VOLATILITY AND PRICE DISCOVERY PROCESS OF INDIAN SPOT AND FUTURES MARKET FOR NON-AGRICULTURAL COMMODITIES

Dr V.P. SARANYA

BSMED, Bharathiar University, Coimbatore

TamilNadu, India

Abstract:

Commodities derivative trading in India has a long history. The evolution of the futures market in various agricultural commodities has been the highlight of the Indian market. Research studies on commodity derivatives market in India have generally focused on agricultural commodities. Non-agricultural commodities have not been adequately covered in the research literature. Therefore the current research study focused on futures market for selected non-agricultural commodities. In this connection, whether futures markets signal the spot market trends or vice-versa is another issue taken up for research. Volatility in the futures prices is the third dimension of the study. There is a scope for applying various tests to study the time series properties of futures and spot market. The study has used secondary data relating to futures prices and the spot prices of eleven non-agricultural commodities which are inclusive of energy and precious metals. Daily closing spot prices and futures prices, trading volume and open interest positions have been gathered from the website of one of the leading commodity exchanges in India. The study computed the returns in the spot and futures market for the period 2008-2014. This study has used certain econometric tools such as unit root test to test the stationarity and Granger causality test to measure the lead-lag relationship between the spot and futures returns. GARCH model has been used to examine the volatility in the spot and futures returns.

Key Words: Commodities, Futures and Spot Market, Volatility, Derivatives

INTRODUCTION

India's major growth sectors of future, including food, textiles, housing, infrastructure and energy are commodity intensive in nature. The country is set to become a major producer, consumer, exporter and importer of a wide range of commodities. Commodity markets have an important role in the price stabilisation of commodities and contribute immensely to the economic development of the country.Commodity derivatives trading in India has a chequered history. It is stated that India is a pioneer in using some form of derivatives in commodities. Beginning from the cotton futures in 1875, it has grown phenomenally over the years. In the course of time the commodity derivatives market expanded so as to include other commodities like oil seeds (1900), raw jute and jute goods (1912), wheat (1913), and bullions (1920). Few studies have discussed the causalities between spot and futures of oil prices with nonlinear methods (Bekiros and Diks, 2008). Huang *et al.* (2009) have examined the efficiency of crude oil markets conditional on some episodes of extreme volatility. Chan *et al.* (2004) examined the daily volatility of selected futures contracts on Chinese Futures Exchanges and found that the returns have asymmetric effects of volatility. Volume is found to be positively related to volatility; open interest was found to be negatively related to volatility and the impact of large trader's participation in the market was also found to be positively related to volatility.

With the growth in the volume and activity in the commodity market, an associated issue that came up for a wider debate in the financial press relates to volatility. The futures market witnessed an increased volatility in prices, which lead to an increase in the volumes. As more stakeholders require the price risk management and the participants take short term positions by entering and exiting the market repeatedly, it causes excessive volatilty. The increase in the volume of trades is not a symptom of price rise. The trade volumes may also increase even in the fluctuating market. At the macro level, introduction of new commodities and operation of new exchanges also add to the trading volume. Furthermore, the increase in volumes does not lead to an increase in prices; rather, it makes the price discovery more efficient by increased participation and consequential liquidity. Such an active and increased market participation can lead to the reduction in price volatility.

The proponents of the commodity futures trading assert that these markets help in the price discovery of underlying physical commodities. Further, it is argued that the derivatives market provides a platform for hedgers such as farmers, industrial units, exporters and importers who have price risk exposure. From their point of view, commodity futures trading is looked upon as a risk management activity. Futures market provide a platform for hedging the risks. However, critics argue that derivatives are detrimental to the healthy functioning of the spot market for the underlying commodities. In this background, the present research study looks at the linkages between spot and futures market, volatility in the derivative instruments, the cause and effect relationships, and the lead-lag relationships in a specific segment of the Indian commodities market.

