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ORIGINAL ARTICLE

PRICE DISCOVERY AND VOLATILITY SPILLOVER IN SPOT AND FUTURES: AN EMPIRICAL STUDY OF GOLD MARKET IN INDIA

Piyush Pandey

Research Scholar, Department of Financial Studies, University of Delhi, India.

Abstract:

If markets are informationally efficient then information should be factored in both spot and derivatives markets simultaneously, but market imperfections leads to lead/ lag relationship and one market acts a dominant while other acts a satellite market. In this study, we examine the price discovery and volatility spillover between spot and futures segments of gold market in India. The daily data files stretch from 1 April 2009 to 31 March 2014. Cointegration and related tools were used to examine the price discovery process and empirical results suggested bidirectional causality between spot and futures. A bivariate EGARCH model was used to study volatility spillover. Empirical results for information transmission through volatility spillover suggest that it is the spot market which leads the futures. The study contributed to the information transmission literature in India for commodity markets ie. gold.

KEYWORDS:

price discovery, information transmission, volatility spillover, market efficiency

INTRODUCTION

India is world's largest market for gold jewellery and a key driver of the global gold demand. In 2012, India imported around 850 tonnes of gold in 2012, out of a total estimated world demand of 4450 tonnes. Most of India's gold consumption is in the form of jewellery and as investment demand. Indians predilection for gold is driven primarily by religious and cultural traditions and economics of demand and supply ensures that the prices remain at elevated levels even during lull periods. The steady rising prices of gold inherently increase the value of the gold jewellery which constitutes an important component of investments. The growth in investment demand has sparked numerous innovations in gold investment products.

Currently, there are three major commodity exchanges, the Multi Commodity Exchange of India Ltd (MCX), the National Commodity and Derivative Exchange (NCDEX), and the National Multi Commodity Exchange of India Ltd (NMCE). All three have electronic trading and settlement systems and a national presence. Gold is traded on all the three major commodity exchanges, led by MCX that started its operations in November 2003. The highest daily turnover of Rs. 1,149 billion was achieved by MCX on April 15, 2013. During January 2014 at MCX, total volume of gold contracted was 387238 kg, number of contracts was 387238, and value of contracts was Rs. 11266942.87 lakh (1126.7 billion). The exchange operates within the regulatory framework of the Forward Contracts (Regulation) Act, 1952, administered by the Forward Markets Commission (FMC). It is to be noted that for the spot trade in gold, FMC is the designated regulator. Although the spot market for gold is less active in India as compared to trading in gold internationally, India accounts for more than 20% of global trading in gold. Fungibility is seen in the case of gold trading since the spot and futures contracts are both traded on the same exchange, and both are regulated by the FMC (although for spot trade, FMC is the designated regulator).

In a perfectly efficient market system, market traders are indifferent to trade in any particular

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market as any new information will be reflected in both the markets simultaneously. However rarely are the markets efficient which necessitates the lead/ lag relationship between the market segments due to information asymmetry owing to difference in market microstructure. One of the economic functions of futures markets is price discovery besides risk hedging. Efficacy of the risk hedging depends on the price discovery process which helps to reveal information about expected spot price through futures market and hints at where do informed traders trade. More precisely, Schreiber and Schwartz (1986) described price discovery as the process by which markets attempt to find their fair prices. According to Black (1976) the primary benefits from commodity futures markets are informed production, storage and processing decision.

The purpose of this study is to examine the price discovery and information transmission through volatility spillover between the spot and futures market trading platform for Gold commodity in India. The present study possesses significance in the sense that it enables to determine which market is more efficient in processing and reflecting of new information. The remainder of the paper is organized as follows: Section two gives a brief review of literature. Section three discusses data sources and description. Section four deals with the methodology while section five discusses the empirical results. Section six provides summary and concluding observations.

