Analysing the Relationship of selected Agricultural Commodities Futures and Spot Prices

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Abstract

Commodity derivatives are widely used to speculate and manage the risk associated to the agricultural commodities price fluctuations. During Harvest of agricultural commodities, the price of these commodities decreases due to spike in supply. These commodity derivatives help the farmers fix the price for their produce at an earlier state of their harvest and thereby help in managing the risk associated to price changes in agricultural commodities. As the Consumer Price Index (Inflationary rates) increases, it is expected a corresponding change in revenue to the farmers, however the same is not the case in the economy. In this paper attempt is made to analyse selected agricultural commodities prices in the futures Derivative market and spot market to understand the relationship between the prices in the futures derivatives market and the spot market. Study identifies that the prices of select agricultural commodities namely CARDAMOM, CASTORSEED and PEPPER MINI are highly positively correlated and are efficient in price discovery. However, it is important to mention that the results also projected that the Consumer Price Index (inflationary rates) in the economy did not have a significant relationship on the price change in the futures derivatives market and spot market.

Keywords: Agricultural Commodities, Commodity Derivatives, Consumer Price Index, Future Price, Price risk, Spot Price.

Introduction

Trading on futures Agricultural Commodity derivatives is considered as speculative instruments. The production and sale of agricultural produce can become a less of a gamble for present day Indian farmers by trading on these commodity futures derivatives contract. The objective of introducing current day derivatives is to make the market cost-effective hedging to market participants like farmers. Thes financial instruments value is derived from the underlying asset. When the underlying assets are Agricultural commodities, these derivatives would be referred to as Agricultural Commodity derivatives.

The history of derivatives dates back to the Middle Ages; however, it is not very clear whether derivatives originated in Asian Rice Markets or Europe in medieval trade fairs. The Current day Derivatives futures were first seen in Chicago board Trade in 1848 [Ashutosh Vashishtha, 2010]. It is very imperative to understand why the Chicago Board Trade was formed to understand the need and importance of current day derivatives. In the mid of 19th century Chicago was evolving as a hub of transport and commerce and had become the centre for trading of agricultural production in the United States. Wheat, corn, and soya bean were brought to the Chicago market from the Midwestern farmers for selling. Since, similar products arrived at a time of the year there was huge crunch for storage and other physical facilities at the market, because of this, there was a huge downtrend in the prices and farmers found it more feasible to dump the grains in the Chicago River rather than spending on the transport to taking them back to the farm. In contradiction to this situation, other times of the year, prices would rise steeply.

Few traders found this situation to be an unnecessary volatility and waste of agricultural produce. Therefore, these traders established Chicago Board of Trade in which they created a financial instrument called "to-arrive" contract. This contract enabled the farmers decide the revenue for their agricultural Commodities well in advance even before the produce arrived to the

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market. Grains were also storable for relatively longer period; therefore, this arrangement was most feasible and reduced the market volatility which was beneficial to all the parties in the market. Soon, the traders began to pick this fascinating contract and speculators started trading on these contracts. This speculative interest of the traders in the market added to the market growth and later a clearing house and a performance guarantee facility were added to this contract paving path for the evolution of current days Futures contracts.

The Future contracts, today have become a speculative instrument used to manage the allocation, transfer and management of Risk, discovery of Price information, increasing the market efficiency. However, these instruments also are also used for speculation and for gambling. The prices of these derivatives are determined based on underlying assets. Therefore, the worth of derivatives is exactly same to the worth of asset. The price of these underlying assets can be estimated by the present value of all the future cash flows of the assets discounted at a required rate of return along with a risk premium attached to the asset. Therefore, it is very important to understand the relationship existing among the Future prices, the Spot prices, and the inflationary rates impact on the price movement of these futures. Therefore, the attempt is made to understand these underlining problems in which 3 agricultural commodities are considered, namely, CARDAMOM, CASTORSEED and PEPPER MINI. Price Discovery is one of the important function of Commodities Futures derivatives market, therefore, this study researches to understand the efficiency of price discovery of futures commodities derivatives market of the three selected agricultural commodities.

