103.1	116.7	127.0	149.6	162.5	228.1
Wheat	126.8	114.9	109.2	128.5	225.9	288.0
Maize	118.9	124.9	109.9	136.8	189.0	253.2
Rice	97.9	120.6	141.2	149.0	163.1	343.6
Sugar	86.7	87.6	120.9	180.6	123.2	156.5
Coffee	80.6	92.3	131.8	144.8	166.3	192.3
Cocoa	197.7	174.5	173.3	179.4	219.9	287.1
Palm Oil	142.9	151.9	136.1	154.2	251.5	305.8
Agricultural Raw Materials	112.4	123.5	132.2	152.2	169.4	202.2
Cotton	107.1	103.6	91.5	97.0	106.8	120.8
Tropical logs	114.3	136.3	136.7	130.2	155.7	216.8
Rubber	162.0	194.9	224.4	315.2	342.3	391.3
Mineral ores and metals	97.6	137.3	173.2	277.7	313.2	332.4
Aluminum	92.4	110.8	122.5	165.9	170.3	166.1
Copper	96.6	152.8	198.4	361.2	392.6	383.6
Gold	130.3	146.6	159.4	216.6	249.7	312.4

Source: Dema (2009, p.15).

A similar approach has been adopted by Anderson et al (2008), who in their support for the speculative bubble hypothesis, also resort to the 'Goldman roll' effect to explain the impact of excessive speculation in inflating oil prices. However, rigorous empirical evidence adduced by Interagency Taskforce on Commodity Markets - ITCM (2009) decisively refutes any consequential impact of the Goldman roll on oil prices. Using regression models, ITCM demonstrates that while the price spread from the roll of wheat, soybeans and corn was significant, it was small and that in actual fact, "the sizable and predictable rolling that occurs by traders anticipating the roll of the commodity index actually reduces the volatility of the price spread considerably" (ITCM, 2009:11). Thus, refuting the argument by Masters and White (2008) of a significant Goldman roll effect on commodity prices. Medlock and Jaffe (2009) find strong correlations between the long positions of commodity index trade and oil prices for the period between 2003 and 2008. However, as asserted by Irwin and Sanders (2011), correlation does not necessarily imply causation and in the absence of empirical evidence to back their claims, the findings by Medlock and Jaffe (2009) face serious credibility issues.

Figure 1. Column Graph Showing Trends in Commodity Prices (2003-2008)



Using Commitment of Traders (COT) data for the period 1995-2006, Sanders and Merrin (2007) carry out Granger causality tests to determine the relationship between speculation and oil prices, and find little support for the speculative bubble theory. However, their study has been criticized on a number of grounds. According to Rossi (2011:8), "The data used for this analysis can be called into question due to a high degree of aggregation of contracts and the data's reliance on weekly or monthly reporting. A lack of position matching and granularity at a daily level for positions can render the use of Granger-causality tests of limited value."

Using proprietary data from private players rather than the publicly available COT reports, the ITCM also carries out Granger causality tests for the two variables, focusing on the period between 2003 and 2008. Unlike Sanders and Merrin (2007) who used weekly and monthly data, the ICTM (2008) deploys daily data. Other improvements over the Merrin and Sanders study (2007) is the decomposition of the commodity traders into their respective categories and the testing of the variables based on each subcategory. The study does not find any support for the speculative bubble hypothesis, and attributes the high energy prices to market fundamentals. These findings are supported by the findings of Buyuksahin and Harris (2011), whose longitudinal studies also involved Granger causality tests. Using Disaggregated Commitment of Traders (DCOT) and Commodity Index Trader (CIT) data from the US Commodity Futures and Trading Commission (CFTC), Irwin and Sanders (2011) also apply Granger causality tests and demonstrate that there is no statistical evidence to attribute the high oil prices to speculative activity.

