This paper is being Submitted at 4th Annual Conference of the Asia-Pacific Association of Derivatives (APAD)

CASTOR SEED FUTURES TRADING : SEASONALITY IN RETURN OF SPOT AND FUTURES MARKET

♦ASHUTOSH ROY And BRAJESH KUMAR

INTRODUCTION

Variability in commodity prices has always been a major concern of the producers as well as the consumers. They have to face price risk associated with the commodities. The importance of price stability in the edible oil sector can hardly be over emphasized. The production of oilseeds takes place in small part of country, predominantly rainfed regions and in India there are distributional implications. This gives rise to more regionally balanced agricultural growth. The current yields of most oilseeds are low as compared to international levels and this can be improved by technological improvements and ensuring a more stable price environment would help realize this growth potential. The consumption of oil seeds in India in increasing and it also plays an important role in nutritional security.

In a policy controlled regime risk management markets and instruments such as futures and options contracts are developed to provide price stability and hedging their risks. The government has in recent years enlarged the coverage of futures markets to minimize the wide fluctuations in commodity prices and for hedging their risks.

♦ *Authors are Doctoral Candidate in the Area of Agriculture at Indian Institute of Management Ahmedabad, India*

For agricultural commodities there is seasonality in demand and supply, the spot price of agricultural commodities usually increases before harvest and fall after harvest.

Seasonals in demand and supply can generate seasonals in inventories. Inventories seasonals generate seasonals in the marginal convenience yield and in the basis. Because of this pattern, the basis is positive when the futures contract matures in the current crop year and negative when the futures contract matures in the next crop year.

There would exist seasonality in returns or variances if the average returns were not same in all periods. The importance of monthly seasonality lies in the challenge that it is an indicator of market efficiency or informational efficiency. The understanding of seasonality in spot and future risk and returns should help financial managers, financial analysts and investors to develop appropriate strategy.

The issue of seasonality is not new. In 1942, Wachtel was the first to point out the seasonal effect in the US market. Various work has be done on the stock return in developed and developing or emerging capital markets (Officer, 1975; Brown, Keim, Kleidon and Marsh, 1983; Lewis, 1989; Berges, McConnell,and Schlarbaum, 1984; Tinic, Barone-Adesi and West, 1990;Aggarwal, Rao and Hiraki, 1990; Boudreaux, 1995; Aggarwal and Rivoli, 1989; Ho, 1990; Lee Pettit and Swankoski, 1990; Lee, 1992; Ho and Cheung, 1994; Kamath, Chakornpipat, and Chatrath, 1998; and Islam, Duangploy and Sitchawat, 2002 and Ramcharran (1997).

There are very few works who investigated the seasonality in the risk and returns in commodity market. Indian commodity market is very recent and growing very fast. No work has been done on the presence of seasonality Indian commodity market. Castor seed is one of the most traded items on the exchange (NCDEX – National Commodity and Derivatives Exchange). Investigating seasonality would help in understanding market efficiency and information efficiency.

Castor seed market: an Introduction

Castor is very important non-edible oil seed. It is cultivated around the world because of the commercial importance in vast range of industry. Due to its tremendous and valuable industrial application, castor oil enjoys heavy demand world-wide, estimated at about 220,000 tons per annum. Castor is produced in only about 30 countries lying in the tropical belt of the world. Due to its production in the fewer countries and continuous change in the trend of production in theses countries, the world production of castor and its derivatives is highly fluctuating. The world production of castor seed hovers around at an average of 12.5 lakh tons and of castor oil is 5.5 lakh tons. The major producer countries of castor are India, China, Brazil, Paraguay, Ethiopia, Philippines, Russia, and Thailand. Shares of castor producing countries during 2001-2002 are given in figure 1. India is the largest producer of the castor contributes to around 65 % of the world's total production. India produces around 8 lakh2 tons of castor seed and around 3 lakh tons of castor oil. In India, Castor is planting season is during July or August and harvested around December or January. The seedpods are dried, de-podded and brought to the market yards during December or January for trading. India nearly consumes ¼th of its total production and exports the rest but it still is the second largest consumer in the world. India exports castor oil in two forms namely First Special grade and Castor Oil Commercial. This figure of exports from India is on a rising (figure 4) trend and much of the world's requirements are fulfilled by India only. The countries that imports castor oil from India are European Union, USA, Japan, China, and Thailand. Its adaptability and a large number of down-stream products make consumption demand of this oil price-inelastic. In the international market, castor oil is one of the most expensive vegetable oils. Despite India's dominant position in the global castor market, India is not price-setters in the Export market, but mere price takers.

Methodology:

The main objective of this work is to find the presence of seasonality in return of spot and futures market.

