
**International Journal of Economic Research**

ISSN : 0972-9380

available at http: www.serialsjournals.com



**Volume 14 • Number 17 • 2017**

# Cointegration and Causality among the Crude Oil Market and the Gold Market

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***Abstract***: This paper focuses on the relationship between the crude oil price and gold prices. This paper aims to explore the interaction between the two markets from two perspectives: price cointegration and price causality. This study is based on secondary data obtained from various data sources for the period from January 1st, 2008 to October 30th, 2015. In the course of analysis, ADF unit root test, Johansen cointegration analysis and Granger causality test have been designed. Johansen cointegration test result indicates that there exists a long-term relationship among the crude oil price and gold price. Granger causality test result shows significant between the gold price and the crude oil price but not vise versa.

***Keywords***: crude oil market, gold market, cointegration test, granger causality

## 1. INTRODUCTION

Investment can be made either directly or indirectly, with the hope in time the capital owners (investors) receive some benefit from the capital investment (Levišauskait, 2010). Investment at the present time is not only dominated by investment in financial market, but also commodity market. Today, commodity market is highly developed market and the price movement in this market is also able to affect the stock price movement in the capital market.

There is a common belief that the prices of commodity tend to move in unison. The reason why commodity prices tend to rise and fall together is because they are influenced by common macroeconomic factors such as interest rates, exchange rates and inflation (Hammoudeh *et al.*, 2008). Oil and gold, among others, are the two strategic commodities which have received much attention recently, partly due to the surges in their prices and the increases in their economic uses. Crude oil is the world's most commonly traded commodity, of which the price is the most volatile and may lead the price procession in the commodity

market. Gold has a critical position among the major precious metal class, even considered the leader of the precious metal pack as increases in its prices seem to lead to parallel movements in the prices of other precious metals (Sari *et al.*, 2010).

The first connection between gold and oil have begin in history, when producers of the Middle East required gold in exchange for crude oil. Important milestone was in 1933. In 1933, the original oil concession in Saudi Arabia could be traded in gold only. As a result of many historical events, gold and oil markets went through huge development and significant relationship between these two commodities was no longer determined at the level of payment only.

In the second half of 2008, due to the serious global financial and economic crisis, the large commodity markets basically faced an austere test. As a result, the crude oil price continually declined from 147 $ per barrel to nearly 30 at the end of 2008; at the same time, the gold also saw a sharp price collapse from over 1000 $ per ounce to 700 or so. However, ever since 2009, with the emergence of global economic recovery expectation, the large commodity market demand began to rise again and both the crude oil and gold prices changed their staggering tumble trends and started a new surging stage.

The above feature descriptions of crude oil and gold justify the economic importance of investigating the relationship between these two commodities. Particularly, since the crude oil and gold are considered the representatives of the large commodity markets, their price movement may provide some reference information for forecasting the price trends of the whole large commodity market. Beahm (2008) opines that the price relationship between oil and gold is one of the five fundamentals that drive the prices of precious metals. Further, their special features make the prices of oil and gold not only influenced by the ordinary forces of supply and demand, but also by some other forces. Therefore, it is of crucial practical significance to figure out how oil price is related to gold price and whether oil prices have forward influences on the prices of gold. This paper aims to shed light upon the reasons for the consistent changes of the two prices, as well as the interactive mechanism of them. It should be noted that discussion on these topics is of crucial importance for risk managers so as to resist the large commodity market risk and forecast market dynamics in the future.

Additionally, as we know, price is a concentrated carrier of market information and price fluctuations can often reflect the comprehensive change of market information. According to Stock and Watson (1988) market information is comprised of two parts: effective information and noisy information. Therefore, the real market price can be divided into two parts: effective price and noisy price. In this paper, the common effective price of the crude oil and gold markets embodies the common effective information between the two markets, which can be viewed as an important reference of the overall trend of the large commodity markets, due to the dominant positions of crude oil and gold in the large commodity markets. In terms of not only the outstanding trading volume and value, but also evident market influence and attraction among investors, the crude oil and the gold play the main roles in the large commodity markets, hence it is fairly important for related market consultants and investors to conduct an investigation of price cointegration relationship, lead-and-lag relationship between the two markets.

