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RETURN SPILLOVERS IN INDIAN BRENT CRUDE OIL MARKET

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Abstract - *The purpose of this study is to investigate whether there exists any kind of a relationship between the spot and future prices of Brent crude oil. The data has been extracted from NCDEX for January 1, 2011 to December 31, 2013. For this purpose ADF has been used to test the stationarity whereas granger causality test has been used to identify the significance of return spillovers from futures and spot market. Further, the result of the test reveals that in case of this commodity, futures granger causes the spot returns but the same might not be the case vice-versa. These findings will pave a way for arbitragers to strategize in order to gain maximum profit in the financial market.*

Keywords- Return spillovers, Granger causality, oil markets

1. Introduction

In the recent decade, the energy markets have witnessed extreme volatility due to economic crisis of 2008 and this crisis could not be restrained to a limited geographical area. With the presence of the inter-linkages in the world economy, we saw the world financial markets shaken apart from the sub-prime crisis. Such a volatile market environment fostered the need of price risk management amongst traders, producers and wholesalers dealing in energy products across the world. In particular, for a country like India, which accounted for almost 33% of its import bill in the year 2007-08 on POL (Petroleum, oil and lubricants), the risk arising from the variation in oil prices called for a change in its management. Such oil price increase had a negative impact on national economies and stock market returns. To manage the investment risk in commodity markets world trade organization and UNCTAD has promoted instruments like futures and options for price discovery and price management.

Throughout the world, economies have undertaken steps to organize themselves which reduces the risk to the minimum and make the market more efficient for its players. In the context of International commodity market, crude oil market includes a large variety of products such as West Texas Intermediate (WTI), Brent Blend (BB), Maya, Bonny Light (BL) and Dubai-Fateh (DF). Particularly, in the Indian scenario, Brent Crude is traded in the commodity market on Multi Commodity Exchange (MCX) and National Commodity and Derivative Exchange (NCDEX). MCX is a major Indian commodity exchange. It helps us in understanding the information transmission process within the Indian market for crude oil. An efficient derivates market is a consequent of efficient spot market which is characterized by the reflection of all the available information with the investors in the assets spot prices, Gujarati (2004). According to the efficient market hypothesis, the new information which is incorporated in the price of assets does not permit any speculative or arbitrage activities between the spot and future markets, Sehgal, Berlia and Ahmad(2013).

However, many research studies have found that future markets lead spot markets due to structural differences like lower transaction costs and short selling activities. The spot purchases require higher initial outlay and could take longer time to implement whereas futures transactions can be implemented immediately. Hence, it increases the trading activity of speculators without any interest in the physical commodity in the futures market. Also, hedgers dealing with physical commodities with storage constraints will prefer futures contract over spot, Silvapule and Moosa (1999). It has also been argued that unlike spot markets, futures market establishes price knowledge for continuous price

discovery, Yohannes(2011). Garbade & Silber (1983) found that futures prices lead spot prices for storable commodities and there are reverse information flows from the spot market to futures market. Researchers have also found that futures market could attract significant amount of new hedging activities without sufficient speculative trading for effective risk transfer, thereby causing distortions in the spot markets, Figlewski(1981). In this context, empirical findings suggest that the prices have become volatile and US future markets may have contributed to price spikes and volatility, Stoll and Robert Whaley (2010). Difference in influence of markets has been attributed to maturity of the futures. For instance, in case of contracts with less than one year to maturity spot prices tend to lead futures prices whereas in the contracts with more than one year of maturity, spot prices seems to lag behind the future prices, Ahma, Z & Shah (2010). The price movements of futures and spot market is influenced by their past history as well as current market information, Kawaller et al. (1988).

Ever since the introduction of index futures in the International markets, many researchers have investigated impact on the spot market volatility before and after the introduction of stock index futures. Literature on the lead-lag relationship between spot and futures market in equity and commodities assets have been quite diverse and has been reflected in the research papers examining the first and second movements, i.e. return and volatility spillovers across markets, Nath and Lingareddy (2008), Roy (2008). Gupta and Guidi (2012) have used granger causality between Asian US and Indian stock markets to examine their lead lag behavior before and after global financial crisis of 2008. Nevertheless, further empirical testing is required to infer on this issue with respect to the crude oil market.

In our study, we examine the causal behavior between spot and futures market for Crude Oil prices. It will help us in understanding the large volatility in the prices of Crude Oil and thereby, issues related to risk management of the asset. The study in this paper attempts to investigate the change, if any, in the instability observed in the spot market due to the introduction of futures trading and vice-versa. This paper is also an attempt to learn that whether there has been significant change in the volatility of the spot return and future return or if at all these two markets are related. To answer these questions we apply the Grangers causality model and Unit root Test to the crude oil using data of daily spot and future prices, keeping other factors constant that effect the volatility.

2. Descriptive analysis

Brent crude oil is a global benchmark for other grades and is widely used to determine crude oil prices in Europe and in other parts of the world. Oil accounts for about 30 per cent of India's total energy consumption and Imports oil of about 70 per cent of the total oil consumption. Crude is the base material that makes gas, diesel, jet fuels and thousands of other petrochemicals.

