

Original Research Article

Volatility Spillover Effect of NCDEX Spot and Futures Prices in Spices

ABSTRACT

This research is an attempt to assess the volatility in spot and futures prices in spices on NCDEX. Spot price and futures price Volatility is prominent indicators of the commodity futures market to protect the interest of beneficiaries and to hedge sharp price fluctuations in commodity markets. The study tested price patterns using data for FY2015 to FY2022 daily spot and futures price series of near month contracts. VECM test and EGARCH were computed to examine spot and futures prices for three selected spices, namely jeera (cumin), turmeric and coriander. The results revealed that Turmeric and Coriander had significant bidirectional relationship and Jeera had significant unidirectional relationship between futures and spot market prices. Higher half-life (days) values of futures prices indicates more stability than spot prices of selected spices. Higher asymmetric effect value of spot market indicates higher volatility impacts because of noisy shocks than futures market.

Keywords: Spot Price, Futures Price, commodity Futures Trading, Relationship, Volatility spillover, Spices.

1. INTRODUCTION

The commodity futures in particular, as well as any type of financial unit are concerned about the expanding interdependence of a market with other markets. Since the value of commodities on the spot market is used to determine futures prices, markets are interdependent. As a result, the volatility in one market spreads to the other. A market's volatility of returns has a significant impact on the other market's volatility of returns if there is volatility spillover between the two markets (Edward and Rao, 2013). Due to the fact that futures prices are derived from spot market pricing for commodities, markets are interdependent. As a result, the volatility in one

market "spills over" into the other market. If two markets experience volatility spillover, it means that the volatility of returns in one market has a significant impact on the volatility of returns in the other market (Edward and Rao, 2013). Standardized, organised and centrally located futures markets ensure that risks are shared by many investors (including speculators) in exchange for a premium and the variety of needs and viewpoints of market participants endorses effective price discovery. Producers and consumers can use futures prices as requisite indicators of expected future-ready (spot) pricing and demand-supply circumstances (Singh and Singh, 2015).

National Commodity & Derivatives Exchange Limited (NCDEX/ the Exchange) offers three spices commodities for trading viz., Jeera (Cumin), Turmeric and Coriander. In India, cumin seed commonly known as 'Jeera' is the dried, white fruit with greyish brown colour of a small slender annual herb. Whereas, Turmeric is one of the most important spices as well as therapeutic agent and is grown during Kharif season and Coriander being the most widely used spices in India and around the world is one of those herbs whose all parts are edible. Keeping in view the above facts, an attempt is made to critically examine the volatility of NCDEX futures and spot prices in spices with the following specific objective is to assess volatility spillover of agricultural commodity market through futures and spot market prices.

2. METHODOLOGY

To examine the main objectives of the study, secondary data on selected spices crops (i.e., Jeera, Turmeric, Coriander) were collected from the reports available on NCDEX website. The data set comprises of daily closing spot prices and near-month futures contract prices for each commodity. The historical price reports were collected for a period of seven years from 2015-16 to 2021-22 with 1777 observations. For the purpose of the study, selection of appropriate and sufficient data is significant to achieve the best possible outcomes. In this context, sampling is taken from the available data at NCDEX platform. For measures of central tendency, dispersion, skewness and kurtosis, a total of seven years data is taken. Since Covid 19 pandemic has highly impacted all sectors including agriculture. Post covid 19, commodity futures market dominates the prevailing market through digital platform wherein the buyers and sellers are able to fulfill their demand and supply efficiently. Because of this reason, the study data from FY 2019-20 to 2021-22 is considered as a sample.

For assessing the volatility spillover, the data is taken from FY 2019-20 to FY 2021-22 excluding the dates that have insufficient data (whether of futures price or spot price or both) in order to fulfil the demand of model applied for continuous data. VECM (Vector Error Correction Model) is used to analyze whether a set of variables are found to have one or more cointegrating vectors. This is a suitable estimation technique which adjusts to both short-run changes in variables and deviations from equilibrium. To assess volatility spill over EGARCH model is applied rather than ARCH and GARCH models because these models impose the non-negative constraints on the parameters, α_i and γ_j , while there are no restrictions on these parameters in the EGARCH model. Therefore, in this analysis EGARCH model was used.

