

**FACTORS AFFECTING PRICE DISCOVERY IN CRUDE OIL:  
A LITERATURE REVIEW**

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**ABSTRACT**

Crude being essential product, oil prices act as a prime driver in becoming reason for up and down movement of general price levels. India fulfils its major crude oil requirements by imports. Crude oil price determination mechanism is still not left open fully to the market forces as it is a developing country. Seasoning and maturity of Indian economy needs to understand reasons for price discovery in crude oil, thus, a relationship based understanding of the variables is the need of the hour. Crude oil as energy source is imperative for running economies and sustaining economic growth. The price discoveries of this commodity therefore impact both on exporting and importing countries. The mechanism of price formation is very complex and varies in accordance with supply and demand structure for physical oil whereas paper trading activity including speculation of forwards, futures, options and swaps has also become huge part business directing price of crude oil depending on financial circumstances of the market. The aim of this paper is to reveal, through a literature review, the price discovery of crude oil. The factors revealing changes in crude oil has been subject of analysis. In this paper the literature review of the relevant studies have been enclosed. This review tries to sum up the macro economic factors causing volatility in crude oil prices. The goal of this review is to provide academicians, researchers and investors with an overview of the existing factors that contribute to the formation of crude oil prices and causes of its volatility.

**Key Words:** Crude Oil; Volatility; Literature Review; Macro Economic Variables.

**INTRODUCTION**

Petroleum products are hydrocarbon-rich mixture of crude oil and gases. It not only runs factories, cars, heats some homes but drives economies. It has provided Americans with an unprecedented standard of living since its discovery in America in 1859. Oil is a heterogeneous commodity. There are over 160 different types of crude oil products internationally traded in commodity exchanges world over. Crude oil has varied characteristics, quality, and market penetration which determine its price mechanism globally through values of underlying assets. 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). Rise in crude oil prices increases the cost of production of goods, services, transportation and heating. The change in crude oil prices can create both direct and indirect pressure on the worlds' economy and its volatility drive many companies away and it affects the stock market also. India satisfies its major crude oil requirements by importing it from oil producing nations.

Therefore, any upward and downward movements in prices are closely tracked in the domestic market place which is influenced by international factors. Continuous instability in crude oil prices has an impact on the other industrial segments also. Higher crude oil price results into the higher price of energy, which negatively affects other trading practices (Sood, et al, 2012). The investors react differently towards the rapidly changing oil prices for their interest as the different industries also get affected by such changes. It is observed that, in the short run, price of crude oil is influenced by many factors like, socio, economic and political events, status of financial markets, whereas in a medium to long run, it is influenced by the fundamentals of demand and supply resulting into self-price correction mechanism. There are numerous other factors which influence the price movement of crude oil internationally also. The behaviour of oil prices has received special attention in the current environment of rapid rises and marked increase in oil price volatility. It is widely believed that high oil prices can slow economic growth, cause inflationary pressures and create global imbalances. Volatile oil prices can also increase uncertainty and discourage much-needed investment in the oil sector.

High oil prices and tight market conditions have also raised fears about oil scarcity and concerns about energy security in many oil-importing countries (Fattouh, 2007).

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India fulfills its major crude oil requirements by imports. Though it is large ones, like other oil importing countries, it is price-taker in the international oil market; countries usually exercise discretion in passing on international price shocks to domestic prices, sometimes immediately and sometimes with lag. Crude oil price determination mechanism is still not left open fully to the market forces as it is a developing country. The administered price system has traditionally offered a mechanism to cushion the international price changes and achieve domestic policy objectives on inflation, growth and equity (Park and Ratti, 2008). The administered price system for oil is supported by subsidies in budgets. Present international situations do not support subsidy based system. The pass-through policy, presently on the reform agenda, thus, has important implications for the way international oil price changes impact the macro economy (Hammoudeh, et al, 2004; Hammoudeh and Huimin, 2005). Seasoning and maturity of Indian economy needs to understand crude oil price determination independently, thus, a relationship based understanding of the variables is the need of the hour.

