

1 **Original Research Article**

2 **Volatility Spillover Effect of NCDEX Spot and Futures Prices in Spices**

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4

5 **ABSTRACT**

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

17
18 **Keywords:** Spot Price, Futures Price, commodity Futures Trading, Relationship, [Volatility](#)
19 spillover, Spices.

20 **1. INTRODUCTION**

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

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

8
9 National Commodity & Derivatives Exchange Limited (NCDEX/ the Exchange) offers
10 three spices commodities for trading viz., Jeera (Cumin), Turmeric and Coriander. In India, cumin
11 seed commonly known as 'Jeera' is the dried, white fruit with greyish brown colour of a small
12 slender annual herb. Whereas, Turmeric is one of the most important spices as well as therapeutic
13 agent and is grown during Kharif season and Coriander being the most widely used spices in
14 India and around the world is one of those herbs whose all parts are edible. Keeping in view the
15 above facts, an attempt is made to critically examine the volatility of NCDEX futures and spot
16 prices in spices with the following specific objective is to assess volatility spillover of
17 agricultural commodity market through futures and spot market prices.

18 19 2. METHODOLOGY

20 To examine the main objectives of the study, secondary data on selected spices crops (i.e.,
21 Jeera, Turmeric, Coriander) were collected from the reports available on NCDEX website. The
22 data set comprises of daily closing spot prices and near-month futures contract prices for each
23 commodity. The historical price reports were collected for a period of seven years from 2015-16
24 to 2021-22 with 1777 observations. For the purpose of the study, selection of appropriate and
25 sufficient data is significant to achieve the best possible outcomes. In this context, sampling is
26 taken from the available data at NCDEX platform. For measures of central tendency, dispersion,
27 skewness and kurtosis, a total of seven years data is taken. Since Covid 19 pandemic has highly
28 impacted all sectors including agriculture. Post covid 19, commodity futures market dominates
29 the prevailing market through digital platform wherein the buyers and sellers are able to fulfill
30 their demand and supply efficiently. Because of this reason, the study data from FY 2019-20 to
31 2021-22 is considered as a sample.

Comment [KK1]: Which is this three spices is mostly traded? What is the quantity traded on the NCDEX?

Comment [KK2]: This objective is broad. This study is looking at the sub-sector, Spices only, not the entire agricultural commodity market. This is misleading.

Comment [KK3]: Does this imply a sub sample based on trading data or production season?

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

Comment [KK4]: This sentence still sounds like it is hanging statement. I would suggest to rephrase.

11 2.1. Analytical tools and statistical techniques

13 2.1.1 Vector error correction model (VECM)

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

Comment [KK5]: How did the author/s get around the issue of stationarity in the data series?

Comment [KK6]: Year?

Comment [KK7]: Why are the equations not numbered? Is this a requirement of the journal?

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

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

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

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

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

15 2.1.2. Exponential generalized autoregressive conditional heteroskedasticity (EGARCH)

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

Comment [KK8]: Take note that some of your parameters are not defined in this list, like λ , k , and your difference parameters and lagged variables. The summation of differenced lagged Y and differenced lagged values of X are not corrected stated. This is misleading model structure.

Comment [KK9]: Rephrase this statement

Comment [KK10]: At least provide a justification for only using the AIC above all other information criterion? Is this by preference?

Comment [KK11]: What is on the LHS of this equation? Remember that previous comment still apply here. For ease of reference, the author/s should number all equations and refer to these equation numbers in the text.

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

(13)

Comment [KK12]: Here the number appears, why? This shows very inconsistency approach. Refer to previous comment.

Comment [KK13]: Where are these equations? There is only eq.13 provided above. The author/s should recognise the importance of coherent and consistency equation numbering.

Comment [KK14]: What about the issue of unit root of the series? How was this dealt with? Was this due to the dynamic analysis involving the differencing of the data?

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 $\lambda_1 = \lambda_2 = \dots = 0$ 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 ~~used~~ 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

1 | To check the short-run and long-run relationship between the spot (S) and futures (F) price
2 | series, VECM has been performed. Error correction terms (ECT) coefficients (i.e., α_S and α_F)
3 | have been reported in Table 1 instead of complete VECM with lags. It is seen the number of
4 | observations for jeera, turmeric and coriander is 598, 547 and 621 respectively. In the case of
5 | Spot Price Return, the Error correction terms (α_S) for jeera is -0.12, for turmeric it is -0.15 and
6 | for coriander it is -0.08. Likewise, in the case of Futures Price return, the Error correction terms
7 | (α_F) for jeera is -0.04, for turmeric -0.02 and for coriander it is -0.07. All these values are
8 | statistically significant at 5 per cent level of significance except one, i.e., for the Error correction
9 | terms for Futures Price return of jeera which is not significant.