Review of Literature

Research is to look at the agricultural commodity derivatives futures markets in India. The Price discovery of agricultural commodities does not occur in the agricultural commodity futures market, according to a statistical examination, data on price discovery was considered for four samples of agricultural commodities traded on futures exchanges. The volume of trade and dept are not considerably impacted on the return and price movements of futures and spot markets, according to an econometric investigation of the relationship of price return, volume, market depth, and volatility. The way forward of India's agricultural commodity derivatives futures market necessitates government to have a realistic approach. Forward Markets Commission and the Securities and Exchange Board of India (SEBI) play a greater role in addressing all institutional and policy level constraints in order to make agricultural commodity derivatives futures a meaningful and a purposeful vibrant segment for agricultural commodity price risk management in India's [Salvadi & Ramasundaram, 2008].

Existing studies were made to understand the link between the spot and derivatives future markets; the long-run correlations among the spot and derivatives future prices are examined using unit root tests and cointegration test, allowing for an unknown number of breaks. After accounting for structural discontinuities in the data, the spot, and the futures prices are cointegrated in the long term [Efe & Pinar, 2013]. The nonlinear Black-Scholes equation and the non-discretization techniques on the linear partial differential equations with variable coefficients proposed by Schwartz and termed as one factor, two factor and three factor commodity price models would form the basis for my Base Model for predictions of Prices of Select Agricultural Commodities [Pavan, 2014]. The technique of forecasting the price is more generic than earlier model-free efficiency assessments, which focused on put-call parity breaches or the spot-futures pricing connection. The findings show that there are regular and economically significant pricing inefficiencies in this market [Alejandro, Anna & Javier, 2015]. Raising in the prices of commodities which turn out to be unprecedented over the period, there is specific focus on the commodity pricing and an emphasis made on developing a model that can build up a relationship between Gibson's Schwarts model and Gabillon model. There were various option pricing models to determine the future value of commodity stocks in special reference to the agricultural produce which help the farmers determine the price of the stock even before the stock is brought to the market. Stochastic volatility model also corrects the problem of opposite underlying-volatility correlation against market data in many other models by introducing correlation parameter explicitly [Zaizhi, 2012].

The features of price fluctuations in spot markets and futures markets for storable commodities are also examined in few studies. An analytical model of simultaneous price dynamics that implies that price correlation is a function of the elasticity of arbitrage between the physical commodity and its equivalent futures contract over short time periods. Greater elasticity encourages more highly linked price fluctuations, making the risk transfer function easier. Storage and transaction costs, among other factors, limit the supply elasticity of arbitrage services. As a result, futures contracts will not provide ideal risk transfer facilities across short time horizons in most cases. Studies have concluded that, the utility of futures derivatives markets to hedgers is dependent on these findings on market integration and price co-movement [Kenneth & William, 2013]. The outcomes are uneven among commercial forecasts, but futures derivatives prices perform better on

average, but not uniformly, for lives stock commodities, econometric forecasts seem to be preferable. While the results for other commodities are mixed. Forecast error decomposition suggests that the futures derivatives market was generally accurate in terms of bias, while the econometric models were accurate in terms of variance [Richard & Gordon, 2015].