#### **CRUDE OIL AND MACRO ECONOMIC VARIABLES**

Oil price fluctuations tremendously affect any economy both directly and indirectly. Oil price is a critical leading indicator of the economic health and prosperity of any nation and results in drastic economic changes. When oil price rises, economy tends to fall into recession. Any upward and downward motion of oil prices is closely tracked in the domestic marketplace also. Crude oil is a biggest influential commodity that has competency to dominate the world. It also affects the price trends in financial and capital markets across the globe. The reform agenda further signifies the importance of understanding the relationship of crude oil with other macro economic variables to gradually adopt a free market mechanism of petroleum products and to make the country able to sustain subsidy free price system in future. Therefore, it is necessary to explore the relationship of crude oil pricing with major macroeconomic indicators like; exchange rate, forex reserve, GDP, gold, growth rate, inflation, interest rate, S&P CNX Nifty, S&P CNX Nifty futures, SENSEX and silver.

#### **REVIEW OF LITERATURE**

The study suggests that gold is an integral part of the international reserve portfolio of several countries including the oil producing countries, the research argued that if some shock leads to expectations of official gold purchases, the expected future price of gold will rise. When oil price rises, oil exporter's revenues from oil tends to rise. They also argued that, this may have implications for the price of gold, provided that gold consists of a significant share of the asset portfolio of oil exporters (relative to other nations) and oil exporters purchase gold in proportion to their wealth. This will lead to a rise in demand for gold and a rise in price of gold. Hence, an oil price rise leads to a rise in gold prices (Melvin and Sultan, 1990). Empirical results show that, from 1970 to 1988, gold prices and stock/ bond markets had negative correlation that is when gold prices were rising, the stock/ bond were declining (Moore, 1990).

Changes in exchange rate affect international trades; thereby, affect the stock market of the country. When domestic exchange rate appreciates, the domestic currencies importers need to exchange for the same amount of foreign currencies. This will decrease the country's foreign reserves and thus, the cost of imports decreases. With the same selling price for the merchandises, the profits increase and stock prices go up; On the contrary, when domestic exchange rate depreciates, the domestic currencies exporters will receive for the same amount of foreign currencies will decrease. With the same selling price for the merchandises, profits decrease and the stock prices go down. It can be seen that changes in the exchange rate, through changes in costs and revenues, will have direct

impact on profits and, thus, impact on stock prices. Therefore, it is necessary to explore the impact of exchange rate fluctuations on stock indices in various countries (Golub, 1983; Krugman, 1983; Bloomberg and Harris, 1995).

The another study was conducted using crude oil, stock returns, interest rate and industrial production implying negative returns caused by all these factors on crude oil. The study was based on US economy which shows that, oil price volatility shocks have asymmetric effects on the economy. On analysing the impulse response functions, it was concluded that oil price movements are important in explaining movements in stock returns. The oil price movements explain a larger fraction of the forecast error variance in real stock returns than do interest rates that results in positive shocks to oil prices depress real stock returns while shocks to real stock returns have positive impacts on interest rates and industrial production (Sardosky, 1999). The study focused on volatility of the price of a barrel Brent crude oil, over the period ranging from 1982 to 2002 representing that, there were no asymmetric leverage effects of crude oil. The paper also unfolds the nature of dependence of the conditional variance on past volatility in oil prices. Time-varying conditional variances are estimated using univariate (G)ARCH models. The result was the same that there is no conditional heteroscedasticity or conditionality of crude oil pricing (Kuper, 2002).

Oil prices can affect stock prices in several ways. When oil price changes and volatility exceeds a threshold, they possess as significant explanatory power for the outcome of economic variables such as industrial production and stock market returns. Further, it was also examined how unexpected oil price shocks affect the dynamics of US Stock Market returns showing unexpected jumps. The unexpected oil price shocks as jump shocks originating from the crude oil market and its impact on the distribution of US Stock Market returns using an asymmetric GARCH-jump model was very high (Huang, et al, 2005). The price of gold and stock, among others, can help to form expectations of higher inflation over time. In the short run, only gold price impacts the interest rate in Japan. Overall findings could benefit both the Japanese monetary authority and the investors holding the Japanese Yen in their portfolios. The study also infers that, when a common stochastic shock hits the system, all the variables move together but the four variables: oil price, gold price, stock price and exchange rate move first and then the interest rate follows (Liao and Chen, 2005).

