Day of the Week and Month of the Year Effects in the Indian Commodity Market

** Rajesh C. Jampala*
*** P. Adi Lakshmi*
**** O. A. R. Kishore*

Abstract

This paper empirically investigated the day of the week effect and month of the year effect on the returns of the Indian commodity market indices with special references to the Multi Commodiy Exchange. Ordinary least squares dummy variable regression model with GARCH(1,1) coefficients was used to identify day of the week and month of the year anomalies. The conditional auto regressive models were used to overcome the impact of heteroscedasticity on the time series data to capture the true calendar effects in the commodity markets in India. The results indicate that day of the week and month of year effects are present in the commodity market after adjusting the returns to the heteroscedasticity. The agricultural, metal, and energy indices showed different day and month effects. No significant weekend and year end effects were observed in the commodity market index returns.

Keywords: **day of the week effect, month of the year effect, GARCH (1,1), commodity markets**

JEL Classification: C22, G14, O53

Indian markets have recently thrown open a new avenue for retail investors and traders to participate in the commodity market. For those who want to diversify their portfolios beyond shares, bonds, and real estate, commodities are the best option. Commodities actually offer immense potential to become a separate asset class for market-savvy investors, arbitrageurs, and speculators. Hence, study of commodity market performance is the need of the hour.

The efficient market hypothesis (EMH) postulates that stock prices must efficiently reflect all available information about their intrinsic value (Fama, 1970). The prices in an efficient capital market fully reflect their investment value. The market has the capability to instantaneously impound the given set of information into the pricing. It should be impossible to outperform the overall market through expert stock selection or market timing, and that the only way an investor can possibly obtain higher returns is by purchasing riskier investments. Till the late 1970s, various studies tried to prove the market efficiency. However, studies since the 1980s proved that the markets do not follow random walk, and markets are not efficient. There are many focused studies that demonstrated the possible trading strategies yielding abnormal rates of return using historical data and publicly available information, thereby ruling out the efficacy of the markets. The efficient market hypothesis was contradicted by anomalies such as calendar anomalies, fundamental anomalies, and technical anomalies. In this perspective, one major anomaly explored was the calendar- related abnormal returns. Calendar anomalies refer to the tendency of securities to behave differently on a particular day-of-the-week or month-of-the-year.

* *Head,* Department of Business Administration, PG Center, P. B. Siddhartha College of Arts and Science, Vijayawada, Andhra Pradesh. Email: rajeshjampala@yahoo.com

** *Head,* Department of Business Administration, P. V. P. Siddhartha Institute of Technology, Kanuru, Vijayawada, Andhra Pradesh. Email: lakshmi_jampala@yahoo.com

*** *Assistant Professor,* Department of Business Administration, P. V. P. Siddhartha Institute of Technology, Kanuru, Vijayawada, Andhra Pradesh. Email: oarkishore@yahoo.co.in.

Seasonality or calendar anomalies have been the topic of interest among researchers since a long time. Numerous studies have been conducted in the developed and developing countries in this area. Studies conducted by Kelly (1930) and Fields (1931) can be identified as the first studies that were conducted to study market anomalies, followed by Fama (1965), who reported Monday variance to be 20% greater than other daily returns. Many studies, including Cross (1973), French (1980), Gibbons and Hess (1981), Keim and Stambaugh (1984), Lakonishok and Levi (1982), Rogalski (1984), Smirlock and Starks(1986), Jaffe, Westerfield, and Ma (1989), Wong, Hui, and Chan (1992), and Das and Jariya (2009) supported the day of the week patterns in stock returns. Recent studies including Kiymaz and Berument (2000), Sarma(2004), Singhal and Bahure (2009) too have confirmed the day effects in the stock markets. Rozeff and Kinney Jr. (1976) documented the January effect. Keim (1983), Reinganum (1983), Gultekin andGultekin (1983), and Mehta and Chander (2010) found similar conclusions. The Diwali effect was highlighted by Kumar (2012). Raj and Thurston (1994), Mill and Coutts (1995), and Choudhary (2001) observed no significant seasonal patterns in stock markets. Kaur (2011) denied the day of the week effects, but confirmed the month of the year effect.