Seasonality in the time series model:

A. OLS method:

OLS with seasonal Dummy variable can be used to for testing monthly seasonality. An intercept term along with dummy variables for all months except one is used. The omitted month is January, which is our base month. Thus, the coefficient of each dummy variable measures the incremental effect of that month relative to the base month of January. The existence of seasonal effect will be confirmed when the coefficient of at least one dummy variable is statistically significant.

$$\begin{aligned} S_t &= \alpha_1 + \alpha_1 M_2 + \alpha_3 M_3 + \alpha_4 M_4 + \alpha_5 M_5 + \alpha_6 M_6 + \alpha_7 M_7 + \alpha_8 M_8 + \alpha_9 M_9 \\ &+ \alpha_{10} M_{10} + \alpha_{11} M_{11} + \alpha_{12} M_{12} + \mu_t \end{aligned} \tag{1}$$

The intercept term indicates mean return for the month of January and coefficients of dummies represent the average differences in return between January and each month.

Transfer function model or a multivariate autoregressive-moving average (MARMA) model:

Error term from the OLS equation is analyzed further. Stationarity is tested and an ARIMA model for the residual series is constructed. To find the seasonal effect, a transfer function model or a multivariate autoregressive-moving average (MARMA) model was used which relates a dependent variable to lagged value of itself, current and lagged value of one or more independent variable and an error term which is partially explained by a time series model (in this case it was ARMA model). i.e. ARIMA model for the implicit error term is substitute the in OLS Equation. The augmented model is as follows:

$$S_t = \alpha_1 + \alpha_1 M_2 + \alpha_3 M_3 + \alpha_4 M_4 + \alpha_5 M_5 + \alpha_6 M_6 + \alpha_7 M_7 + \alpha_8 M_8 + \alpha_9 M_9 + \alpha_{10} M_{10} + \alpha_{11} M_{11} + \alpha_{12} M_{12} + \phi^{-1}(B)\theta(B)\eta_t \quad (2)$$

The Autoregressive model with GARCH effect:

Residuals from the OLS model are also tested for autoregressive heterosckedasticity For identifying seasonality generalized autoregressive conditional hetroskcedasticity (GARCH (1,1)) model is used.

Data:

The data analyzed here were sourced from National Commodity & Derivatives Exchange (NCDEX), India (http://www.ncdex.com). Daily percentage changes in risk and returns are examined for castor seed spot and futures returns. The data set extends over the period July 2004 – November 2006. In total we have 512 data points available. All data are analyzed in log return and volatility is calculated as the square of the log return.

The descriptive statistics of spot return, spot volatility, future return and future volatility for the entire period and each month is presented in tables 1-4.

Spot return:

Mean daily spot returns of the months January, March, April, November and December are negative. Mean return of February, and June was also higher than returns of the other months. The maximum average return occurs in the month of February. Spot returns also show negative skewness for six months and positive for other six months. The daily average return for the entire period is positive. The spot return series for the entire period show leotokurtic (kurtosis>3) and skewness is positive.

Table1: Descriptive statistics, the castor seed Spot return: July 2004-November 2006													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**2004-2006**
Mean	-0.0014	0.0028	-0.0006	-0.0009	0.0001	0.002	0.0008	0.0002	0.001	0.0012	-0.0015	-0.0002	0.0004
Median	-0.0009	0.0019	-0.0004	-0.0015	-0.002	0.002	0.0017	-0.002	0.0007	0.001	-0.0009	-0.0002	0
Max	0.02016	0.0208	0.0153	0.01813	0.0279	0.0204	0.0223	0.0552	0.0315	0.0196	0.0268	0.01183	0.0552
Min	-0.032	-0.019	-0.0114	-0.0148	-0.015	-0.0137	-0.02	-0.019	-0.028	-0.019	-0.0312	-0.0166	-0.032
SD	0.00805	0.0081	0.0069	0.00663	0.0088	0.0079	0.0082	0.0132	0.0098	0.0086	0.0097	0.00647	0.0089
CV	-558.76	287.05	-1109.5	-769.34	7627.8	400.32	1049.1	6380.1	981.65	690.06	-640.63	-2874.7	2305.1
Kurtosis	5.68576	1.0458	-0.501	1.38891	1.9225	-0.1974	1.7429	5.664	2.4769	0.0254	2.2662	0.23503	3.7358
Skewness	-1.0574	-0.396	0.4373	0.65032	1.0978	0.2685	-0.384	1.7509	0.535	-0.169	-0.1476	-0.5326	0.5625
Obs	37	35	32	31	45	48	49	47	55	51	40	41	511

Future return:

Mean daily future returns of the all the months are positive and same except august. Future returns are highly skewed towards positive for all months. The daily average return for the entire period is positive. The future return series for the entire period show leptokurtic (kurtosis>3) and Skewness is positive.

