

# Day-of-the-Week Effect and January Effect Examined in Sweet Crude Oil

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## Abstract

This study examined the day-of-the-week effect and January Effect in the crude oil returns for the period March 30<sup>th</sup> 1983 through October 12<sup>th</sup> 2012. The results of this study indicate the presence of the day-of-the-week effect in Crude Oil Markets. The results of this study also indicate that there may be a daily seasonality in the variance of oil returns. However, the findings of this study show that January effect in the crude oil market does not exist in the mean returns or variance.

## I. Literature Review

### Day-of-the-Week effect in Equity and Currency Markets

*Day-of-the-week effect* is a well-documented seasonal anomaly in the US equity, international equity and in foreign exchange markets. For example, Fama [1965] and Merrill [1966] show empirical evidence of the Calendar related anomalies in stock prices as early as mid-60s. According to the *day-of-the-week effect*, the daily returns in financial markets on different days of week are statistically not the same. Specifically, Mondays' returns are observed to be significantly negative, while Fridays' returns are found to be statistically positive. For example, Aggarwal and Rivoli [1989], Dyl and Maberly [1992], Kohli [1996], and Pettengill, Wingender and Kohli [2004] have found the existence of the *day-of-the-week effect* in the U.S. and in overseas equity markets. McFarland, Pettit, and Sung [1982] have investigated the *day-of-the-week effect* in one of the earliest studies in foreign exchange markets. MPS observed that the distribution of price changes on Mondays was different from the distribution of price changes on other days of the week. Interestingly, MPS findings indicate negative price changes on Fridays and positive price changes on Mondays which are opposite to general findings of the *weekend effect* in the equity markets. Similarly, Jaffe and Westerfield [1985, 1985] report a higher than average return on Wednesday and a lower than average return on Friday for all currencies. Yamori and Kurilhara (2004) report the presence of the *day-of-the-week effect* in some currencies in 1980s and absence of the effect in most currencies. Aydogan and Booth (2005) report presence of the *day-of-the-week effect* in Turkish and German Markets. Kohli [2004, 1995] explored seasonal anomalies in selected and dominant currencies. Ariel [1987] has found statistical evidence of a new monthly effect (returns in two halves of month are statistically different) in the US stock markets.

### January Effect in Equity and Currency Markets

In the economic and finance literature, *January Effect* is also reported in US equity, international equity and currency markets. McFarland, Pettit, and Sung [1982], Jaffe and Westerfield [1985, 1985] in some of the earliest studies of January Effect, report the presence of this seasonal anomaly in domestic and overseas equity markets. The *January effect* states that the mean monthly returns during month of January are greater than the mean monthly returns during any other month of a year. For example, Kohers and Kohli [1991] provided evidence of a robust *January effect* presence of in major international stock markets including the United States. Kohli [1996] observed presence of January Effect in the foreign exchange markets. In another article,

Kohli [1996] reported higher returns in month of January than the other months in international equity markets.

### Day-of-the-Week Effect in Gold and Silver Markets

Precious metals (Gold, Silver and Platinum) possess similar characteristics to money and medium of exchange and unit value (Goldman, 1956; Solt and Swanson, 1981; Dooley, Israd and Taylor, 1995). Ball, Torous and Tschoegl (1982) observed weekend effect in London fixing Gold prices from January 1975 through June 1979. Ma (1986) examined Gold markets and reports positive weekend returns prior to 1981 and negative Monday returns during the period 1981 through June 1985.

Lucey and Tully (2006) examined seasonality in the conditional and unconditional mean and variance of daily Gold and Silver contracts over the 1982–2002 periods. Using COMEX cash and futures data, they find weak evidence for the mean returns and strong evidence for the variance. They report negative Monday effect in both Gold and Silver, across cash and futures markets. Using a GARCH framework, they report that the Monday seasonal does not disappear, indicating that it is not a risk-related artefact, the Monday dummy in the variance equations being significant also.

