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Assessing the Impact of Futures Trading Availability on Spot Market Dynamics of Indian Pepper

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ABSTRACT

Modern agricultural tools boost productivity across crops. Pepper, a lucrative cash crop, attracts global cultivation, bolstering yields. However, heightened productivity brings risks like price fluctuations and supply-demand imbalances, impacting the market's stability and success. Utilizing futures contracts is a common strategy to mitigate risks, yet the challenge lies in ensuring the availability of futures aligned with the specific commodity and contract size. In the Indian context, where pepper futures have been introduced and withdrawn multiple times, this study seeks to examine the impact of the presence or absence of pepper futures trading on pepper spot prices. Econometric techniques such as the Johansen cointegration test, VECM, Granger causality test, and ARIMA modeling were employed to analyze market integration and price autocorrelation. Findings indicate short-term cointegration between pepper spot and futures markets, striving for long-term equilibrium. Futures were found to influence the pepper spot market. ARIMA modeling recommended ARIMA(11,1,7) during futures presence and ARIMA(1,2,2) during absence for representing distinct periods.

Keywords: Pepper, futures trading, cointegration, causality and autocorrelation.

INTRODUCTION

Markets are highly dynamic and the prices of commodities traded in the market will change from time to time in its response different factors influencing the market like demand, supply, income distribution, economic condition, etc. Markets will always try to achieve the most updated prices of commodities by incorporating all the available information. Efficient Market Hypothesis (EMH) states that the prices prevailing in the market at a point of time will reflect all the available information prevailing in the market at that point of time. That is the reason why arbitraging opportunities arising out of price mismatch in different markets will not continue to exist for a long time as the markets will absorb the information of price mismatch quickly from changes in market forces and attain a new equilibrium price very quickly. When two markets operate parallel with lot of participants engaging in both of them simultaneously, there will be high flow of information between them and the prices in both markets will be very close as the prices in both markets will be reflecting same available information. The convergence of spot and futures market prices as future contracts approach their expiration date stems from this flow of information between these markets. As all the available information spreads in

to both the markets, any arbitraging opportunities arising out of price discrepancies between these markets will get nullified.

Future contracts are highly accepted as an effective method for hedging price risks in spot markets as well as earning speculative gains. Both spot and futures markets operate in the same economy and trade the same commodities with specific grade and quality specifications. So these markets will be highly interactive and information will flow spontaneously between them. However, a futures market does not trade all the commodities being traded in the spot markets and there are numerous number commodities which do not have any futures contracts being traded on them. Also there are contracts in futures market which are not actively traded and having many trade breaks or trade gaps during their life. Also there are instances where the future contracts being withdrawn by the exchanges or being banned by the governing institutions and authorities. This activeness and passiveness of futures market can cause information disparity between the markets. Therefore, it is pertinent to examine the interaction between the spot and futures markets when futures contracts are available for trading. Understanding how the spot market reacts in both the presence and absence of futures contracts in the futures market is crucial.

Pepper, a globally cherished spice with a diverse culinary and medicinal profile, is among the most extensively traded commodities. Despite a slight decline from 2021's 580,000 tonnes, global pepper production in 2022 reached an estimated 560,000 tonnes. Similarly, global pepper exports witnessed a marginal increase from 310,000 tonnes in 2021 to 320,000 tonnes in 2022. India, Brazil, Vietnam, and Indonesia stand as the world's foremost pepper producers. During the 2022-2023 periods, India's pepper exports are projected to reach 17,958 tonnes, valued at Rs. 7.27 billion. Meanwhile, India's pepper production is estimated at 64,000 tonnes for the same period. In India, Kerala, Karnataka and Tamil Nadu are the major producers of pepper. India was always one among the leading pepper producer on the globe and many Indians are actively involved in pepper cultivation and trade. The substantial production and trade of pepper in India inherently generated price volatility and substantial trading volumes, which inevitably led to the need for futures trading in cardamom. Pepper futures trading underwent turbulent fluctuations on Indian commodity exchanges. Launched on the MCX, NCDEX, and ICEX in 2003, these contracts were suddenly withdrawn from all platforms in 2015. Yet, there was a turnaround as pepper futures re-entered MCX and NCDEX in 2016, persisting as active tradable assets. Yet, these revitalized contracts failed to exert a significant impact on the commodity markets, witnessing a persistent decrease in trading volume and open positions before eventually fading into untraded future contracts.