United Nations Conference on Trade and Development - UNCTAD (2011) takes the position that speculative activity plays a substantial role in the determination of commodity prices. According to UNCTAD, the efficient functioning of the commodity derivatives market is based on a number of assumptions, among them: traders in the market act rationally, they have the ability to assess – based on the prevailing market dynamics - all the financial assets being traded, and to make the optimal decision independently based on information available to them. However, Lavrovski (2008) reports that in many cases, traders in this market don't make their decisions rationally but engage in various forms of herd behavior. Such herd behavior includes 'noise trading' (Shleifer and Summers, 1990), spurious herding, or intentional (compensation, reputation, conformity, or information based) (Bikhchandani and Sharma, 2001).

Such herd behavior often leads to irrational behavior, which can create cascading effects that eventually trigger the market bubble. The strength of the herding behavior's impact on the price is contingent on the level of uncertainty in the market (Cunado and de Gracia, 2003). While such herding behavior can be almost instantaneously eliminated through arbitrage, Lavrovski (2008) contends that this may not be necessarily the case since constraints to arbitrage exist. This position is supported by, among others, Gromb and Vayanos (2010). According to Cunado and de Gracia (2003), herding also reduces or distorts price information, and because it is done on the basis of small scraps of information, subjects the commodities being traded to even larger price shocks. "Consequently, commodity prices risk being subject to speculative bubbles, move far away from fundamental values and display high volatility" (UNCTAD, 2011:23). Based on this literature review, this paper therefore attempts to evaluate the relationship between speculative activity on oil prices, and in so doing, to offer the evidentiary basis on which to infer what the main drivers of oil prices are. Having done that, it will offer a raft of recommendations on how the free market dynamics of the global energy market can be enhanced for the welfare of all the stakeholders involved.

3. Methodology

This study adopts the positivistic research stance. Based on its objective of establishing the existence / non-existence of causal relationships between speculative activity and high oil prices, the research purpose is explanatory and predictive rather than merely descriptive. To accomplish this objective, the study tests the following hypothesis: *"There is a significant and positive correlation between commodity derivatives (oil futures) and oil prices."*

Data for the study is collected from a wide variety of secondary sources, including: the internet, books, industry publications, government publications, and journals. Rather than evaluating the global energy market in its entirety, this report narrows its focus on five oil-rich countries: Saudi Arabia, Russia, Iran, Nigeria and Mexico. Taking into consideration the different categorizations of probabilistic and non-probabilistic sampling techniques, the choice of these five countries is reflective of the purposive sampling technique (Dawson, 2002).

These five nations chosen as the focus of this study can be considered to form a substantial proposition because they collectively account for 37.1% of all global oil production. Not only that, Saudi Arabia, Russia, Iran, and Nigeria (in that order) are the largest net exporters of oil globally, accounting for more than 42.1% of all net global oil exports. With Mexico's figures factored in, the substantiality of these countries' proposition is enhanced even further. Three of them (Russia, Iran, and Saudi Arabia) account for more than a quarter of the global production of natural gas while two of them (Russia and Nigeria) are ranked among the top ten largest exporters of natural gas globally (with Russia being the world's largest natural gas exporter) (IEA, 2011). Not only that, a good measure of a sample is its representativeness. Geographically, the choice of these five nations meets this criterion. Russia is from Europe, Nigeria from Africa, Mexico from Latin America, and Saudi Arabia and Iran from the Middle East. Additionally, this sample balances Organization of the Petroleum Exporting Countries (OPEC) and non-OPEC considerations (with Saudi Arabia, Iran and Nigeria being OPEC producers and the other two countries being non-OPEC producers).

To examine the nature of the relationship between speculative activity in the commodity derivatives market and high energy prices, the Ordinary least squares (OLS) regression technique is used, where the open market position is taken as the proxy measure for speculation and oil prices as the dependent variable. The causality between these two variables is examined using the Granger Causality test, with one-tailed and two-tailed tests being used to evaluate the significance of the findings. The OLS regression is run using the Excel spreadsheet package while the causality tests are run using online algorithms. These tests are run at both the individual country level and also at global level.