2. REVIEW OF LITERATURE

Attempts to investigate the futures-spot price relationships and volatility spillover have received considerable attention in the futures market literature. Xu & Fung (2005) examine the gold, platinum and silver futures contracts traded in the U.S. and Japan. Their results indicate that the information flow leads from the U.S. to Japan. However, this information transmission from the U.S. to Japan is as rapid as within a trading day. Praveen and Sudhakar (2006) analyzed price discovery between stock market and the commodity futures market. They considered Nifty futures traded on National Stock Exchange (NSE) and gold futures on Multi Commodity Exchange of India (MCX). The result empirically showed that the Nifty futures had no in?uence on the spot Nifty. Besides, the casual relationship test in the commodity market showed that gold futures price in?uenced the spot gold price, but the opposite was not true. Srinivasan and Deo (2009) had examined gold trading during 2005-08 and found unidirectional causality from spot to futures market, with spot market acting as the centre for price discovery. Iyer and Pillai (2010) had examined whether futures markets play a dominant role in the price discovery process. They used two-regime threshold vector autoregression (TVAR) and a two-regime threshold autoregression for six commodities. They found that commodity futures market prices play the vital role in the price discovery process. For copper, gold and silver, the rate of convergence is almost instantaneous during the expiration week of the futures contract af?rming the utility of futures contracts as an effective hedging tool. Shihabudheen and Padhi (2010) examined the price discovery mechanism and volatility spillovers effect for six Indian commodity markets, viz., Gold, Silver, Crude oil, Castor seed, Jeera and Sugar. The study result supported that futures price acts as an ef?cient price discovery vehicle in the case of Gold, Silver, Crude oil, Castor seed, Jeera. They found that the volatility spillover exists from futures to spot market in all cases except sugar. Pavabutr & Chaihetphon (2010) examines the standard futures contract and mini contracts for the gold prices in Multi Commodity Exchange of India (MCX). They conclude the futures prices of both standard and mini contracts lead spot prices. The mini futures contracts account to 30% of price discovery even though the trading volume represents only 2% on the MCX. Berlia and Sehgal (2013) examined the process of information transmission in futures prices of bullion (gold and silver) and metals (aluminum, copper, and zinc) between India, represented by MCX, and its global counterparts trading platforms. It was inferred that except precious metals (gold and silver), futures markets of emerging countries such as China and India have started playing prominent role in price discovery process.

Although there is no dearth of literature available on the price discovery and information transmission in the mature markets, this paper is an attempt in the direction to ascertain the lead lag relationship in the spot and futures segment of the NSE 50 index of an emerging market i.e India based on information stored in both first and second moment.

3 DATA SOURCES AND ITS DESCRIPTION

MCX is the most active metal exchange, with about 2/3rd share of all metal trading in India. It offers both spot and futures contracts on gold. MCX has a market share of about 89 per cent in terms of the value of commodity futures contracts traded in H1 FY 2013-14, and the second largest exchange, after Commodity Exchange Inc. (COMEX), in gold trading. The daily prices data for Gold spot and Gold futures trading on MCX was retrieved from Bloomberg from the period 1st April 2009 to 31 March 2014.

4 Methodology

The methodology used includes first converting the daily closing price data of spot and futures series to daily returns by taking the log first difference. Return Rt at time t is given by Rt = lnPt – lnPt-1, where Pt is the closing price for day t. This was followed by an analysis of the characteristic properties of the return series, by looking at the first four moments (mean, standard deviation, skewness and kurtosis), and substantiating the results of skewness and kurtosis through the Jarque Bera Test for testing normality, and finally, the Ljung Box to check the independence of the series. Thus, the i.i.d. (identically and independently distributed) property of the all the series was tested.

This was followed by testing for stationarity of the data through the Augmented Dickey Fuller (ADF) Test. Then, the appropriate lag length for the autoregressive process was estimated through the Schwarz Information Criteria (SIC), by selecting the lag length which minimized the SIC. Next, pairwise Johansen's Cointegration procedure was applied to the data to capture the presence of any long run equilibrium relationships between them. After confirming the long run relationship, Vector Error Correction Model (VECM) test was undertaken to check their short-run dynamics. Accordingly, the VECM for change in the futures prices Ft and in the spot prices St can be represented as under:

$$?F_t = \delta_f + \alpha_f \hat{e}_{t-1} + \beta_f ?F_{t-1} + \gamma_f ?S_{t-1} + ?_{ft} \quad (1)$$

$$?S_t = \delta_s + \alpha_s \hat{e}_{t-1} + \beta_s ?S_{t-1} + \gamma_s ?F_{t-1} + ?_{st}\ , \quad (2)$$

where $\hat{e}_{t-1}$ measures how the current price of the dependent variable adjusts to the previous period's deviation from the long run, while $?S_{t-1}$ and $?F_{t-1}$ measure how the current price adjusts to the change in the variables in the previous period. The first part represents the error correction (EC), and its coefficients (α_f and α_s) indicate the speed of adjustment in the futures prices and the spot prices respectively; the smaller the absolute value of the EC term, faster is the adjustment made by the concerned market towards equilibrium and leads the price discovery process. Results of the VECM tests were confirmed through the Granger Causality Test which indicates direction of the causality.