Frequent withdrawals can render futures contracts unreliable and inconsistent. The liquidity of these contracts directly correlates with their trade volume and the number of open positions. A decrease in trade volumes suggests reduced interest, potentially leading to a lack of counterparties when exiting a position, posing a risk. Moreover, inconsistent availability for trade discourages potential participants from engaging in these contracts. This situation mirrors the case of pepper futures on MCX, where multiple introductions and withdrawals occurred due to various reasons. Hence, exploring the impact of futures contracts' availability on pepper's spot price becomes imperative in understanding its market dynamics.

REVIEW OF LITERATURE

The spot market is being stabilized by the shocks in futures market and the initially destabilized spot market of oil in US was stabilized in the long run by the shocks in futures markets (Miljkovic & Goetz, 2020). Being traded in spot, futures as well as export markets, the price and volatility of pepper is crucially impacted by its global demand and supply. Also, it is not effective to appropriately predict the subsequent pepper prices by applying simple linear regression model (Nadiq & Viswanathan, 2022). The increased competitiveness between pepper producing countries is becoming a new challenge for pepper cultivators as this increased competitiveness is reflected more in the global pepper production growth than the growth in global pepper export. The trade specialization index (ISP) of pepper for Indonesia, Vietnam and Brazil showed their solid competitive capabilities (Gustrinazul *et al*., 2023).

Volume of production and export of pepper, area of harvested pepper, cultivation and the yield of pepper are playing significant role in prediction of pepper price in India, Sri Lanka, Vienam, Brazil and Indonesia. However, consumption of pepper couldn't be considered as a significant determinant of pepper price (Korah & Mohankumar, 2011). Transportation cost is an important determinant in the price of pepper in Lagos as there is a strong positive correlation exists between them. Apart from these, factors such as the price of pepper in Lagos is also affected by seasonality, perish ability, unit price, volume of sales and competitions in the market are also affecting the price of pepper. Limited adoption of technologies, shortage of farmers' capital, climate change and global price fluctuations has caused decrease in productivity of production centres in Indonesia along with some other reasons (Karmawati *et al*., 2020).

The Government of India's decision to reduce its direct intervention in agricultural and allied sectors and the encouragement of private participation has increased the exposure of agricultural produce to price and other market risks in India. The role of future market in price discovery and price management is gaining more importance in this scenario of decreasing government intervention (Ali & Gupta, 2011). As per the asymmetric causality test, the causality from futures to spot in Indian commodity market is significant during periods of positive as well as negative shocks with presence of stronger causality during negative shocks as compared to positive shocks (Joseph *et al*., 2015). The near-month futures contracts on some selected Indian spices dominated their spot market in price discovery whereas the far-month futures on the same commodities didn't depict any significant long term relationship. However the hedging performance of these near-month and far-month future contracts didn't differ significantly (Yaganti & Kamaiah, 2012).

Agri-commodity markets in India showed both unidirectional and bidirectional causality between spot and futures markets. The forecasting error was explained by the lagged future prices for the spot market of a particular commodity whereas the forecasting error in its futures prices were mainly explained by the lagged values of futures market itself (Chauhan. *et al*., 2013). The price of black pepper in India is showing more volatility in the post liberalization period as compared to the pre liberalization period price variations. Also the pepper price in India is affected significantly by seasonality as the harvesting period coincided with trough phase of price cycle and non-harvesting period coincided with peak phase of price cycle (Sabu *et al*., 2019). The price of black pepper in India showed a growing trend with seasonality from 2002 to 2021 with a slow decline after 2016. Moreover, the pepper prices exhibited non-linear patterns and the volatility in prices will be directly conveyed to domestic pricing as a result of the greater connection with foreign markets (Kiranjit & Promila, 2022). The price discovery in the case of rubber in Indian markets happens in futures markets as there is a strong information flow

to the spot market from futures. The trading activity in the rubber futures markets is at the same time a cause as well as consequence for the price volatility in spot market of rubber in India (Gupta & Varma, 2016).

OBJECTIVES OF THE STUDY

1. To check the short run cointegration between spot and futures markets of pepper in India.
2. To check the long run cointegration between spot and futures markets of pepper in India.
3. To examine the causality relationship between spot and futures markets of Indian pepper.
4. To compare the autocorrelation effect of pepper spot market during the presence and absence of active trading in pepper futures.