Serving as a major benchmark price in the world for purchase of oil, Brent Crude is a classification of sweet light crude oil. It is sourced from North Sea and the oil maker for this product is known as Brent Blend, London Brent and Brent Petroleum. Different qualities of crude oil supplies play a crucial role in market prices. Crude oil is classified by density and sulfur content. Refiners consider light and sweet crude (containing less than 0.5 percent sulfur) the best because it takes little refining to produce high quality products, such as gasoline. 40% of the world's energy supply is crude and is the most actively traded commodity contract worldwide.

Brent, a commodity in the energy sector products was originally traded on the open-outcry International Petroleum Exchange in London, but since 2005, it has been traded on the electronic Intercontinental Exchange, known as ICE. It is also traded on NYMEX in the futures market. In India, Brent Crude is traded in the commodity market on Multi Commodity Exchange (MCX) and National Commodity and Derivative Exchange (NCDEX).

Data used consists of spot prices and daily closing prices of futures contracts of Brent Crude Oil reported in NCDEX and MCX from 2011 to 2013. Since, the data analyzed is only for three years, the author assumes that heteroskedasticity is not important and hence she measures volatility by computing the standard deviation of daily returns.

3. Descriptive statistics

Table no. 1 Descriptive statistics for the Spot and Futures returns.

	Spot Returns	Future Returns
Mean	0.000289	0.000348
Median	0	0.000406
Std. Dev.	0.008568	0.006083
Skewness	-0.121959	0.632405
Kurtosis	42.68474	11.06495
Jarque-Bera	47707.5	2018.733

Table 1 depicts the Descriptive Statistics of the return series. The average prices in future returns are higher as compared to its spot returns for Brent crude. This indicates the market situation of contango, which states that the hedgers are willing to pay more in the futures than the expected price. Further, standard deviation, a tool often used to study the volatility, reveals that for the commodity in question, the spot returns have higher volatility and that future markets are lesser prone to fluctuations in the commodity market.

The return series exhibit asymmetric distribution with future return series being positively skewed, indicating most of the distribution is concentrated on the left of the mean and has a longer right tail while the spot return series are negatively skewed with most of the distribution on the right of the mean and has a longer left tail.

The statistics kurtosis which is used in distribution analysis to determine the flatness or peakness reveals that both the distributions have a K higher than three, i.e. leptokurtic distribution implying high probability of extreme values and thicker tails.

4. Methodology

Unit Root Test – Augmented Dickey-Fuller test

Most realistic work usually assumes that the data is stationary. This implies that at any point of time, if our data is measured, the measure will be time invariant. The series that we get at the stock exchanges is non-stationery and will have a time-varying variance or time-varying mean or both. This non-stationery data also entails that the statistics produced related to the context are also for that particular period when the series actually happened. However, we know that there is significant volatility in the futures and spot markets due to more than one factor. Therefore, the result from the non-stationery data may generate a spurious regression. To avoid this, it is necessary to convert them into a stationary series and this can be done by changing them into log returns, ratios, error correction, co-integration or first difference and then further test the time series data for stationarity. Augmented Dickey-Fuller (1981) unit root test has been employed for the purpose of study.

The ADF test (1981) was conducted for each spot and futures price series at the level and first difference. The test here consisted of the following regression:

$$\Delta Y = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t$$

where, Y_t is log returns; $\Delta Y_t = Y_{t-1} - Y_{t-i}$, where, t is time or trend variable and εt is an error-term. The null hypothesis that, $\delta = 0$; signifying unit root, states that the time series is non-stationary while, the alternative hypothesis, $\delta < 0$ signifies that the time series is stationary, thereby rejecting the null hypothesis. Before running any test on their relativity, each price series was examined to determine whether they were stationary or not.

Granger causality test

Although regression analysis deals with the dependence of one variable on other variables, it does not necessarily imply causation. In other words, the existence of a relationship between variables does not prove causality or the direction of influence. This is roughly the idea behind the Granger causality test.

The granger causality test exhibits whether the present value of Y can be better predicted using the histories of both X and Y than it can by using the past values of Y alone. Similarly, it explains whether the past values of both X and Y can be used to estimate the current value of X.

The Granger test therefore explains whether variable X "causes" variable Y (X→ Y) or variable Y "causes" variable X (Y→X), where the arrow points to the direction of causality. The Granger causality test assumes that the information relevant to the prediction of the respective variables, X and Y, is contained solely in the time series data on these variables.