The rest of the paper is structured as follows. Section 2 briefly summarizes the existing literature related with the topics in this paper. Section 3 presents data section follows and methodology. Then, section 4 "Empirical results and discussions" provides the empirical study and policy implications of this

paper, which mainly includes three parts, i.e. the long-term equilibrium and short-term adjustment between the crude oil and gold markets. Finally, Section 5 presents some concluding remarks are put forward in the last section and recommendations.

## 2. LITERATURE REVIEW

Crude oil is considered to be the world's most influential physical commodity that plays a prominent role in all economies by way of trade mobilization and production of utility based commodities. Thus, oil price fluctuations affect the world economy in different and significant ways (Bapna *et al*., 2013). This means that oil price changes might not only have a direct effect on consumption and production, but that oil price changes can also proxy for changing risk aversion in the economy. Oil was initially traded for its fundamental purposes, but over time gained a permanent place in the investment portfolio. Oil and its derivates are specific with high liquidity, volatility and relatively high profit opportunities for investors. Price formation is an important factor influencing the oil market. Determining the price of this commodity is derived from the market mechanism (the relationship of the global and regional supply and demand). Bhar and Nikolova (2010) to promote a greater understanding of the implications of oil price changes on the equity investment climate in Russia. A dynamic bivariate exponential general autoregressive conditional heteroscedastic (EGARCH) analysis shows that global oil price returns have significant impact on Russian equity returns and volatility. Lee and Chiou (2011) develop a two-step methodology to facilitate an examination of the impact of oil shocks on stock returns. Oil price volatility is monitored in this study through the use of a regime-switching model, with the presence of jumps subsequently being taken into consideration to examine the asymmetric effects of oil prices on stock returns. Ghorbel *et al.* (2014) attempts to shed light on the impact of oil prices, investor sentiment, and conventional index on 11 Islamic indices, particularly during the subprime financial crisis and the oil crisis. Empirical evidence suggests that the Malaysian and Indonesian Islamic indices are very much affected by the oil volatility. Estimation results of the BEKK-GARCH model reveal that the pessimistic sentiment during the subprime crisis is transmitted to Islamic indices, suggesting the herding contagion.

Gold has been an important precious metal for many centuries, and plays a special role as a store of value especially in times with political and economic uncertainties (Aggarwal and Lucey, 2007). Hence, compared with other metals in the large commodity market, gold registers an evident advantage and outstanding position. In recent years, because of the nice profit-making situation and remarkable risk-avoidance feature, gold market has seen a very active picture. As a result, the role of gold market in the large commodity market even in the whole social economy has received increasing attention by both academia and industrial cycles, and research concerned also can be found emerging. Shafiee and Topal (2010) the global gold market has recently attracted a lot of attention and the price of gold is relatively higher than its historical trend. For mining companies to mitigate risk and uncertainty in gold price fluctuations, make hedging, future investment and evaluation decisions, depend on forecasting future price trends. Wang and Lee (2011) examine whether gold could be an exchange rate hedge in Japan, using data from 1986 to 2007. In the literature on this area, most research focuses on the linear relationship rather than the non linear one between gold returns and the exchange rate fluctuation of the Japanese yen. In the present paper, we use the depreciation rate of the yen as a threshold variable to distinguish between a high depreciation regime and a low depreciation (or appreciation) regime. With this specification, we build a

threshold vector autoregressive model to investigate the causality between the gold return and the yen depreciation rate. Coudret and Feingold (2011) looks into the role of gold as a safe haven or a hedge against stocks. We extend the existing literature in two ways. First, we consider crisis periods successively defined by recessions and bear markets. Second, we use a bivariate ARMA -GARCH-X model to estimate conditional covariances between gold and stocks returns. Bia³kowski *et al.* (2014) motivated by the recent gold price boom, this paper examineswhether an asset bubble exists in the gold market. We approximate gold's fundamental value using several econometric models and apply a Markov regime-switching Augmented Dickey–Fuller (ADF) test which has substantial power for detecting explosive behavior.