Most of the studies in this domain, by using parametric and non-parametric tests on the stock returns data, proved that turn of the year, month, week, and holidays generate abnormal equity returns in both the developed and emerging markets, irrespective of the effect of the attendant risks. Taxation effect at the year-end, cash flows effect at the month-end, unfavourable news releases at the weekend can be attributed to such calendar anomalies. Presence of calendar anomalies in commodities markets returns have been observed, but are not as extensive as that of stock returns. Studies including Ball, Torous, and Tschoegl (1982), Chang and Kim (1988), Milonas (1991), Coutts and Sheikh (2002), and Sørensen (2002) mentioned calendar anomalies in commodity markets. Studies on the Indian commodity markets' calendar anomalies are very few. In an attempt to fill this gap, the present study explores the Indian commodity market efficiency in the 'weak form' in the context of calendar anomalies, especially with respect to the day of the week effect and month of the year effect.

Methodology and Model Specification

The study period between July 2005 and June 2013 was considered and various market indices of the multi commodity index (MCX) were chosen for the study. MCX indices were chosen as it has more than 86% (Department of Consumer Affairs, Ministry of Consumer Affairs, Food and Public Distribution, 2012) of the total volume of trade in commodity exchanges. Both the spot and future indices of MCX including composite index, (COMDEX), energy index (MCX Energy), agriculture index (MCX Agri), and metal index (MCX Metal) were chosen for the present study.

As the earlier studies have used the closing values for return generating procedure with an implied assumption of trading done at the closing value, the natural log of index closing value is, thus, the measure of daily return, which was used for this study. The following is the formula used to calculate the daily returns :

$$R_t = l_n [I_t / I_{t-1}]$$

where,
R_t = return on day *'t'*,
I_t = index mean value on day *'t'*,
I_{t-1} = index mean value on day *'t*-1*'*, and
l_n = natural log.

Seasonality can be tested by using non parametric as well as parametric tests. Kruskall-Wallis test is one of the non - parametric tests used, but researchers tend to perform parametric tests (typically dummy variable regression) due to the superiority of the parametric test over non - parametric tests.

Ordinary Least Squares (OLS) Approach : The model for testing the day of the week effect is :

$$R_{it} = \sum_{t=1}^{6} \propto_t D_{it} + \mu_t \qquad \mu_t \approx (0, \sigma_t^2)$$

where,

R_{it} = return on day *'t'*,

D_{it}*'s* ($D_1, D_2, D_3, D_4, D_5,$ and D_6) are the dummy variables representing Monday, Tuesday, Wednesday, Thursday, Friday, and Saturday consecutively,

α is the constant.

The values of dummy variable are assigned as '1' if the day represents their own, '0' otherwise. μ is the error term. The constant of the regression equation is eliminated to avoid the trap of collinearity.

The model for testing the month of the year effect is :

$$R_{it} = \sum_{t=1}^{12} \propto_t D_{it} + \mu_t \qquad \mu_t \approx (0, \sigma_t^2)$$

where,

R_{it} = return on day *'t'*,

D_{it} ($D_1, D_2, D_3, D_4, D_5, D_6, D_7, D_8, D_9, D_{10}, D_{11}$, and D_{12}) are the dummy variables representing January, February, March, April, May, June, July, August, September, October, November, and December consecutively, The values of dummy variable are assigned as '1' if the month represents their own, '0' otherwise; and μ_t is the error term. The constant of the regression equation is eliminated to avoid the trap of collinearity.

Breusch-Godfrey serial correlation LM test for testing auto correlation and ARCH LM test for testing heteroscedasticity were used in the study.

Generalized Autoregressive Conditional Heteroskedasticity (GARCH) Approach : It has long been documented in finance literature that the homoscedasticity assumption of OLS is likely to be violated in the context of financial time series, that is, stock returns. If the assumption is not satisfied, the standard errors could be wrong, and, therefore, conclusions inferred from the model could be misleading (Brooks, 2002). To deal with this issue, the generalized autoregressive conditional heteroskedasticity (GARCH) model developed independently by Bollerslev (1986) and Taylor (1986) is to be applied.

Garch (1,1) model specification :

$$R_{it} = \sum_{t=1}^{n} \propto_t D_{it} + \mu_t \qquad \mu_t \approx (0, \sigma_t^2)$$

$$\sigma_t^2 = \omega + \delta \mu^2_{t-1} + \gamma \sigma^2_{t-1})$$

where,

R_{it} is the log return of the market index at day *t*,

D_{it}'s are the dummy variables for days and months,

n = 6 for day of the week effect and n =12 for the month of the year effect,

μ_t is an error term and assumed to be independently and identically distributed, and represents the return variance.

