CHAPTER - IV

RESULTS AND DISCUSSIONS

This chapter is devoted to presentation and interpretation of the results obtained through the analysis of the data. In this chapter the data collected from the sample population were critically analysed using different analytical tools and the results are presented under the following heads:

4.1 To examine the extent of market integration between spot and future market prices for coriander.

4.2 To understand the behaviour and pattern of causality between spot and future market for coriander.

4.3 To assess the efficiency of coriander future market in its role of price discovery and risk management function.

4.4 Forecasting of spot and future prices for coriander.

4.1 TO EXAMINE THE EXTENT OF MARKET INTEGRATION BETWEEN SPOT AND FUTURE MARKET PRICES FOR CORIANDER.

In this study, co-integration and error-correction methodology was used to explore the relationship and its direction(s) between the spot and futures markets of selected agricultural commodities. The analysis consists of following steps:

I. Lag selection criteria
II. testing for a unit root, I (1), in each series;
III. testing for the number of co-integrating vectors in the system;
IV. estimating and testing for the co-integrating relationship in the framework of a vector error correction model (VECM);

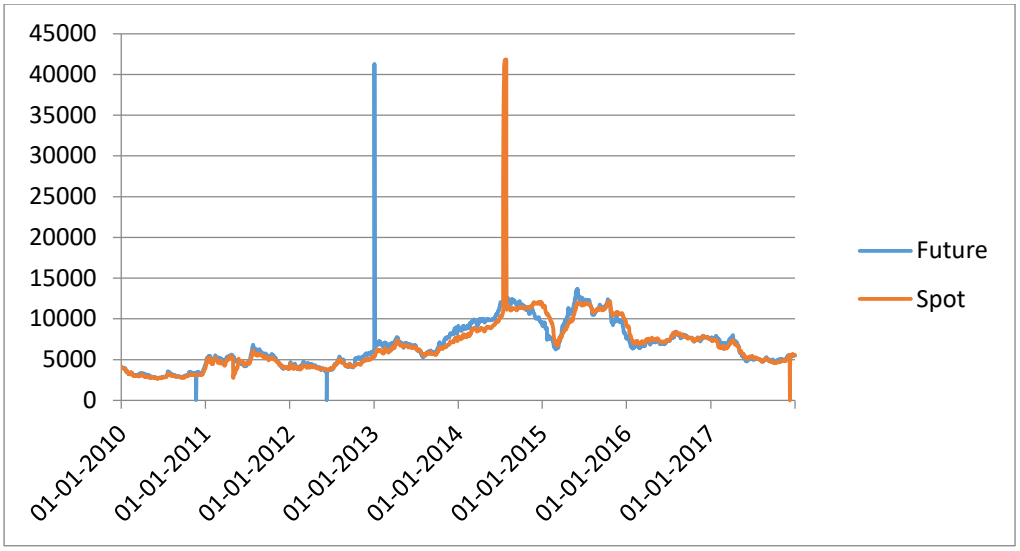

Figure 4.1 Daily plotting of spot and future price movements of Coriander.

Figure 4.1 shows the daily plotting of spot and future price movements of coriander. Before examining the empirical results to see performance and efficiency, it is better to understand the basic individual characteristics of the futures and spot price series with the help of its descriptive statistics i.e., mean, S.D, skewness, kurtosis and Jarque-Bera (J-B). Basic individual characteristics of the futures and spot price series can be seen in Table 4.1. It can be seen from the table that the means of both spot and futures prices for the whole period are respectively 6677.318 and 6709.571. It is seen that futures price mean is lower than spot price. The volatility is greater in spot market compare to future market this result as the S.D. is found to be 3499.836and 2711.111. Normality is tested using Jarque-Bera test, where it is found the data attained normality at 1% level. Kurtosis of the normal distribution is less than 3 for spot 2010 to 2013 and future 2014 to 2017. For all other Kurtosis of Normal distribution is less than 3. Finally, regarding the asymmetry of the distribution of the series around their mean, we found negative skewness for future 2010,2012,2015,2016 and spot 2011, 2015, 2017. For all other remaining price series is positive skewness during the period of study.