4. Findings and Results

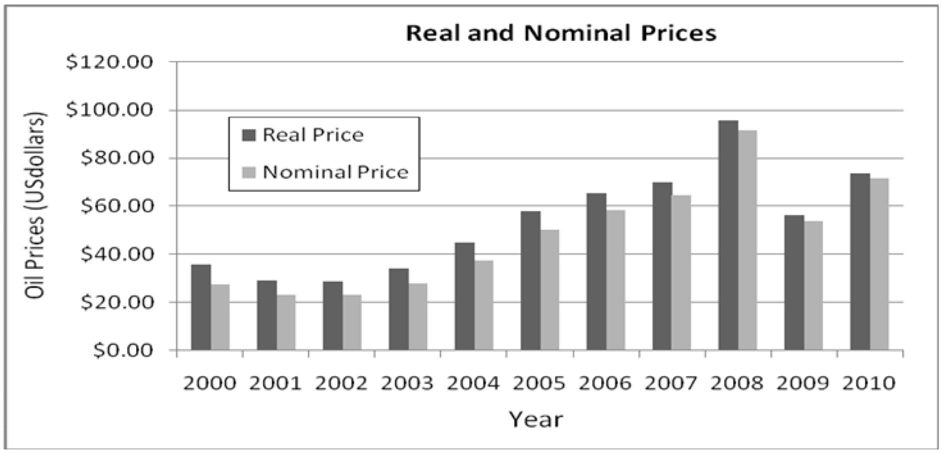
Oil prices are taken as the dependent variable. Oil prices for the eleven years from 2000 to 2010 inclusive are shown in table 2. As it is shown, oil prices have generally increased over that period (with the exception of 2009 when oil prices fell as a result of the global economic recession of the previous year). The prices in table 2 above can also be shown in the form of a line graph, as depicted in figure 2.

Table 2. Global Oil Prices – 2000 – 2010:

YEAR	MONTHLY AVERAGES (NOMINAL PRICES IN US$)												AVERAGE ANNUAL NOMINAL PRICE	AVERAGE ANNUAL REAL PRICE
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
2010	69.85	68.04	72.90	76.31	66.25	67.12	67.91	68.34	67.18	73.63	76.00	81.01	71.211667	73.44
2009	33.07	31.04	40.13	42.45	51.27	61.71	56.16	62.80	60.98	67.43	69.43	66.33	53.566667	55.96
2008	84.70	86.64	96.87	104.31	117.40	126.33	126.16	108.46	96.13	68.50	49.29	32.94	91.4775	95.25
2007	46.53	51.36	52.64	56.08	55.43	59.25	65.96	64.23	70.94	77.56	86.92	83-46	64.196667	69.51
2006	58.30	54.65	55.42	62.50	62.94	62.85	66.28	64.93	55.73	50.98	50.98	54.06	58.301667	65.03
2005	42.21	42.91	48.55	46.63	43.27	49.56	52.13	58.07	58.56	55.12	51.18	52.31	50.041667	57.57
2004	30.87	31.03	33.48	33.08	36.31	33.80	36.25	40.67	41.25	48.71	44.30	39.20	37.4125	44.81
2003	29.44	32.13	30.26	25.22	23.61	27.23	27.39	28.33	25.14	27.07	27.66	28.83	27.6925	33.86
2002	16.65	18.88	20.97	22.83	23.79	22.16	23.69	24.90	26.28	25.38	22.92	25.25	22.808333	28.50
2001	28.66	26.72	23.96	26.77	25.44	24.27	23.58	24.08	20.82	19.04	16.45	16.21	23	29.23
2000	24.11	26.54	27.44	22.99	26.06	28.57	27.17	28.27	30.88	30.01	31.16	25.50	27.391667	35.76

Source: WTRG Economics (2011).

Figure 2. Trends in Real and Nominal Global Oil Prices, 2000 – 2010:



Speculative activity, which is measured through the all open positions, number of traders, and change in total open interest positions of the 'light sweet' variant of global crude traded at the NYMEX (New York Mercantile Exchange), is shown for the years 2000 to 2010 in table 3.

