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Impact of the financial crisis on Indian commodity markets: Structural breaks and volatility dynamics

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ABSTRACT

The shocks transmitted across the financial markets during the financial crisis resulted in structural changes in commodity volatility. Hence, understanding volatility dynamics in changing scenario is vital for derivative pricing, risk management and monetary policy stabilization. This paper studies the impact of the financial crisis by analyzing the following aspects: 1.) Presence of structural break/regime shift in volatility by deploying Markov and Wavelet model during financial crisis; and 2.) Crisis impact on volatility dynamic behavior such as persistence, leverage and long memory by deploying hybrid Wavelet-EGARCH and fractional integration. Spot prices of 18 commodities were examined, including all sub-sectors of energy, metals and agriculture; Indian commodity indices & sub-indices, global benchmark indices, and also stock indices such as S&P 500, S&P and VIX, Nifty 50. The results show that there was a shift from low to high volatility regime in commodity market returns during the global financial crisis. The duration of stay in each regime, and the convergence and divergence from long run equilibrium were different across commodities; agricultural commodities showed faster convergence to long run equilibrium while metal and energy experienced higher persistence and attracted more financial speculation. The impact of the crisis on agricultural commodities was limited to internationally traded commodities such as sugar and rubber. The common breaks and different volatility dynamics have been attributed to systematic risk and to idiosyncratic components respectively. It was also found that during and after the crisis, more than idiosyncratic risk, it was systematic risk that contributed significantly to the volatility patterns of Indian commodity markets.

1. Introduction

The global financial crisis and the consequent rise of commodity prices in all sectors such as energy, precious metals, industrial metals and agricultural products led to researchers and policy makers analyzing market volatility dynamics. While rising commodity prices offered higher returns for the investors, they also resulted in higher input costs for the industry and caused higher inflationary pressure in the economy. The influx of investors into commodity markets witnessed an exponential growth leading to a rise in market prices and volatility (Baffes, 2011; Chan et al., 2011). In such a scenario, it is necessary to analyze the price series, in order to understand the dynamic time series properties like volatility clustering & persistence, leverage effect and long memory. Poterba and Summers (1988) proved that asset prices are affected by the amount of volatility persistence. Lamoureux and Lastrapes (1999) found that transitory volatility shocks have a smaller impact in derivative pricing than otherwise. Volatility dynamics plays an important role in derivative pricing, portfolio management and risk management. It also affects the design and effectiveness of monetary policy stabilization (Byrne et al., 2013).

The financial crisis originated in modern finance centers, but its impact was amplified due to the integration of financial markets. The primary causes of the crisis are well documented in contemporary literature, with the following reasons being identified as the roots of the crisis — real estate burst, complex securitization techniques, loose monetary policy and the lack of financial regulation (Blanchard, 2008; Lin and Martin, 2011). On the other hand, Caballero et al. (2008) reported high prices of commodities like oil and gold as one of key forces in driving the financial crisis. Nissanke (2012) stated that the link between financial markets and commodity markets served as a fast transmission channel which magnified the crisis impact in the developing nations that were initially insulated from the financial turmoil. There is a wide gap in the understanding of the complex channelization between the financial crisis and the commodity markets.

There is abundant literature available on the epistemology of the financial crisis epistemology and market contagion. However, the impact of the crisis on commodity market characteristics is largely unknown (Guo et al., 2011). In contemporary literature, the knowledge of dynamic volatility characteristics like persistence, leverage effect and long memory in the current drastic economic scenario remains sketchy.

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The few available papers have focused predominantly on oil and gold and other metals only, and therefore do not give a holistic view on commodity markets taking into consideration all sectors. Thus, this study is a pioneering effort in analyzing commodity volatility dynamics and the impact of the financial crisis from the point of view of India, an import dependent country, which also happens to be an economy that is gaining prominence as an emerging market on the global investment landscape.

Before looking into volatility dynamics it is necessary to explore the impact the crisis had on commodity volatility. Though it is consensually accepted that the crisis caused high volatility in commodity, empirical evidence supporting this is limited. While Gilbert (2010) and Phillips and Yu (2011) proved that high volatility was prevalent in all commodity sectors during the crisis, a recent study by Vivian and Wohar (2012) has provided evidence that except in the grains sector, commodity price volatility was not exceptionally higher during the crisis period. They have also stated that though the metals and energy sectors are likely to be influenced by financial speculation, they did not have volatility breaks during the crisis period. Instead, they found structural breaks in the volatility of the grains sector, which is more surprising. So, the first question that this research examines is whether Indian commodity markets experienced high volatility during the financial crisis. The Markov regime switching model was employed to find out the switch from a low volatile regime to a high volatile regime around the time of the financial crisis.