Blose and Gondhalekar (2012) examined the Gold market for the period 1975 through 2011. They report that returns on the weekend are negative and significantly lower than the average returns during the week. They further examined the Gold weekend effect during bull and bear market phases. During bull markets, the difference between weekday and weekend returns is not significant. However, their findings show negative returns on the weekend which are significantly less than returns during the week during the bear market.

### January Effect in Gold Markets

Baur (2013) investigated monthly seasonal in Gold returns for each month from 1980 to 2010 and report that September and November are the only months with positive and statistically significant Gold price changes. This “autumn effect” holds unconditionally and conditional on several risk factors. Baur did not find monthly return pattern in the Silver prices. Coutts and Sheikh (2002) found no evidence of weekend effect or January effect on all Gold indexes on the Johannesburg Stock Exchange during the period 1987 through 1997.

The presence of the seasonal anomalies in stock markets, precious metal markets and foreign currency markets may seem to pose a challenge to the market efficiency. However, bad news informational delay by the companies until the weekend is most common explanation of the day-of-the-week effect in the markets. Pettengill, Wingender and Kohli [2004] found a slightly positive Monday in the stock markets in the decade of 1990. Therefore, the existing evidence suggests some risk-based reason for different returns on different days of the week in the stock markets.

The current study examines two calendar related seasonal anomalies (*Day-of-the-week effect and January effect*) in Sweet Crude Oil Markets over the period March 30th through

September 2012. This study examines both calendar related anomalies simultaneously and for recent and longer period. The results indicate presence of day-of-the week effect in crude oil markets, and absence of January effect in crude oil markets.

## II. Data and Methodology

The daily and monthly closing price data for Sweet Crude Oil are collected for the period March 30, 1983 through October 12, 2012 from the Bloomberg. The daily closing price is used to analyze day-of-the-week effect while monthly closing price is used to examine the January Effect in the above commodities.

The following methodology is commonly used for examining seasonal anomalies in equity markets of US equity markets, international equity markets and foreign exchange markets. This paper uses the same methodology for analyzing calendar related anomalies in crude oil markets.

### Day-of-the-Week Effect

Equation (1) is used to compute daily oil returns.

$$R_{it} = (P_{it} - P_{it-1}) / P_{it-1} \quad (1)$$

Where  $P_{it}$  and  $P_{it-1}$  are the closing oil prices on day<sub>t</sub> and day<sub>t-1</sub> respectively. The following equation (2) is used to test for the presence of the day-of-the-week effect in crude oil.

$$R_{it} = \beta_{iM} D_{iMt} + \beta_{iT} D_{iTt} + \beta_{iW} D_{iWt} + \beta_{iR} D_{iRt} + \beta_{iF} D_{iFt} + e_{it} \quad (2)$$

Where, the  $D_j$  terms are used to represent the process describing the mean return on any day of the week. For example,  $\beta_{iM}$  indicates the mean return on Monday. Similarly,  $\beta_{iT}$ ,  $\beta_{iW}$ ,  $\beta_{iR}$ , and  $\beta_{iF}$  represent mean daily returns on Tuesday through Friday respectively. If the mean return on any day is not significantly different than zero then estimates of  $\beta_{iM}$  through  $\beta_{iF}$  will be zero, and the F-statistic measuring the joint significance of dummy variables should be insignificant.

### January Effect

Monthly oil returns are calculated using the following equation (3).

$$R_{jt} = (P_{jt} - P_{jt-1}) / P_{jt-1} \quad (3)$$

Where  $P_{jt}$  and  $P_{jt-1}$  are the closing oil prices per barrel in US Dollars during month<sub>t</sub> and month<sub>t-1</sub> respectively. Next, the following equation (4) is used to test for the presence of the January effect in the oil markets.

$$R_{jt} = \beta_{jJ} D_{jJt} + \beta_{jF} D_{jFt} + \beta_{jM} D_{jMt} + \dots + \beta_{jD} D_{jDt} + e_{it} \quad (4)$$

