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MARKET EFFICIENCY AND VOLATILITY SPILLOVER IN PEPPER MARKET IN INDIA*

Dr.S.Nirmala*

Deepthy.K**

Abstract

The study analyses market efficiency and volatility spillover of pepper future and spot prices traded in NMCE. The period of the study is from 01/01/2016 to 31/03/2018. The study uses Johansen's cointegration test Granger causality test and VECM to analyse the efficiency of the pepper market to reflect the fair pricing of the commodity which is an integral part of efficiency of a market. The results reveal the inefficiency of future market in fairly disseminating the price. The volatility spillover results also confirm the stronger spillover effects from spot to future market of Pepper.

Key words: Cointegration, Efficiency, Granger causality, GARCH Model, VECM

*** Research Supervisor, Associate Professor- Department of Business Administration & Principal, PSGR Krishnammal College for Women, Peelamedu, Coimbatore.**

**** Research Scholar- PhD, Department of Business Administration, PSGR Krishnammal College for Women, Peelamedu, Coimbatore.**

INTRODUCTION

Pepper is an important agricultural commodity which is used in commerce and trade. In ancient times it is also called Black Gold". Kerala and Karnataka accounts for majority of the Indian Pepper Production. Pepper is a perennial crop which does not require annual planting. In India, the major pepper harvesting extends from November to April. Thus, the period from November to April is the peak arrival period. However, pepper has a long shelf life of several years in normal condition and it is available for trade in the market round the year. The physical market trade and exports occur throughout the year.

In Kerala, Pepper is cultivated in Idukki, Kottayam, Cannanore, Calicut and Wayanad region. In recent years, other states like Andhra Pradesh, Orissa, West Bengal, Assam, Tripura, Meghalaya, etc. have also started showing interest in taking up the cultivation of pepper. Since the year 2008, the contribution of Karnataka is seen significant. Kochi (Kerala) is the major trading center for pepper in India. Thodupuzha, Madikeri, Idukki, Wayanad, Chickmagalur and Sakaleshpur are the other major trading centers in the country. Chikamagalur and Coorg (Karnataka) and Gudalur (Tamil Nadu) are also major suppliers to major consuming centers. More than 70 % of Exports goes to Countries like US, UK and Canada. Other countries including European Union countries contribute other 30% of total exports from India.

REVIEW OF LITERATURE

Chopra and Bessler (2005) studied the price discovery process of Black pepper in Kerala. The study revealed that futures market is the centre of price discovery process. The study further revealed that only near prices contribute to the price discovery process and distant futures do not contribute to a cointegration relationship between spot and future market.

Chauhan et.al (2013) studied market efficiency and volatility spillover in channa and guar seed market. The study revealed that future market serves as a price discovery process in the selected commodities. The volatility spillover analysis reveled that both markets volatility influence each other, but the volatility of future to spot price is stronger.

Kumar and Pandey (2013) studied the market efficiency of Indian commodity futures market by taking four agricultural commodities (soya bean, castor seed, corn and guar seed) and seven non agricultural commodities (gold, silver, aluminum, copper, zinc, crude oil and natural gas) as sample. The long run market efficiency and unbiasedness is tested using johansen's cointegration test. The Short run dynamics is tested using VECM. The study found out that nearby contracts are co integrated with spot prices unlike far month contracts where trading volume is low. The study concluded that for all the commodities inefficiency exists in short run.

Kristoufek and Vosvrda (2014) studied the commodity futures and market efficiency of twenty five commodity futures belonging to metals, energies, soft commodity and grains. The study revealed that energy commodities as most efficient and agricultural commodities as least efficient.

RESEARCH METHODOLOGY

The study uses secondary data for the analysis. Daily spot and future prices of Pepper Malabar have been taken from the website of NMCE during the period 01/01/2016 to 31/03/2018. The hypothesis that future prices are an unbiased predictor of spot prices is the joint hypothesis of market efficiency and risk neutrality. The long run market efficiency is tested using Johansen's cointegration technique. Short run price dynamics have been analysed using Error correction term under VAR framework. The volatility spillover is analysed using GARCH (1, 1) model using squared lagged residual of the other variables as exogenous variable.

RESULTS AND DISCUSSION

Unit root tests

The unit roots of the prices are investigated using Augmented Dickey Fuller test, Philips Perron test and KPSS test. The variables need to integrate in the same order for doing cointegration test. The results of the unit root tests are presented in the table below:

Table no: 1 Results of Unit root tests

	ADF		**PP**		**KPSS**	
H_0	H_0: Data are stationary		H_0: Data are stationary		H_0: Data are nonstationary	
	At Level	At 1st diff.	At Level	At 1st diff.	At Level	At 1st diff.
Pepper Future	-0.710	-16.192*	-0.781	-16.390*	2.077*	0.041
Pepper Spot	-0.817	-12.102*	-0.765	-12.390	2.063	0.049
Conclusion	I(1)		I(1)		I(0)	

The study revealed that all the variables are stationary in the same order. This shows that the mean, variance and auto correlation are constant over time. As all the variables are integrated in the same order, preliminary condition for performing cointegrating test is satisfied.