Table2: Descriptive statistics, the castor seed Spot Volatility: July 2004-November 2006													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**2004-2006**
Mean	7.9E-05	8.4E-05	5.3E-05	5.47E-05	8.6E-05	6.9E-05	7.2E-05	0.00019	0.00011	1E-04	0.00011	4.6E-05	9.1E-05
Median	2.8E-05	3.6E-05	4.5E-05	2.15E-05	3.1E-05	3.2E-05	1.7E-05	6.3E-05	5.9E-05	4.1E-05	4.2E-05	1.8E-05	3.5E-05
Max	0.00102	0.00043	0.00023	0.000329	0.00078	0.00041	0.0005	0.00305	0.00099	0.00076	0.00097	0.00028	0.00305
Min	8.8E-08	2.7E-07	1.1E-07	1.48E-08	4.9E-07	1.1E-06	0	-2E-05	0	8.2E-08	9.4E-09	2.9E-08	-2E-05
SD	0.00018	0.00011	5.4E-05	7.57E-05	0.00015	9.3E-05	0.00012	0.00046	0.00021	0.00015	0.00019	6.2E-05	0.00019
CV	227.884	133.35	103.025	138.3306	174.634	133.984	169.689	240.597	181.398	154.591	174.866	133.433	214.165
Kurtosis	22.5333	2.11077	2.43635	4.984883	10.5922	4.12498	4.14074	34.8	10.9477	8.52696	14.3469	5.16526	108.698
Skewness	4.48124	1.67971	1.38019	2.107933	3.10734	2.02392	2.2468	5.59097	3.28683	2.77182	3.63695	2.19056	8.31629
Obs	37	35	32	31	45	48	49	47	55	51	40	41	511

Spot Variance:

Mean daily spot variance of the months January, March, April, May, July, august November and December are negative. Mean variance of February was also higher than returns of the other months. Spot variance also shows negative skewness for six months and positive for other six months. The daily average variance for the entire period is negative. The future return series for the entire period show leptokurtic (kurtosis>3) and skewness is positive.

Table 3: Descriptive statistics, the castor seed Future return: July 2004-November 2006

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2004-2006
Mean	-0.0010	0.0039	-0.0014	-0.0011	-0.0006	0.0010	-0.0003	-0.0018	0.0005	0.0003	-0.0014	-0.0003	-0.0002
Median	-0.0006	0.0038	-0.0025	-0.0008	-0.0022	0.0003	0.0007	-0.0030	-0.0009	-0.0005	-0.0004	0.0006	-0.0003
Max	0.0291	0.0307	0.0286	0.0105	0.0341	0.0288	0.0192	0.0294	0.0482	0.0535	0.0131	0.0098	0.0535
Min	-0.0347	-0.0214	-0.0222	-0.0139	-0.0168	-0.0155	-0.0389	-0.0207	-0.0203	-0.0284	-0.0165	-0.0191	-0.0389
SD	0.0088	0.0101	0.0115	0.0059	0.0090	0.0080	0.0099	0.0087	0.0105	0.0124	0.0069	0.0065	0.0093
CV	-888.6	260.0	-810.6	-557.1	-1401.7	839.8	-3052.9	-476.8	1983.1	4761.8	-478.1	-2371.7	-5274.2
Kurtosis	8.3797	1.0087	0.7338	-0.0795	4.6068	2.3080	5.3253	2.6804	6.9278	6.3968	0.1349	0.7572	4.9763
Skewness	-0.4897	0.1533	0.6357	-0.1896	1.4976	0.9210	-1.5774	0.9382	1.5879	1.2849	-0.3975	-0.9776	0.6404
Obs	37	35	32	31	45	48	49	47	55	51	40	41	511

Future Variance:

Mean daily future variance of the all the months are positive and same except February. Future returns are highly skewed towards positive for all months. The daily

Table 4: Descriptive statistics, the castor seed Future Volatility: July 2004-November 2006

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2004-2006
Mean	9E-05	0.0002	0.0001	5E-05	9E-05	7E-05	0.0001	9.9E-05	0.0001	0.0002	7E-05	4.8E-05	0.0001
Median	2E-05	6E-05	7E-05	3E-05	2E-05	3E-05	2E-05	4.4E-05	4E-05	3E-05	2E-05	2.2E-05	3E-05
Max	0.0012	0.0009	0.0008	0.0004	0.0012	0.0008	0.0015	0.00087	0.0023	0.0029	0.0005	0.00036	0.0029
Min	0	0	2E-07	4E-07	4E-07	1E-07	0	-9E-05	5E-08	6E-08	0	0	-9E-05
SD	0.0002	0.0002	0.0002	8E-05	0.0002	0.0001	0.0003	0.00017	0.0004	0.0005	0.0001	7.1E-05	0.0003
CV	277.02	147.98	142.41	154.39	214.35	193.97	250.25	174.06	253.78	252.42	162.08	148.03	239.98
Kurtosis	16.88	4.21	5.00	9.98	18.94	22.65	22.46	11.18	25.29	19.69	9.41	8.96	45.24
Skewness	4.0958	2.1345	2.1792	2.8907	4.0213	4.4224	4.5595	3.19092	4.8054	4.2294	2.7065	2.64425	5.8516
Obs	37	35	32	31	45	48	49	47	55	51	40	41	511

average return for the entire period is positive. The future variance series for the entire period show leptokurtic (kurtosis>3) and Skewness is positive.

Unit root test of the return and volatility series:

The unit root test of the all the series are tested using Augmented Dickey-Fuller Stationarity (ADF) Test. The autocorrelation and the partial autocorrelation of all the series are tested against 40 lags. Figure 20 also shows the plot of ACF and PCF and their confidence limit. The autocorrelation and partial autocorrelation function falls down after 1or 2 lag and then oscillates between -0.1 and 0.1. Also higher order autocorrelation function damps down to zero, so that the all the series can be considered as stationary.