Where  $R_{jt}$  is the average return during calendar month (j) for crude oil. Thus, the random variable to be tested is the  $R_{ij}$ . Where, the  $D_j$  terms are used to represent the process describing the mean monthly return in month of the year. For example,  $\beta_{jJ}$  indicates the mean monthly return

in January. Similarly,  $\beta_{jF}$ ,  $\beta_{jM}$  through  $\beta_{jD}$  represent mean monthly returns during February, March through December respectively. If the mean monthly return during any month is significantly different than zero then estimates of  $\beta_{jI}$  through  $\beta_{jD}$  will be zero, and the F-statistic measuring the joint significance of dummy variables should be insignificant.

### III. Results

#### Day-of-the-Week Effect

The results of the above analysis are reported in Tables 1, 2 and 5. Basic statistics shown in Table 1 indicate that the oil returns are negative on Monday and Tuesday; and positive on all other week days. Standard deviations of returns for Monday to Friday are 0.0258451, 0.0230691, 0.0242866, 0.0235518, and 0.0200302 respectively. Monday crude oil returns have the second highest kurtosis and highest skewness.

Table 2 shows the regression results for weekend effect in crude oil returns. For example, Mondays' mean daily oil returns are -0.0004 with p-value of 0.557, suggesting a probability of 55.7% that the mean daily oil returns on Monday are statistically zero. Similarly, mean daily returns on Tuesday, Wednesday, Thursday and Friday are -0.0006 (p-value 0.31), 0.00098 (p-value 0.10), 0.00094 (p-value 0.11), and 0.00116 (p-value 0.053) respectively. Overall F-value of the regression is 2.046 with significance level of (p-value 0.069) indicating that mean daily oil returns for different days of the week are statistically different from each other.

The analysis reported in Table 2 indicates presence of the day-of-the-week effect in crude oil returns. Specifically, the mean daily oil returns on Monday and Tuesday are negative but statistically insignificant while the daily returns on Wednesday through Friday are positive. The mean returns on Friday are statistically greater than zero. These results are in line with gold markets results reported by Ma (1986).

Table 5 shows the results for the presence of seasonality in second moment. We cannot reject the null of homogeneity of variance across days of the week in both Crude oil. The results in table 5 indicate that there may not be a daily seasonality in the variance of oil returns.

#### *January Effect*

The results of January Effect for Crude oil are reported in Tables 3 to 5. Basic statistics shown in Table 3 indicate negative monthly returns on crude oil for February (-0.006848, skewness -1.690); March (-0.000255, skewness -0.812), November (-0.016436, skewness -0.979); and December (-0.025498, skewness -0.368). While the remaining eight months of the year have positive returns and the average monthly crude oil return in April is the highest.

Table 4 shows the regression results for January effect in crude oil markets. The mean monthly return for April (0.041150) is significant at 5 percent while mean monthly return for May (0.033424) is significant at 10 percent. The overall F-value of 1.323 (p-value 0.203) shows absence of the January effect in oil markets. The monthly returns for April and May are statistically

positive, while mean returns for other months of the year are statistically insignificant. The results do not support presence of the January Effect in crude oil return during the analysis period.

Table 5 shows the results for the presence of seasonality in second moment. We cannot reject the null of homogeneity of variance across months of the year in crude oil. The results in table 5 indicate that there is no seasonality in monthly variance of oil returns.

#### **IV. Conclusion**

The analysis of the daily returns in Crude oil markets shows presence of day-of-the-week effect in crude oil markets. The mean daily returns in crude oil are significantly positive for Friday which is consistent with the common day-of-the-week effect in equity markets. Monday's daily return in crude oil is negative but statistically insignificant. The results of this study does not support presence of January effect in crude oil markets. The findings of this study indicate that there is no seasonality in monthly variance of crude oil.

The major trading in the crude oil markets is dominantly centered in the Middle East Countries where Friday is the weekly day-off. Hence, the crude oil trading on Saturday and Sunday in the OPEC countries may be causing insignificant Monday returns in the crude oil. However, positive Friday crude oil return is still a mystery because crude oil market is an international market with continuous trading throughout the world for 365 days a year.