Table 4.1 Descriptive Statistics of Coriander

Year	Prices	N	Mean	S.D	Skewness	Kurtosis	Jarque-Bera	Prob.
2010	Future	365	3185.0	364.8	-1.00	15.2	3472.1	0.00
	spot	365	3068.3	302.1	1.51	2.1	208.0	0.00
2011	Future	365	5081.1	632.6	0.14	4.5	3.8	0.14
	spot	365	4808.4	569.5	-0.45	0.4	14.7	0.00
2012	Future	366	4517.3	672.5	-0.16	4.5	305.5	0.00
	Spot	366	4299.7	400.3	0.76	-0.3	37.2	0.00
2013	Future	365	6929.6	102.5	14.86	260.3	1016463.0	0.00
	Spot	365	6371.2	529.8	0.39	-0.4	13.1	0.00
2014	Future	365	10527.5	1154.7	0.21	-1.2	25.7	0.00
	Spot	365	11153.3	5999.9	4.38	19.1	6532.4	0.00
2015	Future	365	10204.1	1846.1	-0.40	-0.8	18.9	0.00
	Spot	365	10427.7	1393.0	-1.08	0.4	72.2	0.00
2016	Future	366	7383.7	466.9	-0.13	-0.7	7.3	0.02
	Spot	366	7602.7	433.1	1.28	2.5	187.8	0.000
2017	Future	365	5852.1	1067.8	0.68	-1.3	50.8	0.000
	Spot	365	5690.8	967.9	-0.09	2.1	63.2	0.00
Total	Future	2922	6709.5	2711.1	1.21	8.3	9000.1	0.00
	spot	2922	6677.3	3499.8	4.40	38.9	192880.8	0.00

*Note: * 1% level significant*

Table 4.2 Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-53645.50	NA	3.40e+13	36.83	36.83	36.83
1	-46383.18	14509.68	2.33e+11	31.84	31.86	31.85
2	-45672.48	1418.96	1.43e+11	31.36	31.38	31.37
3	-45510.59	322.99	1.29e+11	31.25	31.28	31.26
4	-45406.75	207.05	1.20e+11	31.18	31.22	31.20
5	-45364.38	84.41	1.17e+11	31.16	31.20	31.17
6	-45333.78	60.92	1.15e+11	31.14	31.19	31.16
7	-45314.67	38.01	1.14e+11	31.13	31.19*	31.15
8	-45300.84	27.49	1.13e+11	31.12	31.19	31.15
9	-45292.05	17.47*	1.13e+11*	31.12*	31.20	31.15*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 4.2 shows the lag selection criteria for further test,* indicates lag order selected by the criterion that is the lowest value. If the value is lower than model is best. So, lowest value should be selected for lag order. In case of LR, FPE, AIC, HQ 9 lag should be chosen. In case of SC 7 lag should be chosen for further analysis. So maximum criteria shows the 9 lag order for best fit in model.

Table 4.3 ADF unit root test for spot and futures prices of selected agricultural commodity

Commodity	Augmented Dickey-Fuller (ADF)	
	Level	**1st difference**
Coriander		
Future price	-1.803979 (0.7029)	-29.46714** (0.000)
Spot price	-4.829104 (0.0004)	-16.72200** (0.000)

** *significant at 1% level*

**MacKinnon (1996) one-sided p-values.*

Table 4.3 contains the results of the Augmented Dickey-Fuller (ADF) unit root test which show that level data were non-stationary but their first differences were stationary (i.e. implying the presence of unit roots in the series). Thus, the price series of spot and futures markets have a unit root. The occurrence of unit root in the price data generation process of these commodities gave a preliminary indication of shocks which may have permanent or long-lasting effect.

Table 4.4 Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.057989	177.3365	15.49471	0.0001
At most 1	0.001160	3.379950	3.841466	0.0660

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

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Based on the Johansen multiple co-integration procedure the integration between the markets were analysed using Eviews software. The results of trace test presented in Table 4.4 for Coriander revealed that trace statistics value of 177.3365 was greater than the critical value of 15.49 and trace statistics value of 3.379950 was lower than the critical value of 3.84. This showed the existence of one co-integrating equation(s) at 5 per cent level of significance. This indicated that the model variables had a long-run equilibrium/co-movement among the spot and futures price series

during the period under study. The existence of co-integration is necessary for long-term market efficiency. It helps to determine whether spot prices are reflected by the futures prices or not.