ω is constant, and

δ, γ are constants to be estimated.

The constant of the regression equation is eliminated to avoid the trap of collinearity.

Results and Discussion

Descriptive analysis of weekday wise index returns shows (Table 1) that the highest returns are observed on Tuesday in comdex spot, comdex future, metal spot, metal future, and energy spot indices. Friday I agricultural spot index and Thursday in the agricultural future index showed highest returns. In the comdex spot, comdex future, metal spot, and energy spot indices, the highest negative returns were observed on Thursday. Tuesday in the agricultural spot index; Monday in agricultural future and metal future indices; and Friday in energy future index had the highest negative returns.

Descriptive analysis of the month wise index returns shows (Table 2) that the highest returns were observed in March at metal spot and future indices; in February at comdex future, agricultural future, and metal spot indices ; in July at agricultural spot index ; in October at comdex spot ; and in November at the metal spot index. Highest negative returns were observed at comdex spot and future indices in September; in May at agricultural spot index ; in August at agricultural future index ; in June at metal spot and future indices; in August at energy spot; and in January at energy future indices.

The descriptive analysis had to be validated by empirical testing. There are many parametric and non parametric techniques that are available to test the significance of day wise and month wise returns. Parametric tests are more popular due their superiority in testing the significance. Testing of anomalies has to be done by using the ordinary regression model by using dummy variable only after testing the stationary of the market returns. Augmented Dickey-Fuller (ADF) test is a widely used method for testing the unit root problem having the null hypothesis that the test series has a unit root. As the test statistics (Table 1) of all the test series reject the null hypothesis ; the test series are suitable for ordinary least squares modeling. To have robust checking of the results of the ADF test, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test was used to test the null hypothesis that the test series is stationary, and the KPSS test too confirmed the ADF results of return series of all indices.

Table 1. Descriptive Statistics (Day Wise Classification) and Unit Root Test Results of Index Return Series

Index	Week→ Descriptives ↓	Mon	Tue	Wed	Thu	Fri	Sat	Total	ADF Test 't' Statistics@	KPSS Test 't' Statistic@@
Comdex Spot	Mean	-0.0004	0.002001	0.000676	-0.00057	0.000331	8.94E-05	0.000358	-52.589*	0.0786#
	Std. Dev.	0.013549	0.015375	0.011115	0.008416	0.011265	0.009406	0.011789		
Comdex Future	Mean	-0.00024	0.001211	0.000536	-0.00038	0.000664	0.000211	0.000335	-61.450*	0.0783#
	Std. Dev.	0.009951	0.011068	0.018478	0.018852	0.006753	0.009876	0.013322		
Agriculture Spot	Mean	3.09E-05	-3.22E-05	0.000155	0.000665	0.001095	0.0004	0.000384	-46.698*	0.1092#
	Std. Dev.	0.007944	0.005618	0.01104	0.005162	0.009656	0.00514	0.007792		
Agriculture Future	Mean	-1.46E-05	0.000246	0.000287	0.000684	0.000294	2.05E-05	0.000254	-47.872*	0.1058 #
	Std. Dev.	0.011121	0.012898	0.013878	0.008395	0.008682	0.016285	0.012181		
Metal spot	Mean	0.001086	0.001131	0.000664	-0.00123	0.000629	0.000334	0.000437	-50.856*	0.2062#
	Std. Dev.	0.011852	0.012926	0.013973	0.011857	0.011431	0.009783	0.012067		
Metal Future	Mean	-0.00052	0.001198	-0.00021	4.15E-05	0.000989	0.001192	0.000444	-54.985*	0.1928#
	Std. Dev.	0.013245	0.013033	0.013028	0.012488	0.011152	0.012838	0.012658		
Energy Spot	Mean	-0.00087	0.002786	0.001321	-0.00193	0.000752	-0.00042	0.000279	-42.699*	0.0460#
	Std. Dev.	0.018574	0.023564	0.020362	0.035839	0.039321	0.018818	0.027403		
Energy Future	Mean	0.000771	0.001847	0.000608	1.08E-05	-0.00385	0.002209	0.000264	-42.012	0.0479#
	Std. Dev.	0.016909	0.017254	0.016618	0.011551	0.037848	0.034827	0.024595		

* Null hypothesis rejected at 1% level of significance, # Null hypothesis cannot be rejected at 1% level of significance
@ Augmented Dickey-Fuller Test, @@ Kwiatkowski-Phillips-Schmidt-Shin test