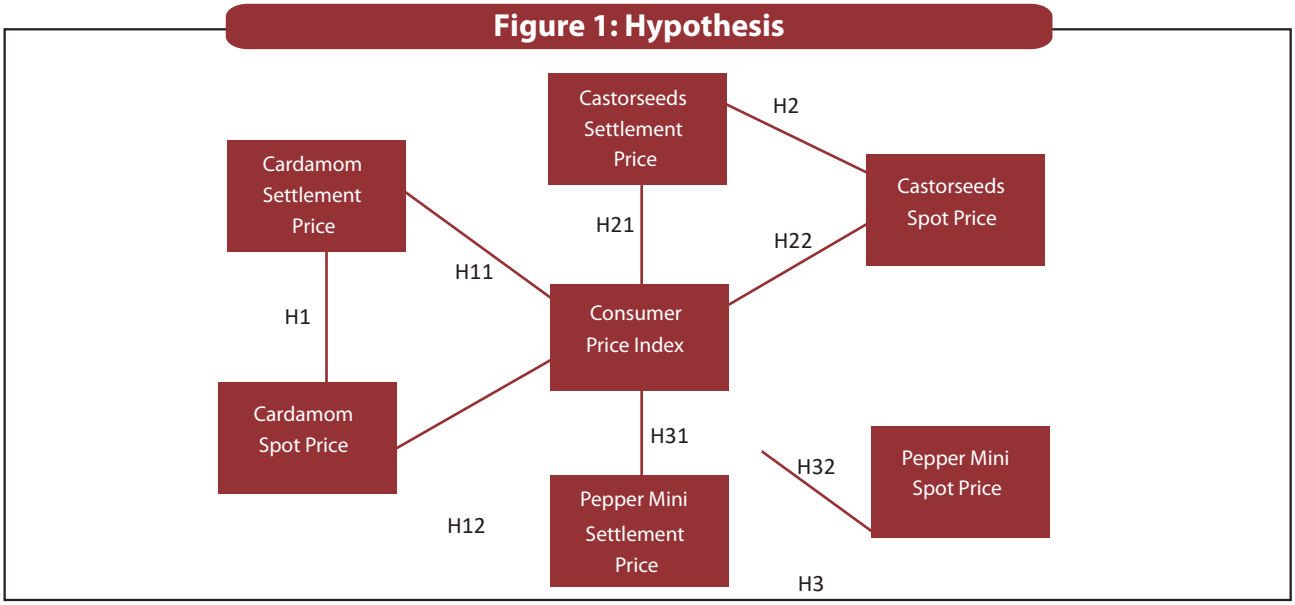
Existing studies have attempted to forecast the prices of agricultural commodities, there are various external factors that influence the agricultural commodities prices and this price forecasting can help farmers to sell their products when the prices are high. Market players and intermediaries play a prominent role in managing the storage facility, providing market yard and other facilities to the farmers for smooth and benefits of the farmers in the process of sale of agricultural produce [H & Devendra, 2020].

Objectives of the Study

1, To Analyse the relationship between the Consumer Price Index, Spot Price, and Future Price of Selected Agricultural commodities.

2, To Understand the price discovery and price predictability of the Commodities Futures derivatives market.

Figure 1: Hypothesis



Instance 1:

H0: There is no significant relationship between the Settlement Prices and Spot Prices of selected Agricultural commodities.

H1: There is a significant relationship between the Settlement Prices and Spot Prices of Cardamom

H2: There is a significant relationship between the Settlement Prices and Spot Prices of Castorseed

H3: There is a significant relationship between the Settlement Prices and Spot Prices of Pepper mini.

Instance 2:

H0: There is no significant relationship between the

H11: There is a significant relationship between the Consumer Price Index and Settlement Prices of Cardamom.

H12: There is a significant relationship between the Consumer Price Index and Spot Prices of Cardamom.

H21: There is a significant relationship between the Consumer Price Index and Settlement Prices of Castorseed.

H22: There is a significant relationship between the Consumer Price Index and Spot Prices of Castorseed.

H31: There is a significant relationship between the Consumer Price Index and Settlement Prices of Pepper Mini.

H32: There is a significant relationship between the Consumer Price Index and Spot Prices of Pepper Mini.