Rising oil prices are often seen as inflationary by policy makers and central banks respond to inflationary pressures by raising interest rates which affects the discount rate. When oil prices rise, economy always falls into a recession and stock market declines; hence oil price is a critical leading indicator of the economy health and change in the stock market (Basher and Sadorsky, 2006). India is one of the largest consumers of crude oil, importing nearly 70% of its requirement, due to which, the oil price shocks are more vulnerable and the price hike is observed. Oil prices have been gradually rising from mid 2001 and there has been a phenomenal acceleration in the recent months. The reasons for the increase in the oil prices can be observed both from the demand side and the supply side. On the demand side, the most prominent reason for the recent snowballing in the price of oil is the corresponding world economic growth (Pescatori and Mowry, 2008). While China and USA have shown the largest increase in the consumption of oil over the past years, countries like India and Japan have also parallel raised their consumption of oil. The other cited supply side factors affecting the oil price hike is the low stock of fuel in the US due to the devastating effects of natural disasters like Katrina and Rita, oil supply bottlenecks, low inventories and very low output capacity (Boyer and Filion, 2007; Henriques and Sadorsky, 2008).

Oil price has a crucial role in explaining the stock market performance in oil-importing countries. The impact was less for oil-exporting countries. For most European countries, an increase of oil price volatility significantly depressed the real stock market returns. For the United States, shocks of oil price appear to explain more of fluctuations in real stock returns compared to those of interest rates (Park and Ratti, 2008; Kilian, 2009). The study concluded that the interest rates may also affect oil prices through a connection with inflation. Unexpected inflation erodes the real value of investments like stocks and bonds. Central banks can respond to inflationary pressures by raising interest rates. International investors looking for better investments in inflationary times may prefer to invest in real

assets like oil, which drives the price of oil up and puts further pressure on inflation. Recycled petrodollars from oil rich countries can help to reduce the impact of increases in interest rates (Akram, 2009). The researchers tested a mediator variable between Crude Oil Company and stock exchange in England, France and Japan by E-GARCH model. They discovered two implied events in series behaviours' a low median and high variance as well as high median and low variance relation. The study concludes that, economic crisis followed low median and high variance regimes against crude oil pricing mechanism (Alouei and Jamazi, 2009).

The study measured a dynamic relation between stock exchange and crude oil prices in Russia by two variables E-GARCH model and concluded that there exists a negative relation between Russia stock exchange and crude oil prices (Behran and Nikolovann, 2010). The relationship between oil price and Vietnam Stock Market exists for a very reason. There is a long-run relationship, among oil price, the nominal exchange rate of Vietnamese Dong vis-à-vis the US Dollar (VND/USD exchange rate) and Vietnam's stock prices. It was also concluded that both oil price and the VND/USD exchange rate have significantly positive effect on Vietnam's stock prices (Narayan and Narayan, 2010). Oil prices respond not just only to economic fundamentals like, oil supply and real economic activity, but also to movements in emerging stock prices and the Treasury Bills and Euro Dollar Futures (TED) Spread. Stock markets are often seen as leading economic indicators. Rapidly rising stock prices in emerging markets signals the expectation of higher economic growth ahead. If emerging market stock prices get trapped in a bubble, however, oil prices will overshoot in relation to economic fundamentals (Basher, et al, 2010).

There exist co-integrations among fluctuations in oil price, gold price and exchange rates of the Dollar vs. various currencies, and the stock markets in Germany, Japan, Taiwan and China. They indicated that, there exist long-term stable relationships among these variables. Whereas, there is no co-integration relationship among these variables and the US Stock Market indices, indicated that, there is no long-term stable relationship of it with the oil price, gold price and exchange rate. In addition, results of the causal relation empirically proved that, in Taiwan, oil price, stock price and gold price have two-way feedback relations (Wang, et al, 2010). The researcher using co-integration and VECM analysis found that, overall BRICs have strong, stable, bidirectional and long-term relationship with the BRENT price index. The results also illustrated an absence of short-term linkages of crude oil importing countries with BRENT except Russia, where it can influence the short term oil prices. The study also inferred that, the volatility spill over effect was there and also found that, equity markets are highly interconnected with crude oil market and found to be significant and bidirectional in nature (Khan, 2010).