Table 3. Disaggregated Commitment of Traders (DCOT) Reports – 2000 – 2010

YEAR	All Open Interest Positions (Crude Oil)	Number of Traders	Change in Total Open Interest Positions
2000	16,339,983	5,962	-76,938
2001	32,599,007	8,384	73,467
2002	40,540,147	9,025	271,651
2003	43,176,982	10,072	-107,459
2004	53,759,396	12,883	274,852
2005	69,947,044	14,368	334,758
2006	90,507,652	17,082	435,027
2007	127,717,012	18,635	127,000
2008	154,261,142	17,882	506,812
2009	159,305,820	17,198	-577,754
2010	161,287,109	19,454	26,770

Source: FCTC (2011).

The study was also interested in evaluating the relationship between speculative activity and oil prices at the individual country level. Figures 3 and 4 show the trends in 'all open interest positions' and 'number of traders', as depicted in table 3.

Figure 3. Trends in All Open Positions at the NYMEX, 2000 – 2010

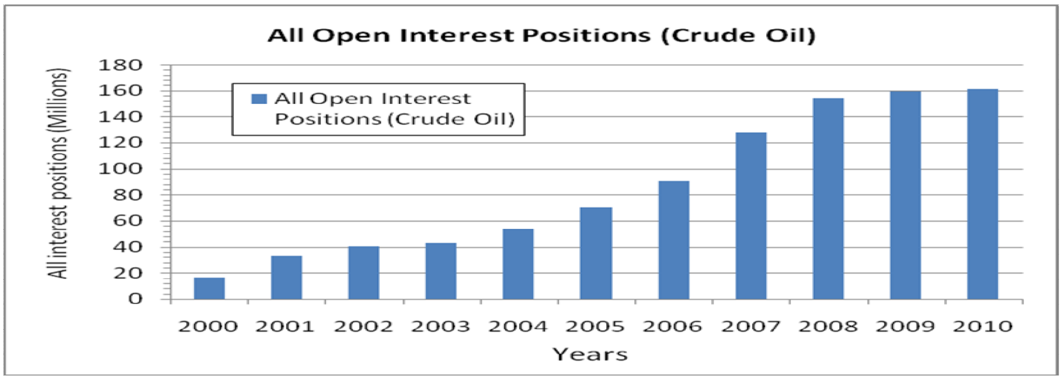


Figure 4. Trends in Number of Traders at the NYMEX, 2000 – 2010:

As figures 3 and 4 above show, both 'open interest positions' and number of traders increased over the period, suggesting an increase in speculative activity. The specific variants traded in the five countries were seen as being accurate predictors of the speculation/price relationship at the national level, and the information regarding them is presented in table 4.

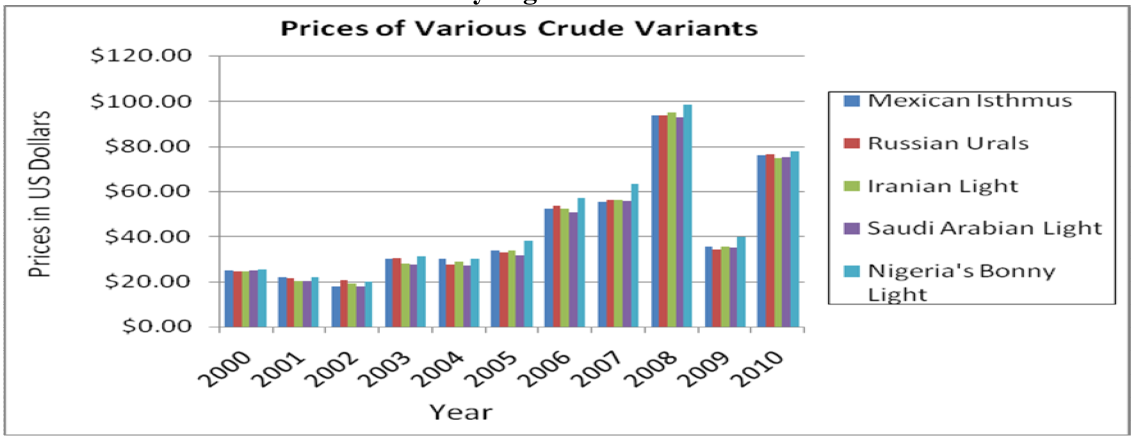
Table 4. Different Grades of Oil and their Historical Prices:

Country	**Crude (API Gravity)**	**Sulfur Weight**	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Mexico	Isthmus (33)	1.3	24.75	22.03	17.72	30.14	29.99	33.87	52.41	55.46	93.74	35.31	76.00
Russia	Urals (32)	1.3	24.71	21.40	20.85	30.31	27.42	33.06	53.70	56.09	93.98	34.20	76.57
Iran	Iranian Light (34)	1.4	24.63	20.20	18.90	27.85	28.67	33.84	52.56	56.28	94.96	35.31	74.94
S/Arabia	Arabian Light (34)	1.8	24.78	20.30	17.68	27.39	27.08	31.86	50.86	55.94	93.02	35.21	75.21
Nigeria	Bonny Light (37)	0.1	25.55	22.00	19.88	31.16	29.97	38.21	56.97	63.28	98.52	39.85	77.69

Source: International Energy Agency (www.eia.gov/emeu/.../table71.xls).

The trends in the prices of the various variants of oil, as shown in table 4 above, are depicted in the following line graph in figure 5.

Figure 5. Trends in the Prices of the Isthmus, Urals, Iranian Light, Arabian Light, and Bonny Light Oil Variants



The hypothesis which this study seeks to test is that "There is a significant and positive correlation between commodity derivatives (oil futures) and oil prices." Speculative activity is adopted as the X variable and real oil prices as the Y variable. For the X variable, the 'all open interest positions' is examined. The regression tests are run, and the results for the individual countries are presented in table 5.

Table 5. Regression Coefficients and t-statistics for five countries, using all open interest positions as the proxy measure for speculative activity):

COUNTRY	SLOPE (REGRESSION COEFFICIENT)	t STATISTIC	SIGNIFICANCE LEVEL	PROBABILITY TESTS (t-test)
MEXICO	4.06543E-07	5.429999833	0.01	One-tailed (0.0002); two-tailed (0.0004)
RUSSIA	4.0651E-07	5.429999828	0.01	One-tailed (0.0002); two-tailed (0.0004)
SAUDI ARABIA	4.15775E-07	5.429999905	0.01	One-tailed (0.0002); two-tailed (0.0004)
NIGERIA	4.42009E-07	5.429999644	0.01	One-tailed (0.0002); two-tailed (0.0004)
IRAN	4.16752E-07	5.429999853	0.01	One-tailed (0.0002); two-tailed (0.0004)

Adopting the significance level of 0.01, a cross-check of t-statistics against the values provided in the significance tables is made and for the relationship between speculation and oil prices at the national level, it is found that:

1. There is a positive, but weak relationship between speculative activity and oil prices
2. From Mexico's t statistic (5.429999833) > 2.821, it can be concluded that this finding is significant and the null hypothesis for Mexico is rejected in favor of the alternate hypothesis.
3. From Russia's t statistic **(**5.429999828) > 2.821, it can be concluded that this finding is significant and the null hypothesis for Russia is rejected in favor of the alternate hypothesis.
4. From Iran's t statistic (5.429999853) > 2.821, it can be concluded that this finding is significant and the null hypothesis for Iran is rejected in favor of the alternate hypothesis.
5. From Saudi Arabia's t statistic (5.429999905) > 2.821, it can be concluded that the relationship is significant and the null hypothesis is rejected for Saudi Arabia in favor of the alternate hypothesis.
6. From Nigeria's t statistic (5.429999644) > 2.821, can be concluded that this relationship is significant and the null hypothesis is rejected in favor of the alternate hypothesis.
7. For all the five countries, one and two tailed probability tests return values of 0.0002 and 0.0004 respectively for each country, which are less than the alpha value of 0.01 and therefore it can be concluded that for all the five countries that the findings are significant.