Research Methodology

This study is descriptive and analytical in nature. The data set comprises of the spot price and settlement price of the Cardamom, Castor seed and Pepper mini from January 2021 to December 2022. Correlation Analysis and Durbin-Watson Test was used to study the relationship between the prices and consumer price index. Beta value calculations were used to understand the volatility in the prices and returns. Anova Test was used to test the data and Residual values were also calculated to check the price predictability. The data was collected from ICEX, the monthly price movements of Spot and settlement prices of Cardamom, Castorseed and Pepper Mini were captured for the study along with the Consumer price Index from the Ministry of Statistics and Program implementation (Press information Bureau), Government of India.

Data Analysis and Interpretations

Cardamom

Table1: Descriptive statistics and Summary Output and Anova test results of Cardamom spot and settlement prices

Descriptive Statistic

Settlement_price		Spot_Price	
Mean	1504.85	Mean	1501.333333
Standard Error	39.75278054	Standard Error	41.32160146
Median	1419.4	Median	1427.5
Mode	1400	Mode	1400
Standard Deviation	137.7076713	Standard Deviation	143.1422264
Sample Variance	18963.40273	Sample Variance	20489.69697
Kurtosis	-0.516089582	Kurtosis	1.457949965
Skewness	1.04315035	Skewness	1.424617603
Range	380	Range	452
Minimum	1400	Minimum	1388
Maximum	1780	Maximum	1840
Sum	18058.2	Sum	18016
Count	12	Count	12

Regression Statistics

Multiple R	0.449200309
R Square	0.201780917
Adjusted R Square	0.024398899
Standard Error	0.740859757
Observations	12

Anova

	df	SS	MS	F	Significance F
Regression	2	1.248741384	0.624370692	1.137550012	0.362701605
Residual	9	4.939858616	0.54887318		
Total	11	6.1886			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	8.752143638	2.459434165	3.558600496	0.006132706	3.188517026	14.31577025
Settlement price	-0.005706061	0.007750466	-0.736221666	0.480343863	-0.023238832	0.011826711
Spot Price	0.003313469	0.00745621	0.444390516	0.667253904	-0.013553651	0.020180589

Table 2: Residual Output and CPI predictions for Spot and settlement prices of Cardamom

Observation	Predicted Inflation Rates (CPI General)	Residuals
1	4.692138978	-0.632138978
2	4.542620553	0.487379447
3	4.800373473	0.719626527
4	4.745869344	-0.455869344
5	5.477993744	0.822006256
6	5.319266406	0.940733594
7	5.318362436	0.271637564
8	5.402515582	-0.102515582
9	5.316924672	-0.966924672
10	5.314071642	-0.834071642
11	5.402515582	-0.492515582
12	5.347347588	0.242652412

These statistics indicates that the F value is 1.137550012 projecting a significant variance between the spot and Future prices of Cardamom and P Value 0.006132 is less than the significance level at 5%, therefore null hypothesis is rejected and it concludeds that the means are not equal and there exists a significant relationship between the Spot prices and Future prices of Cardamom.

Castorseed

Table 3: Descriptive statistics and Summary Output and Anova test results of Castorseed spot and settlement prices

Descriptive statistic			
Settlement_price		Spot_Price	
Mean	5357.666667	Mean	5365.833333
Standard Error	221.1393477	Standard Error	214.0622903
Median	5145	Median	5157.5
Mode	#N/A	Mode	#N/A
Standard Deviation	766.0491716	Standard Deviation	741.5335257
Sample Variance	586831.3333	Sample Variance	549871.9697
Kurtosis	-1.548356646	Kurtosis	-1.39413996
Skewness	0.2805602	Skewness	0.280297049
Range	2125	Range	2130
Minimum	4358	Minimum	4370
Maximum	6483	Maximum	6500
Sum	64292	Sum	64390
Count	12	Count	12

Regression Statistics	
Multiple R	0.39046454
R Square	0.152462557
Adjusted R Square	-0.035879097
Standard Error	0.763403943
Observations	12