In case of inflation, industry, interest rates and stock prices of gold mining companies, least square method verified Just Inflation Regression Model. Regarding Granger Causality Test, causal links between gold and oil price levels was identified and Johansen Co-integration Test revealed long-term relationship between examined variables and Vector Error Correction Model confirmed that, after market fluctuations, both time series return to long-term equilibrium (Simakova, 2011). The relationship between oil prices and emerging market stock prices and oil prices and exchange rates were studied. A relatively little was known about the relationship between oil prices, exchange rates and emerging stock markets. The researchers proposed and estimated a structural vector auto-regression and investigated that, the dynamic relationship between these variables existed in long run. The model supported the facts that, positive shocks to oil prices tend to depress emerging market stock prices and US dollar exchange rates in the short run (Basher et al., 2011).

The researchers used a single variant GARCH model to test S&P 500 index and WTI crude oil prices relation and concluded that, there existed significant volatilities in crude oil prices having negative impact on S&P500 return but, their results has not been approved in low price volatilities (Lee and Chiou, 2011). The study conferred that the oil price shocks have two different negative effects on firm profitability. First, it has a direct negative effect as it increases the production costs of firms and secondly, it has an indirect negative effect because investors foresee the decline in profit margins of firms and make decisions that affect the stock market indexes. The study recommended that policies

should be improved for enhancing energy efficiency; promote energy conservation and use of alternative fuels (i.e. coal, natural gas and renewable energy). The research finally inferred that, oil-importing countries should enhance dialogue with oil-exporting countries in order to increase multilateral cooperation and to minimise shocks that have an adverse effect on the national economy (Masih et al, 2011).

An increase in the price of oil culminated in an appreciation of the Nigerian exchange rate against the US Dollar. An asymmetric effect was established with magnitude of positive and negative oil price shocks on exchange rate volatility. The results, for the GARCH models, indicated that a 100% increase in oil price returns leads to a 1.073% appreciation of the Naira with respect to the US Dollar, while for the EGARCH, the magnitude of response was slightly higher at about 1.140% (Adeniyi, et al, 2012). The study focused on measuring the volatility of crude oil and gold prices using GARCH model then the relation of gold, crude oil prices and their volatilities with stock markets of selected member of OPEC was examined by panel data model. The results proved that, crude oil price had significant positive effect on stock index of studied countries; also gold price had noticeable significant negative effect on stock indices of selected country meanwhile crude oil and gold volatilities' had respectively low positive effects and noticeable significant positive effects on stock markets of studied countries. The study concluded that, crude oil price volatility had inevitable impact on most of the macroeconomic factors, because of small scale of capital market for selected countries and lag of its impact on corporations' profitability and their stock prices. Stock index in those countries had a minor repercussion to Global crude oil prices. Thus, stock index reaction to gold price and its volatility was rigorous and stock indices volatility is more predictable by Global gold price index (Hamed and Ehsan, 2012).

The paper investigated the co-movements of World Gold price, World Oil price, US Stock price (measured by Dow-Jones Industrial Index) and real exchange rate for US dollar over a period of time using daily data for over twenty years. It was examined that the existence of co-integration, common trend, Granger causality and volatility spill over for these macro variables. The study concluded the existence of co-movements among them however, not all of them are moving simultaneously. The study also inferred that, stock price and gold price are more likely to move on their own while oil price and exchange rates likely to be influenced by other variables (Samanta and Ali, 2012).