Overall, an array of research on the price dynamics in crude oil market and gold market, respectively, has been identified and historical data indicated that their price movement proved highly related, but research on the interaction of the two markets appears still scarce now (Yang, 2007; Zhang *et al.*, 2007), and even some key topics have not been discussed by existing literature. For example, whether there is strong influence between the crude oil and gold markets, what the influential extent may be and what their relative positions may stay in the large commodity market, etc. However, these topics are of crucial practical significance for further recognizing the features of commodity markets. Therefore, more careful investigation should be carried out. For this purpose, this paper aims to explore the interaction between the two markets from two perspectives: price cointegration and price causality.

As for the price cointegration discussion, the cointegration theory and error correction model provided by Engle and Granger (1987) are applied here. And then this paper attempts to quantitatively study the lead-and-lag relationship between the crude oil price and the gold price. For this topic, it has been universally acknowledged that one of the main methods should be Granger causality test approach (Yang, 2000; Jiao *et al.*, 2004, 2005; Tang, 2008; Erdal *et al.*, 2008; Bekiros and Diks, 2008; Henriques and Sadorsky, 2008; Zhang and Wei, 2010; Samanta and Zadeh, 2012; Bhunia, 2013).

Nevertheless, the interaction among oil price, gold price and other financial variables tends to show some complexity, Narayan *et al.* (2010) studied the long-run relationship between gold and oil futures prices at different levels of maturity and found cointegration relationships existing, for all pairs of sport and futures gold and oil prices. Sari *et al.* (2010) explored the directional relationships between spot prices of four precious metals (gold, silver, platinum, and palladium), oil and USD/euro exchange rate. Zhang and Wei (2010) the gold market and the crude oil market are the main representatives of the large commodity markets, it is of crucial practical significance to analyze their cointegration relationship and causality, and investigate their respective contribution, from the perspective of price discovery, to the common price trend so as to interpret the dynamics of the whole large commodity market and forecast the fluctuation of crude oil and gold prices. Le and Chang (2011) using the monthly data spanning 1986-2011 to investigate the relationship between the prices of two strategic commodities: gold and oil. They examine the relationship through the inflation channel and their interaction with the index of the US dollar. They used different oil price proxies for our investigation and found that theimpact of oil price on the gold price is not asymmetric but non-linear. Bhunia (2013) studied investigates the cointegration relationships among crude oil price, domestic gold price and selected financial variables (exchange rates and stock price indices) in India. The study is based on secondary data obtained from various data sources including BSE database, NSE database and World Gold Council database for the period from January 2, 1991 to October 31, 2012. In the course of analysis, ADF unit root test, Johansen cointegration analysis and granger causality test have been designed.

## 3. DATA AND METHODOLOGY

### 3.1. Data

In this study, we use daily data the West Texas Intermediate (WTI) crude oil price is chosen as a representative of world oil price. The original WTI crude oil spot price (quoted in US dollar per barrel) is acquired from the U.S. Energy Information Administration (EIA). Over the time period studied, West Texas Intermediate crude oil is widely seen as a benchmark for world oil markets. While the gold price data come from the global insight and are based on the London Bullion Market Association, which are also spot price and quoted in U.S. dollars per troy ounce. The sample period is from January 1st 2008 to October 30th 2015.

### 3.2. Methodology

It is of great importance for not only the crude oil market and gold market dynamic analysis but also for the whole large commodity market forecast to test whether there exists a lead-and-lag price mechanism between the crude oil price and gold price. For this purpose, a cointegration test is investigated at first, and then Granger causality test approaches are used here so as to fully examine the price information transfer mechanism.