Summarizing the results of the regression and probability tests above, the study concludes that there is a 0.99 (or 99%) chance that high prices of oil are due to speculation. Repeating the same procedure above for all the five countries, with the number of traders, and change in total open interest positions at the NYMEX respectively being taken as proxy measures for speculative activity, the results are displayed as shown in tables 6 and 7.

Table 6. Regression Coefficients and t-statistics for five countries using number of traders as a proxy measure for speculative activity.

COUNTRY	SLOPE (REGRESSION COEFFICIENT)	t STATISTIC	SIGNIFICANCE LEVEL	PROBABILITY TESTS (t-test)
MEXICO	0.003995685	8.927135701	0.01	One – tailed: <.0001; Two-tailed: <.0001
RUSSIA	0.003985908	8.927084057	0.01	One – tailed: <.0001; Two-tailed: <.0001
SAUDI ARABIA	0.004038992	8.927852921	0.01	One – tailed: <.0001; Two-tailed: <.0001
NIGERIA	0.004363535	8.925257198	0.01	One – tailed: <.0001; Two-tailed: <.0001
IRAN	0.004077056	8.927330223	0.01	One – tailed: <.0001; Two-tailed: <.0001

From table 6; it can also be inferred that:

1. There is a positive but weak relationship between speculative activity and oil prices.
2. From Mexico's t statistic (8.927135701) > 2.821, it can be concluded that this finding is significant and thus the null hypothesis for Mexico is rejected in favor of the alternate hypothesis.
3. From Russia's t statistic **(**8.927084057) > 2.821, it can be concluded that this finding is significant and the null hypothesis for Russia is rejected in favor of the alternate hypothesis.
4. From Iran's t statistic (8.927330223) > 2.821, it can be concluded that this finding is significant and the null hypothesis for Iran is rejected in favor of the alternate hypothesis.
5. From Saudi Arabia's t statistic (8.927852921) > 2.821, it can be concluded that the relationship is significant and the null hypothesis for Saudi Arabia is rejected in favor of the alternate hypothesis.
6. From Nigeria's t statistic (8.925257198) > 2.821, it can be concluded that this relationship is significant and the null hypothesis is rejected in favor of the alternate hypothesis.
7. One tailed and two tailed probability tests return values of less than 0.001 for all the five countries, which are less than the alpha value of 0.01, therefore it can be concluded that the findings are significant.

For these set of results, it can also be concluded that there is a 0.99 (or 99%) chance that the high oil prices witnessed are as a result of speculation. Again, table 7, represents regression coefficients and t-statistics for all the five countries understudy i.e. relationship between speculation and oil prices, using change in open market positions as a proxy measure for speculative activity**.**

From table 7, it can further be inferred that:

- There is a positive but weak relationship between speculative activity and oil prices.
- From Mexico's t statistic (0.977426963) < 2.821, it can be concluded that this finding is significant and thus the null hypothesis for Mexico is rejected in favor of the alternate hypothesis.
- From Russia's t statistic **(**0.977426303) < 2.821, it can be concluded that this finding is significant and the null hypothesis for Russia is rejected in favor of the alternate hypothesis.
- From Iran's t statistic (0.977429453) < 2.821; it can be concluded that this finding is significant and the null hypothesis for Iran is rejected in favor of the alternate hypothesis.
- From Saudi Arabia's t statistic (0.97743614) < 2.821, it can be concluded that the relationship is significant and the null hypothesis for Saudi Arabia is rejected in favor of the alternate hypothesis.
- From Nigeria's t statistic (0.977402932) < 2, it can be concluded that this relationship is significant and the null hypothesis for Nigeria is rejected in favor of the alternate hypothesis.

- One tailed and two tailed probability tests return values of greater than 0.001 for all the five countries, which are higher than the alpha value of 0.01. Therefore, it be concluded that the findings are significant.

Table 7. Regression Coefficients and t-statistics for all the five countries using change in open market positions as a proxy measure for speculative activity.