The results of the Augmented Dickey-Fuller Stationarity (ADF) Test for all the series are presented in Tables 2a to 2d **(Appendix -2)**. The results show consistency with different lag different lag structure to the presence of the intercept or intercept and trend. The p value for each test and each series is well below significant level of 5 percent. Thus the ADF test also shows that all series are stationary.

OLS regression

The spot return, the spot volatility, future return and future volatility is regressed on monthly dummies. January is taken as base year. So, all the parameters have been compared with January. Durbin-Watson test is also performed to check the serial correlation in the residuals. Results of OLS regression and Durbin-Watson test of all four series are presented below.

Table 5.0 Spot Return with monthly dummies			
Parameter Estimates			
Variable	Parameter Estimate	t Value	Pr > |t|
Intercept	-0.00144	-0.99	0.3231
M2	0.00428	2.05	**0.0413**
M3	0.00081854	0.38	0.7023
M4	0.00058022	0.27	0.7882
M5	0.00156	0.79	0.4293
M6	0.00342	1.76	**0.0786**
M7	0.00222	1.15	0.2500
M8	0.00165	0.85	0.3982
M9	0.00244	1.30	0.1955
M10	0.00269	1.41	0.1604
M11	-0.00007630	-0.04	0.9699
M12	0.00122	0.60	0.5455
		Adj R-Sq	-0.0024

Table 6.0 Future return with monthly dummies:			
Parameter Estimates			
Variable	Parameter Estimate	t Value	Pr > |t|
Intercept	-0.00099280	-0.65	0.5176
M2	0.00487	2.22	**0.0272**
M3	-0.00042060	-0.19	0.8519
M4	-0.00007280	-0.03	0.9744
M5	0.00035163	0.17	0.8652
M6	0.00195	0.96	0.3393
M7	0.00066865	0.33	0.7421
M8	-0.00084088	-0.41	0.6818
M9	0.00152	0.77	0.4433
M10	0.00125	0.62	0.5338
M11	-0.00044076	-0.21	0.8359
M12	0.00071784	0.34	0.7344
		Adj R-Sq	0.0004

R^2 of all the four regression are very small. The insignificant F-statistics shows poor model fit. Regression of spot return on monthly dummies shows that return in the month of February and July is significantly higher than the return in the month of January. All other month have statistically same return as in January. In the case of future return only return in the month of February is significantly higher than the return in the month of January. Spot volatility is same in all month except august, which is higher than January and future volatility in the month of October is only significantly higher than January.

Durbin-Watson D test of these models indicates serial correlation in the residuals. So the residuals of these models are further analyzed.

Table 7.0 Spot volatility with monthly dummies:

Parameter Estimates		
Variable	**Parameter Estimate**	**Pr > |t|**
Intercept	0.00007873	**0.0133**
M2	0.00000571	0.9001
M3	-0.00002598	0.5771
M4	-0.00002398	0.6098
M5	0.00000757	0.8597
M6	-0.00000945	0.8229
M7	-0.00000719	0.8642
M8	0.00011125	**0.0089**
M9	0.00003469	0.3980
M10	0.00002117	0.6114
M11	0.00002770	0.5292
M12	-0.00003234	0.4599
	Adj R-Sq	0.0161

Table 8.0 Future volatility with monthly dummies

Parameter Estimates			
Variable	**Parameter Estimate**	**t Value**	**Pr > |t|**
Intercept	0.00008504	2.04	**0.0419**
M2	0.00007572	1.27	0.2059
M3	0.00004813	0.79	0.4321
M4	-0.00003329	-0.54	0.5900
M5	0.00000857	0.15	0.8791
M6	-0.00001580	-0.28	0.7759
M7	0.00001607	0.29	0.7711
M8	0.00001434	0.26	0.7970
M9	0.00005952	1.10	0.2701
M10	0.00010791	1.97	**0.0493**
M11	-0.00001873	-0.32	0.7461
M12	-0.00003701	-0.64	0.5201
		Adj R-Sq	0.0082

Residual analysis:

The residual obtained from four models are further analyzed. The unit root test of the all the error series are tested using Augmented Dickey-Fuller Stationarity (ADF) Test. The autocorrelation and the partial autocorrelation of all the series are plotted against 40 lags. All four error series are stationary so ARMA model is tried these models. The results of the Augmented Dickey-Fuller Stationarity (ADF) Test for all the error series are presented in Tables 3a - 3d **(Appendix 3)**. The results show consistency with different lag different lag structure to the presence of the intercept or intercept and trend. The p value for each test and each series is well below significance level of 5 percent. Thus the ADF test also shows that all series are stationary.

<u>Identification of ARIMA process and estimation of seasonality using Transfer function (MARMA):</u>

After hit and trial observations (Minimum AIC criterion), ARIMA (5,0,0) is fitted for the residual series of spot return. For residual series of future return ARIMA (2,0,0), for residual series of spot volatility ARIMA (4,0,3) and, for residual series of future volatility ARIMA (3,0,0), is fitted. The residuals of all ARIMA models were assumed to be white noise and there is no arch effect. The transfer function or '*multivariate autoregressive-moving average*' model is used to combine ARIMA residuals into the regression model.