DATA AND METHODOLOGY

This study follows analytical approach to the empirical price data of pepper in its spot and futures markets. Aiming to examine the effect of presence and absence of active trading in pepper futures market on its spot market prices, the short run and long run cointegration between these two markets were investigated first. For satisfying the pre-conditions for different econometric tests, stationarity of the series were attested and attained based on Schwartz Information Criteria (SIC). Engel and Granger cointegration test was applied to ensure the presence of cointegrating equation between the two markets before running Vector Error Correction Model (VECM). After estimating the error correction term (ECT) using VECM, granger causality test was applied to check the causality between the markets. Daily prices in the spot and futures markets of pepper, during 1st August 2017 to 20th November 2017, sourced from the database of Multi Commodity Exchange (MCX) of India were used. To test the autocorrelation in spot prices during the availability and non-availability of active futures trading, Autoregressive Integrated Moving Average (ARIMA) method was applied. Two sets of data were used for this purpose. First data set pertained to the period 1st August 2017 to 20th November 2017 when there were active trading in both futures and spot markets of pepper. The second set of data was the spot price of pepper from 21st November 2017 to 28th February 2018 when there was no active trading in pepper futures.

ANALYSIS AND FINDINGS

To get an overview of the general trend of the price movement and volatility of the pepper during the presence of futures trading (phase 1) and absence of future trading (phase 2), the price series and the daily return series of pepper in spot market during both phase of the study were plotted as a spike chart (Fig. 1). There is clear difference observed in the trend and pattern of price movements of pepper in spot markets during both phases

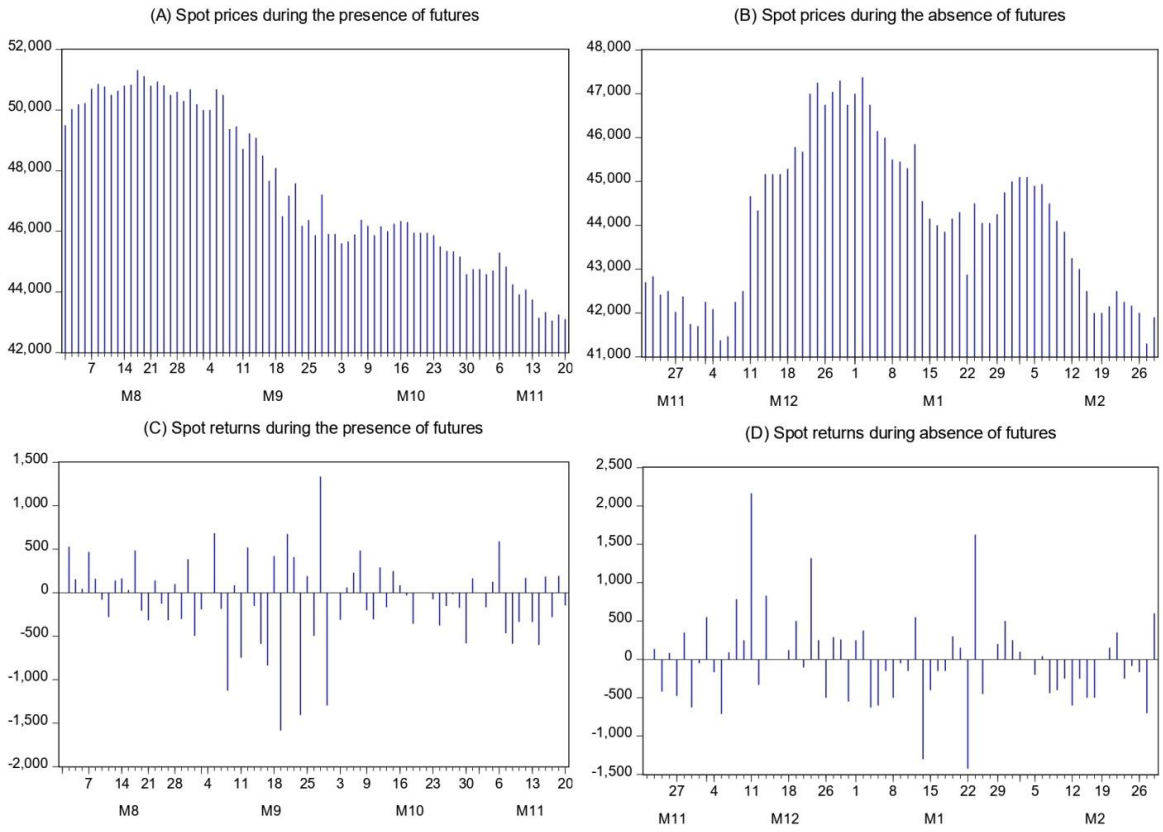

Figure-1: Spot price and spot returns of pepper during the presence and absence of futures. Source: Multi Commodity Exchange of India (MCX).