STATEMENT OF THE PROBLEM

An increasing number of research studies have emerged over the past few decades on the commodity derivatives market and most of these studies have focused primarily on the volatility of spot and futures markets for agricultural products, currencies and stocks. Pindyck (2004), for example, examined the short-run dynamics, commodity prices and inventories, focusing on the behavior and the role of volatility. Chen *et al*. (2005) examined the relationship between spot and futures prices of energy commodities and found that futures prices are unbiased predictors of future spot prices. Several studies have dealt with the lead-lag relationship of spot and futures prices of commodities with the objectives of examining the issues of market efficiency. Garbade and Silber (1983) first presented a model to examine the price discovery role of futures prices and the effect of arbitrage on price changes in spot and futures market. An issue often raised in the discussions on the market behaviour is whether price formation in one market is aided by the other market in the case

of spot and futures market for commodities. It is essential to examine whether prices are formed independently or there is a dependency of one market on the other. Similarly the issue of cointegration between markets has to be verified in the study. In a fairly efficient stock market, it is always observed that the spot and futures market are cointegrated. In the same way, the cointegration that exists between the spot and futures market commodities have to be checked and reported.

Though a number of research studies have been conducted in studying the volatility of spot and futures market for commodities in India, yet these studies yielded mixed results. Volumes and open interest positions of the futures market and their impact on futures returns have not been critically examined in different studies. Hence, an attempt has been made in this study to investigate the issues of stationarity, co-movement, lead-lag relationship, impact of trading volume, open interest, etc., on futures returns, and the volatility of selected non-agricultural commodities in the Indian commodities market. The performance of spot market and futures market for selected commodities of energy, base metals and precious metals in the derivative segment of the market has also been examined.

RESEARCH QUESTIONS

The background of the research problem described above has raised the following research questions for examination.

(i) What are the time series properties of the returns of selected non-agricultural commodities in the spot and futures markets?
(ii) How do the spot returns and futures returns behave over a period of time in the case of selected non-agricultural commodities?
(iii) What is the extent of volatility in the futures returns for selected commodities?

OBJECTIVES

Based on the research questions stated in the previous section, the objectives of the study have been framed as follows:

1) To examine the stationarity in the prices of selected non agricultural commodities in the Indian spot and futures market.
2) To study the lead-lag relationship between the spot and futures returns of the sample commodities.
3) To examine the extent of volatility of prices in spot and futures market for the selected commodities.

SIGNIFICANCE OF THE STUDY

This study demonstrates the relationship between the spot and futures returns of energy, base metals and precious metals. The study also attempts to unravel the impact of the stationarity in spot and futures returns of selected commodities. It would help the individual investors to understand the directions of return, movements of individual contracts for energy, base metals and precious metals. It would also help the commodity market investors to understand whether spot returns lead futures returns or *vice-versa*. It would help the commodity market investors to identify if they are rational or biased during the trading process. The study also attempts to find out the impact of trade volume and open interest positions on futures returns. The present research would facilitate commodity producers, consumers, processors, traders and financial institutions to design an efficient asset allocation strategy.

REVIEW OF LITERATURE

The predictive content of commodity futures was reported by Chinn and Coibion (2013). The study examined the predictive content of futures prices for energy, agricultural, precious and base

metal commodities. In particular, the authors examined whether futures prices are (1) unbiased and/or (2) accurate predictors of subsequent prices. A little evidence that these differences reflect liquidity conditions across markets was found. In addition, a broad decline in the predictive content of commodity futures prices since the early 2000s was reported. Al-Fattah (2013) developed a new predictive model, WTI futures price volatility and WTI spot prices volatility, to forecast the global oil price volatility applying artificial intelligence with artificial neural network (ANN) modelling technology. Using historical oil market data these models were designed, verified and tested. The approximations and predictions from the ANN models, intimately match the historical data of WTI from January 1994 to April 2012. The outcome of this work is that greater price stability of oil prices reduces uncertainty in energy markets, which leads to the benefits for consumers and producers.

Karali (2012) simultaneously measured the impact of selected USDA reports on the conditional variances and co-variances of returns on corn, lean hogs, soybeans, soybean meal, and soybean oil futures contracts using a multivariate GARCH model. It was shown that the largest movements in co-variances were observed on the release days of Feed Outlook, Grain Stocks, and Hogs and Pigs reports. The results suggested that the selected USDA reports have stronger implications for soybean meal return variance in the near term than in the longer term. Dwyer, Holloway and Wright (2012) debated whether financial investors have caused inordinate gains in the level and volatility of commodity prices. The relationship between the futures markets for commodities and the spot markets are discussed in this research work. It concludes that the evidence does not support the hypothesis that financialisation has been the main driver of commodity price developments in the 2000s.