Table 9.0 Spot Return with monthly dummies and ARIMA (5,0,0) residual model:

Parameter	Estimate	Approx Pr > |t|	Lag
MU	-0.0015452	0.1727	0
AR1,1	-0.03907	0.3809	1
AR1,2	-0.14520	0.0011	2
AR1,3	0.01266	0.7795	3
AR1,4	-0.0028706	0.9490	4
AR1,5	-0.13585	0.0025	5
M2	0.0044467	0.0074	0
M3	0.0010537	0.5282	0
M4	0.0005804	0.7306	0
M5	0.0017355	0.2553	0
M6	0.0035159	0.0193	0
M7	0.0024336	0.1062	0
M8	0.0016260	0.2850	0
M9	0.0026635	0.0693	0
M10	0.0028005	0.0605	0
M11	-0.0001431	0.9280	0
M12	0.0012629	0.4261	0

Table 10.0 Future Return with monthly dummies and ARIMA (2,0,0) residual model:

Parameter	Estimate	Approx Pr > |t|	Lag
MU	-0.0009670	0.5130	0
AR1,1	0.09847	0.0271	1
AR1,2	-0.13260	0.0029	2
M2	0.0048455	0.0229	0
M3	-0.0004567	0.8335	0
M4	-0.0001240	0.9549	0
M5	0.0004688	0.8142	0
M6	0.0017938	0.3615	0
M7	0.0006833	0.7274	0
M8	-0.0009557	0.6290	0
M9	0.0015546	0.4162	0
M10	0.0011782	0.5443	0
M11	-0.0004006	0.8454	0
M12	0.0006464	0.7521	0

Table 11.0 Spot Volatility with monthly dummies and ARIMA (4,0,3) residual model:			
Parameter	**Estimate**	**Approx Pr > |t|**	**Lag**
MU	0.00007868	0.0512	0
MA1,1	-0.38038	0.2495	1
MA1,2	-0.24319	0.3428	2
MA1,3	-0.86281	0.0029	3
AR1,1	-0.16199	0.1919	1
AR1,2	-0.16121	0.2104	2
AR1,3	-0.72238	<.0001	3
AR1,4	0.20244	<.0001	4
M2	8.3998E-6	0.8831	0
M3	-0.0000279	0.6370	0
M4	-0.0000240	0.6875	0
M5	5.20986E-6	0.9240	0
M6	-3.143E-6	0.9535	0
M7	-7.3677E-6	0.8903	0
M8	0.0001016	0.0592	0
M9	0.00003424	0.5122	0
M10	0.00002967	0.5753	0
M11	0.00002306	0.6798	0
M12	-0.0000314	0.5672	0

Table 12.0 Future Volatility with monthly dummies and ARIMA (3,0,0) residual model:			
Parameter	**Estimate**	**Approx Pr > |t|**	**Lag**
MU	0.00009150	0.0759	0
AR1,1	0.10755	0.0157	1
AR1,2	-0.01093	0.8075	2
AR1,3	0.13553	0.0024	3
M2	0.00006456	0.3725	0
M3	0.00003961	0.6000	0
M4	-0.0000331	0.6630	0
M5	-2.766E-6	0.9684	0
M6	-0.0000141	0.8380	0
M7	6.61177E-6	0.9228	0
M8	4.40832E-6	0.9489	0
M9	0.00004806	0.4711	0
M10	0.0001063	0.1159	0
M11	-0.0000222	0.7541	0
M12	-0.0000493	0.4806	0

After accounting for the serial correlation in the residuals the some of the estimated coefficients of the Spot returns becomes significant. Earlier when OLS was used only dummies of February and June were significant, but in this model parameter estimates of February, June, September and October are significant which shows that the spot return in these month are significantly higher than January. For future return, spot volatility and spot volatility significance of all parameters are same as OLS estimates.

Conditional Volatility Modeling - Identification of seasonality using autoregressive and GARCH model:

Earlier we have assumed that the residual from the error models are white noise and there is no arch effect. Most of the error models are autoregressive model (SR, FR, FV models). We have used error model of spot volatility as ARIMA (4,0,3), first order autoregressive can be used and it was. Now here, We have used autoregressive model with GARCH (1,1) to estimate the seasonality.

After accommodating GARCH effect in the model the spot return seasonality was same as that of OLS estimator. The coefficients of ARCH-0 and ARCH -1 were significantly other than zero which shows ARCH effect in the model. The p value of the GRACH (1,1) parameter is very high which indicates no GRACH effect.

The future return seasonality was also same as that of OLS estimator. The coefficients also show ARCH effect in the model. There is no GRACH effect.

In The spot volatility models seasonality is observed in august November and December which is different than OLS and MARMA model. The model has ARCH effect no GRACH effect.

The ARCH and GARCH effect is present in the futures volatility model and seasonality was found in the all months except February and March. It shows that the volatility in the all months other than February and March was significantly different than the volatility in the January.