Johansens Cointegration test

For confirming long run market efficiency, the future and spot prices should be cointegrated in long run. To test the cointegration of spot and future prices, johansen's cointegration test is performed. The results of cointegration test are presented in the table below:

Table No: 2 Results of Johansen's Cointegration Test

Hypothesized	**Eigen**	**Trace**	**0.05**		**Max-Eigen**	**0.05**	
No. of CE(s)	**value**	**Statistic**	**Critical Value**	**Prob.****	**Statistic**	**Critical Value**	**Prob.****
None *	0.068	23.102	15.4947	0.003	22.549	14.2646	0.002
At most 1	0.002	0.553	3.8414	0.457	0.553	3.8414	0.457

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

The results reveal that the future and spot prices of Pepper Malabar are integrated in long run. This shows that both future and spot prices exhibit a long run equilibrium relationship and are efficient in long run.

Vector Error Correction Model

The cointegration test revealed that both the variables are integrated in long run. The short run dynamics in case disequilibrium is analysed using Error correction model. The results of Error correction model are presented in the table below:

Table no: 3 Results of VECM

Variables	Δ Future	Δ Spot
ECT	-0.115*	-0.021
Future(-1)	0.010	0.290
Future(-2)	0.057	0.076
Spot(-1)	0.322*	0.290*
Spot(-2)	-0.007	0.076
Constant	-0.001	-0.0009

From the table above it can be seen that the error correction term is negative and significant in future equation. This implies that in case of disequilibrium between futures and spot market in short run, the future market makes greater adjustment to achieve equilibrium. Thus it is concluded that in Pepper Malabar market, the information is first absorbed in spot market, which is then transmitted to future market. Thus in pepper Malabar, spot market is more efficient in reflecting new information than future market.

Granger Causality Test

The causality relationship between future and spot prices help to understand the lead lag relationship between the variables. The results of granger causality test are presented in the table below:

Table no: 4 Results of Granger Causality Tests

Null Hypothesis	Obs.	F Statistic	P Value
Spot price does not Granger cause Future Price	320	10.496	0.000
Future Price does not Granger cause Spot Price		2.439	0.089

From the above table it can be seen that null hypothesis spot price does not granger because future price is rejected. This shows that the past values of spot prices can be used to predict future prices of pepper. It is also seen that there is no causality relationship between future to spot as the null hypothesis future prices does not granger cause spot prices is rejected. So it can be inferred that there is a unidirectional lead lag relationship from spot to future and in short run, spot prices leads and future prices lags.

Volatility Spillover

For analyzing volatility spillover between future and spot prices of pepper,GARCH (1, 1) model have been used. The squared lagged residual of the other variable have been used as exogenous variable to analyse the spillover of volatility between the markets. The GARCH (1, 1) model have been developed by Bollerslev(1986) and Taylor (1986) independently. The GARCH model, allows conditional variance to be dependent on its own previous lags.The conditional variance in the simplest case can be represented as below:

$\sigma^2_t = \alpha_o + \alpha_1 u^2_{t-1} + \beta \sigma^2_{t-1}$ eq.1

In the conditional variance, mentioned in the equation no.1 one more term is included, where the squared lagged residual of the other term is included as exogenous variable using ARMA forecasting models. The new equation can be represented as follows:

$\sigma^2_t = \alpha_o + \alpha_1 u^2_{t-1} + \beta_1 \sigma^2_{t-1} + \beta_2 \varepsilon^2_{t-1}$ eq.2

where, the term represents the squared lagged residual of other variable. The results of the equation 2 for pepper spot and future prices are shown in the table no: 5 and 6 below:

Table 5: Results of Volatility spillover effects from Future to Spot prices of Pepper

Dependent Variable: Spot returns of Pepper **Method: ML - ARCH (Marquardt) - Normal distribution**				
Mean Equation				
	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.212	0.036	-5.852	0.000

Variance Equation				
C	0.106	0.038	2.797	0.000
ARCH Term	0.328	0.082	3.975	0.000
GARCH Term	0.283	0.078	3.610	0.000
Squared Lagged Residual in future return of Pepper	0.093	0.011	8.435	0.000

Table 6: Results of Volatility spillover effects from Spot to Future prices of Pepper

Dependent Variable: Future returns of Pepper **Method: ML - ARCH (Marquardt) - Normal distribution**				
Mean Equation				
	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.233	0.066	-3.537	0.000
Variance Equation				
C	0.751	0.140	5.351	0.000
ARCH Term	0.191	0.048	3.964	0.000
GARCH Term	0.095	0.126	0.761	0.447
Squared Lagged Residual in Spot return of Pepper	0.277	0.097	2.841	0.004

From the table it can be seen that there is bi directional volatility spillover between future and spot prices of Pepper. Since, the magnitude of coefficient in future equation is more, it can be concluded that the spillover of volatility is stronger from spot to future than future to spot. This confirms the spot market is more efficient than the future market for Pepper.

CONCLUSION

The efficiency and volatility spillover of Pepper future and spot market is analysed for period between 01/01/2016 to 31/03/2018. The daily closing future prices of pepper traded in NMCE

have been taken into account. After confirming the stationarity using unit root test, the cointegration test is performed which revealed that there is a long run equilibrium relationship between future and spot prices of Pepper. The VECM and Granger causality test results revealed the inefficiency of future market to reflect the new information. The spot market of pepper is found to absorb new information faster, and discover the price first which is then transmitted to future market. The volatility spillover test also confirms that the spillover of volatility is stronger from spot to future than future to spot. So the study concluded that the future market is inefficient to accurately predict the future spot prices. So the policy makers should take appropriate measures such increasing participation of investors and technological advancement to improve the future market of Pepper.

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