**Unit root test**. A time series is stationary or not or include unit root for which Augmented Dickey-Fuller (ADF) test method has been used in the study. ADF test considered as an appropriate tool to check the stationariaty of time series data (Mehmood and Ahmad, 2012; Mehmood, 2012a; Naz, 2012, and Mehmood, 2012b). The time series is non-stationary if the critical value is lower than the calculated value, subsequently null hypothesis is rejected and series is decided to be stationary.

$H_0$ *: Series is stationary*

$H_1$ *: Series is non-stationary*

If all the sets of data are found I (1) (non-stationary), and if the regression produces a I (0) error term, the equation is said to be cointegrated. On the other, if there are two variables, $x_t$ and $y_t$, which are both non-stationary in levels but stationary in first differences, then $x_t$ and $y_t$ would become integrated of order one, I(1), and their linear combination should have the form (Gilmore *et al.*, 2009):

$$Z_t = x_t - ay_t \quad (1)$$

However, if there is a $I(0)$ such that $z_t$ is also integrated of order zero, $I(0)$, the linear combination of $x_t$ and $y_t$ is said to be stationary and the selected variables are also to be cointegrated (Engle and Granger, 1987). If two variables are cointegrated, there will be an underlying long-run relationship between them.

The ADF test uses a regression of the first differences of the series against the series lagged once, and lagged difference terms, with optional constant and time trend terms:

$$\Delta y_t = a_0 + a_1 t + \gamma y_{t-1} + \Sigma b_i y_{t-1} + e_t \quad (2)$$

In the equation $\Delta$ is the first-difference operator, $a_0$ is an intercept, $a_1 t$ is a linear time trend, $e_t$ is an error term, and i is the number of lagged first-differenced terms such that $e_t$ is the white noise. The test for a unit root has the null hypothesis that signifies $\gamma = 0$. If the coefficient is significantly different from zero,

the hypothesis that $y_t$ contains a unit root is considered as rejected. If the test on the level series fails to reject, the ADF procedure is then applied to the first-differences of the series. Rejection leads to the conclusion that the series is integrated of order one, I (1).

**Johansen cointegration test.** Cointegration tests provide a mean to determine whether a set of endogenous variables share a common long-run stochastic trend. A finding of cointegration indicates interdependence of the endogenous variables, which may be the result of economic linkages between the markets or arbitrage activity between investors. Hypothesis to be examined with Johansen cointegration test to be applied on the study has been presented below:

*$H_0$: There is no cointegration relationship between variables*

*$H_1$: There is cointegration relationship between variables*

The Johansen (1988) and Johansen and Juselius (1990), the JJ cointegration is based on a Vector Auto Regression (VAR) model that can be formulated as follows:

$$\Delta X_t = \delta + \Gamma_i \Delta X_{t-1} + \ldots + \Gamma_k \Delta X_{t-k} + \Delta X_{t-k} + \varepsilon_t \quad (3)$$

Where $\Delta$ first difference, $\mathbf{X}_t$ is an $n$ x 1 vector of variables and $\delta$ is an $n$ x 1 vector of constant, respectively. $\Gamma$ is an $n$ x $n$ matrix (coefficients of the short-run dynamics), $\Pi = \alpha\beta$ where $\alpha$ is an $n$ x 1 column vector (the matrix of loadings) represents the speed of short-run adjustment to disequilibrium and $\beta$ is an 1 x n cointegrating row vector (the matrix of cointegrating vectors) indicates the matrix of long-run coefficients such that $Y_t$ converge in their long-run equilibrium. Finally, $\varepsilon_t$ an $n$ x 1 vector of white noise error term and **k** is the order of autoregression. Johansen proposed two statistics to test the rank of the long-run information $\Pi$, namely, maximum likelihood and trace.We note that, the results of JJ test tend to be sensitive to the lag length. Following Hall (1989) and Johansen (1992), we specify the lag length that renders the VAR residuals serially uncorrelated. In order to test for the number of cointegrating vectors, this study employs Johansen and Juselius (1990) and Osterwald-Lenum (1992) statistics that are adjusted for the degree of freedom.