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

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

30 | 3.2. EGARCH Model Outcomes

31 | In the bivariate EGARCH (1,1) results shown in Table 2, it is noted that the number of
32 | observations each for jeera, turmeric and coriander is 555. All values of the given parameters are

1 significant at 1 per cent level of significance. Hence, the null hypothesis (H_0) is rejected which
2 means that the values of all parameter are volatile. The value of constant (φ_i) for spot prices
3 series for jeera, turmeric and coriander is 4.52, 29.16 and 7.87 respectively. However, the value
4 of constant (φ_i) for futures prices series for jeera, turmeric and coriander is 3.13, 5.09 and 3.60
5 respectively. The higher values of constant for spot price series revealed higher volatility in spot
6 market as compared to futures market in all the selected commodities.

7 The value of ARCH effect (η_i) for spot price series for jeera, turmeric and coriander is 6.75,
8 22.05 and 5.88 respectively. The value of ARCH effect (η_i) for futures prices series for jeera,
9 turmeric and coriander is 3.87, 8.85 and 2.81 respectively. The higher values of ARCH effect for
10 spot price series revealed higher risk in spot market as compared to futures market in all the
11 selected commodities. The value of GARCH effect (θ_i) for spot prices series for jeera, turmeric
12 and coriander is 87.56, 4.86 and 41.12 respectively. Also, the value of GARCH effect (θ_i) for
13 futures prices series for jeera, turmeric and coriander is 77.52, 77.51 and 46.75 respectively. The
14 significant values of GARCH effect (θ_i) for spot and futures price series revealed that price
15 becomes more volatile during periods of financial crises or world events and less volatile during
16 periods of relative calm and steady economic growth.

17 The value of Asymmetric effect (λ_i) for spot prices series for jeera, turmeric and coriander is
18 7.20, 16.49 and 8.38 respectively. Likewise, the value of Asymmetric effect (λ_i) for futures prices
19 series for jeera, turmeric and coriander is 4.99, 16.04 and 6.48 respectively. The positive values
20 of asymmetric effect (λ_i) implies that the model is asymmetric and good news (positive shocks)
21 generates larger volatility than bad news (negative shocks) for spot and futures market in all the
22 selected commodities. On the other hand, the positive coefficient of volatility spillover
23 (asymmetric effect) means that the future (spot) market is slow to adjust to spot (future) market to
24 restore an equilibrium point. These results also revealed that as the information flow increases in
25 the futures market, the volatility of spot market also increases.

26 27 28 29 30 31 32 **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

Comment [KK15]: But higher or larger price volatility are associated with high risk. How will speculators cushion the riskiness to take advantage of positive shocks? What are the response rate to "good news"?

1 more quickly than future prices. It shows that, in comparison to the spot market, the futures
2 market is more effective at reflecting new information to prices. The futures market for turmeric
3 has a noisy shock half-life of 28.53 days, while the spot market has a half-life of 4.36 days for
4 other commodities. The half-life of noisy shocks for coriander is 9.14 days in the futures market,
5 and 8.89 days in the spot market. With a decrease in the market's ECT coefficient, loud shocks
6 have a longer half-life. The higher the half-life value, the greater the market's contribution to
7 price discovery, which suggests that for jeera, turmeric, and coriander, price discovery is
8 dominated by the futures market. The results for Turmeric and Coriander are on par with
9 Manogna and Mishra (2020).

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

15 5. CONCLUSION

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

21 REFERENCES

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23 spot and futures prices: evidence from National Commodity and Derivative Exchange Ltd
24 (NCDEX). *Int. J. Exclusive Manag. Res.*, **3**(12): 1–23.
- 25 2. Manogna, R. L. AND Mishra, A. K., 2020, Price discovery and volatility spill over: empirical
26 evidence from spot and futures agricultural commodity markets in India. *J Agribus.*
27 *Developing Emerging Economies.* **10**(4): 447-473.

Comment [KK16]: How sustainable and attainable are these days? How can speculators adjust to these short-term days given the logistics and transaction costs involved in trading?

Comment [KK17]: How comparable are these findings to other agricultural commodity markets? Make reference to the mentioned objective of this study?

Comment [KK18]: What are the implications of this findings to policy makers and traders?

Comment [KK19]: This is not conclusive. What does it mean "come in investment action at the time of good news"?

Larger volatility also imply riskiness of the return. The positive shocks are not sustained for a long duration (refer to the half-life values for the respective spices?)

- 1 3. Singh, A. and Singh, N. P., 2015, Testing seasonality and efficiency in chana futures market.
 2 *Apeejay Business Rev.*, **14**(2): 5–15.

Table 1: VECM statistics for selected Spices

Commodity	Observations	Adjustment coefficients/E		Correlation	Half-life(days)	
		CT			Spot	Futures
		Spot market (α_S)	Futures market (α_F)			
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.

Comment [KK20]: At least underneath the table the author/s should include the source, probably as Authors compilation based on model results. This comment should apply to all the tables.

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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