Table 4.5 Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value
None *	0.057989	173.9566	14.26460
At most 1	0.001160	3.379950	3.841466

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

* denotes rejection of the hypothesis at the 0.05 level

The results of Maximum Eigenvalue test presented in Table 4.5 for Coriander revealed that Eigen statistics value of 173.9566 was greater than the critical value of 14.26460 and trace statistics value of 3.379950 was lower than the critical value of 3.84. This showed the existence of one co-integrating equation(s) at 5 per cent level of significance. This indicated that the model variables had a long-run equilibrium

Table 4.6 Vector error correction model (VECM) estimates Coriander

Error Correction:	D(SPOT)	D(FUTURE)
CointEq1	-0.067630	0.010272
	(0.00510)	(0.00799)
	[-13.2560]	[1.28568]
D(SPOT(-1))	0.565910	0.023395
	(0.01807)	(0.02830)
	[31.3191]	[0.82674]
D(SPOT(-2))	-0.199275	-0.001978
	(0.02090)	(0.03272)
	[-9.53693]	[-0.06044]
D(SPOT(-3))	0.169371	0.004016
	(0.02121)	(0.03322)
	[7.98368]	[0.12089]
D(SPOT(-4))	-0.023863	0.006100
	(0.02143)	(0.03356)

	[-1.11343]	[0.18175]
D(SPOT(-5))	0.063129	0.000949
	(0.02143)	(0.03356)
	[2.94553]	[0.02827]
D(SPOT(-6))	0.023788	-0.000697
	(0.02140)	(0.03351)
	[1.11162]	[-0.02081]
D(SPOT(-7))	0.039569	0.007771
	(0.02131)	(0.03338)
	[1.85650]	[0.23282]
D(SPOT(-8))	0.027101	0.005336
	(0.02075)	(0.03249)
	[1.30613]	[0.16421]
D(SPOT(-9))	0.043759	0.001016
	(0.01854)	(0.02904)
	[2.35988]	[0.03500]
D(FUTURE(-1))	-0.068405	-0.808923
	(0.01293)	(0.02025)
	[-5.29132]	[-39.9545]
D(FUTURE(-2))	-0.061344	-0.655494
	(0.01601)	(0.02508)
	[-3.83127]	[-26.1410]
D(FUTURE(-3))	-0.053727	-0.525501
	(0.01763)	(0.02761)
	[-3.04789]	[-19.0353]
D(FUTURE(-4))	-0.045802	-0.415782
	(0.01840)	(0.02882)
	[-2.48904]	[-14.4275]
D(FUTURE(-5))	-0.035955	-0.318073
	(0.01859)	(0.02911)
	[-1.93446]	[-10.9273]
D(FUTURE(-6))	-0.034516	-0.240640
	(0.01821)	(0.02852)

	[-1.89547]	[-8.43823]
D(FUTURE(-7))	-0.025595	-0.165726
	(0.01723)	(0.02699)
	[-1.48536]	[-6.14125]
D(FUTURE(-8))	-0.020210	-0.101317
	(0.01537)	(0.02407)
	[-1.31517]	[-4.20999]
D(FUTURE(-9))	-0.013521	-0.049264
	(0.01189)	(0.01862)
	[-1.13755]	[-2.64642]
C	0.356290	2.232202
	(8.54588)	(13.3836)
	[0.04169]	[0.16679]

Standard errors in ( ) & t-statistics in [ ]

The coefficient of error equilibrium it is also called speed of adjustment towards equilibrium was found to be -0.067630 from Table 4.6 in the spot market equation for Coriander. If coefficient of error equilibrium is negative and significant at 5% level than there is long run relationship between the markets. This indicated that when the average spot price of coriander was too high, it immediately fell back towards future price. That is, the spot price corrects to its previous period's equilibrium by 6.7 per cent. These results revealed that there was long run relationship between futures and spot prices and the adjustment towards equilibrium was made by spot prices. For short causality Wald test is used. If coefficient future market is equal to zero than the null hypothesis is no short run causality running from spot to future. The result of Wald test show in table 4.7.

F statistic and chi-square value are significant at 5% level. So reject the null hypothesis.

It implies that price discovery occurred in markets and it was also transmitted in short run.

Table 4.7 Wald Model

Test Statistic	Value	df	Probability
F-statistic	2.889383	(10, 2892)	0.0013
Chi-square	28.89383	10	0.0013

Null Hypothesis: C(11)=C(12)=C(13)=C(14)=C(15)=C(16)=C(17)=C(18)=C(19)=C(20)=0

Regression model for ascertaining lead-lag relationship

Table 4.8 results of regression model reveal mixed findings. There is one-way causal linkage from future market to spot market prices for Coriander. This indicates that information gets reflected first in the future prices and then it transmitted to spot market prices. This reveals that future markets price of Coriander plays the leading role in the price discovery process.