## **RATIONALE OF THE STUDY**

Oil price is a critical leading indicator of the economic health and prosperity of any nation and results in drastic economic changes. Crude oil price determination mechanism is still not left open fully to the market forces as it is a developing country. Therefore, any upward and downward movements in prices are closely tracked in the domestic market place which is influenced by international factors. Oil price fluctuations tremendously affect any economy both directly and indirectly. The purpose of this research is to explore the variables having impact on crude oil pricing and the spill over in the prices of crude oil affecting macroeconomic variables. The reviews of literature unearth the factor that, contributed the price formation of crude oil across the globe.

## **OBJECTIVE**

Crude oil, drive, control and regulate the world economy and is a barometer of economic health. Price determination of crude oil has gained significant attention regarding imports and consumption. This article reviews the relevant literature on crude oil in order to provide information about factors contributing to its price formation, volatility, causality and impact.

## **METHODS**

Studies were identified through search from 1983 to 2012. Description of impact, cause, effect and volatility of crude oil using various macroeconomic variables is presented through review of the studies.

## **UNDERLYING FACTORS: PRICING CRUDE OIL**

A suggested literature review of crude oil markets analysis is to treat oil as an asset, besides its role as a commodity, and to recognize the influence of macroeconomic variables on oil price behavior. The prices of crude oil across the world are driven by most common factors like gold, stock prices, index, stock futures, silver, dollar, GDP, inflation, interest rate, imports, exports, T- Bills and BOP deficits and many more. These variables directly or indirectly contribute in shaping prices of crude oil as presented in the above literature reviews. The literature also revealed that any changes in macroeconomic variables are affected tremendously by the change in crude oil prices. India is price taker in the international market. It is noteworthy that any changes in the pricing pattern of crude oil abroad tend to influence adversely the pricing strategy of importing countries. There is an obvious hike in the pricing of oil in the domestic importing markets of non oil producing countries. Hence shaping of oil pricing and manage float in regulating prices should be done on the basis of keeping in mind these macroeconomic variables.

## **Discussion**

An examination of the price determination and factors contributing towards shaping crude oil prices revealed a significant correlation among the variables. In case of developed and developing countries crude oil compliment gold prices, Index, silver prices, GDP, imports, exports, equity stocks of oil producing companies and their futures. It is also observed that, crude oil has indirect correlation with inflation, CPI and interest rate. It was also observed that, the crude oil prices are negatively affecting equity shares and futures of non oil producing companies. The studies also revealed that, economic growth in case of developing countries affected crude oil prices. This may be due to the fact that, during the developmental phases the consumption of crude oil increases, which further result in increase in crude oil prices. Using Johansen model by various researchers it was noteworthy that, there existed a long term relationship between crude oil, exchange rate, gold and capital market determinants. The studies (Kilian, 2009) unearthed the fact that oil extracting countries has a less impact on price changes on the basis of macroeconomic variables than oil importing countries. The studies also provided a linkage of crude oil with money market instruments like T- Bills and Euro rate and it was seen that, there was a long term impact and relationship among these variables (Basher, et al, 2010). Few researches focused on the contribution of crude oil prices affecting stock prices future cash flows of the listed companies and concluded that, there were instances that, these changes affect the investment pattern of investors at large. This provokes banks to raise interest rates and further financial innovations were carried to cater to these revisions and there was push strategy in capital market. Finally, it was observed that crude oil prices increases cost of production, reduces profits of companies and their stock and futures prices which leads a positive shocks and spillover in almost all the studied macroeconomic variables.

## **CONCLUSIONS**

Research in crude oil pricing should incorporate comparison of domestic macroeconomic and international variables for predictions. Pricing and prediction models may be developed for short term period. The Government of developing countries on the basis of these derived results, may device another controlled price mechanism and gradually can move towards market based price mechanism to decide equilibrium in long term of their own and may quit from subsidy gradually in due course. Using causal relationship one can use the results to hedge their risks subject to limitations. Investors can take benefit of the results and discussions in their investment strategies considering Oil price hedging against gold, index and silver. This is also suggested that, more transparency should be

adapted by developing countries in fixing the price of crude oil. The government should not adapt differential pricing and crude should not be subsidies rather its price float should be managed by importing countries. Developing countries should set substantial standards and norms to set price revision in crude on continuous basis. More focus on infrastructural development should be given so as to minimise and curtail cost of carry and production.

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