2.1. Analytical tools and statistical techniques

2.1.1 Vector error correction model (VECM)

After confirming that the two series are cointegrated with a common stochastic trend, we proceed to represent the spot and future prices using the VECM as per the cost-of-carry relationship to examine the lead-lag dynamics. Hasbrouck describes this common stochastic trend as the common implicit efficient price in the cointegrating system. The bivariate cointegrated series, $P_t = (Y_t, X_t)$, is represented by a VECM:

$$\Delta X_t = C_X + \lambda_1 Z_{t-1} + \sum_{i=1}^k \alpha_{X,i} \Delta X_{t-1} + \sum_{i=1}^k \beta_{X,i} \Delta Y_{t-1} + \varepsilon_{X,t}$$

$$\Delta Y_t = C_Y + \lambda_2 Z_{t-1} + \sum_{i=1}^k \alpha_{Y,i} \Delta Y_{t-1} + \sum_{i=1}^k \beta_{Y,i} \Delta X_{t-1} + \varepsilon_{Y,t}$$

$$Z_{t-1} = X_{t-1} - b_i Y_{t-1}$$

Where, a is the speed of adjustment coefficient or error correction term (ECT) that measures the convergence speed to long-term equilibrium state and β constitute the short-run adjustment coefficient. Z_{t-1} is the error correction term that amounts to the unbalanced error of the bivariate time series and long-run multiplier represented by b_i . α , the adjustment coefficient measures the causal relationship between the future and spot prices and denotes the rate at which short-term adjustments gradually correct the long-term equilibrium relationship between spot and future prices. Thus, VECM helps us to dynamically understand the characteristics of long-run equilibrium and short-term equilibrium process. The optimal lag length for VECM is identified using vector autoregressive (VAR) model, a simple extension of autoregressive (AR) framework and the lags are chosen based on AIC (Akaike information criterion) criteria. ECT coefficients are used to compute half-lives of the shocks from the equilibrium position. Half-life of shocks in both the spot and futures markets is calculated using the formula:

$$\frac{\ln(0.5)}{\ln(1 - |\text{ECT coefficient}|)}$$

2.1.2. Exponential generalized autoregressive conditional heteroskedasticity (EGARCH)

This study focuses on how news from one market affects the volatility of the other market. A simple GARCH model generally suggests a negative conditional variation and is not suitable for further inferences. To overcome the negative problem to take logs on both sides of the GARCH equation, we consider the EGARCH model, which explains volatility more accurately than GARCH model. Thus, the conditional variance for the EGARCH (p, q) is used to examine the volatility spillover between futures price and spot price in Indian agricultural commodity market.

$$\ln(h_t) = \varphi + \sum_{i=1}^q \eta_i \left| \frac{\varepsilon_{t-i}}{\sqrt{h_{t-i}}} \right| + \sum_{i=1}^q \lambda_i \frac{\varepsilon_{t-i}}{\sqrt{h_{t-i}}} + \sum_{k=1}^p \theta_k \ln(\varepsilon_{t-k}) \quad (13)$$

LHS is the log of variance series (h_t) which automatically restricts the volatility to a positive value, makes the leverage effect exponential rather than quadratic. This ensures that the estimates are non-negative. The constant level of volatility, which is a function of volatility, is represented by coefficient φ , η is the ARCH effects, λ is the asymmetric effects and θ is the GARCH effects. If $\lambda_1 = \lambda_2 = 0$ the model is symmetric. If $\lambda_i < 0$ it implies that bad news (negative shocks) generates larger volatility than good news (positive shocks). But if $\lambda_i > 0$ it implies that good news (positive shocks) generates larger volatility than bad news (negative shocks). The uncorrelated residuals $\varepsilon_{s,t-1}$ and $\varepsilon_{F,t-1}$ in the given equations are obtained from VECM (Equations (9) and (10)) and are used in the bivariate EGARCH (1,1). This approach is equivalent to a joint estimation of the VECM and EGARCH models as estimating them simultaneously is not practical for large number of parameters. constant (φ_i) implies for level of volatility of any time series data. The ARCH effect is concerned with a relationship within the heteroskedasticity and is use to estimate risk due to volatility in any time series data. GARCH effect describes financial markets in which volatility can change, becoming more volatile during periods of financial crises or world events and less volatile during periods of relative calm and steady economic growth.