Table 1: Moments of the Distribution by Day of the Week for Sweet Crude Oil					
March 30, 1983 through October 12, 2012					
Day	Mean	Std. Dev.	Kurtosis	Skewness	N
Monday	-0.00035	0.025945	8.191	0.331	1541
Tuesday	-0.000595	0.023069	7.324	-0.065	1541
Wednesday	0.000977	0.024286	3.862	-0.025	1541
Thursday	0.000939	0.023551	28.332	-1.775	1542
Friday	0.001155	0.02003	4.19	-0.113	1542

Table 2: Day-of-the-Week Effect Results for Sweet Crude Oil					
Data from March 30, 1983 through October 12, 2012					
Day	Unstandardized Coefficients		Standardized Coefficients	t-statistics for Unstandardized Coefficients	p-value* for Unstandardized Coefficients
	B	Std. Err.	Beta		
Monday	-0.0004	0.0006	-0.006685	-0.587051	0.55719
Tuesday	-0.0006	0.0006	-0.011353	-0.996975	0.31881
Wednesday	0.00098	0.0006	0.01863	1.636112	0.10186
Thursday	0.00094	0.0006	0.017908	1.572706	0.11583
Friday	0.00116	0.0006	0.022029	1.934599	0.05308
N	7,707		F-Value	2.046	0.069(Sig F**)

\*denotes probability that  $\beta_{ij} = 0$ ;  
\*\*denotes probability that  $\beta_{iM} = \beta_{iT} = \beta_{iW} = \beta_{iR} = \beta_{iF}$

Table 3: Moments of the Distribution by Month of the Year for Sweet Crude Oil					
March 1983 through September 2012					
Month	Mean	Std. Dev.	Kurtosis	Skewness	N
January	0.00405	0.080231	-0.373	0.03	29
February	-0.006848	0.101039	3.8	-1.69	29
March	-0.000255	0.100959	0.911	-0.812	29
April	0.04115	0.110718	1.495	0.539	29
May	0.033424	0.081763	-0.138	0.164	30
June	0.003557	0.105253	0.974	0.508	30
July	0.002786	0.07425	-0.026	0.224	30
August	0.020462	0.082175	3.069	0.768	30
September	0.023584	0.11073	2.897	1.432	30
October	0.013102	0.105538	2.572	0.927	30
November	-0.016436	0.097251	4.58	-0.979	29
December	-0.025498	0.09261	0.233	-0.368	29

Month	Unstandardized Coefficients		Standardized Coefficients	t-statistics Unstandardized Coefficients	p-value* Unstandardized Coefficients
	B	Std. Error	Beta		
January	0.00405	0.01782	0.01202	0.2273	0.82033
February	-0.0068	0.01782	-0.0203	-0.3843	0.70098
March	-0.0003	0.01782	-0.0008	-0.0144	0.98856
April	0.04115	0.01782	0.12208	2.30937	0.02152
May	0.03342	0.01752	0.10085	1.90781	0.05725
June	0.00356	0.01752	0.01073	0.20305	0.83921
July	0.00279	0.01752	0.00841	0.159	0.87377
August	0.02046	0.01752	0.06174	1.16793	0.24365
September	0.02358	0.01752	0.07116	1.34615	0.17915
October	0.0131	0.01752	0.03953	0.74785	0.45507
November	-0.0164	0.01782	-0.0488	-0.9224	0.35697
December	-0.0255	0.01782	-0.0756	-1.4309	0.15337
F-value	1.323	Sig F**	0.203	N=	354

\* denotes probability that  $\beta_{ij} = 0$ ;  
 \*\* denotes probability that  $\beta_{iJ} = \beta_{iF} = \dots = \beta_{iD}$

	Levene Stat	Significance
Day-of-the-Week Effect	2.108	0.147
January Effect	0.05	0.823

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