Table 13.0 GARCH Modeling

Spot Return with monthly ...ssive residual model with GARCH (1,1):		
Variable	Estimate	Approx Pr > |t|
Intercept	0.000123	<.0001
M2	-0.000040	0.4233
M3	-0.000086	0.2236
M4	-0.000076	0.1421
M5	-0.000074	0.1065
M6	-0.000056	0.2071
M7	-0.000060	0.1391
M8	-0.000112	0.0980
M9	-0.000045	0.3096
M10	-0.000042	0.2296
M11	-0.000102	0.0140
M12	-0.000102	0.0231
AR1	-0.007489	0.9435
AR2	-0.0643	0.1590
AR3	-0.0811	0.1038
AR4	-0.1671	<.0001
AR5	-0.0374	0.5603
ARCH0	1.9737E-8	<.0001
ARCH1	1.0282	<.0001
GARCH1	7.54E-17	1.0000

Spot Return with monthly dummies and autoregressive residual model with GARCH (1,1):		
Variable	Estimate	Approx Pr > |t|
Intercept	-0.001347	0.3332
M2	0.004173	0.0300
M3	0.000620	0.7603
M4	0.000413	0.8277
M5	0.001625	0.3474
M6	0.003134	0.0694
M7	0.002200	0.2192
M8	0.000184	0.9153
M9	0.002258	0.1824
M10	0.002172	0.1940
M11	-0.000898	0.6106
M12	0.001278	0.4978
AR1	0.0312	0.5788
AR2	0.1373	0.0010
AR3	-0.0101	0.8158
AR4	0.002856	0.9460
AR5	0.1313	0.0013
ARCH0	0.0000540	<.0001
ARCH1	0.2921	<.0001
GARCH1	0.001843	0.9892

Future volatility with monthly dummies and autoregressive residual model with GARCH (1,1):		
Variable	Estimate	Approx Pr > |t|
Intercept	0.000173	<.0001
M2	0.0000267	0.2439
M3	-0.000100	0.1243
M4	-0.000122	0.0021
M5	-0.000173	<.0001
M6	-0.000076	0.0033
M7	0.0000304	0.0542
M8	-0.000117	0.0531
M9	-0.000203	<.0001
M10	-0.000064	0.0233
M11	-0.000094	0.0003
M12	-0.000134	0.0010
AR1	-0.1071	0.2448
AR2	-0.0156	0.8113
AR3	-0.1464	0.0275
ARCH0	1.0537E-8	<.0001
ARCH1	0.9099	<.0001
GARCH1	0.3692	<.0001

Discussion and Conclusions:

Futures contracts will pay when the spot price at maturity turns out to be higher than future price, and lose when the spot price is lower than anticipated. Therefore a futures contract is like a bet on the future spot price. A buyer (seller) assumes the risk of unexpected movements in the future spot price by entering into a futures contract. The expected future prices and deviations from it are unpredictable so expected returns on the future contracts should be zero. The risk premium is the return that a buyer (seller) in futures can expect to earn if he does not benefit from expected spot price movements. The risk premium is the difference between the current futures price and the expected future spot price. If today's futures price is set below the expected future spot price, a purchaser of futures will on average earn money. If the futures price is set above the expected future spot price, a seller of futures will earn a risk premium.

The Keynes's theory of normal backwardation was based on three assumptions.

1. Speculators have to be risk averse
2. They hold net long positions and
3. They are unable to forecast future prices.

Dusak (1973) examined the existence of risk premium within the context of the Capital Asset Pricing Model. She viewed the futures price as consist of two components: an expected risk premium and a forecast of a forthcoming spot price. According to this concept, futures contract should depend on the extent to which the variations in prices are systematically related to variation in return on total wealth. She found that the systematic risks of the three commodity contracts investigated were not significantly different from zero.

Carter, Rausser and Schmitz (1983) modified Dusak's study by allowing systematic risk to be stochastic and to be a function of speculators' actual net position. They estimated non market and systematic risk as time varying parameter to incorporate seasonality in commodity market. They found the evidence of systematic risk and non-market risk that varies seasonally. By using a combined stock and commodity index as proxy for the market portfolio, they found nonzero estimates of systematic risk for most of the speculative return series they examined.

Seasonality in spot prices is not likely to influence futures returns because they represent foreseeable fluctuations that are taken into account when market participants set futures prices.

The seasonality of agricultural production and prices has inspired numerous studies into the seasonality of futures contracts on agricultural commodities. Much of the research on this topic has focused on the existence of seasonal price pressure, and the evidence is mixed. For example, Cootner found evidence that futures prices display a seasonal drift, possibly because of the demand pressure caused by seasonally changing needs to use the futures market to hedge production and inventory against price risk. Telser, on the other hand, found no evidence of seasonality and debated whether speculators require a positive drift to take the opposite side of hedgers' contracts.

On the other hand, modern portfolio theory (Markowitz) indicates that the compensation required by speculators in any period would be proportional to the contribution of each contract to the risk of speculators' portfolios.

