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An Analysis Of Information Flow And Causal Relationship Between Cardamom Spot And Futures Market In India

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Abstract

India being the largest producer of cardamom stands second largest in exports after Guatemala. The major cardamom production in Western Ghats of South India, especially Kerala, Karnataka and Tamil Nadu were the major contributors. Among these states Kerala produces more cardamom. The cardamom prices are collected with the help of MCX website during 2013 to 2018. Econometric tools such as Unit root test, Johansen's Cointegration (JC), Vector Error Correction Model (VECM), Breusch-Godfrey test, Cumulative Sum (CUSUM) and Granger Causality (GC) test were employed to find the flow of information and causality relationship between the cardamom spot and future daily prices. The Johansen's cointegration result conforms that there is a long-run equilibrium among both spot and futures prices in cardamom commodity market. Granger causality test also reveals that futures market is efficient and this information leads to the spot.

Keywords: Cardamom spot and future prices, VECM, JC, GC etc.,

Introduction

India become trading in futures (cotton) in the year of 1875 after establishment of Chicago Board of Trade (CBOT) in 1848. In continuation to the cotton trading in the year 1900 commodities like oil seed, cotton, groundnut and castor seeds were introduced. At a later point commodities namely raw jute, Bullion and Jute goods etc were introduced in 1919, 1920 and 1927 respectively. (Ilankadhir & Rao, 2018). During the world war (1930 to1945) the trading was banned due to short supply. After the independence, the Central Government regulated the futures market. In 1950, for the purpose of establishing Derivatives Market, Union Government instituted **Shroff committee**. As per the reports submitted by the committee, The Forward Market Commission (FMC) was developed in 1953, to regulate the futures market.

The initial spice trading took place through IPSTA ("Indian Pepper and Spice Trade Association"). However during 1996 commodities other than turmeric were banned (namely linseed, castor seed, and pepper) due to price fluctuation and scarcity. To overcome these

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crises, the Government introduced a concept of Minimum Support Price (MSP) for select agricultural produced. During 1960-1980, Danwala Committee and Khusro Committee was formed with the objective of establishing derivative market and based on the reports of the above mentioned committee commodity futures market was reinstated. Based on the Kabra committee report on derivative market, 17 commodities were recommended for futures trading, including both agricultural and non-agricultural commodities. Government of India officially permits commodity trading on extensive verities of commodities in 2003. The Kabra committee was constituted in 1993 for the forward market. This along with the National Agriculture Policy Export Committee paved the pathway for the commodity trading. National Multi Commodity Exchange (NMCE) was introduced in 2002. Multi Commodity Exchange (MCX) was introduced in the year, 2003. In the same year, the National Commodity Derivative Exchange (NCDEX) was introduced. On September 11, 2018 NMCE merged with the Indian Commodity Exchange Ltd (ICEX).

After the establishment of the Exchanges, the commodities were considered as a part of portfolio construction. In the year 2015, the FMC got merged with SEBI. Hence the Commodity markets were also brought under the purview of SEBI through Securities Contracts Act, 1956.

Information flow plays a vital role in every commodity futures market. The market participants like producer, Farmers and the exporters are benefited in the following ways namely producers with price information and Farmers benefit from future expected spot prices for their choice related to the cropping pattern and the Exporters benefits of futures trading using an advance indication of the price in the competitive market(Ilankadhir & Rao, 2017).

Overview of cardamom:

Cardamom being the ginger family consider to be the world's oldest spices which is placed third after the vanilla and saffron. It has two types, namely Elettaria and Amomum, the former one is called as small and later one as larger cardamom. Elettaria is light green in color and typically 7 mm in size, while Amomum is larger and dark brown 20 mm to 50 mm in size("The world market for cardamom," 2011). Small cardamom also known as Queen of spices, is grown in mountainous regions. It is commonly used in spice mixtures like Garam Masala, curries, pickles etc., and also used in aromatic perfumes. Guatemala is carrying major cardamom exporting country followed by India. Middle Eastern countries like Saudi