Anova

	df	SS	MS	F	Significance F
Regression	2	0.943529779	0.47176489	0.809499936	0.475023421
Residual	9	5.245070221	0.58278558		
Total	11	6.1886			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	4.400960459	1.885822635	2.333708578	0.044476198	0.134933278	8.66698764
Settlement price	-0.006144958	0.004891641	-1.256216069	0.24066555	-0.017210618	0.004920703
Spot Price	0.006273336	0.005053362	1.241418257	0.245830758	-0.005158163	0.017704835

Table 4: Residual Output and CPI predictions for Spot and settlement prices of Castorseed

Observation	Predicted Inflation Rates (CPI General)	Residuals
1	4.985175001	-0.925175001
2	5.035712438	-0.005712438
3	5.584805283	-0.064805283
4	5.266825204	-0.976825204
5	5.307358311	0.992641689
6	5.265627388	0.994372612
7	5.014138021	0.575861979
8	5.142258269	0.157741731
9	5.200756289	-0.850756289
10	4.37137496	0.10862504
11	5.339882672	-0.429882672
12	5.166086163	0.423913837

In the statistics results, it is very clear that the F value 0.809499936 shows that there is a significant variance among the spot and Future prices of Castorseed and P Value 0.044476198 is less than the significance level at 5%, therefore Null Hypothesis is rejected and it is concluded that the means are not equal and there exists a significant relationship between the Spot prices and Future prices of Castorseed.

Pepper Mini

Table 5: Residual Output and CPI predictions for Spot and settlement prices of Castorseed

Descriptive Statistic			
Settlement_price		Spot_Price	
Mean	417.3583333	Mean	418.65
Standard Error	16.13519801	Standard Error	16.46921485
Median	417	Median	417.5
Mode	#N/A	Mode	#N/A
Standard Deviation	55.8939655	Standard Deviation	57.05103377
Sample Variance	3124.135379	Sample Variance	3254.820455
Kurtosis	0.783528755	Kurtosis	0.449749217
Skewness	0.847698376	Skewness	0.809096656
Range	189.95	Range	184
Minimum	346.2	Minimum	346
Maximum	536.15	Maximum	530
Sum	5008.3	Sum	5023.8
Count	12	Count	12

Regression Statistics	
Multiple R	0.226259548
R Square	0.051193383
Adjusted R Square	-0.159652532
Standard Error	0.807725519
Observations	12

Anova

	Df	SS	MS	F	Significance F
Regression	2	0.31681537	0.158407685	0.242799976	0.789404634
Residual	9	5.87178463	0.652420514		
Total	11	6.1886			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	4.071063804	1.850898897	2.199506311	0.055385144	-0.115960393	8.258088002
Settlement price	0.023810366	0.047018544	0.50640373	0.624745333	-0.08255297	0.130173701
Spot Price	-0.02118361	0.046064947	-0.459863986	0.656521038	-0.125389761	0.08302254

Table 6: Residual Output and CPI predictions for Spot and settlement prices of Castorseed

Observation	Predicted Inflation Rates (CPI General)	Residuals
1	4.984683331	-0.924683331
2	5.00901057	0.02098943
3	4.96890554	0.55109446
4	5.123977535	-0.833977535
5	5.094824861	1.205175139
6	5.17507641	1.08492359
7	5.156689121	0.433310879
8	5.174754537	0.125245463
9	5.136903671	-0.786903671
10	5.222858079	-0.742858079
11	5.022638297	-0.112638297
12	5.609678048	-0.019678048

In the above statistics, it is very clear, the F value 0.242799976 shows a significant variance between the spot and Future prices of Pepper Mini and P Value 0.055385144 is less than the significance level at 5%, therefore null hypothesis is rejected and it is concluded that the means are not equal and there exists significant relationship among the Spot prices and Future prices of Pepper Mini.

Findings and Conclusions

In this study, the relationship between the spot prices and futures prices of Cardamom, Castorseed and Pepper Mini are analysed in to check efficiency of price discovery in the market.