For instance, during peak planting and growing seasons, resolution of agricultural production uncertainty is typically the primary factor causing changes in agricultural prices. Since agricultural production is a component of economic output, which in turn is an important determinant of total returns on speculators' wealth, a positive correlation should exist between speculators' returns and agricultural production in these months. Because of the inverse relationship between agricultural prices and production, agricultural prices should be negatively correlated with speculators' returns during such months, and long positions on agricultural futures contracts would tend to reduce speculators' portfolio risk.

On the other hand, during months of low agricultural production, resolution of agricultural demand uncertainty typically has a relatively larger impact on agricultural prices than supply uncertainty, and the correlation between agricultural prices and speculators' returns should be positive because of the positive correlation between economic output, investors' returns, income, and demand for agricultural products.
Thus, during months of low agricultural production, long positions on agricultural futures contracts would increase speculators' portfolio risk. Such seasonal differences in the contribution of agricultural futures to speculators' portfolio risk would imply that the return on futures positions would exhibit seasonal patterns.
During months of high (low) agricultural production, the return on long agricultural futures positions would be expected to be low (high) because of their negative (positive) contribution to speculators' portfolio risk in those months.

The purpose of this study is to investigate the risk and return seasonality of agricultural futures positions. Because the usefulness of the futures market for improving the risk return tradeoff for speculators and hedgers alike has been well researched and documented in determining the relative risk and return on agricultural futures positions during different months of the year should be of concern to all futures participants, including general investors, professional traders, and agricultural producers, as well as agricultural researchers. Based on empirical finding in this work, the seasonality in the castor spot return, future return, spot volatility and future volatility was analyzed as separate time series data. The daily spot and future prices of castor seed from July 2004 to November 2006 were analyzed. The OLS, MARMA and Autoregressive GARCH model were used. ARCH effect was present in all models. GARCH effect was present only in the future volatility model. February and June effect was present in spot return, whereas in future return, returns are February is significantly different than January. Spot volatility was significantly different in November and December than January. In all months other than February and March future volatility was significantly different than January.

References:

Aggarwal, Raj, Ramesh P. Rao and Takto Hiraki, "Regularities in Tokyo Stock Exchange Security Returns: P/E, Size and Seasonal Influences," *Journal of Financial Research*, Vol. 13, (Fall 1990), 249-263.

Aggarwal. R. and P. Rivoli, "Seasonal and Day-of-the Week effects In Four Emerging Stock Markets. "*The Financial Review*, 24, (1989), 541-550.

Berges, A., J. McConnell, and G. Schlarbaum, "An Investigation of the Turn-of-the-Year Effect, the Small Firm Effect and the Tax-Loss Selling Pressure Hypothesis in Canadian Stock Returns," *Journal of Finance*, 39, (March1984), 185-192.

Boudreaux, Denis O., "The Monthly Effect in International Stock Markets: Evidence and Implications", *Journal of Financial and Strategic Decisions*, Vol. 8, No. 1, (1995), 15-20.

Brown, P., D.B. Keim, A.W. Keleidon, and T.A. Marsh "Stock Return Seasonalities and theTax-Loss-Selling-Hypothesis: Analysis of the Arguments and Australian Evidence," *Journalof Financial Economics*, 12, (June1983), 105-127.

Ho, Y., "Stock Return Seasonalities in Asia Pacific Markets," *Journal of International Financial Management and Accounting*, 2, (1990), 47-77.

Islam, Anisul M., Orpin Duangploy, and Saowanww Sitchwart, "Seasonality in Stock Returns: An Empirical Study of Thailand," *Global Business and Finance Review*, Vol. 6, No.2, (2001), 65-75.

Kamath, R., R. Chakornpipat, and R. Chatrath, "Return Distribution and the Day-of-the-Week Effects in the Stock Exchange of Thailand," *Journal of Economics and Finance*, 22, 2-3, (1988), 97-107.

Lee, I., R. Pettit, and M.V. Swankoski, "Daily Return Relationship Among Asian Stock Markets," *Journal of Business Finance and Accounting*, 17, (1990), 265-283.

Lewis, Mario, "Stock Market Anomalies: A Re-Assessment Based on The U.K. Evidence,"*Journal of Banking and Finance*, Vol. 13, (1989), 675-696.

Officer, R.R., "Seasonality in Australian Capital Markets: Market Efficiency and Empirical Issues," *Journal of Financial Economics*, Vol. 2, (March 1975), 29-52.

Pindyck, Robert S. and Daniel L. Rubinfeld, Econometric Models and Economic Forecasts,New York: McGraw-Hill, International Edition, (1998).

Ramacharran, H., "Seasonality in the Jamaican Stock Market: An Examination of StockReturns and the Volume Traded," *Journal of Emerging Markets*, 2, 1, (1997), 23-35.

Tinic, Seha M., and Richard R. Wesst, "Risk and Return: January and the Rest of the Year," *Journal of Financial Economics*, Vol. 13, (December 1984), 561-574.

Wachtel, S.B., "Certain Observation on Seasonal Movement in Stock Prices," *Journal of Business*, 15, (1942), 184-193.