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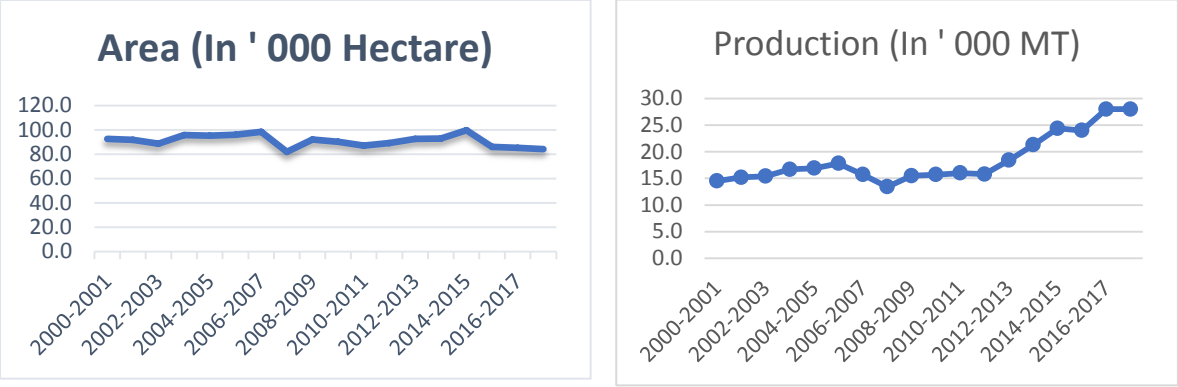
Arabia and United Arab Emirates were the major importers of cardamom (Hareesh et al.,2012).

India being the largest producer of cardamom stands second largest in exports after Guatemala(Hareesh et al., 2012). The major cardamom production in Western Ghats in South India especially the main states are Kerala, Karnataka and Tamil Nadu and for that Kerala produces more cardamom producing state. Below mentioned table presents the trend of Cardamom.

Table 1: Cultivation Area, Production Volume and Yield of Cardamom

Year	Area (In ' 000 Hectare)	Production (In ' 000 MT)	Yield (In MT/Hectare)
2000-2001	92.4	14.5	0.2
2001-2002	91.6	15.2	0.2
2002-2003	88.5	15.4	0.2
2003-2004	95.6	16.7	0.2
2004-2005	95.2	16.9	0.2
2005-2006	95.8	17.8	0.2
2006-2007	98.2	15.7	0.2
2007-2008	81.8	13.4	0.2
2008-2009	92.0	15.5	0.2
2009-2010	90.2	15.7	0.2
2010-2011	87.0	16.0	0.2
2011-2012	89.0	15.8	0.2
2012-2013	92.4	18.4	0.2
2013-2014	92.8	21.3	0.2
2014-2015	99.6	24.4	0.2
2015-2016	86.0	24.0	0.3
2016-2017	85.0	28.0	0.3
2017-2018	84.0	28.0	0.3

Figure 1: Area, production and yield



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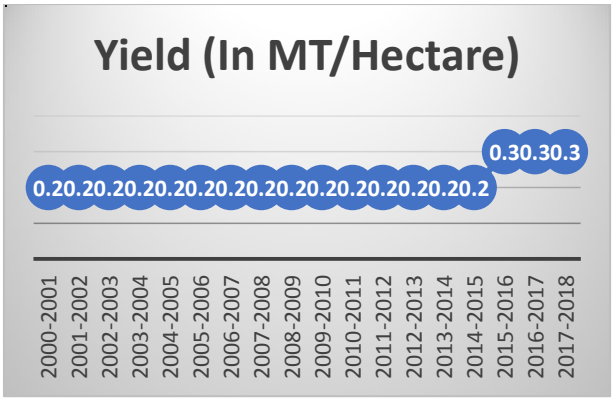

Review of literature

Jobst (2005) studied the relationship which between the equity's price series and ABS issued by the same entity. The relationship was found to be intertemporal and causal, This study found that strong co-movement between the variables. Price discovery is also happening in the long run. Finally, the CMB and credit card reveal stronger relationships than whole business ABS.