The commodity futures market efficiency in India and inflationary impacts were analyzed by Gupta and Ravi (2013). The authors explored whether the efficiency exists between commodity futures and spot markets using the data derives for three commodity exchanges MCX, NMCE and NCDEX. The study further examined the association between the spot price of commodities and WPI. The evidences of efficiency in most of the sample commodities, though it may depart in some time periods and establish that the huge volatility of spot prices and other market imperfections and irregularities were responsible for lifting WPI was found. The relationship between price and open Interest in Indian futures market was studied empirically by Gulati (2012). This paper examined the relationship between the closing price and open interest in Indian stock index futures market. The evidence of Granger Causality showed that the information of open interest can be used to predict future prices in the long run. Moreover, the long-run information role of open interest is a good indicator of the usefulness of a technical analysis in future markets. The study provided the financial managers in the Indian futures market some very useful input. Bohl and Stephen (2012) stayed propelled by repeated price spikes and crashes over the recent past years. The authors investigated the destabilization of commodity spot prices by the growing market shares of futures speculators. The study concludes that the increasing financialization of the raw material markets does not make them more volatile.

Byrne *et al.,* (2012) contributed to the empirical evidence on the co-movement and determinants of commodity prices. Using non stationary panel methods, the study documented a statistically significant degree of co-movement due to a common factor. Evidence was robust to the inclusion of demand and supply shocks, which both positively impact on the co-movement of commodity prices. Chaarlas et al., (2012) documented commodity derivative market as one of the important and flourishing markets in India which supports the agricultural sector. It was found that the commodity: Aluminium, had suffered less volatility when compared to other base metals. From the analysis of the volatility of the prices of Base metals, Aluminium has been considered to be the safest metal to invest in. Therefore, it was suggested that the investors who trade in Multi Commodity Exchange were advised to invest in this commodity.

Srinivasan (2012) tested the price discovery process and volatility spillovers in Indian spot-futures commodity markets through the Johansen cointegration test, Vector Error Correction Model and the bivariate EGARCH model. The study used four futures and spot indices of the Multi Commodity Exchange of India, representing relevant sectors like agriculture, energy, metal, and the composite index of metals, energy and agro-commodities. The presence of long-term equilibrium relationships between the futures price and its underlying spot price of the commodity markets was confirmed from the Johansen cointegration test. Mukherjee and Mishra (2004) studied the impact of open interest and trading volume in the option market and found that trading volume showed more impact compared to open interest in the matter of price prediction in the cash market. Srivastava (2003) examined the role of open interest and trading volume from the stock option market in determining the price of the underlying shares in the cash market. He concludes that the explanatory power of open interest is more significant than trading volume.

METHODOLOGY

This study is based on the secondary data pertaining to spot and futures prices of selected non-agricultural commodities for the period 2008-2014. Daily closing prices in the spot and futures market, statistics of trading volume and open interest positions have been collected from the website of Multi-Commodity Exchange Ltd - *www.mcxIndia.com*. Apart from computing the returns on the price data, this study has used certain econometric tools such as unit root test to test the stationarity and Granger causality test to measure the lead-lag relationship between the spot and futures returns. GARCH model has been used to examine the volatility in the spot and futures returns.