. During phase 1 the price was falling continuously from around Rs.51000 to Rs.43000 per ton whereas the prices moved up from Rs.41000 to per ton to around Rs.47000 per ton before falling again to Rs.42000 per ton during phase 2 (Fig 1- A&B). The volatility in the returns of spot market during phases 1 showed negative volatility with higher frequency and intensity than positive volatility to a small extent (Fig 1- C). On the other hand, the volatility during phase 2 presented more frequency of negative returns but along with positive returns of higher intensity (Fig 1- D). Being observed these behavior of the pepper market, further application of different econometric tools were done and the results are presented under the following subheads..

1. Stationarity test of the price series of pepper spot and futures markets

To apply tools like cointegration test, VECM, etc. both price series need to be stationary at same order. Unit root test based on SBIC was applied here and the results are presented below (Table.1). As per the results, the series were non-stationary at level and attained stationarity at first difference.

Null Hypothesis (H_0): Series has a unit root			
SERIES	**TREND ASSUMPTION**	**AT LEVEL**	**AT 1ST DIFFERENCE**
Spot	Without trend	0.9741	0.0001
	With trend	0.1874	0.0001

Futures	Without trend	0.8240	0.0000
	With trend	0.4694	0.0000

Table-1: Unit root test results of price series of pepper spot and futures markets.
Source: Calculated from MCX data.

Cointegration between pepper spot and futures markets in India

The Engel and Granger cointegration test is applied in this study to check the short run cointegration between the spot and futures markets of pepper in India. The results of cointegration test (Table-2) shows that the price series under consideration are cointegrated as the null hypothesis stated as "series are not cointegrated" is rejected for both Tau- statistic and Z-statistic at 5% significance level. So it can be inferred that the pepper spot and futures markets in India moves together following the same direction and trend in the short run. As a result we can observe almost similar short run patterns and trends being happening in both these markets.

Null Hypothesis (H_0)	Tau-Statistic		Z-Statistic		Result
	Value	P-value	Value	P-value	
Series are not cointegrated	-3.55604	0.0360	-27.3137	0.0062	Rejected H_0 as the values of both statistics are less than 0.05. So the series are cointegrated

Table-2: Cointegration test results of pepper spot and futures markets.
Source: Calculated from MCX data.

2. Error correction between the pepper spot and futures markets in India

The long run association between the markets can be examined using Vector Error Correction Model VECM). VECM will provide two results by assigning different markets as the target variable in each result. It can be observed from the results presented below (Table.3) that the error correction term (ECT) is negative and statistically significant when the spot market was taken as the target variable. On the other hand, when the futures market was taken as the target variable, the coefficient of error correction term is non-negative and not statistically significant.

Target		Intercept (C)	1st Difference Spot (ΔLS)	1st Difference Futures (ΔLF)	Error Correction Term (ECT)
SPOT	Coefficient	-111.162	-0.27827	0.053446	-0.16765
	T-Statistic	-2.14954	-2.48046	0.457954	-2.13464
	P-Value	0.035	0.0155	0.6484	0.0362
FUT	Coefficient	-50.0973	-0.03812	0.203587	0.180643
	T-Statistic	-0.827	-0.29007	1.489203	1.963595

U R E S	**P-Value**	0.411	0.7726	0.1409	0.0535

Table-3: VECM cointegration equation between spot and futures markets of pepper.
Source: Estimated from MCX data.

We can infer from the results that the spot and futures markets are corrected in the long run from their deviations to revert back to the equilibrium at the rate of the coefficient of ECT estimated by the VECM and this correction happens in the spot market to follow the futures markets. The model for estimation of the error correction term (ECT) provided be the VECM result is presented (Table-4) below which presents the ECT with both spot and futures as the target variable. Only the ECT with spot as the target variable was statistically significant and the ECT with futures as the target variable didn't prove to be statistically significant.