Table 2. Descriptive Statistics (Month Wise Classification)

Month	COMDEX Spot Mean (Std. Dev.)	COMDEXFuture Mean (Std. Dev.)	Agri Spot Mean (Std. Dev.)	Agri Future Mean (Std. Dev.)	Metal Spot Mean (Std. Dev.)	Metal Future Mean (Std. Dev.)	Energy Spot Mean (Std. Dev.)	Energy Future Mean (Std. Dev.)
Jan	0.000367	-1.06E-05	0.000513	7.02E-05	0.000883	0.000727	-0.000956	-0.001359
	(0.008152)	(0.009201)	(0.005108)	(0.012553)	(0.011402)	(0.010559)	(0.028320)	(0.015586)
Feb	0.000767	0.001336	0.001579	0.001575	0.001565	0.001449	0.001563	0.001483
	(0.008174)	(0.009724)	(0.012229)	(0.009683)	(0.009822)	(0.009361)	(0.020082)	(0.020136)
Mar	-0.000237	0.000710	-0.000732	0.000615	5.38E-05	0.000493	0.001873	0.001862
	(0.009770)	(0.009488)	(0.006446)	(0.009558)	(0.009881)	(0.011126)	(0.018335)	(0.015313)
Apr	0.000672	0.001223	0.000723	0.001085	0.00112	0.000977	0.001300	0.001331
	(0.009106)	(0.010854)	(0.006292)	(0.009671)	(0.013671)	(0.017881)	(0.016263)	(0.012795)
May	-0.001871	-7.08E-05	-0.000765	0.000342	0.000213	-3.97E-05	0.000545	0.000468
	(0.020490)	(0.010968)	(0.013950)	(0.012083)	(0.015246)	(0.013036)	(0.018854)	(0.015171)
June	0.000465	0.000209	0.000176	-8.02E-05	-0.001469	-0.000881	0.000950	0.000686
	(0.006986)	(0.010435)	(0.004849)	(0.019429)	(0.011598)	(0.013458)	(0.016151)	(0.015240)
July	0.001148	0.000448	0.001679	0.000773	0.001357	0.000724	0.000391	0.000524
	(0.007060)	(0.008477)	(0.005488)	(0.009957)	(0.010574)	(0.009082)	(0.016620)	(0.014246)
Aug	0.000244	0.000426	0.000653	-0.000295	0.000577	0.000836	-0.001775	-0.000708
	(0.007096)	(0.009518)	(0.004572)	(0.009365)	(0.011137)	(0.010551)	(0.017026)	(0.015535)
Sept	-0.002395	-0.000998	-0.000350	2.69E-05	8.76E-05	-0.000155	0.000440	-0.001190
	(0.015239)	(0.031738)	(0.007555)	(0.011094)	(0.012375)	(0.018830)	(0.067853)	(0.045095)
Oct	0.002092	0.000100	0.000769	-5.37E-05	-0.000241	-1.11E-05	-0.000226	2.48E-05
	(0.016754)	(0.012344)	(0.008637)	(0.011609)	(0.015925)	(0.012675)	(0.020072)	(0.017513)
Nov	0.001214	0.000854	0.000328	0.000286	0.00109	0.001602	-0.000348	-0.000594
	(0.013316)	(0.010629)	(0.005877)	(0.010373)	(0.009745)	(0.011063)	(0.019144)	(0.015732)
Dec	0.000662	-0.000110	0.000301	5.30E-05	0.000232	-0.000275	-0.000425	0.000678
	(0.013650)	(0.009355)	(0.005366)	(0.012163)	(0.011164)	(0.010267)	(0.024915)	(0.052159)

↳ **Day of the Week Effect :** The Table 3 depicts that a significant Tuesday effect is observed in the comdex spot, comdex future, and energy spot indices, which indicates that the Tuesday returns are significantly higher than that of other days of the week. Positive Friday returns in agriculture spot index and negative Thursday returns in the metal spot index are also significant. None of the day returns are significant in the agriculture future index. The results from the test are considered as valid only when the auto correlation and heteroscedasticity effects are absent. Except for the agriculture future index, all the indices have significant serial correlation or ARCH effect, which affects the validity of the results from the ordinary least squares method.