**Pairwise Granger causality Tests.** Granger causality relationship between the two markets is tested. Based on the stationary market returns, a VAR model is developed as Eq. (4)

$$\mathbf{OIL}_t = \alpha_{10} + \alpha_{11}\mathrm{OIL}_{t-i} + \alpha_{12}\mathrm{GOLD}_{t-j} + \varepsilon_{1t}$$
$$\mathbf{GOLD}_t = \alpha_{20} + \alpha_{21}\mathrm{GOLD}_{t-i} + \alpha_{22}\mathrm{OIL}_{-j} + \varepsilon_{2t} \quad (4)$$

Where OIL stands for the oil price and GOLD denotes the gold price. Then a hypothesis test can be done for the equation in Eq. (4), in which the null hypothesis is $\alpha_{12j} = 0$ (j = 1, 2, ... ,p). When the null hypothesis is rejected, then it can be argued that the change of gold price linearly granger causes the volatility of international crude oil price; similarly, we also can test whether the change of crude oil price linearly granger causes the change of gold price. In Eq. (4), prepresents the largest lag order, which is obtained according to the principle of minimum SIC value.

## 4. EMPIRICAL RESULT AND DISCUSSION

The empirical results are reported from two parts, i.e. the long-term equilibrium and short-term adjustment between the crude oil market and the gold market.

Cointegration analysis is possible if the series are stationary. In order to stationarity analysis, unit root test of *Augmented Dickey-Fuller* (ADF) is conducted with the first differences of each series on the condition that the null hypothesis is non-stationary, so rejection of the unit root hypothesis supports stationarity. Table-1 shows the results of unit root test. It reveals that time series are non-stationary at 1st difference. However, table 1 shows that the oil price and gold price are stationary at 1st difference [1(1)]. *Augmented Dickey Fuller* unit root analysis test reveals that errors have constant variance and are statistically independent. Therefore, cointegration test can be applied on these variables, as supported in (Shahzadi and Chohan, 2012).

**Table 1**
**Results of Augmented Dickey-Fuller Test at 1st difference**

| | *Intercept* | | | *Intercept and Trend* | | |
|---|---|---|---|---|---|---|
| *Variables* | *Test statistics* | *Critical value* | *Prob.* | *Test statistics* | *Critical value* | *Prob.* |
| Oil Market | -20.92 | -3.43 | 0.0000 | -20.91 | -3.96 | 0.0000 |
| Gold Market | -44.45 | -3.43 | 0.0001 | -44.48 | -3.96 | 0.0000 |

*Note:* the lag length is chosen using the modified SIC criteria, using the correction of Reimers (1992). *** denotes statistical significant at the 1% level.

Consequently, Johansen cointegration test is used to determine whether there is cointegration as well as the number of cointegrating relationships, that is, whether there are any long-term cointegration relationships between oil market and gold market. Two likelihood ratio tests are used, the Trace Test and the Maximum Eigenvalue test, to determine the number of cointegrating vectors. The estimation for each series assumes linear deterministic trend unrestricted with intercepts and no trends. A lag of 1 to 4 (in 1st differences) is used for each series, based on the Swartz Information Criterion (SIC).