Sehgal & Dua, (2012) examines the price discovery of ten agricultural commodities. other than turmeric all other commodities are confirmed the price discovery. The study found that the Forward Market Commission needs powers to regulate the market and take adequate action on insider trading and price manipulations.

Bessembinder & Seguin (1993) found that the volatility and the total volume with respect to information flow did not have any relation as compared to small volume. When the small volumes are group into positive and negative, the positive groups have significant relationship with information flow than that of negative groups.

Kumar & Pandey (2011) explored on the price discovery of spot and future through return and volatility spill-overs. It reveals that both the markets help to discover the prices. During the harvest period, discovery of prices under future market is more viable than the spot market. Commodities which are traded in the Futures market are precious metals and energy commodities whereas spot market plays a significant role in industrial metals.

Jian & David.J (1999) concluded the long run stability in the market on his study on the function of Kansas City Board of Trade (KCBT), Chicago Board of Trade (CBT) and

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Minneapolis Grain Exchange (MGE) with respect to price discovery. KCBT has direct relationship with wheat futures price in the long run.

Shakeel & Shriram, (2014) attempt to study the price discovery relationship of Soyabean, Casterseed and Channa. The objective was achieved with the help of ADF test, JC test and VEC model. The results explored that in a long run commodities were having bidirectional causality. In other words, the information in both the markets were found to be effective and doing the price discovery.

Mallikarjunappa & Afsal (2010) employed ADF test, JC test, VECM and EGARCH framework on their study of lead-lag relationship with respect two markets (Spot and Futures). They found that markets were having a bi-directional relationship and both markets play key role with respect to price discovery process. The spill over effect of future market is more as compare to spot to future market.

Sendhil, et al (2013) examines the factors of futures market. The factors under the study are price discovery, transmission and volatility of wheat, chickpea, maize and barley of spot and futures market. The prices maize, wheat and chickpea of spot and futures confirms co-integrated. Further, the price transmission and long-run equilibrium exist for those except barley. It found that wheat and maize futures prices are more efficient in price discovery. However, farmers could not take active role in the futures market due to small-scale production.

Objective of the study

This study is framed with the objective of studying the flow of information in spot and futures market with respect to cardamom and analysing the causality relationship between the spot and futures market of cardamom.

Methods and measurement

The paper follows the analytical research methodology. The prices (closing price) of cardamom traded at MCX were being used in this study with the main focus on Near-month and Mid-month cardamom closing prices and the period is from 2013 to 2018. To avoid the heteroscedasticity problem, we have applied natural logarithm on price series. For the

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purpose of achieving the above mentioned objective the following econometric tools such as unit root test, co-integration test, VECM, Breusch-Godfrey, CUSUM and Causality test were used in this study.

Data Analysis

Before going to the analysis, we have to examine whether the series is stationary or not. For each price series (Unit Root), the order of integration is important to measure. The statistical characteristics for time are a sequence of its means and variance over a time. If the price series are means reverting over time, then the series is called stationary, otherwise, the series has unit root. It is believed that the time series data becomes normal at second difference.

When there is no unit root, it leads to spurious regression as warned by Nelson and Plosser (R.Nelson & I.Plosser, 1992). The data series is stationary at level denoted as I(0) if it is stationary, at first difference denoted as I(1). ADF and PP test were applied to achieve stationarity.

Table 2: ADF and PP Test

Particular			Near Month		Mid-Month	
			T- Value	P value	T- Value	P value
Spot	At level	ADF Test	0.2173042	0.7492658	-0.106571	0.6469
		PP Test	0.008836	0.6854	0.020761	0.6892
	1st difference	ADF Test	-22.58153	**0.000**	-8.134051	**0.000**
		PP Test	-35.83886	**0.000**	-35.66356	**0.000**
Futures	At level	ADF Test	-0.285268	0.5833	-0.12363	0.641
		PP Test	-0.15346	0.6306	-0.174568	0.6232
	1st difference	ADF Test	-34.50975	**0.000**	-6.406397	**0.000**
		PP Test	-35.11822	**0.000**	-34.38021	**0.000**

It is inferred from the table that P value indicates the cardamom prices were made stationary at first differences which is signified first order I(1). But it was not stationary at level. Finally, it reveals that prices of both spot and future at Near-month and Mid-month are stationary in the first order.