COUNTRY	SLOPE (REGRESSION COEFFICIENT)	T STATISTIC	SIGNIFICANCE LEVEL	PROBABILITY TESTS
MEXICO	2.64997E-05	0.977426963	0.01	One tailed 0.1769; two tailed: 0.3539
RUSSIA	2.77132E-05	0.977426303	0.01	One tailed 0.1769; two tailed: 0.3539
SAUDI ARABIA	2.55932E-05	0.977436144	0.01	One tailed 0.1769; two tailed: 0.3539
NIGERIA	2.75477E-05	0.977402932	0.01	One tailed 0.1769; two tailed: 0.3539
IRAN	2.78027E-05	0.977429453	0.01	One tailed 0.1769; two tailed: 0.3539

For this set of data, it can be summarized that even though a positive but weak relationship exists between speculation and oil prices (when the number of traders is used as a proxy measure for speculative activity), the data presented by the findings (at a CI of 0.01) are not strong enough to persuade the researcher to reject the null hypothesis. To satisfy that no type II errors were committed, the t values are retested at higher significance levels (0.05, 0.10), but the findings are broadly consistent. Rationalizing these findings with the previous set of results, again it can be concluded that the number of traders does not necessarily positively correlate with speculative activities – in instances where the number of transactions per trader is higher, for example, speculative activity may be higher in markets which have fewer traders. Thus, there is a high likelihood that the third set of findings occurred by chance, and it can be upheld that the relationship between speculative activity and oil prices is positive (though weak), and that these findings are significant.

The regression tests are run for the five countries collectively (using the all open interest positions only), and the results of that regression test are shown in table 8.

Table 8. Regression Coefficients and t-statistics for the Five Countries as a Bloc (Relationship between Speculation and Oil Prices)

COUNTRY	SLOPE (REGRESSION COEFFICIENT)	t STATISTIC	SIGNIFICANCE LEVEL	ONE AND TWO TAILED PROBABILITY TESTS
Mexico, Russia, Iran, Saudi Arabia, and Nigeria as a bloc	3.88066E-07	4.911619018	0.01	One-tailed (0.0004); two-tailed (0.0008)

The t-statistic against the relevant values in the significance tables (adopting a significance level of 0.01) were evaluated and it was found that as a bloc, the five countries' t statistic is 4.911619018 (> 2.821) and therefore, the finding is significant and the null hypothesis is rejected for the five countries as a bloc in favor of the alternate hypothesis. Additionally, the one-tailed and two-tailed probability tests return values of 0.0004 and 0.0008, respectively; both of which are less than the critical alpha value (0.01), leading to the conclusion that the findings are significant. However, correlation does not necessarily imply causation, and the Granger's causality test is run in order to ascertain whether speculative activity actually causes an increase in oil prices as shown in 'Nigeria Granger's', 'Iran Granger's', 'Saudi Arabia Granger's', 'Mexico Granger's', Russia Granger's' and 'bloc Granger'. For all the countries (separately and as a bloc), the p value > than the critical alpha value, and therefore the study found that in excessive speculation neither Granger causes high oil prices nor do high oil prices Granger cause excessive speculation. These results therefore do not find support for the assertion that high oil prices are the result of excessive speculation.

5. Conclusion

Based on the findings, the study concludes that there is a positive (but very weak) relationship between speculative activity and oil prices. In relative terms, the strength of the relationship appears to be strongest in Nigeria, followed by Iran, Saudi Arabia, Russia and Mexico in that order. Comparing the regression coefficient for the five countries as a bloc with each of the individual countries shows that the coefficient is much weaker for the five countries as a bloc than for any of the five countries considered separately. In absolute terms, that strength is at best weak across the board. These findings confirm the oft-held observation that oil prices generally tend to rise as speculative activity in the commodity derivatives market increases. However, this correlation, even if weak, does not imply causation. Subsequent Granger causality tests do not find support for that causative relationship.