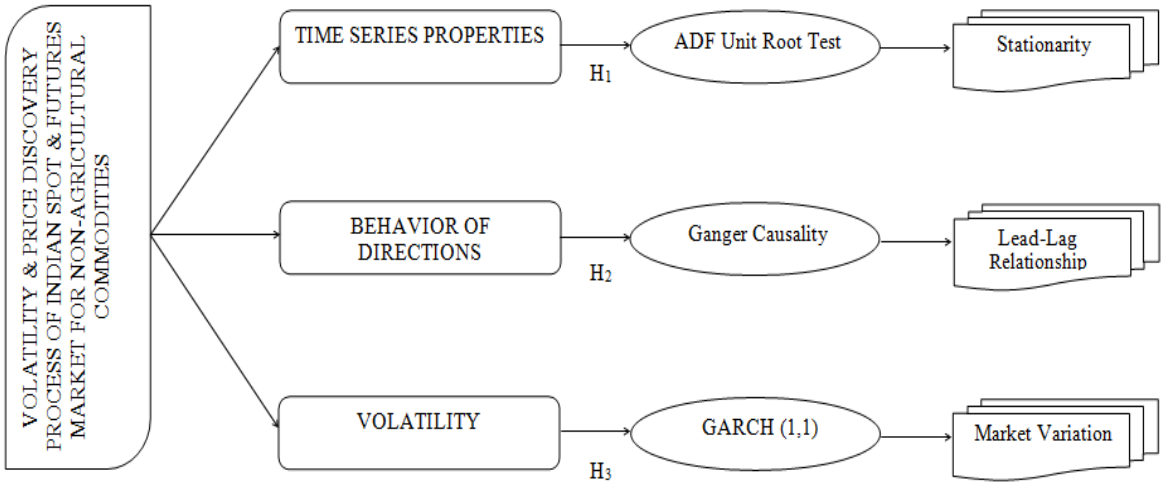
Table 1 SELECTION OF SAMPLE & CHARACTERISTICS

Non-agricultural products	Products	Commodities	No. of Samples	Futures Contracts
Energy	**07**	Brent crude oil	03	3 Months
		Crude oil		6 Months
		Natural gas		3 Months
Base Metals	**13**	Aluminium	06	5 Months
		Copper		8 Months
		Lead		5 Months
		Nickel		5 Months
		Tin		5 Months
		Zinc		5 Months
Precious Metals	**10**	Gold	02	12 Months
		Silver		12 Months

***Source**: www.mcxIndia.com*

CONCEPTUAL FRAMEWORK

TOPIC	ATTRIBUTES	TOOLS USED	RESULTS



RESULTS & DISCUSSION

The absence of unit root is found in the case of spot returns and futures returns for the selected commodities. Based on the Schwarz information criteria, the lag length is 25 and the findings showed that all the eleven ccommodities returns series showed stationarity. One aspects of the current research was to find out which market exerts a stronger influence on the other market in the context of spot and futures market. At the same results given Malabika and Jackline (2011) examined the relationship between the futures market and spot market for the lean hogs and park bellies market. The study tested for causal relationship between the spot and futures returns in each of the eleven commodities to see whether price movements in the futures market lead or lag the price information in the spot market. the results of Granger causality test revealed that the spot returns does Granger cause futures returns but futures returns do not Granger cause spot returns for Tin and Silver. In the case of Copper, a bidirectional causality is absorved. This oimplies that both markets assimilate new information and contribute to price discovery. However, for most of the commodities, a unidirectional lead-lag relationship is found.

The impact of trading volume and open interest positions in the futures market on the futures return was tested by using regression analysis. The results indicate that for Brent crude oil futures, there is a negative co-efficient and for Tin the co-efficient is found to be weak. The p-values of all the commodities are found to be significant except for Tin. The selected non-agricultural commodities exhibit a positive autocorrelation with regard to the Durbin-Watson statistic. This study tested the volatility sot and futures prices by applying GARCH (1,1) model. The results of the model indicated no linear relationship between the two markets. Volatility was found to gradually decling in all commodities. By and large, the model comfirmed the existance of volatility in the spot and futures market. Further, this findings corroborates the earlier findings in this regard. It also goes with the current volatality trends in the market.

CONCLUSION

This study on volatility and price discovery process of Indian spot and futures market for non agricultural commodities has tested various dimensions of time series properties. There is a unidirectional causality in selected commodities like Tin and Silver which indicated that the spot returns lead the futures returns. There is a case of bi-directional causality in copper, where the futures returns lead the spot returns and vice versa. For other commodities like aluminium, copper, lead, zinc, nickel, gold and silver the coefficient of trade volume is positive and open interest is negative. The study confirms the existence of volatility in selected non-agricultural commodities. Volatality is common in both spot and futures market.

LIMITATIONS

The study covers only a subset of the broader commodities market in India. Among various products listed on the commodity market, this study is restricted to energy, base metals and precious metals. Therefore the findings of the study is narrowed down to selected commodities. Data for this study were collected from the website of *Multi-Commodity Exchange Ltd (MCX) – www.mcxIndia.com*. MCX is a major player in the commodities market in India. Though a comparative data exist in the other competing exchanges like NCDEX, NMCE and ICEX, this study has not made any attempt to cross check or enlist those quotations for the current research.