Johansen's cointegration test:

For the purpose of studying cointegration relationship among the variables VAR equation was used, after knowing the order of integration, using following equation

$$y_t = \mu + A_1 y_{t-1} + \ldots\ldots + A_p y_{t-p} + \varepsilon_t$$

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y_t = n x 1 variable vector of order one,

ε_t = n x 1 innovation vector, restructure Vector Auto Regression (VAR) equation

$$\Delta y_t = \mu + \Pi\, y_{t-1} + \sum_{t=1}^{p-1} \Gamma_i \Delta y_{t-1} + \varepsilon_t$$

$$\Pi = \Sigma_{i=1}^{p} A_i - I$$

$$\Gamma_i = \Sigma_{j=i}^{p} A_j$$

The rank of the coefficient framework matrix of Π, $r < n$. It becomes n x r matrices α, β and both have a rank(r) in such technique, that $\Pi = \alpha\beta^1 and \beta^1 y_t$. The number of co-integration, α as stated by R is the variation parameter in VECM and β specifies the co-integrating vector. Using Johansen method, we assess the Π coefficient matrix from an unrestricted VAR model and analyses the possibility that we can dismiss the limits implied by the reducing rank of Π, using likelihood ratio test, viz. trace statistic and maximum eigenvalue statistic. While analysing the long-run relationship, the instrumental components like Trace and maximum eigenvalue statistics were considered.

$$j_{trace} = -T \sum_{i=r+t}^{n} 1n\left(1 - \lambda_i^{\wedge}\right) \qquad r = 0, 1, 2, \ldots . n-1$$

$$j_{\max} = -T\, 1n\left(1 - \lambda_{r+1}^{\wedge}\right) \qquad r = 0, 1, \ldots . , n-2, n-1$$

Here T is sample size and $\lambda^{\wedge}_I$ is i^{th} eigenvalue. We test the null hypothesis (H_0) of r cointegrating vectors against alternative (H_1) of $r+1$ cointegrating vectors. Therefore, the null hypothesis(H_0) $r = 0$ is tested against alternative hypothesis(H_1) of $r = 1, r = 2$ and so forth.

Table 3: Results of Lag Selection Criteria

Lag	Near Month						Mid Month					
	LogL	LR	FPE	AIC	SC	HQ	LogL	LR	FPE	AIC	SC	HQ
0	-15390.57	NA	1.20E+08	24.27849	24.28661	24.28154	-15844.81	NA	2.10E+08	24.83827	24.84634	24.8413
1	-10627.77	9503.046	65957.15	16.77251	16.79686	16.78166	-10208.81	11245.51	30789.23	16.01067	16.0349	16.01977
2	-10611.21	33.00583*	64662.51	16.75269	16.79327*	16.76793*	-10187.64	42.17392	29971.68	15.98376	16.02413*	15.99892*
3	-10606.51	9.343366	64591.41*	16.75159*	16.8084	16.77293	-10181.47	12.28105*	29869.71*	15.98035*	16.03688	16.00158
4	-10606.08	0.852608	64956.23	16.75722	16.83026	16.78466	-10178.05	6.786469	29897.01	15.98127	16.05394	16.00856

Table 4: Johansen Co-Integration Test

Particular		Near Month		Mid Month		Decision
r=0		Value	Prob.	Value	Prob.	Indicates One Co-Integration
	Trace	112.2184	0.0001	58.07116	0.0000	

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	Max	110.9358	0.0001	54.79684	0.0000	
r <=1	Trace	1.282622	0.2574	3.274325	0.0704	
	Max	1.282622	0.2574	3.274325	0.0704	

For the purpose of the JC test, different levels of lags were applied. From the results minimum three lags (out of five) were considered. The long-run relationship among the prices, trace statistics and maximum eigenvalue were taken into consideration. Cardamom with one cointegration at one (1) per cent significance specifies "information shared longer period".