Secondly, the impact of the financial crisis on volatility dynamics has been analyzed. The following are the volatility dynamics components that are analyzed in this paper i) Volatility persistence — usually referred to measure the impact of past shocks on future volatility, ii) Leverage/asymmetric effect — usually referred as risk, and the presence of leverage effect that indicates the existence of arbitrage opportunities due to mispricing, and iii) Long memory — which measures the long term volatility persistence of a time series. A hybrid Wavelet based EGARCH was deployed to capture volatility dynamics such as persistence and leverage. Long memory in volatility was captured by fractional integration.

Unlike previous studies, this research paper reports clear evidence of common breaks and regime shifts in most of the commodities and indices during the financial crisis. These common breaks indicate that there is a common element of variation in commodities across sectors. Though this is not the principal focus of this study, this never-theless indicates indirectly that commodities can be considered as an asset class[2] and can be grouped and represented by an index and sub-indices. This research also provides evidence about the presence of high volatility in commodity markets around the crisis period.

When it came to volatility dynamics, varied results were observed from individual commodities of each sector; this can be attributed to idiosyncratic risk factors in driving commodity volatility. High volatility persistence was found more in energy and metal sectors than in the agricultural sector. The reason for this is that the former sectors are more likely to be influenced by financial speculation, while the agricultural commodities converge faster with the long run mean even after experiencing the shocks generated by the financial crisis. An interesting finding is that Brent crude and WTI crude oil are not perfect substitutes when it comes to volatility dynamics. The same is the case of silver and gold, which is more surprising, and has important implications.

The factors determining commodity market volatility and structural changes during financial crisis have been investigated. The impact of financial, speculative and macro economical factors upon commodity market volatility was studied using Markov Regime Switching Regression. It was found that during and after the crisis, more than idiosyncratic risk, it was the systematic risk that contributed significantly to the volatility patterns of Indian commodity markets. While the impact of the macroeconomic variables was significant during tranquil period, it was minimal during the crisis regime.

These results were relevant to regulators and investors. Increased financialization and speculation require necessary regulatory actions to counteract the negative impact; otherwise commodity prices would deviate from the fundamentals and cause imbalance in the economy. Policy makers must recognize the changing patterns in commodity prices during different economic regimes and their persistence over time period in order to provide a stable monetary policy. Moreover, increasing commodity prices escalates the input costs of various industries. Corporate firms have to identify the volatility patterns in prices that would help them to hedge the associated risks. The results would also guide the portfolio investors while considering commodities as an alternative investment asset class in domestic and international portfolios.

The rest of the paper is organized as follows — Section 2 describes the data; Section 3 discusses the methodologies; Section 4 presents the results; the discussion and economic implications are presented in Section 5, and Section 6 concludes the paper.

2. Data

The spot prices of 18 commodities across different sectors including energy, precious metals, industrial metals, and agricultural products have been considered for analysis (Appendix A). The spot index of the Multi Commodity Exchange called MCXS Comdex and its sub-indices, MCXS Energy, MCXS Metal and MCXS Agri were also included for this analysis. The above data was sourced from the Multi Commodity Exchange (MCX), India's largest and one of the world's prominent commodity exchanges. The global benchmark indices for commodity markets — GSCI Spot, IMF commodity price index from Reuters and IFS database have also been considered. For the purpose of comparison, the analysis was also extended to S&P 500 (U.S. stock index), S&P VIX (U.S. volatility index) and Nifty 50 (Indian stock index). Data was collected from 2005 to 2012. This time period includes steady period, turmoil period, and also the recovery period, and helps to sub-sample according to the break points identified by the wavelet analysis. The logarithm of monthly average returns was calculated for all the series and the same was used for further analysis. The log return, R_t^L for an asset price, P over time, t with S consecutive observations was calculated as follows:

$$R_t^L = \log\left(R_t^S + 1\right) = \log(P_{t+1}) - \log(P_t). \tag{0.1}$$

The logarithmic returns over the period, [t, t + T] is calculated as

$$R_{t\to t+T}^L = \sum_{i=0}^{n} R_{t+i}^L. \tag{0.2}$$

Monthly returns were used because regime shifts can be clearly identified in low frequency data and monthly series have proved to be less noisy (Ramchand and Susmel (1998a,b), Hurst (1951) and Chang (2012)).

3. Methodology

As mentioned earlier, the main purpose of the study was to analyze the impact of the crisis on commodity price dynamics. We looked into alternative methodology to capture the impact more apparently. Popular methods cited in the literature to capture the effect of shocks and breaks were the Perron (1990) stochastic unit root test which captures multiple breaks, the ICSS algorithm Ewing and Malik (2010), Vivian and Wohar (2012), the Markov Regime Shift model (Chan et al. (2011), Guo et al. (2011), Bhar and Malliaris (2011a,b), Alizadeh et al. (2008)) and the Wavelet analysis, the most recently used method (Chang, 2012). This research employed the Markov regime switching to identify the

[2] Assets having similar characteristics can be defined as an asset class. Erb and Harvey (2006) argued that commodities are too distinct to be considered as an asset class.