Table 4.8 Regression model.

	Regression Equation	C	ΔSPOT t-1	ΔSPOT t-2	ΔFUTt -1	ΔFUTt -2	Inference
Coriander	**ΔF on ΔS**	225.50	0.04	0.44	0.46	0.01	F→S
		1.99	0.10	7.20	1.97	0.81	
	ΔS on ΔF	-17.68	1.42	0.0	0.02	-0.47	
		0.45	0.00*	0.00**	0.01**	1.02	

Parenthesis shows p-value *1% and **5% level significant

4.2 TO UNDERSTAND THE BEHAVIOUR AND PATTERN OF CAUSALITY BETWEEN SPOT AND FUTURE MARKET FOR CORIANDER.

The results of VECM on unidirectional causality from future to spot price of coriander market are confirmed by Granger causality test. With the null hypothesis of spot price does not Granger cause futures price and futures price does not Granger cause spot price. The Granger causality tests result can be seen in Table 4.9.

The F statistics test reject the null hypothesis of no Granger causality from future to spot prices, indicates that there is unidirectional causality from future prices to spot. Spot price is said to be granger caused by future prices, means future price helps in the prediction of spot price.

Table 4.9 Granger Causality Test for Coriander

Lags: 9

Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
FUTURE does not Granger Cause SPOT	2913	13.7198	0.0000*
SPOT does not Granger Cause FUTURE		0.57195	0.8211

4.3 TO ASSESS THE EFFICIENCY OF CORIANDER FUTURE MARKET IN ITS ROLE OF PRICE DISCOVERY AND RISK MANAGEMENT FUNCTION.

4.3.1 Extent of Liquidity

It is seen from the table that the portion of the total production of Coriander does not come to the futures market for the year 2010-11, because of the less developed futures market for Coriander. A producer doesn't find greater interest in futures trading because of less developed futures market. This upward and downward trend is an indication of the stakeholder's perceived utility of a futures exchange. Low liquidity indicates that a producer doesn't find utility in futures exchange. It can be seen from Table 1 that, in the Coriander futures market, liquidity varied considerably, ranging from 0.31 to 33.46. Liquidity continuously increases from year to year, except 2015 and 2016. The highest liquidity 33.46 occurs in the year 2014. In 2016 it is lowest 4.51 means producer does not find greater interest.

This variation in different years happens mainly because of high volatility in price of Coriander and a producer doesn't find usefulness of futures market as it is not profitable for them. Overall, liquidity is a serious problem in Coriander market.

Table 4.10 Extent of Liquidity of Coriander Commodity Market

Year	**Traded Volume**	**Production in Ton**	**Liquidity**
2010	116190	372366	0.31
2011	2882410	428687	6.72
2012	6745000	503240	13.40
2013	15288102.5	496240	30.81
2014	15448380	461710	33.46
2015	8879730	584980	15.18
2016	2746010	609400	4.51

4.3.2 Price Volatility

Ratio of the S.D. of the futures prices to spot prices of Coriander calculating price volatility ratio is reported in Table 2. The ratios are more than one most of the percentage times with 72.8 percentages indicating speculative activities in Coriander futures market. The percentage for ratio less than one is 16.6 times, means that information is not fully incorporated. Ratio equal to one is 10.4 times the percentage ratio shows futures price is able to incorporate information efficiently and fully.

Table 4.11 Ratio of the S.D of the Futures Prices to Spot Prices of Coriander

Ratio of the S.D of the Futures Price to Spot Price of Coriander							**Percentage of time the ratio**		
Year/ Month	**Jan-Feb**	**Mar-Apr**	**May-Jun**	**Jul-Aug**	**Sep-Oct**	**Nov-Dec**	**<1**	**1**	**>1.0**
2010	1.0	1.0	1.6	1.6	1.4	2.1	-	33.3	66.6
2011	1.0	0.8	0.5	1.4	1.1	1.1	33.3	16.6	50.0
2012	1.2	1.9	7.3	1.4	3.8	1.2	-	-	100.0
2013	18.7	0.7	1.6	1.2	1.4	1.2	16.6	-	83.3
2014	1.1	1.9	1.3	0.0	3.1	1.9	16.6	-	83.3
2015	0.7	1.7	1.1	1.6	1.7	1.9	16.6	-	83.3
2016	0.6	1.1	1.3	1.1	1.1	1.1	16.6	-	83.3
2017	0.8	1.2	1.2	1.0	1.0	0.3	33.3	33.3	33.3
Total							**16.6**	**10.4**	**72.8**

These analyses suggest that Coriander futures markets are either showing speculative activities or information is not incorporated fully.