3. RESULTS

The daily return price series for the three commodities are examined using the EGARCH model to explore the volatility spillover between the spot and futures markets. To evaluate the model's suitability, diagnostic tests of serial correlation and goodness-of-fit metrics have been carried out. The joint estimation of the VECM and EGARCH models is identical to the empirical analysis in the bivariate EGARCH model, which uses the VECM residuals.

3.1. Vector Error Correction Model (VECM) Outcomes

To check the short-run and long-run relationship between the spot and futures price series, VECM has been performed. Error correction terms (ECT) coefficients (i.e., α_S and α_F) have been reported in Table 1 instead of complete VECM with lags. It is seen the number of observations for jeera, turmeric and coriander is 598, 547 and 621 respectively. In the case of Spot Price Return, the Error correction terms (α_S) for jeera is -0.12, for turmeric it is -0.15 and for coriander it is -0.08. Likewise, in the case of Futures Price return, the Error correction terms (α_F) for jeera is -0.04, for turmeric -0.02 and for coriander it is -0.07. All these values are significant at 5 per

cent level of significance except one, i.e., Error correction terms for Futures Price return of jeera which is not significant.

The adjustment coefficients indicated that there was a unidirectional causal relationship between the spot and futures markets for jeera and coriander, and a bidirectional causal relationship between the spot and futures markets for turmeric and coriander, both at a 5 per cent level of significance. All of the examined commodities have absolute values of α_S greater than α_F , which suggests that spot prices would react to any disequilibrium between future and spot prices more quickly than future prices. It shows that the futures market, as opposed to the spot market, is more effective in reflecting new information to prices. We therefore conclude that the futures market is crucial to the process of determining prices for all three commodities.

Half-life of the shocks from the equilibrium position is calculated using ECT coefficients. According to Table 1, the ECT coefficient for jeera's future market is -0.04, which suggests that the half-life of noisy shocks in the futures market is 18.91 days, whereas the half-life in the spot market is 5.52 days. The half-life of loud shocks for turmeric is 4.36 days for the spot market as well as 28.53 days for the futures market. For coriander, the half-life of noisy shocks in the futures market is 9.14 days as opposed to 8.89 days in the spot market. When the market's ECT coefficient decreases, the half-life of noisy shocks increases. The higher the half-life value, the greater the market's contribution to price discovery, which suggests that for jeera, turmeric, and coriander, price discovery is dominated by the futures market. This should be viewed as an addition to our earlier findings regarding the importance of ECT coefficients and Granger causality studies.

3.2. EGARCH Model Outcomes

In the bivariate EGARCH (1,1) results shown in Table 2, it is noted that the number of observations each for jeera, turmeric and coriander is 555. All values of the given parameters are significant at 1 per cent level of significance. Hence, the null hypothesis (H_0) is rejected which means that the values of all parameter are volatile. The value of constant (φ_i) for spot prices series for jeera, turmeric and coriander is 4.52, 29.16 and 7.87 respectively. However, the value of constant (φ_i) for futures prices series for jeera, turmeric and coriander is 3.13, 5.09 and 3.60 respectively. The higher values of constant for spot price series revealed higher volatility in spot market as compared to futures market in all the selected commodities.