Appendix – 1

Stationarity test:

Test of stationarity is very important in regression because the results of the OLS regressions may be spurious if the dependent variable is non-stationary. So stationarity test of all the series was performed. One simple way of determining whether a series is stationary is to examine the sample autocorrelation function (ACF) and the partial autocorrelation function (PACF). Different pattern in the ACF and PACF gives idea about the stationarity of a time series. The Augmented Dickey-Fuller (ADF) test can also be performed to test the stationarity. In ADF test the first difference of the series is regressed on the series lagged one period, the differenced series at n lag lengths, a time trend with constant.

$$\Delta S_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta S_{t-i} + \lambda t + \rho S_{t-1} + \varepsilon_i$$

If the coefficient of ρ is significantly different from zero, then the hypothesis that *S* is non-stationary is rejected. The ADF test can be carried out with and without the constant or called mean and/or trend. Selection of the lag length is very important.

Appendix - 2

Table 2a: Augmented Dickey-Fuller Stationarity (ADF) Test for castor spot return

Augmented Dickey-Fuller Unit Root Tests							
Type	**Lags**	**Rho**	**Pr < Rho**	**Tau**	**Pr < Tau**	**F**	**Pr > F**
Zero Mean	10	-310.942	0.0001	-6.29	<.0001		
Single Mean	10	-354.295	0.0001	-6.37	<.0001	20.32	0.0010
Trend	10	-406.286	0.0001	-6.44	<.0001	20.75	0.0010

Table 2b: Augmented Dickey-Fuller Stationarity (ADF) Test for caster future return

Augmented Dickey-Fuller Unit Root Tests							
Type	**Lags**	**Rho**	**Pr < Rho**	**Tau**	**Pr < Tau**	**F**	**Pr > F**
Zero Mean	10	3088.439	0.9999	-7.56	<.0001		
Single Mean	10	2925.478	0.9999	-7.56	<.0001	28.57	0.0010
Trend	10	2541.661	0.9999	-7.56	<.0001	28.61	0.0010

Table 2c: Augmented Dickey-Fuller Stationarity (ADF) Test for caster spot volatility

Augmented Dickey-Fuller Unit Root Tests							
Type	**Lags**	**Rho**	**Pr < Rho**	**Tau**	**Pr < Tau**	**F**	**Pr > F**
Zero Mean	10	-42.5111	<.0001	-4.05	<.0001		
Single Mean	10	-168.669	0.0001	-5.87	<.0001	17.24	0.0010
Trend	10	-251.571	0.0001	-6.17	<.0001	19.13	0.0010

Table 2d: Augmented Dickey-Fuller Stationarity (ADF) Test for caster future volatility

Augmented Dickey-Fuller Unit Root Tests							
Type	**Lags**	**Rho**	**Pr < Rho**	**Tau**	**Pr < Tau**	**F**	**Pr > F**
Zero Mean	10	-31.2486	<.0001	-3.74	0.0002		
Single Mean	10	-80.4026	0.0017	-5.02	<.0001	12.67	0.0010
Trend	10	-110.405	0.0001	-5.35	<.0001	14.39	0.0010

Appendix – 3

Table 3a: Augmented Dickey-Fuller Stationarity (ADF) Test for error series of castor spot return

Augmented Dickey-Fuller Unit Root Tests							
Type	**Lags**	**Rho**	**Pr < Rho**	**Tau**	**Pr < Tau**	**F**	**Pr > F**
Zero Mean	10	-964.391	0.0001	-6.98	<.0001		
Single Mean	10	-966.349	0.0001	-6.98	<.0001	24.34	0.0010
Trend	10	-1233.10	0.0001	-7.03	<.0001	24.75	0.0010

Table 3b: Augmented Dickey-Fuller Stationarity (ADF) Test for error series of future spot return

Augmented Dickey-Fuller Unit Root Tests							
Type	**Lags**	**Rho**	**Pr < Rho**	**Tau**	**Pr < Tau**	**F**	**Pr > F**
Zero Mean	10	765.7883	0.9999	-8.03	<.0001		
Single Mean	10	764.1419	0.9999	-8.03	<.0001	32.20	0.0010
Trend	10	741.9049	0.9999	-8.03	<.0001	32.25	0.0010

Table 3c: Augmented Dickey-Fuller Stationarity (ADF) Test for error series of castor spot volatility

Augmented Dickey-Fuller Unit Root Tests							
Type	**Lags**	**Rho**	**Pr < Rho**	**Tau**	**Pr < Tau**	**F**	**Pr > F**
Zero Mean	10	-286.617	0.0001	-6.35	<.0001		
Single Mean	10	-286.982	0.0001	-6.35	<.0001	20.14	0.0010
Trend	10	-777.484	0.0001	-6.87	<.0001	23.67	0.0010

Table 3d: Augmented Dickey-Fuller Stationarity (ADF) Test for error series of castor future volatility

Augmented Dickey-Fuller Unit Root Tests							
Type	**Lags**	**Rho**	**Pr < Rho**	**Tau**	**Pr < Tau**	**F**	**Pr > F**
Zero Mean	10	-104.618	0.0001	-5.43	<.0001		
Single Mean	10	-104.910	0.0001	-5.44	<.0001	14.83	0.0010
Trend	10	-177.181	0.0001	-5.93	<.0001	17.76	0.0010