Hence, day wise results were calculated after adjusting for auto regression and conditional heteroscedasticity (Table 4). The comdex spot and comdex future indices show positive excessive returns on Tuesday. Agriculture spot index shows excessive positive returns on Friday. Excessive returns on Monday and Tuesday in the metal spot index are significant, and on Tuesday, in the metal future index, the positive returns are significant. The energy spot index returns show significant negative returns on Tuesday, Wednesday, and Thursday. Energy future index shows significant day effects on all the days except on Monday, and with Friday being an exception, all the returns are positive. The results are contrary to the results observed from stock markets as the stock markets have positive Friday and negative Monday returns (Chander, Mehta, & Sharma, 2008 ; Liew & Chia, 2010).

Table 3. Results of Ordinary Least Squares Equation Using Dummy Variables for Testing Day of the Week Effect

Variable	Coefficients (*p* - values)							
	COMDEX Spot	COMDEX Future	Agriculture Spot	Agriculture Future	Metal Spot	Metal Future	Energy Spot	Energy Future
MON	-0.000400	-0.000236	3.09E-05	-1.46E-05	0.001086	-0.000521	-0.000865	0.000771
	(0.4943)	(0.7202)	(0.9365)	(0.9806)	(0.0701)	(0.4046)	(0.5258)	(0.525)
TUE	0.002001*	0.001211*	-3.22E-05	0.000246	0.001131	0.001198	0.002786*	0.001847
	(0.0006)	(0.0659)	(0.9338)	(0.6838)	(0.059)	(0.0556)	(0.0408)	(0.1277)
WED	0.000676	0.000536	0.000155	0.000287	0.000664	-0.000206	0.001321	0.000608
	(0.2462)	(0.4139)	(0.6871)	(0.6323)	(0.2666)	(0.7407)	(0.3302)	(0.6145)
THU	-0.000565	-0.000381	0.000665	0.000684	-0.001227*	4.15E-05	-0.001931	1.08E-05
	(0.3349)	(0.5632)	(0.0862)	(0.2575)	(0.0409)	(0.9471)	(0.1566)	(0.9929)
FRI	0.000331	0.000664	0.001095*	0.000294	0.000629	0.000989	0.000752	-0.003846*
	(0.5733)	(0.3151)	(0.0049)	(0.6272)	(0.2964)	(0.1153)	(0.5826)	(0.0016)
SAT	8.94E-05	0.000211	0.0004	2.05E-05	0.000334	0.001192	-0.000419	0.002209
	(0.8803)	(0.7524)	(0.3088)	(0.9733)	(0.583)	(0.0602)	(0.7618)	(0.0726)
Serial Correlation								
LM Test F-Stat#	5.812658*	59.12063*	4.238980*	1.955285	1.952243	14.01931*	791.5408*	104.9607*
	(0.0030)	(0.0000)	(0.0145)	(0.1417)	(0.1422)	(0.0000)	(0.0000)	(0.0000)
Arch LM Test								
F-Stat	635.5984*	786.2403*	0.087549	0.006927	66.47385*	327.7698*	96.46834*	794.6290*
	(0.0000)	(0.0000)	(0.7673)	(0.5520)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

*5% level of significance #Breusch-Godfrey Serial Correlation LM Test

Even though the agricultural spot index has Friday excessive returns as the Friday is not the weekend for the commodity markets, the weekend effect is not significant in the commodity markets.

↳ **Month of the Year Effect :** Significantly higher positive returns are observed in the agriculture spot index for the February and July months (Table 5). In agriculture future index returns, October month has significant positive returns, and May and September have significant negative returns. All the other indices do not have excessive returns in any of the months, which indicates the efficiency of the market. However, with agriculture spot and agriculture future indices, all the other indices have significant ARCH effect, which effects the validity of the results from the ordinary least squares regression.

GARCH (1, 1) model was used to overcome the ARCH effect, and the results show negative June returns for the comdex spot index (Table 6). In the comdex future index, excess positive returns in the months of February, September, and November, and excessive negative May returns are significant. In the agricultural spot index, positive February and July returns are significantly higher than those for other months. In the agricultural future index, excessive negative returns in the months of May and September , and excessive positive returns in the month of October are significant. November month returns in metal spot and future indices, and September month returns in metal future index are significantly excessive. Positive February excessive returns and excessive negative returns in the month of September are significant in the energy spot market. Energy future index shows excessive positive returns in the months of February, September, December, and negative excessive returns are observed in the month of November.