**Tabel 2**
**Result of Johansen Cointegration Test**

Unrestricted Cointegration Rank Test (Trace)

| *Hypothesized No. of CE(s)* | *Eigenvalue* | *Trace Statistic* | *0.05 Critical Value* | *Prob.*** |
|---|---|---|---|---|
| None * | 0.174829 | 285.8886 | 15.49471 | 0.0001 |
| At most 1 | 0.001525 | 2.252778 | 3.841466 | 0.1334 |

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

| *Hypothesized No. of CE(s)* | *Eigenvalue* | *Max-EigenStatistic* | *0.05 Critical Value* | *Prob.*** |
|---|---|---|---|---|
| None * | 0.174829 | 283.6358 | 14.26460 | 0.0001 |
| At most 1 | 0.001525 | 2.252778 | 3.841466 | 0.1334 |

* denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values

Table 2 demonstrates the Johansen cointegration test results. It assures the long-term relationship among the selected variables. The result shows that the series is cointegrated, as both the trace and the maximum eigenvalue tests reject the null hypothesis of no cointegration, suggesting that there are two significant cointegrating vectors in the model. This implies that there are two common stochastic trends, indicating a degree of market integration.

The Granger causality test is a statistical proposition test for determining whether one time series is helpful in forecasting another. The Granger causality test has been performed in the present study in search of direction of causation among the selected financial variables. Both the $OIL_t$ and $GOLD_t$ series are stationary, which comply with the precondition of the VAR models, and then Granger causality test is done whose detailed results are shown in Table 3.

It is important to note that the pronouncement of causality between the selected variables does not mean that movement in one variable actually causes movements in another variable. To a certain extent, causality basically entails in order of movements in the time series (Awe, 2012).

**Table 3**
**Granger Causality Test Results**

| *Null Hypothesis* | *Obs* | *F-Statistic* | *Prob.* | *Type of Causality* |
|---|---|---|---|---|
| GOLD does not Granger Cause OIL | 1266 | 2.76709 | 0.0049 | Causality |
| OIL does not Granger Cause GOLD | | 8.68060 | 1.E-11 | No Causality |

*Note*: Decision rule: reject $H_0$ if P-value < 0.01

According to Table 3, there exists a significant Granger causality between the gold market and the crude oil market. Specifically, in the sampling period, the gold price significantly Granger causes the change of the crude oil price; put it another way, the gold price soaring causes the crude oil price moving to the same direction based on the fact that the two prices have very similar trends but not vice versa.

## 5. CONCLUSIONS AND RECOMMENDATIONS

This paper conducts a comprehensive empirical study on the interaction between the crude oil market and the gold market from two perspectives, i.e. price cointegration and price causality, so as to provide some rewarding support for recognizing and analyzing the dynamics of the crude oil market, gold market and even the whole large commodity market. To recap what we have done above, several main conclusions and recommendation can be obtained as follows.

1. Based on unit root test shows that the oil price and the gold price are stationary at 1st difference [1 (1)]. Significant cointegration relationship can be identified between the crude oil price and the gold price. Put it another way, there exists long-term equilibrium relationship between the two markets, Furthermore, we find that the long-term equilibrium across the crude oil and the gold markets can only adjust their short-term change in a fairly limited manner. Therefore, when we analyze the main factors driving the crude oil price short-term change, the volatility of the gold market is necessary to be considered as a dominant factor and can only provide a supplementary reference.

2. Granger causality test, there can be found significant the gold price and the crude oil price but not vise versa. The gold naturally plays a nice role in hedging inflation, which is rooted in gold's abilities to ensure against uncertainty and instability and protect against risk. In the sampling period, the international crude oil price broke through historic records time and time again, which augmented the attraction of gold for hedging inflation and spurred on a great deal of gold trading for resisting market risk; as a result, the gold price saw a fast soaring.

Similarly, knowing the integration among the commodity markets would give an idea the potential benefits from international portfolio diversification and hedging strategies. The significantly extended the variety of investment and risk management strategies available to investors and help managers to mitigate international risks and managing economic, transaction and translation of risks.

As for the future work, with respect to the relationship between the crude oil and the gold markets, at least two things have to be conducted further. For one thing, in this paper, we are focused on their overall relationship, so the results here are relatively static with an average meaning; in the future, attention can be paid to their dynamic and time-varying interaction. For another, this paper sheds light upon their relationship in the mean perspective, while other perspectives also can be considered in the future, such as the volatility, risk spillover, etc., in order to foster a more holistic comprehension about the crude oil and the gold markets even the whole large commodity market.