4.4 FORECASTING OF SPOT AND FUTURE PRICES FOR CORIANDER.

ARIMA model is estimated only after transforming the variable under forecasting into a stationary series. The stationary series is the one whose values vary over time only around a constant mean and constant variance. There are several ways to ascertain this. The most common method is to check stationary through examining the graph or time plot of the data. Fig1 revealed that the data were non stationary. Non-stationary in mean is corrected through appropriate differencing of the data. The newly constructed variable was stationary in mean, the next step is to identify the

values of p and q. For this Autocorrelation (ACF) and Partial Autocorrelation (PACF) of various orders of were computed and presented in Figer 2,

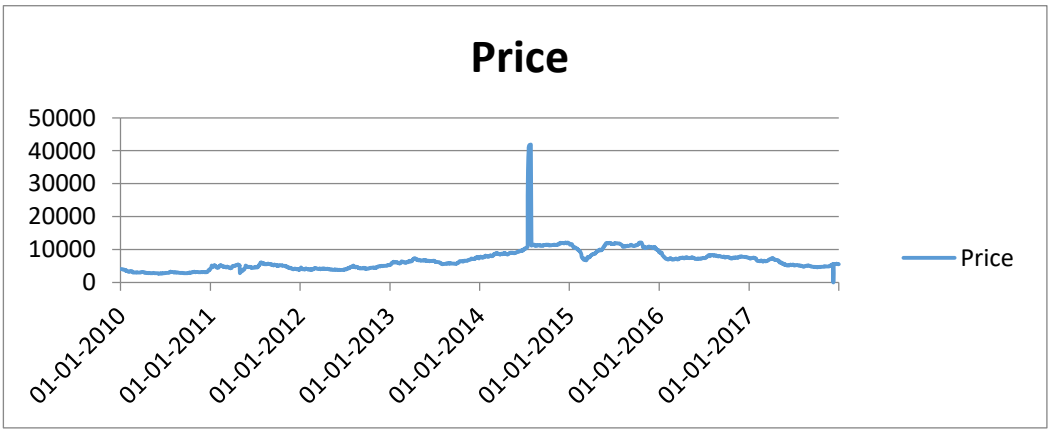

Figure 4.2 Daily plotting of spot price of Coriander.

The graphical presentation ACF and PACF are given in Figure 4.2 .partial auto correlation function (PACF) declined rapidly, which also indicated the non-stationarity of the spot price series. It was corrected through appropriate differencing of the data. Since differencing was carried out only once to arrive at stationary series, the value of ***d*** in the ARIMA model was unity.

The results presented in Table 4.12 showed that the auto correlation function (ACF) declined gradually. The graphical presentation of Table 4.12 is given in Fig. 4.3 and 4.4. It is observed from Fig. 4.3 that many ACFs were significantly different from zero and fell outside the 95 per cent confidence interval. Hence, the spot price of Coriander was non-stationary. It is seen from Fig. 4.4 that the partial auto correlation function (PACF) declined rapidly after the first lag period, which indicated the non-stationarity of the spot price series. The non-stationarity was corrected through appropriate differencing of the data. The value of ***d*** in the ARIMA model was unity (1) as the differencing was done only once to arrive at stationary series.

Table 4.12 Autocorrelation and partial autocorrelation coefficients of Spot price of Corianer

Lag period	Auto-correlation	Partial auto-correlation
1	0.978	0.978
2	0.957	0.009
3	0.943	0.163
4	0.931	0.028
5	0.917	-0.001
6	0.903	-0.017
7	0.889	0.000
8	0.876	0.005
9	0.866	0.065
10	0.856	0.017
11	0.845	-0.004
12	0.831	-0.075
13	0.818	0.011
14	0.803	-0.092
15	0.785	-0.063
16	0.766	-0.071