The observed results are contrary to the evidence from the stock exchange as they show the January effect (Pandey, 2002). There is no observed impact of 'tax-loss' effect in the commodity markets, which is very common

Table 4. Results of Modified Equation with GARCH (1,1) and AR (1) Models for Testing Day of the Week Effect

Variable	Coefficients (*p* - value) -Mean equation							
	COMDEX Spot	COMDEX Future	Agriculture Spot	Agriculture Future	Metal Spot	Metal Future	Energy Spot	Energy Future
Monday	-0.000149	0.000293	3.20E-05	-1.46E-05	0.001012*	0.000255	0.000615	0.001243
	(0.7786)	(0.4975)	(0.9342)	(0.9806)	(0.0360)	(0.6656)	(0.5621)	(0.0600)
Tuesday	0.001317*	0.005994*	-4.14E-05	0.000246	0.001678*	0.001193*	-0.001655*	0.002615*
	(0.0085)	(0.0000)	(0.9148)	(0.6838)	(0.0002)	(0.0162)	(0.0335)	(0.0000)
Wednesday	0.001395*	0.000944*	0.000150	0.000287	0.000431	-0.000256	-0.002441	0.001584*
	(0.0086)	(0.0378)	(0.6978)	(0.6323)	(0.3624)	(0.6048)	(0.0072)	(0.0134)
Thursday	-0.000713	0.000657	0.000667	0.000684	-0.000722	0.000148	-0.00191*	0.009380*
	(0.2104)	(0.1780)	(0.0855)	(0.2575)	(0.0963)	(0.7557)	(0.0310)	(0.0000)
Friday	-0.000716	1.98E-06	0.001104*	0.000294	0.000179	0.001198	-0.002125	-0.001580*
	(0.1867)	(0.9975)	(0.0046)	(0.6272)	(0.7427)	(0.0578)	(0.0503)	(0.0233)
Saturday	0.000440	9.79E-05	0.000395	2.05E-05	0.000471	0.000727	0.002148	0.001634*
	(0.5328)	(0.8159)	(0.3152)	(0.9733)	(0.4682)	(0.2738)	(0.1287)	(0.0392)
AR(1)	NA	NA	0.047975*	NA	NA	NA	NA	NA
			(0.0185)					
	Coefficients (*p* - value) -Variance Equation							
C	1.51E-68	6.30E-05*	NA	NA	2.55E-07*	9.59E-06*	-4.33E-07*	0.000144*
	(0.0000)	(0.0000)			(0.0000)	(0.0000)	-0.586	(0.0000)
RESID(-1)^2	0.031593*	0.747462*	NA	NA	0.004276*	0.102357*	0.105513*	1.227814*
	(0.0000)	(0.0000)			(0.0000)	(0.0000)	(0.0000)	(0.0000)
GARCH(-1)	0.960161*	0.111561*	NA	NA	0.005435*	0.835459*	0.935061*	0.047957*
	(0.0000)	(0.0000)			(0.0000)	(0.0000)	(0.0000)	(0.0000)

Note : *5% level of significance

in stock markets. Agricultural yield is available in the month of January, and due to more supply, the prices come to their lowest possible rates. The immediate month February has significant excessive positive returns, which is evident from the present study. Hence, farmers can get better returns by holding their crop for one month after receiving the crop. The same logic can be applied to July excessive returns, but it takes two months from May. Excess returns in the metal markets in the month of November can be attained due to the 'Diwali Effect'.

Research Implications

The study proves the presence of market inefficiencies in the commodity market. However, a perfect efficient market should not have any information content that creates excessive profits. The policy makers must see that loans are available at lower costs on produce to the farmers/ other commodities so that seasonal fluctuations may come down. Policy makers must take reasonable steps towards improving the food storage and food processing industry to help the farmers in getting the right price and reduce seasonal anomalies. The buyers/sellers of commodities can observe the day wise and month wise anomalies and can plan their purchase/sales schedules accordingly.