It is therefore reasonable to argue that while excessive speculation may have an impact on spot prices; such an impact can only be temporary as a result of the arbitrage process. Furthermore, equating the monetary investments into oil derivatives with demand as a way of justifying the causative role of speculation on oil prices does not make sense because such money flows are fundamentally different from actual demand for physical commodities. Additionally, the fact that the possibility for the creation of an infinite number of futures and other commodity derivatives at any one price point exists necessarily implies that the existence of a huge pool of future flows of money will not in itself affect the commodity's futures price. Furthermore, commodity derivatives are just financial transactions which, in most cases, do not eventually lead to the change in ownership of the physical commodity. For the dealers in the commodity derivatives to affect the commodity prices, they must take physical delivery of the commodities (which rarely occurs) and keep these inventories outside the cash market.

Additionally, for speculation (risk-taking) to be considered as being overly excessive, it is necessary to also consider the hedging (risk-avoiding) position. But an examination of the data available between 2006 and 2008 shows that the speculative positions had equal parity with the hedging positions, with hedging activity sometimes even exceeding the speculative activity. This makes nonsense of the excessive speculation argument advanced by the bubble theorists. Instead, this study attributes the rise in oil prices to other factors, including but not limited to the peaking of oil discoveries and production and simultaneous increase in demand (primarily from emerging economies such as China and India), a weak dollar, and heightened political instability in various oil-exporting countries.

The study explains the apparent disparities in the coefficients for the relationship between speculation and oil prices by pointing out to the differences in the prices of the oil variants traded by the respective countries. Obviously, the effects of speculation will be amplified for the premium-priced crude (such as Nigeria's bonny light) than for those trading at discounts (e.g. the Oseberg blend). The other possible explanation would relate to the level of physical transparency in the respective markets. Markets that are more transparent are also typically more efficient, and prices in such markets are primarily determined by market fundamentals. In contrast, markets with low levels of physical transparency leave a lot of room for the prices to be determined by factors unrelated to the supply and demand dynamics.

The major inference thus is that some countries such as Nigeria and Iran have lower levels of market efficiency and transparency than others (such as Mexico or Russia). With lower levels of market efficiency therefore, market abuse and manipulation levels are higher, leading to higher levels of speculation and speculation-driven prices than in markets such as Mexico. Even though the paper finds no evidence to support the claims that high oil prices are the result of excessive speculation, it establishes a degree of correlation between the two which has the potential to lead to (modest) price increase in the short run. This ability is however subject the effectiveness of the market's arbitrage process, which in turn depends on the efficiency of the market. The disparities in the correlation coefficient values for the five countries shows that market transparency has a role to play in determining whether excessive speculative activity will affect oil prices. As such, focus should be on enhancing market transparency (both the physical and financial transparency) and efficiency and strengthening the market fundamentals of supply and demand. This can be achieved through the adoption of regulations aimed at eliminating market abuses and safeguarding market integrity and transparency. Such regulations would ensure that:

a) Incidents of insider trading and market manipulation are minimized. This will bar players from trading based on privileged information relating to the storage, transportation or production of oil, or manipulating the capacities of transport, storage and production facilities in order to profit.

b) Emission rights trading and the trading of over-the-counter (OTC) derivatives (which in most parts of the world are unregulated) are brought under the ambit of market abuse directives.

c) All the dealers in the energy markets are registered and made to comply with reporting requirements. Among other areas, the dealers should be required to make regular disclosures on the quantity of their purchases and sales, their prices, dates and time of the transactions, and parties involved in the transactions. Such disclosures must be timely, complete and accurate. While initiatives such as Joint Oil Data Initiative (JODI) have been established and made progress in this front even for countries traditionally considered opaque, there is need for an international framework to coordinate national efforts. At present, the IEA is limited in its membership and cannot play this role, unless if its membership is expanded to include players such as India and China.

d) Financial transparency should also be enhanced through standardizing and centralizing the clearance of derivatives, which can in turn be achieved through the setting up of a central clearing house. Capital adequacy requirements should also be strengthened and stricter margin requirements adopted. Finally, the efficiency and stability of the global energy market can be boosted through the use of 'position limits and hedge exemptions.' Position limits involve putting an upper limit on the number of speculators who can be allowed to operate in the market.

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