IMPLICATIONS FOR FUTURE RESEARCH

The current research study offers adequate scope for undertaking further research studies on related issues. Firstly, instead of considering only non-agricultural commodities, the study can be expanded with additional commodities to test the market efficiency. Secondly, the inter market cointegration relationships can also be tested. For example, commodities market volatility viz-a-viz the volatility of stock market can be a subject of research. Volatality comparisons can be made

between the domestic commodities market and other international commodities market of comparable magnitude or activity. Lastly, the dimensions of volatility, cointegration and causality could be tested by considering various commodity indices across markets.

References

Bohl, M. T., & Stephan, P. M. (2013). Does Futures Speculation Destabilize Spot Prices? New Evidence for Commodity Markets. *Journal of Agricultural and Applied Economics*, *45*(4), 595-616.

Bose, S. (2008). Commodity Futures Market in India A Study of Trends in the Notional Multi-Commodity Indices. *Money & Finance*, *3*(3), 125-158.

Byrne, J. P., Fazio, G., & Fiess, N. (2012). Primary Commodity Prices: Co-movements, Common Factors and Fundamentals. *Journal of Development Economics*, *101*, 16-26.

Caporale, G. M., Ciferri, D., & Girardi, A. (2010). Time-Varying Spot and Futures Oil Prices Dynamics. *Economics and Finance Working Paper Series*, (10-06), 1-28.

Chaarlas, L. J., Lydia, J., Kogila, N., Rajkumar, R., & Noorunnisha, A. (2012). An assessment of safety in investing commodity Derivatives of base metals traded in mcx. *Arabian Journal of Business and Management Review*, *1*(9), 1-11.

Chinn, M. D., & Coibion, O. (2012). The Predictive Content of Commodity Futures.

Ciner, C. (2001). On the long run relationship between gold and silver prices A note. *Global Finance Journal*, *12*, 299-303.

Floros, C. (2007). Price and Open Interest in Greek Stock Index Futures Market. *Journal of Emerging Market Finance*, *6*(2), 191-202.

Heaney, R. (2002). Does knowledge of the cost of carry model improve commodity futures price forecasting ability? A case study using the London Metal Exchange lead contract. *International Journal of Forecasting*, (18), 45-65.

Juhl, T., Kawaller, I., & Koch, P. (2012). The Effect Of The Hedge Horizon On Optimal Hedge Size And Effectiveness When Prices Are Cointegrated. *The Journal of Futures Markets*, *32*(9).

Kellard, N., Newbold, P., Rayner, T., & Ennew, C. (1999). The Relative Efficiency of Commodity Futures Markets. *Journal of Futures Markets*, *19*(4), 413?432.

Kenourgios, D. F., & Samitas, A. G. (2004). Testing efficiency of the copper futures market: New evidence from london metal exchange. *Global Business and Economics Review*.

Kumar, B., & Singh, P. (2008). Volatility Modeling, Seasonality And Risk-Return Relationship In Garch-In-Mean Framework: The Case Of Indian Stock And Commodity Markets. *The 5th Conference of Asia-Pacific Association of Derivatives Paper*, 1-26.

Lien, D.L. (2008). Hedging with Chinese metal futures. *Global Finance Journal*, *19*, 123-138.

Pindyck, R. S. (2001). Volatility And Commodity Price Dynamics. *The Journal of Futures Markets*, *24*(11).

Power, G. J., & Vedenvo, D. (2010). Dealing with downside risk in a multi-commodity setting: a case for a ?texas hedge?? *The Journal of Futures Markets*, *30*(3), 290?304.

Srinivasan, K., & Malabika Deo (2009). The Temporal Lead Lag and Causality between Spot and Futures Markets: Evidence from Multi Commodity Exchange of India. *International Review of Applied Financial Issues and Economics*, *1*(1), 74-82.

Srinivasan, P. (2012). Price Discovery and Volatility Spillovers in Indian Spot-Futures Commodity Market. *Journal of Behavioral Finance*, *9*(1), 71-85.