The value of ARCH effect (η_i) for spot price series for jeera, turmeric and coriander is 6.75, 22.05 and 5.88 respectively. The value of ARCH effect (η_i) for futures prices series for jeera,

turmeric and coriander is 3.87, 8.85 and 2.81 respectively. The higher values of ARCH effect for spot price series revealed higher risk in spot market as compared to futures market in all the selected commodities. The value of GARCH effect (θ_i) for spot prices series for jeera, turmeric and coriander is 87.56, 4.86 and 41.12 respectively. Also, the value of GARCH effect (θ_i) for futures prices series for jeera, turmeric and coriander is 77.52, 77.51 and 46.75 respectively. The significant values of GARCH effect (θ_i) for spot and futures price series revealed that price becomes more volatile during periods of financial crises or world events and less volatile during periods of relative calm and steady economic growth.

The value of Asymmetric effect (λ_i) for spot prices series for jeera, turmeric and coriander is 7.20, 16.49 and 8.38 respectively. Likewise, the value of Asymmetric effect (λ_i) for futures prices series for jeera, turmeric and coriander is 4.99, 16.04 and 6.48 respectively. The positive values of asymmetric effect (λ_i) implies that the model is asymmetric and good news (positive shocks) generates larger volatility than bad news (negative shocks) for spot and futures market in all the selected commodities. On the other hand, the positive coefficient of volatility spillover (asymmetric effect) means that the future (spot) market is slow to adjust to spot (future) market to restore an equilibrium point. These results also revealed that as the information flow increases in the futures market, the volatility of spot market also increases.

4. DISCUSSION

The adjustment coefficients showed a bidirectional causality between spot and future market in turmeric and coriander and unidirectional causality between spot and future market in jeera. Error correction terms are higher than absolute terms for all of the commodities chosen, which suggests that spot prices would react to any disequilibrium between future and spot prices more quickly than future prices. It shows that, in comparison to the spot market, the futures market is more effective at reflecting new information to prices. The futures market for turmeric has a noisy shock half-life of 28.53 days, while the spot market has a half-life of 4.36 days for other commodities. The half-life of noisy shocks for coriander is 9.14 days in the futures market, and 8.89 days in the spot market. With a decrease in the market's ECT coefficient, loud shocks have a longer half-life. The higher the half-life value, the greater the market's contribution to price discovery, which suggests that for jeera, turmeric, and coriander, price discovery is

dominated by the futures market. The results for Turmeric and Coriander are on par with Manogna and Mishra (2020).

In the bivariate EGARCH (1,1) results indicated the futures (spot) market takes a while to react to the spot (future) market in order to return to equilibrium due to the positive coefficient of volatility spillover (asymmetric impact). These results also revealed that as the information flow increases in the futures market, the volatility of spot market also increases. The results are contradicting with Manogna and Mishra (2020).

5. CONCLUSION

The positive coefficient of volatility spillover means that the future (spot) market is slow to adjust to spot (future) market to restore an equilibrium point. These results also revealed that good news (positive shocks) generates larger volatility than bad news (negative shocks) for spot and futures market in all the selected commodities. Speculators should come in investment action at the time of good news.

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Table 1: VECM statistics for selected Spices

Commodity	Observations	Adjustment coefficients/E CT		Correlation	Half-life(days)	
		Spot market (α_S)	Futures market (α_F)		Spot	Futures
Jeera	598	-0.12*	-0.04	0.98	5.52	18.91
Turmeric	547	-0.15*	-0.02*	0.97	4.36	28.53
Coriander	621	-0.08*	-0.07*	0.98	8.89	9.14

Note(s): * indicate significance 5% level of confidence. SD stands for standard deviation.
Half-life is shown in days for our daily data.

Table 2: EGARCH statistics for selected Spices

Sl. No.	Commodity	Prices	Observations	Parameter			
				Constant (φ_i)	ARCH effect (η_i)	Asymmetric effect (λ_i)	GARCH effect (θ_i)
1	Jeera	Spot	555	4.52**	6.75**	7.20**	87.56**
		Futures	555	3.13**	3.87**	4.99**	77.52**
2	Turmeric	Spot	555	29.16**	22.05**	16.49**	4.86**
		Futures	555	5.09**	8.85**	16.04**	77.51**
3	Coriander	Spot	555	7.87**	5.88**	8.38**	41.12**
		Futures	555	3.60**	2.81**	6.48**	46.75**

Note: ** indicates significant at 1 per cent level of significance.

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