Table 7: Results of the data analysed

	Cardamom		Castorseed		Pepper Mini	
	Settlement price	Spot Price	Settlement price	Spot Price	Settlement price	Spot Price
Correlation between Spot prices and Future	0.9779		0.9981		0.9957	
Correlation between Inflation rates and Prices	-0.4293	-0.3921	-0.0856	-0.0621	0.1700	0.1554
Durbin -Watson Test	1.285		1.690		1.537	
Beta	0.84		1.10		1.07	

Durbin-Watson Statistic: 5 Per Cent Significance Points of dL and dU, n=12, k=3

dL	0.658
dU	1.864

The above results indicates that there is significant positive correlation between the historical settlement prices and spot prices as the correlation for all the three selected commodities is above 0.9 and there exist a positive autocorrelation between the historical settlement and spot prices of all the three selected commodities as the values are below 2.

Table 8: Analysis of Volatility, Returns and beta calculations

Cardamom		Castorseed		Pepper Mini	
Settlement price	Spot Price	Settlement price	Spot Price	Settlement price	Spot Price
-0.05	-0.11	-0.02	-0.02	0.00	0.00
-0.02	0.01	0.07	0.09	0.05	0.06
-0.02	-0.05	0.02	0.01	0.12	0.11
-0.13	-0.09	0.05	0.05	-0.04	-0.04
0.01	-0.02	0.00	0.00	0.09	0.10
0.02	0.04	0.05	0.04	-0.02	-0.02
-0.04	-0.05	0.05	0.05	-0.01	-0.01
0.01	0.00	0.13	0.13	0.00	0.00
0.00	0.00	-0.01	-0.03	0.04	0.04
-0.01	0.00	0.05	0.08	0.15	0.19
0.00	-0.01	-0.03	-0.03	0.08	0.03

Commodities	Cardamom	Castorseed	Pepper Mini
Beta	0.84	1.10	1.07

The results projects that there is a significant relationship among the spot prices and settlement prices of all the three selected agricultural commodities which are positive and are near to Zero, therefore, the H0 is rejected in Instance 1. A comparison of the variations in prices of cardamom, Castorseed and Pepper Mini show that price fluctuations are lower and the variability is low. Prices of the selected commodities move in the same direction and are positive which are near to 1. This signifies that the future markets are efficient in price discovery for the spot prices of these commodities. H0 is accepted in Instance 2, as there is no significant relationship between the consumer price index and

prices (both spot and settlement) of commodities signifying less of an impact of the CPI in the price of commodities selected for the study. This is because there is a significant difference in the price the agricultural producers gets and the end consumer pays. Major contribution to the consumer price of the selected agricultural commodities is contributed after the production and in the process of distribution and consumption. Hence, it is appropriate to develop a model for price fixation considering the Consumer Price Index and build in a system to enable easy movement of commodities from spot market to future markets which would reduce the distress caused to farmers with the issue of Price Risk; which the author is currently researching.

Appendix:

The above results indicates that there is significant positive correlation between the historical settlement prices and spot prices as the correlation for all the three selected commodities is above 0.9 and there exist a positive autocorrelation between the historical settlement and spot prices of all the three selected commodities as the values are below 2.

Table 9: Settlement Price and Spot Prices of Agricultural Commodities

Month	Inflation Rates (CPI General)	Cardamom		Castorseed		Pepper Mini	
		Settlement price	Spot Price	Settlement price	Spot Price	Settlement price	Spot Price
January	4.06	1780.00	1840.00	4453.00	4455.00	346.20	346.00
February	5.03	1686.00	1633.00	4358.00	4370.00	347.80	346.65
March	5.52	1650.70	1650.00	4677.00	4770.00	366.00	369.00
April	4.29	1616.70	1575.00	4790.00	4830.00	408.10	409.00
May	6.30	1410.00	1440.00	5008.00	5050.00	390.55	390.65
June	6.26	1423.30	1415.00	5025.00	5060.00	427.15	428.00
July	5.59	1458.30	1475.00	5265.00	5255.00	420.15	421.00
August	5.30	1400.00	1400.00	5530.00	5535.00	417.35	417.00
September	4.35	1415.00	1400.00	6230.00	6230.00	416.65	418.00
October	4.48	1415.50	1400.00	6171.00	6040.00	434.05	433.50
November	4.91	1400.00	1400.00	6483.00	6500.00	498.15	515.00
December	5.59	1402.70	1388.00	6302.00	6295.00	536.15	530.00