Table 5. Results of Ordinary Least Squares Equation Using Dummy Variables for Testing Month of the Year Effect

Variable	COMDEX Spot	COMDEX Future	Agriculture Spot	Agriculture Future	Metal Spot	Metal Future	Energy Spot	Energy Future
Jan	7.02E-05	-1.06E-05	0.000513	0.000367	0.000883	0.000727	-0.000956	-0.001359
	(0.9323)	(0.9909)	(0.3462)	(0.6660)	(0.2960)	(0.4122)	(0.6190)	(0.4306)
Feb	0.001575	0.001336	0.001579	0.000767	0.001565	0.001449	0.001563	0.001483
	(0.0632)	(0.1631)	(0.0047)*	(0.3791)	(0.0710)	(0.1111)	(0.4277)	(0.4017)
Mar	0.000615	0.000710	-0.000732	-0.000237	5.38E-05	0.000493	0.001873	0.001862
	(0.4513)	(0.4419)	(0.1735)	(0.7781)	(0.9486)	(0.5736)	(0.3240)	(0.2746)
Apr	0.001085	0.001223	0.000723	0.000672	0.001120	0.000977	0.001300	0.001331
	(0.1996)	(0.2005)	(0.1942)	(0.4397)	(0.1951)	(0.2814)	(0.5085)	(0.4505)
May	0.000342	-7.08E-05	-0.000765	-0.001871	0.000213	-3.97E-05	0.000545	0.000468
	(0.6750)	(0.9387)	(0.1540)	(0.0257)	(0.7977)	(0.9638)	(0.7734)	(0.7830)
June	-8.02E-05	0.000209	0.000176	0.000465	-0.001469	-0.000881	0.000950	0.000686
	(0.9223)	(0.8224)	(0.7455)	(0.5830)	(0.0808)	(0.3183)	(0.6195)	(0.6894)
July	0.000773	0.000448	0.001679	0.001148	0.001357	0.000724	0.000391	0.000524
	(0.3732)	(0.6278)	(0.0033)*	(0.1762)	(0.1262)	(0.4132)	(0.8463)	(0.7603)
Aug	-0.000295	0.000426	0.000653	0.000244	0.000577	0.000836	-0.001775	-0.000708
	(0.7275)	(0.6494)	(0.2413)	(0.7752)	(0.5054)	(0.3473)	(0.3666)	(0.6823)
Sept	2.69E-05	-0.000998	-0.000350	-0.002395	8.76E-05	-0.000155	0.000440	-0.001190
	(0.9741)	(0.2864)	(0.5214)	(0.0050)*	(0.9176)	(0.8620)	(0.8192)	(0.4914)
Oct	-5.37E-05	0.000100	0.000769	0.002092	-0.000241	-1.11E-05	-0.000226	2.48E-05
	(0.9480)	(0.9142)	(0.1556)	(0.0135)	(0.7749)	(0.9900)	-0.9057	-0.9885
Nov	0.000286	0.000854	0.000328	0.001214	0.001090	0.001602	-0.000348	-0.000594
	(0.7302)	(0.3632)	(0.5491)	(0.1556)	(0.1995)	(0.0724)	(0.8571)	(0.7317)
Dec	5.30E-05	-0.000110	0.000301	0.000662	0.000232	-0.000275	-0.000425	0.000678
	(0.9486)	(0.9054)	(0.5789)	(0.4344)	(0.7822)	(0.7552)	(0.8240)	(0.6930)
AR-LM	6.284415	60.91419	2.713708	1.826500	2.512036	15.28615	98.52145	105.8807
	(0.0019)*	(0.0000)*	-0.0665	-0.1612	-0.0813	(0.0000)*	(0.0000)*	(0.0000)*
ARCH-LM	635.9286	2.047445	0.087584	0.008717	70.78501	329.6935	791.8472	792.7868
	(0.0000)*	(0.0210)*	-0.7673	-0.9256	(0.0000)*	(0.0000)*	(0.0000)*	(0.0000)*

Note : *5% level of significance

Conclusion

The day effects are significant in the commodity markets and there is no similarity in the day wise patterns in the various indices in the commodity markets. Except for the agricultural spot and future market indices, all the other composite metal and energy indices return series showed heteroscedasticity, which was tested by ARCH-LM test. Results indicate that day of the week effect and month of year effect are present in the commodity market after adjusting the returns to heteroscedasticity. The agricultural, metal, and energy indices showed different patterns in the day and month effects. End of the week and end of the year effects were not observed in the commodity market index returns. No significant weekend and year end effects were observed in the commodity market index returns.