Following equations have been used in testing the causality between the two stationary series X_t and Y_t :

$$X_t = \alpha_0 + \Sigma^k{}_{j=1}\, y_j\, x_{t-j} + \Sigma^k{}_{j=1}\, \beta_j y_{t-j} + \mu_{xt}$$

$$Y_t = \alpha_0 + \Sigma^k{}_{j=1}\, y_j\, x_{t-j} + \Sigma^k{}_{j=1}\, \beta_j y_{t-j} + \mu_{yt}$$

Here k is the chosen integer, y_j and B_j, j=0, 1....k parameters, α is a constant while U_t is an error term with zero means and finite variance. The null hypothesis (Ho) that Y_t doesn't granger cause X_t is not accepted if β_j s, j>0 as in equation 1, are jointly different from zero using a standard test. Similarly, X_t Granger causes Y_t, if y_j are j>0, coefficients in equation 2 are jointly different form zero. The null hypothesis (Ho) is rejected if the p-value is less than 0.05.

Looking at the F-statistic value and probability value, the conclusion can be drawn that there were uni-directional, bi-directional and no causality relations between the selected variables.

5. Results

Augmented Dicker Fuller test results

The results of the Augmented Dicker Fuller (ADF) test on Spot and future prices in both Level form and Return form are given in table 2.

Table no. 2

Brent crude oil	Level form		Return form	
	t-statistic	Prob-value	t-statistic	Prob-value
Spot Price	-2.364196	0.1524	-23.20549	0.000
Futures price	-2.128851	0.2334	-25.56779	0.000

In the above table, the two time series of price, i.e. spot and futures are individually subjected to unit root analysis. The spot and futures prices without the log returns have alternative hypothesis, having p-value greater than 0 and thus shows non-stationary series. While, in the ADF test conducted in the series of log returns, the p-value is equal to 0 which shows it is stationary. Hence, it is observed that for Brent Crude Oil the series is non-stationary at the level form whereas it is stationary at return form (log P_t/P_{t-1}).

Granger Causality test results

Results of granger causality tests between spot and future returns:

Null hypothesis: Spot volatility does not cause futures volatility

Table no. 3			
	f-statistic	Prob. value	Significance
Brent Crude Oil	1.62294	0.198	

Null hypothesis: Futures volatility does not cause Spot volatility

Table no. 4			
	f-statistic	Prob. value	Significance
Brent Crude Oil	61.1526	3.00E-25	*

* Significance Level At 1%

Table no. 3 & 4 indicates significant one way causality in Brent crude oil. It is further observed that the future market does not become volatile in the event of a new information generated in the spot market. However, the cash price volatility reacts to the movements in information in the futures market. This provides an incentive to keep large size of holdings and hedge through the futures market. The general documentation that the derivative market helps in price discovery in the spot market can be noted here due to the structural advantages in the futures market.

6. CONCLUSION

The empirical results indicate that at the outset, unit root tests confirm that spot and futures prices of Brent crude oil are stationary. The Granger causality test exhibits uni-directional relationship, which implies that the futures volatility granger causes spot volatility. Moreover, it explains that the flow of information in the futures market causes an effect on the spot market, which in turn reacts to this information. However, the information in the spot market might not play a vital role in price discovery of the futures. This would suggest that the cash prices could be usefully forecasted using the lagged price information from the futures market.

References

[1] Ahmad, H., Z. S., & Shah, A. I. (2010). Impact of Futures Trading on Spot Price Volatility: Evidence from Pakistan. International Research Journal of Finance and Economics (59), 145-165.

[2] Figlewski, Stephen (1981). Futures Trading and Volatility in the GNMA Market. Journal of Finance, 36, 445-84.

[3] Garbade, K. D., & Silber, W. L. (1983). Price Movement and Price Discovery in Futures and Cash markets. Review of Economics and Statistics (65), 289-297.

[4] Gujarati (2004), Basic Econometrics Fourth Edition. The McGraw Hill Companies.

[5] Gupta, R. and Guidi, F. (2012). Cointegration Relationship and Time Varying Co-movements among Indian and Asian Developed Stock Markets. International Review of Financial Analysis, 21, 10-22.

[6] Kawaller, I.G., Koch, P.D., and Koch, T.W. (1988). The relationship between the S&P 500 index and the S&P 500 index futures prices. Federal Reserve Bank of Atlanta Economic Review 73 (3), 2–10.

[7] Nath, G.C. and Lingareddy, T. (2008) Impact of Futures Trading on Commodity Prices. Economic and Political Weekly, 43 (3), pp 18-23.

[8] Sehgal, Sanjay; Berlia, Neha; Ahmad, Wasim, (May 2013). An Examination of Price Discovery and Volatility Spillovers of Crude Oil in Globally Linked Commodity Markets. International Journal of Economics & Finance;May2013, Vol. 5 Issue 5, p15-34.

[9] Silvapulle, P. and Moosa, I.A. (1999). The Relationship between Spot and Futures Prices: Evidence from the Cruide Oil Market. The Journal of Futures Markets 19, 175-193.

[10] Stoll, H. R., & Whaley, R. E. (1990). The Dynamic of Stock Index and Stock Index Futures Returns. Journal of Future Market. , 25 (4), 441-468.

[11] Yohannes, M. G. (2011). Testing for Unit Roots, Causality, Cointegration, and Effeciency: The Case of the Northwest US Natural Gas Market. Elsevier (36), 3489-3500.