Source: ICEX

Figure 2: Monthly log prices of Cardamom's Settlement and Spot Prices

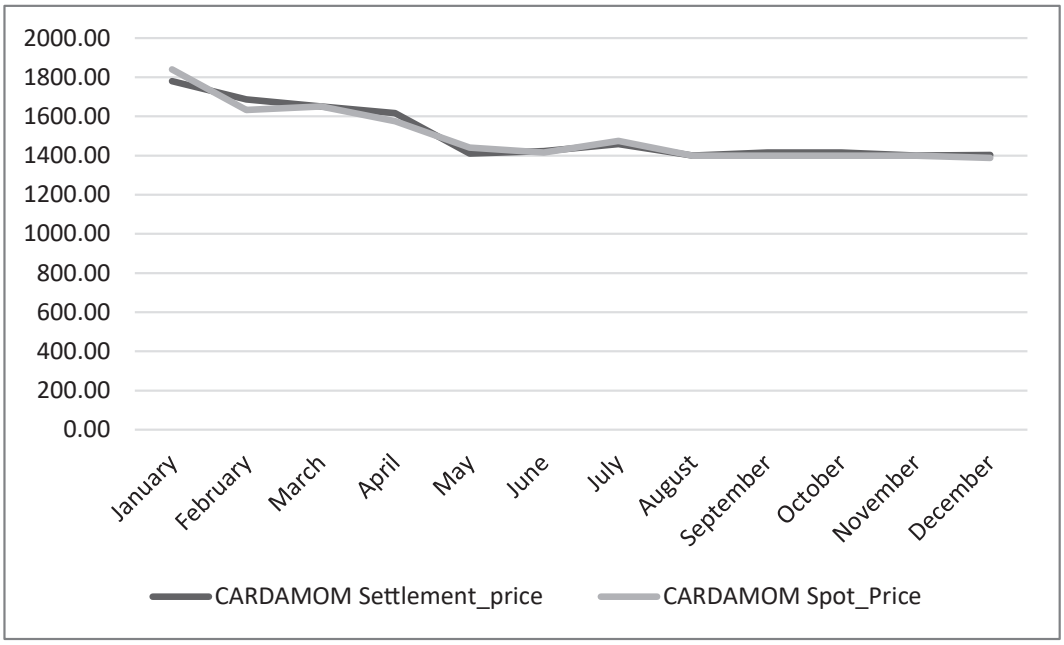


Figure 3: Monthly log prices of Castorseed's Settlement and Spot Prices