## REFERENCES

A. Bhunia (2013), "Cointegration and causal relationship among crude price, domestic gold price and financial variables-an evidence of BSE and NSE," *J. of Contemporary Iss. in Bus. Res.*, vol. 2, no. 1, 1-10.

A. Ghorbel, M. Abdelhedi, and Y. Boujelbene (2014), "Assessing the Impact of Crude Oil Price and Investor Sentiment on Islamic Indices: Subprime Crisis," *J. of African Bus.*, 15(1), 13-24.

C. F. Tang (2008), "A re-examination of the relationship between electricity consumption and economic growth in Malaysia," *Energy Pol.*, 36, 3077-3085.

C. G. Gilmore, G. M. McManus, and R. Sharma (2009), "The Dynamics of Gold Prices, Gold Mining Stock Prices and Stock Market Prices Comovements," *Res. in App. Econ.*, 2 (II).

D. Beahm. (2008), 5 Factors Driving Gold in 2008 [Online]. Available: *http://www.blanchardonline.com/beru/five_factors.php*

F. Naz (2012), "A univariate time series modelling of dates exports in Pakistan," *J. of Contemporary Iss. in Bus. Res.*, 1 (2), 37-48.

G. Erdal, H. Erdal, and K. Esengun (2008), "The causality between energy consumption and economic growth in Turkey," *Energy Pol.*, 36, 3838–3842.

H. E. Reimers (1992), "Comparisons of Tests for Multivariate Cointegration," *Stat. Pap.*, 33, 335-346.

H. Shahzadi, and M. N. Chohan, "Impact of Gold Prices on Stock Exchange: A Case Study of Pakistan." *Working paper series*, 10 (2), 1-12, 2012.

H. Y. Yang (2000), "A note on the causal relationship between energy and GDP in Taiwan," *Energy Econ.*, 22, 309-317.

I. Bapna, V. Sood, N. K. Totala, and H. Saluja (2013), "Crude Oil: Relationship with Exchange Rate, Gold, S&P CNX Nifty and SENSEX," in *Proceedings of the AIMS International Conference on Management*, Managing Services, 10, 553-561.

I. Henriques and P. Sadorsky (2008), "Oil prices and the stock prices of alternative energy companies," *Energy Econ.*, 30, 998-1010.

J. Bia³kowski, M. T. Bohl, P. M. Stephan, and T. P. Wisniewski (2014), "The gold price in times of crisis," *Int. Rev. of Fin. Anal.*.

J. H. Stock and M. W. Watson (1988), "Testing for common trends," *J. Am. Stat. Assoc.*, 83, 1097–1107.

J. L. Jiao, Y. Fan, J. T. Zhang, and Y. M. Wei (2004), "Study on the interaction between Chinese crude oil price and international crude oil price," *Man. Rev.*, 16, 48-53.

J. L. Jiao, Y. Fan, J. T. Zhang, and Y. M. Wei (2005), The analysis of the effect of OPEC oil price to the world oil price," *J. Syst. Sci. Info.*, 1, 113-125.

K. Levišauskait (2010), "Investment Analysis and Portfolio Management," Vytautas Magnus Univ., Kaunas, Lithuania.

K. M. Wang and Y. M. Lee (2011), "The yen for gold," *Res. Pol.* 36, 39-48.

M. Osterwald-Lenum (1992), "A Note with Quintiles of the Asymptotic Distribution of the Maximum Likelihood Co-integration Rank Test Statistic," *Oxford Bulletin of Econ. and Stat.*, 54, 461-472.

O. O. Awe (2012), *On Pairwise Granger causality Modelling and Econometric Analysis of Selected Economic Indicators*.

P. K. Narayan, S. Narayan, and X. Zheng (2010), "Gold and oil futures markets: are markets efficient?," *App. Energy*, 87(10), pp. 3299-3303.