Table 6. Results of Equation with GARCH (1,1) and AR(1) Models for Testing Month of the Year Effect

Variable	COMDEX Spot	COMDEX Future	Agri Spot	Agri Future	Metal Spot	Metal Future	Energy Spot	Energy Future
Jan	0.000366	0.000198	0.000513	0.000367	0.000690	0.000491	-0.000306	-0.000970
	(0.5224)	(0.7498)	(0.3462)	(0.6660)	(0.3189)	(0.4425)	(0.7878)	(0.4222)
Feb	0.000922	0.001318	0.001579	0.000767	0.001078	0.001031	0.001956	0.004012
	(0.1399)	(0.0002)*	(0.0047)*	(0.3791)	(0.1694)	(0.1110)	(0.0209)*	(0.0000)*
Mar	0.000426	0.000488	-0.000732	-0.000237	-5.61E-05	0.000298	0.001098	0.001440
	(0.5531)	(0.4156)	(0.1735)	(0.7781)	(0.9430)	(0.6865)	(0.2973)	(0.1374)
Apr	0.000548	0.000435	0.000723	0.000672	0.000600	1.64E-05	0.000898	0.002074
	(0.3816)	(0.5091)	(0.1942)	(0.4397)	(0.3065)	(0.9799)	(0.4294)	(0.0635)
May	-0.000720	-0.001335	-0.000765	-0.001871	-0.000357	0.000137	0.001251	0.001550
	(0.2280)	(0.0007)*	(0.1540)	(0.0257)*	(0.6141)	(0.8741)	(0.1947)	(0.0609)
June	-0.009021	-0.000146	0.000176	0.000465	-0.000858	-0.000536	0.001140	0.000756
	(0.0000)*	(0.8235)	(0.7455)	(0.5830)	(0.2775)	(0.4130)	(0.2550)	(0.4454)
July	0.001457	0.001003	0.001679	0.001148	0.001001	0.000564	0.001880	0.001008
	(0.0749)	(0.1173)	(0.0033)*	(0.1762)	(0.2058)	(0.4778)	(0.0809)	(0.3777)
Aug	0.000191	-0.000302	0.000653	0.000244	0.000635	0.000882	-0.001866	-0.002857
	(0.7845)	(0.6002)	(0.2413)	(0.7752)	(0.3543)	(0.2259)	(0.1332)	(0.0010)*
Sept	0.000876	0.012916	-0.00035	-0.002395	0.001252	0.009467	-0.028871	0.012739
	(0.1178)	(0.0000)*	(0.5214)	(0.0050)*	(0.0573)	(0.0000)*	(0.0000)*	(0.0000)*
Oct	0.000583	0.001203	0.000769	0.002092	0.000436	0.000403	0.001789	0.001532
	(0.3699)	(0.1694)	(0.1556)	(0.0135)*	(0.5496)	(0.6473)	(0.3722)	(0.1352)
Nov	0.000975	0.001583	0.000328	0.001214	0.001683	0.002243	0.001191	-0.000129
	(0.1506)	(0.0057)*	(0.5491)	(0.1556)	(0.0234)*	(0.0006)*	(0.2970)	(0.9054)
Dec	0.000246	-0.000334	0.000301	0.000662	1.08E-06	-0.000334	0.000632	0.015740
	(0.7274)	(0.4612)	(0.5789)	(0.4344)	(0.9988)	(0.6284)	(0.6173)	(0.0000)*
C	2.13E-06	6.49E-06	NA	NA	2.57E-06	8.47E-06	5.89E-06	6.11E-05
	(0.0000)*	(0.0000)*			(0.0000)*	(0.0000)*	(0.0000)*	(0.0000)*
RESID(-1)^2	0.116281	0.236936	NA	NA	0.058773	0.165477	0.148046	0.800400
	(0.0000)*	(0.0000)*			(0.0000)*	(0.0000)*	(0.0000)*	(0.0000)*
GARCH(-1)	0.884567	0.762308	NA	Na	0.923009	0.794504	0.867480	0.390409
	(0.0000)*	(0.0000)*			(0.0000)*	(0.0000)*	(0.0000)*	(0.0000)*

NA- Not applicable *5% level of significance

Limitations of the Study and Scope for Future Research

The markets are becoming mature, and the anomalies observed in the study may not exist in the future. The study of indices cannot be attributed to individual commodities as every commodity has its own seasonal effects. The study is limited only two anomalies - namely day of the week and month of the year.

The interest rates are very high in developing countries like India, and the impact of that can be included in the model. The study can be extended to individual commodities as every commodity has its own market environment, seasonal effects, and no indexed based trading in derivatives is available. The relationship between energy markets and agricultural spot market has to be explored as both of them show February excessive returns. Seasonality in the volatilities can also be studied by researchers..

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