Target	Intercept (C)	1st Difference Spot (ΔLS)	1st Difference Futures (ΔLF)
Spot	-4099.29	1.000	-0.95622
Futures	4286.973	-1.045785	1.000

Table-4: ECT equation of pepper spot and futures as per VECM.
Source: calculated from MCX data.

3. Causality between the pepper spot and futures markets in India

Since the ECT as per the VECM proved only the one with spot market as the target variable to be statistically significant, it is an indication that the markets are being corrected in the long run from deviations by reverting spot prices to futures prices. The Granger causality test can be applied to examine this phenomenon more specifically. The test results presented below (Table -5) shows that there is a unidirectional causality from futures market of pepper to spot market of pepper. This explains that the price movements in the futures of pepper are followed by the spot market to remain cointegrated in the long run. Or in other words, the lagged prices in the futures markets of pepper is granger causing the subsequent prices in pepper spot market as the new information in the market will first reflect in the futures before being transmitted to spot markets.

Null Hypothesis	F-Statistic	P-value	Causality	Direction
H_0 = Lagged values of spot prices doesn't granger cause future prices.	0.86347	0.5273	**F → S**	Unidirectional
H_0 = Lagged values of future prices doesn't granger cause spot prices.	3.29883	0.0074		

Table-5: Causality between pepper spot and futures markets.
Source: calculated from MCX data.

4. Spot price autocorrelation in Indian pepper market during presence and absence of futures trading

Autocorrelation in the spot market price of pepper in analyzed using Autoregressive Integrated Moving Average (ARIMA) for both phase 1 and phase 2 as mentioned earlier. Phase 1 is during the presence of active futures trading and phase 2 is the period of absence of futures trading in Indian pepper market.

SERIES	ARIMA	SIGMA SQ	AR		MA		Adj. R^2	SIC
			Coeff.	Prob.	Coeff.	Prob.		
Spot with futures	1,1,1	196018.8	-0.11222	0.6729	-0.26265	0.6729	0.08735	15.25
	1,1,7	193658.9	-0.32121	0.0049	0.183621	0.1541	0.09833	15.24
	11,1,1	186247.9	0.225377	0.0640	-0.32050	0.0091	0.13284	15.21
	11,1,7	197927.5	0.265467	0.0136	0.261105	0.0043	0.13284	15.21
Spot without Futures	1,2,1	324832.6	-0.29573	0.0647	-0.79259	0.0000	0.54350	15.80
	1,2,2	305077.7	-1.00000	0.0032	-0.99968	0.0000	0.57126	15.80
	1,2,5	436820.7	-0.63399	0.0000	-0.12999	0.5061	0.38612	16.09

Table-6: ARIMA models of cardamom spot during presence and absence of futures. Source: Calculated from MCX data.

The results of ARIMA (Table-6) shows the presence of autocorrelation (AR) and moving average (MA) in the spot market of pepper during the presence as well as absence of active trading in pepper futures. The ARIMA model having most number of significant coefficients and with highest R^2 value and lowest SIC will be the most appropriate model. As per this selection criteria, ARIMA(11,1,7) model found to be more appropriate to represent the phase 1. When it comes to the phase 2, the series was differenced to twice to get a better representation of the series and subsequently ARIMA(1,2,2) model was found to be more appropriate to represent the phase.

CONCLUSION

The primary objective of this study was to analyze the affect of presence and absence of active futures trading on the spot market price of pepper in India. Accordingly, the study period comprised two different time periods as phase 1 where there was active futures trading in the market and phase 2 where there is absence of active futures trading in the market. The spike chart presentation of the spot prices during both phases as well as the daily returns during these phases, showed that the prices followed a study decline during the phase 1 whereas it moved up in the beginning of phase 2 before falling again at the end of the phase. Both phases showed different trend and pattern of price movements. The spot and

futures price series during phase 1 was differenced to attain stationarity before applying cointegration test, VECM test and causality test. The series were cointegrated as per engel and granger cointegration test and the VECM results provided error correction term (ECT) with spot market as the target variable. Information flow happens from futures to spot as the futures market is granger causing the spot market of pepper. Finally the ARIMA model suggested ARIMA(11,1,7) for phase 1 and ARIMA(1,2,2) for phase 2 as the most representative models.

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