Vector Error Correction Model

To run this model, data should not be stationary or no unit root at level. Which confirms that model is performed only on cointegrated series (Mantu kumar, Acharya, & Suresh Babu, 2014). For the purpose of mean-reverting process the following equation is used.

$$\Delta S_t = \alpha_{s,0} \sum_{i=1}^{p-1} \alpha_{s,j} \Delta S_{t-1} + \sum_{i=1}^{p-1} b_{s,j} \Delta F_{t-i} + \alpha_s Z_{t-1} + \varepsilon_{s,t}$$

$$\Delta F_t = \alpha_{F,0} \sum_{i=1}^{p-1} \alpha_{F,i} \Delta F_{t-1} + \sum_{i=1}^{p-1} b_{F,j} \Delta F_{t-i} + \alpha_F Z_{t-1} + \varepsilon_{F,t}$$

Table 5: Vector Error Correction Model

Error Correction:	Near Month		Mid Month	
	D(SP)	D(FP)	D(SP)	D(FP)
	-0.00596	-0.01536	-0.00384	-0.00715
	[-6.12878]	[6.59594]	[-6.89955]	[0.31610]
D(SP(-1))	-0.005712	0.214263	-0.066443	0.077385
	[-0.19940]	[2.90169]	[-2.27244]	[1.42186]
D(SP(-2))	0.047643	0.19955	-0.008744	0.112619
	[1.67960]	[2.72887]	[-0.29940]	[2.07163]
D(SP(-3))			0.002928	-0.023493
			[0.10214]	[-0.44025]
D(FP(-1))	0.049612	0.063043	0.104679	0.025326
	[4.28681]	[2.11303]	[6.46072]	[0.83975]
D(FP(-2))	-0.00972	0.000499	0.046519	-0.005528
	[-0.83764]	[0.01668]	[2.83185]	[-0.18080]
D(FP(-3))			0.01696	-0.047004
			[1.03347]	[-1.53873]
C	0.098278	0.091546	0.106696	0.100902
	[0.34556]	[0.12486]	[0.38462]	[0.19541]

Table 6: Breusch-Godfrey Test:

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Particulars	Near	Mid	Particulars	Near	Mid
F-statistic	0.213671	2.382268	Prob. F(2,1261)	0.8076	0.0928
R-squared	0.429907	4.784166	Prob. Chi-Square(2)	0.8066	0.0914

Figure 2 : Near month CUSUM Test

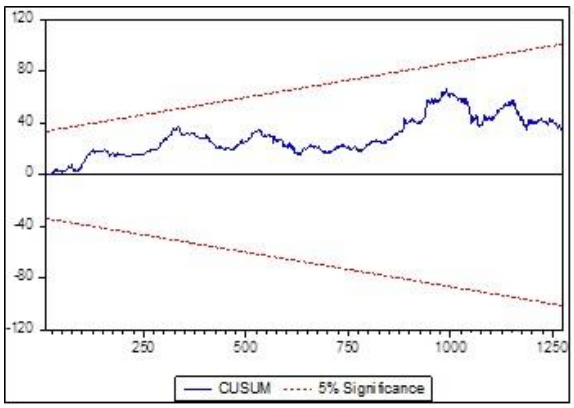
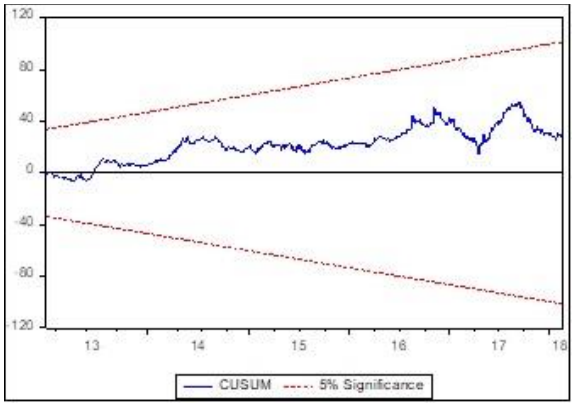


Figure 3: Mid month CUSUM Test



The VECM table 5 reveals that the spot return Error Correlation Model is negatively significant but future return Error Correlation Model is insignificant. Therefore, spot return Error Correlation Model is responded to the error correction process and causal relationship from futures to spot return. Therefore, it reveals that the futures market leads to spot market. The Breusch-Godfrey diagnostic test agrees to the lack of serial correlation. Stability of parameter were confirmed with Cumulative sums (CUSUM) test.