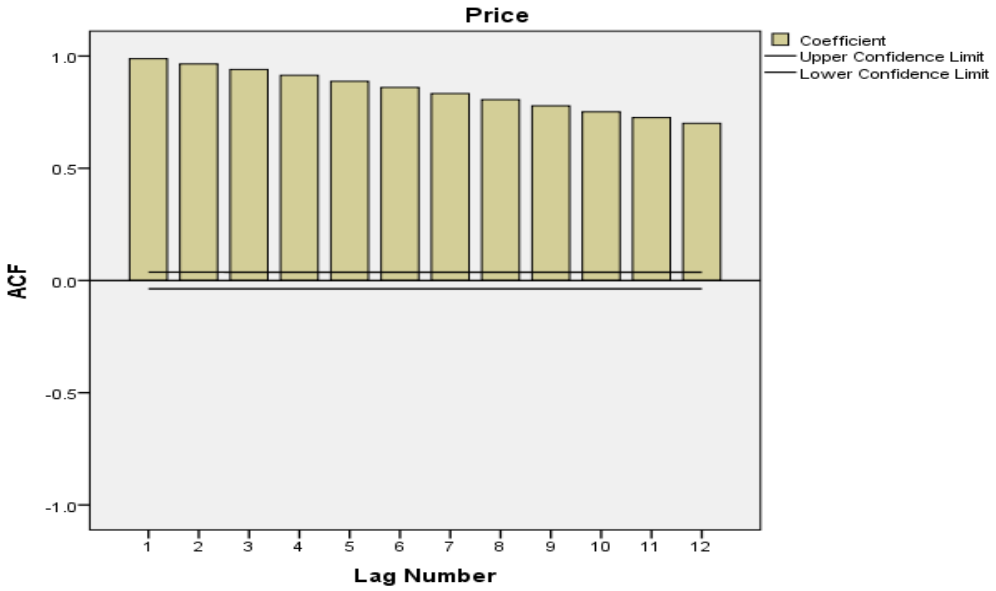

Figure 4.3 Diagram of Auto Correlation Function

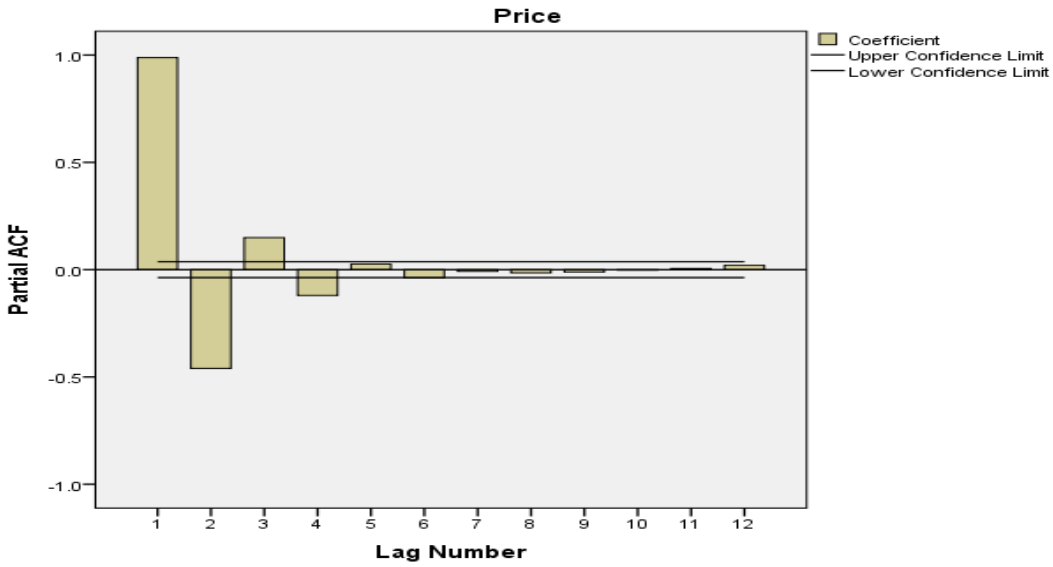

Figure 4.4 Diagram of Partial Auto Correlation Function

The best model was chosen from the following ARIMA models viz. ARIMA (1, 1, 13); ARIMA (1, 1, 14); ARIMA (1, 1, 15) on the basis of least MAPE and SBC criteria. The models as identified above were estimated using SPSS 20 version of the SPSS package. On comparing the alternative models on the basis of statistics such as Schwarz Bayesian Criteria (SBC) and Mean Absolute Percentage Error (MAPE), it is observed that both MAPE and SBC were the least for ARIMA (1, 1, 14) model that given in Table 4.13.