For volatility spillover process, AR(1) process is used as the mean equation for each return series. Using a bivariate EGARCH model (Bollersleve, 1986) to capture asymmetric impacts of shocks, we examine the patterns of information flows between the market segments. We use the following model for spot and future case:

$$con\_spott = \alpha + \beta_1 resid\_spot^2_{t-1} + \beta_2 con\_spot_{t-1} + \beta_3 resid\_fut^2_{t-1} + \beta_4 con\_fut_{t-1} \quad (3)$$

where,

con_spot/ con_fut= conditional volatility of spot/futures
resid_spot/resid_fut= residuals of mean equation of spot/futures

The coefficient β_1 measures clustering (ARCH) effect; β_2 measures persistence (GARCH effect; β_3 measures short term spillover from future to spot and β_4 measures long term spillover from future to spot. Hence this model specification is run on other possible pairs (spot/futures and future/options) using generalized least squares (GLS) regression. The coefficient covariance estimator is a heteroskedasticity and autocorrelation consistent covariance (HAC) or Newey-West estimator which changes the coefficient standard errors of an equation, but not their point estimates.

5. EMPIRICAL RESULTS

The descriptive statistics of sample daily return series is shown in Table 1. The mean returns appear to be the highest for spot (.0444%) than futures (.0439%). The standard deviation as a measure of volatility was highest for futures (1.02%) than spot (0.90%). Thus spot is giving more risk adjusted returns to the investor, All return series exhibit negative skewness and are also leptokurtic which leads to the violation of normality assumption as exhibited by Jarque-Bera (JB) statistics. The results imply that all the sample markets are not informationallly efficient. Ljung-Box (LB) test at level confirms no autocorrelation in level of sample series up to 12 lags.

Results confirm the existence of unit root at level and exhibit stationarity at first difference (refer Table 2) for all sample series thus conforming that they are integrated to the first order. The Johnson Cointegration results (refer Table 3, Panel A) clearly confirm the strong informational linkages between the two gold trading platforms having 1 cointegrating vectors in each case. VECM results (refer Table 3, Panel

B) show error correction coefficient of the spot is smaller than both futures and options though both are significant. Hence if the co-integrated series is in disequilibrium in the short-run, it is the spot price that makes less adjustment than the futures price in order to restore the equilibrium. In other words, the spot markets leads the price discovery process and hence the information path is from spot to futures. Further Granger causality test was performed to ascertain the direction of relationship. Results (refer Table 3, Panel C) confirmed that spot/futures bilaterally causing each other. Combining this result with VECM results, spot prices influence the futures prices and vice versa, implying bi-directional causality between spot and futures markets.

The estimated results of volatility spillover process (refer Table 4) shows that clustering (ARCH) effect was found to be significant. The persistence (GARCH) effect was however found significant thus showing that previous day volatility in gold prices impacted current day's volatility. No significant short term volatility spillover was found as measured by the t stat of its β_3. However a unidirectional long term spillover was observed from spot to futures. The sign of the coefficient showed that any shock which increases the standard deviation of returns of gold in the spot market increases the standard deviation of returns of gold in the futures market as is seen by the positive coefficient β_4. Thus spot market is the dominant trading market in volatility spillover process than the futures market.

6. SUMMARY AND CONCLUSIONS

This paper examines the price discovery and volatility spillover process in the spot and futures segments of MCX Gold spot and Futures in India during the sample period from 1 April 2009 to 31 March 2014. The sample time series (spot and futures) were found to be integrated to order 1 and subsequently longrun equilibrium relationship was confirmed. VECM analysis and Granger causality test showed that the spot market has a bilateral causal relationship with futures market. This result is understandable, particularly in the period under study, because since second half of 2012, gold prices have seen a sudden jump, which led the Government to more than double the import duty from 6% in January, 2013 to 15% in September 2013, in addition to levy of CTT at the rate of 0.01%, making gold imports and domestic available stocks more expensive. With limited physical stocks of gold and rising demand, any small change in spot prices is immediately matched by corresponding changes in the futures market and vice versa. However, volatility spillover results were in contrast to the price discovery results, indicating that it is the spot market which clearly is leading vis-a vis futures when it comes to risk hedging. Thus investors looking for price signals to make returns in the spot market and hedge their exposure in the futures market. This study will be immensely useful for the traders to hedge their market risk. Besides, the study provides useful insights to the arbitrageurs, who are formulating their long/ short trading strategies based on market imperfections. The study is relevant to market regulators to revisit the market efficiency definition in this micromarket.

The relevance of the study could also be enhanced further by extending its scope to cross-markets analysis, to include inter-market linkages. Also besides information content in first and second moments, higher order spillovers (skewness and kurtosis) between markets could be studied to get a broader picture.

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Piyush Pandey
Research Scholar, Department of Financial Studies, University of Delhi, India.