Granger Causality Test

After confirming cointegration among the prices of two markets, it is important to study the information flow between the markets. For this purpose, GC test was used. Which is most commonly used for predicting the cause and effect correlation among the two (or more) variables, Granger (1969). The following regression models was used to check the information flows between the variables.

$$\Delta Y_t = \alpha_0 + \Sigma_{i=1}^{k} \alpha_i \Delta Y_{t-i} + \Sigma_{j=1}^{k} \beta_j \Delta X_{t-j} + \mu_{Yt}$$

$$\Delta X_t = \alpha_0 + \Sigma_{i=1}^{k} \alpha_i \Delta Y_{t-i} + \Sigma_{j=1}^{k} \delta_j \Delta X_{t-j} + \mu_{Xt}$$

$H_{0a} : \beta_1 = \beta_2 = ... = \beta_k = 0$

$H_{0b} : \alpha_1 = \alpha_2 = ... = \alpha_k = 0$

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Here, the null hypothesis is that the p-value is less than 0.05. There is no Granger cause between the variables.

Table 7: Near month GC Test

No. of Lag	H_0	F	P value	Directions	Info. flow
1	FP does not cause SP	65.8708	0.000	FP↔SP	Bi directional
	SP does not cause FP	26.4347	0.000		

Table 8: Mid month GC Test

No. of Lag	(H_0)	F	P value	Directions	Info. flow
1	FP does not cause SP	86.2078	0.000	FP→SP	Uni directional
	SP does not cause FP	0.56234	0.453		
2	FP does not cause SP	61.3399	0.000	FP→SP	Uni directional
	SP does not cause FP	1.022	0.360		
3	FP does not cause SP	41.3998	0.000	FP→SP	Uni directional
	SP does not cause FP	1.73885	0.157		
4	FP does not cause SP	30.157	0.000	FP→SP	Uni directional
	SP does not cause FP	1.78019	0.130		
5	FP does not cause SP	23.72	0.000	FP→SP	Uni directional
	SP does not cause FP	1.54715	0.172		
6	FP does not cause SP	20.7964	0.000	FP→SP	Uni directional
	SP does not cause FP	1.9095	0.076		
7	FP does not cause SP	17.0058	0.000	FP→SP	Uni dirctional
	SP does not cause FP	1.91308	0.064		
8	FP does not cause SP	14.9459	0.000	FP↔SP	Bi directional
	SP does not cause FP	2.20113	0.025		
9	FP does not cause SP	12.8759	0.000	FP↔SP	Bi directional
	SP does not cause FP	2.58481	0.005		
10	FP does not cause SP	11.8369	0.000	FP↔SP	Bi directional
	SP does not cause FP	2.40062	0.008		

Above table 7 and 8 presents the results of GC test. From the results one can accept the alternate hypothesis at a 5% significance level. Thus, there exists bi-directional causality relationship among the markets. The near month results reject the null hypothesis in both cases of cardamom market in first lag period. But while comparing to the mid-month, both the cases of null hypothesis rejected with seven lag period. The future market is found more proficient than the spot market. It is mainly because of the reasons such as lesser transaction cost and margin, high liquidity, ease leverage positions. In the near month spot market leads

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the futures return but in mid-month futures return leads the spot return after the seventh lags, it explains that there is delay of information to the future market with seven lags.

Conclusion

The ADF and PP test results reveals that, the prices suffer from unit root at level. However, at first difference it was made stationary. The long-run relationship and co-movement among the markets is evident through JC test. It reveals that both near month and mid-month prices travel together over time. The Bi-directional information flow of both near and mid-month cardamom market is revealed by the GC test and futures market is having superior in price discovery than the spot with respect to near and mid-month market.

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