Table 4.13 ARIMA model for the futures price of Coriander

ARIMA (p, d, q)	MAPE	SBC (BIC)
1,1,13	37.56	12.27
1,1,14	**37.61**	**12.19**
1,1,15	37.72	12.10

Table 4.14 Summary statistics of ARIMA (1,1,14)

Fit Statistic	Mean
Stationary R-squared	0.34
R-squared	0.984
RMSE	441.137
MAPE	37.611
MaxAPE	106459
MAE	82.431
MaxAE	15476.14
Normalized BIC	12.19

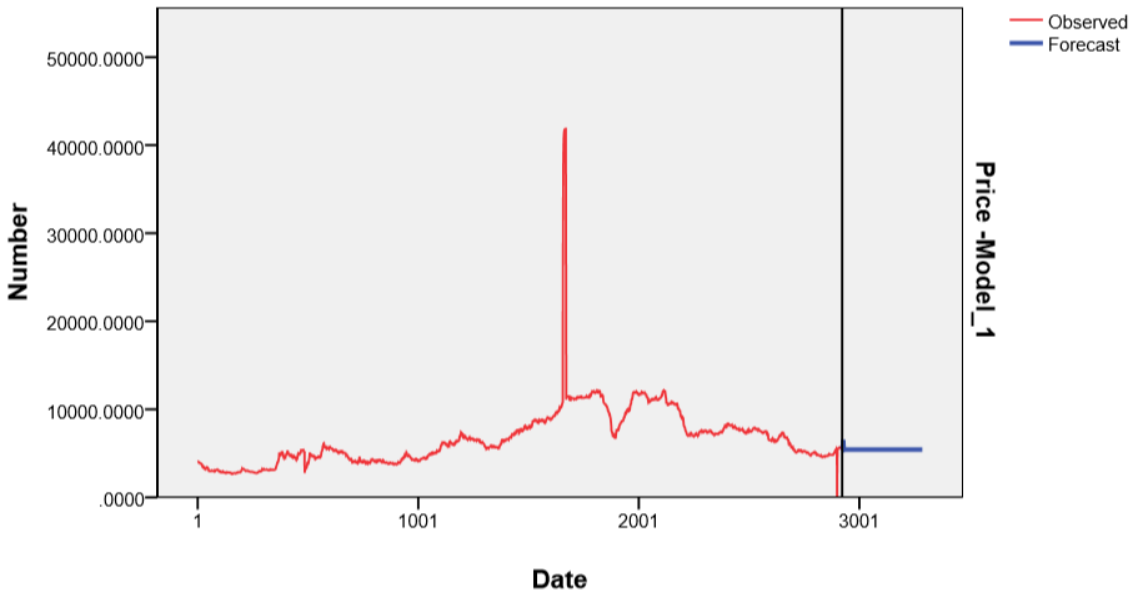

Figure 4.5 Price forecast

Table 4.15 shows the forecasts for spot s price series of Coriander based on ARIMA (1, 1, 14). It shows the actual and forecasted price for coriander. This proved that the selected ARIMA model was most suitable for forecasting the futures price of coriander during the period under study.

Table 4.15 Forecasts for spot s price series of Coriander based on ARIMA (1, 1, 14)

Date	Spot Price Rs./qtl	
	Actual	**Forecasted**
01-01-2018	5540.475	5544.6621
02-01-2018	5580.75	5557.05
03-01-2018	5560.225	5539.91
04-01-2018	5523.225	5914.22
05-01-2018	5479	5689.05
06-01-2018		6552.3
07-01-2018		6008.23
08-01-2018	5509.375	5606.34
09-01-2018	5533.375	5519.56
10-01-2018	5623.2	5500.5
11-01-2018	5630.175	5492.69
12-01-2018	5606.25	5473.44
13-01-2018		5458.11
14-01-2018		5438.73
15-01-2018	5585.925	5431.02
16-01-2018	5503.575	5427.96
17-01-2018	5459.4	5426.74
18-01-2018	5428.075	5426.26
19-01-2018	5410.225	5426.06
20-01-2018		5425.99
21-01-2018		5425.96
22-01-2018		5425.94
23-01-2018	5496.425	5425.94
24-01-2018	5487.75	5425.94
25-01-2018	5568.8	5425.94
26-01-2018		5425.94

27-01-2018		5425.94
28-01-2018		5425.94
29-01-2018	5529.575	5425.94
30-01-2018	5474.8	5425.94
31-01-2018	5527.425	5425.94