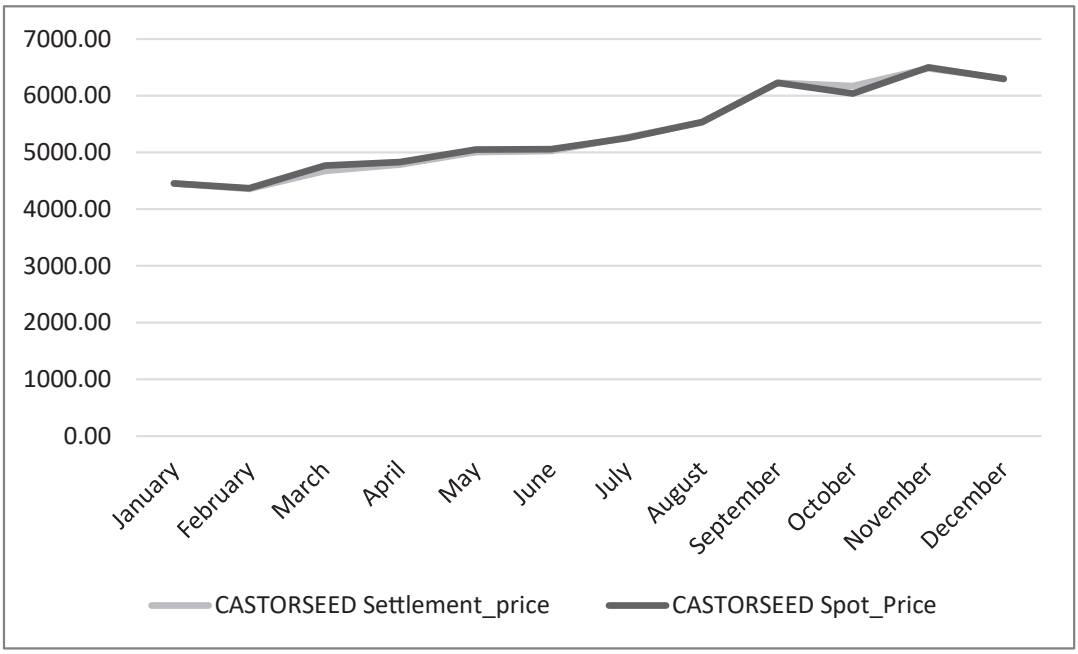
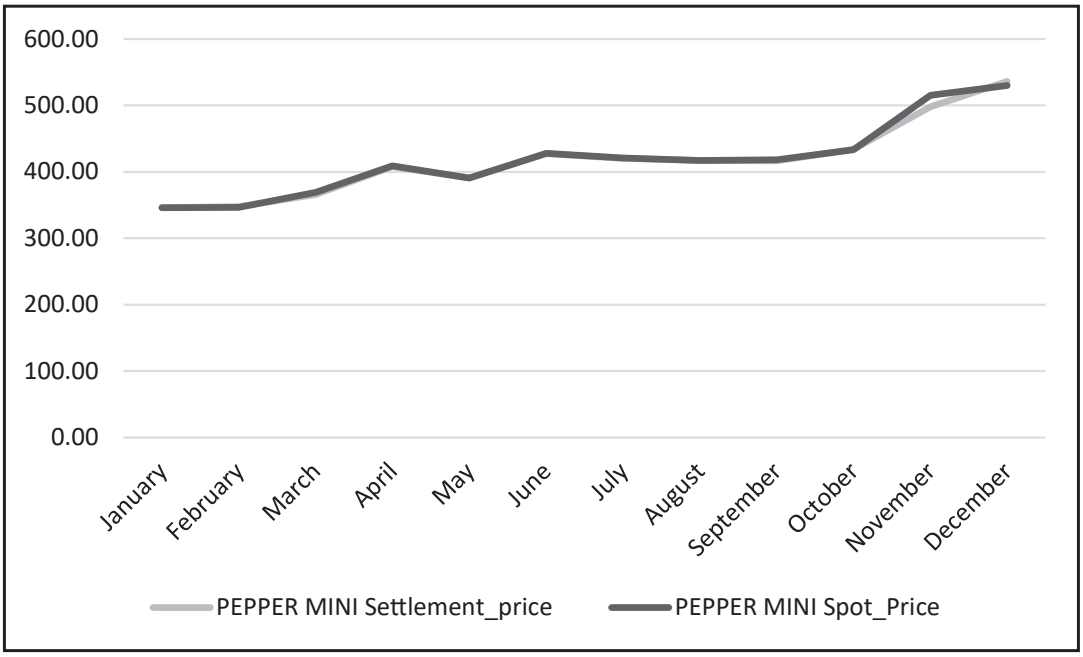


Figure 4: Monthly log prices of Pepper Mini's Settlement and Spot Prices



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