R. Aggarwal and B. M. Lucey (2007), "Psychological barriers in gold prices?," *Rev. Fin. Econ.*, 16 (2), 217-230.

R. Bhar and B. Nikolova (2010), "Global Oil Prices, Oil Industry And Equity Returns: Russian Experience," *Scottish J. of Political Econ.*, vol. 57, no. 2.

R. F. Engle and C. W. J. Granger (1987), "Co-integration and error-correction: representation, estimation and testing," *Econometrica*, 55, 251-276.

R. Sari, S. Hammoudeh, and U. Soytas (2010), "Dynamics of oil price, precious metal prices, and exchange rate," *Energy Econ.*, 32, pp. 351-362.

S. D. Bekiros and C. G. H. Diks (2008), "The relationship between crude oil spot and futures prices: cointegration, linear and nonlinear causality," *Energy Econ.*, 30, 2673-2685.

S. G. Hall (1989), "Maximum likelihood estimation of cointegrating vectors: an example of Johansen's procedure," *Oxford Bulletin of Econ. and Stat.*, vol. 51, pp. 213-18.

S. Hammoudeh, R. Sari, and B. T. Ewing (2008), "Relationships among strategic commodities and with financial variables: A new look," *Contemporary Econ. Pol.*, 27(2), pp. 251-264.

S. Johansen (1988), "Statistical analysis of cointegrating vectors," *J. of Econ. Dynamics and Control*, vol. 12, pp. 231-54.

S. Johansen (1992), "Testing weak exogeneity and the order of cointegration in UK money demand data," *J. of Pol. Modeling*, vol. 14, pp. 313-34.

S. Johansen and K. Juselius (1990), "Maximum Likelihood Estimation an d Inferences on Co-integration with Applications to the Demand for Money," *Oxford Bulletin of Econ. and Stat.*, 52, 169-210.

S. K. Samanta and A. H. M. Zadeh (2012), "Co-Movements of Oil, Gold, the US Dollar, and Stocks," *Modern Econ.*, 3, 111-117.

S. Mehmood (2012a), "Dynamics of Exports and Economic Growth at Regional Level: A Study on Pakistan's Exports to SAARC," *J. of Contemporary Iss. in Bus. Res.*, 1 (1), 11-19.

S. Mehmood (2012b), "Effect of Different Factors on Gross Domestic Product: A Comparative Study of Pakistan and Bangladesh," *Acad. of Contemporary Res. J.*, 1 (1), 18-35.

S. Mehmood and Z. Ahmad (2012), "Forecasting Pakistan's Exports to SAARC: An Application of Univiriate ARIMA Model," *J. of Contemporary Iss. in Bus. Res.*, 1 (3), 41-54.

S. Shafiee and E. Topal (2010), "An overview of global gold market and gold price forecasting," *Res. Pol.* 35, 178-189.

T. H. Le and Y. Chang. (2011), Dynamic Relationships between the Price of Oil, Gold and Financial Variables in Japan: A Bounds Testing Approach [Online]. Available: http://mpra.ub.uni-muenchen.de/33030/ MPRA Paper No. 33030

V. Coudert and H. R. Feingold (2011), "Gold and financial assets: Are there any safe havens in bear markets?," *Econ. Bulletin*, Vol. 31 no. 2 pp. 1613-1622.

Y. H. Lee and J. S. Chiou (2011), "Oil sensitivity and its asymmetric impact on the stock market," *Energy*, 36, 168-174.

Y. J. Zhang, and Y. M. Wei (2010), "The crude oil market and the gold market: Evidence for cointegration, causality and price discovery," *Res. Pol.*, 35, pp. 168-177.

Y. Yang (2007), "Analysis of linkage between gold price and oil price," *Gold* 28, 4-7.

Y. Zhang, L. Xu, and H. M. Chen (2007), "An empirical study on the relationship between prices of petroleum and gold industry," *Res. Finan. Econ.* (Issues 7), 35-39.