

## Test of Calendar Anomalies in Derivative Market of Pakistan in Context of Covid Environment

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### Abstract

*The aim of this study is to analyze impact and existence of three Calendar Anomalies i.e., day-of-the-week, month-of-the-year, and turn-of-the-month on the commodities i.e., gold, silver, natural gas, oil, and platinum that are traded on the Pakistan Mercantile Exchange (PMEX). The impact of calendar anomalies is investigated separately during and before COVID period. The simple OLS regression along with the three advanced models of Autoregressive Conditional Heteroskedasticity i.e., GARCH (1,1), TGARCH and EGARCH models are used in this research to study the calendar anomalies impact. The significant effect of day-of-the-week anomaly is observed in oil and silver commodity. Month-of-the-year anomaly exists in all commodities except oil. Whereas, significant turn-of-the-month effect is present in all the selected top traded commodities. This study is limited to different periods due to the newly launch commodities of PMEX. PMEX started daily data of silver, platinum, and natural gas from the year 2017, therefore only four commodities have been included in the current research.*

**Keywords:** Calendar Anomalies, Day-of-the-Week Anomaly, Month-of-the-Year Anomaly, Turn-of-the-Year Anomaly, COVID.

The term “efficient market” was first discovered by Fama (1965), showed the efficiency of market, and observed that prices of market completely indicate the possible information at any period. It further explained that markets are either efficient or inefficient based on the ideology of investors, which can be rational or irrational. Thus, the prices of the market can be predicted partially. The theory of efficient market is classified in three main categories i.e., weak form, semi strong form, and strong form. Similarly, Malkiel (1973), presented the random walk theory in support of an efficient market hypothesis and explained that the stock prices followed the random pattern or movement; therefore, it is impossible to anticipate its prices. In contrary to the theory of efficient market hypothesis, Thaler (1999) asserted that the inefficiency in the market caused by the irrationality which affects the prices in stocks. The investors and market participants get the increasing gains through abnormal returns where it is contradicting the assumptions of EMH theory.

Commodity market is considered as a separate class of an asset, where there is a high heterogeneity of assets as compared to the stocks and bonds. Commodity market is leading towards the correlation with low rate of returns when contrasted with the bond and stock markets (Johnson & Soenen, 1997). Furthermore, the real-world calendar anomalies existence and have been studied of the stock markets in different countries while in comparison, the mercantile exchanges are given less importance. Thus, the rationale of this research is to analyze the presence of calendar anomalies in the Mercantile Exchange of Pakistan (PMEX). Pakistan Mercantile Exchange Limited is the first future commodity market of Pakistan that is organized and licensed by the Security and Exchange Commission of Pakistan SECP. Its activities and operations began from 2007, May 11. Pakistan stock market has been studied more for calendar anomalies by researchers, but Pakistan Mercantile Exchange is given less importance because PMEX started its operations from the year of 2007 and launched new commodities by the time.

This research conducted on the three calendar anomalies i.e., Day-of-the-Week anomaly, Month-of-the-Year anomaly and Turn-of-the-Month anomaly that have been examined previously are the focused. Moreover, volatility of returns is also explored which determine whether they alter for a specific period or due to the instability in the PMEX incase seasonal patterns are present and even-if the widespread outbreak COVID 19 causes the seasonality in the

returns of commodities. The return pattern with respect to commodities in COVID 19 and significant differences in returns during pandemic COVID 19 from normal returns are investigated. The most traded commodities of the Mercantile Exchange of Pakistan i.e., gold, silver, platinum, natural gas, and crude oil have been taken to examine significant returns, its patterns, volatility, and calendar anomalies that affects the market. The data was taken from the period of 2014 to 2021 for Gold and Oil and from the duration of 2017 to 2021 for natural gas, oil, and silver from the broker of PMEX. To analyze such type of data, simple OLS regression and GARCH models are used to determine the return patterns. The purpose of this study is to include new commodities of the PMEX to investigate the impact of calendar anomalies, whether there exists any significant impact of calendar anomalies or not.

This research will help investors to analyze different commodities while making investment decisions because investors are always prone to find the ways to beat the market and take advantage of the anomalies (Dinesh & D'souza, 2021). Mainly hedgers trade in future market with the aim to reduce the possible risk they face from the trading in future market. The market inefficiency due to market anomalies can enable the investors to minimize the market risk. The unpleasant circumstances such as rapid increase in the prices of commodities in pandemic period can be avoided by hedging. The policies can be incorporated by the investors to attain abnormal profit, by investing in commodities in specific period. Decision making by investors are interlinked with the behavior of investors in calendar anomalies, so this study will provide opportunity to investors and portfolio managers to classify their investments properly after analyzing the fluctuations in the prices of commodities. (Faizan, Saeed, & Kausar, 2018).

Moreover, the COVID-19 pandemic period is employed to help the local and somehow foreign investors to group their assets in more appropriate portfolio management of derivative market. During the pandemic, there is an extreme fluctuation in the prices of commodities so temporary social isolation during pandemic period increased the ability of the investors to take better decisions in terms of investment. The sentiments of the investors such as liquidity and momentum are also interlinked with the returns that can partly mediate the COVID returns (Yahya, Shaohua, Abbas, & Waqas, 2021). This research will help government and PMEX for better implication and implementations of policies. The investors can invest or trade in the future market in pandemic more efficiently after exploring the calendar anomalies.

#### **Literature Review**

Garcia, Hudson, and Waller (1988) proved the inefficiency in the prices of agriculture commodities of future commodity market. Similarly, Narayan, Narayan, and Zheng (2010) concluded that the gold and oil markets are completely inefficient, where gold market is used for hedging approach against inflation by the investor and prices of gold market can be forecasted by the market of oil and inversely.

The day of the week effect was founded by Osborne (1962) in the market of US stock. Many other authors of 19 century followed his work i.e., (Cross, 1973; French, 1980; Gibbons & Hess, 1981; Jaffe, Westerfield, & Ma, 1989; Lakonishok & Levi, 1982; Rogalski, 1984; Wang, Li, & Erickson, 1997) found Monday with the lower mean returns in the market of US whereas Friday is considered with the higher and positive mean returns. Turn of the month anomaly (TOM) was first investigated by Ariel (1987) in the US equity market. The mean returns are observed to be high at the end of month and at the start of the next month. Furthermore, Lakonishok and Smidt (1988) investigated turn-of- the-month effect by focusing on the final trading day of one month and four trading days of next month. On the other hand, Ma (1986) examined the seasonality in the market of gold in pre 1981 era negative Tuesday and significant positive Wednesday was observed.

Lucey and Tully (2006) analyzed the seasonality using future data and COMEX cash, found negative Monday effect for cash gold, but for the market of futures seasonality is not identified. Moreover, the negative Monday is also present in the silver market and proved the daily seasonality and variations in the prices of silver. On the contrary, returns of Wednesday are significant and positive and showed effect of day-of-a-week anomaly in the silver market. Similarly, according to the study of Aksoy (2013) the day-of-the-week anomaly is found in the market of the Istanbul Gold Exchange (IGE) on two commodities silver and gold and only Monday and Friday turned out to be significant. The study by (M. Qadan, D. Y. Aharon, & R. Eichel, 2019a) found the impact of the day-of-the-week in 9 natural resources of New York Mercantile Exchange and concluded that the Friday is associated with the returns that are positive in copper, palladium, and gold and significant as well. Whereas the Monday showed the overall negative coefficient that are

significant for the heating oil and zinc. Furthermore, Quayyoun, Khan, Shah, Simonetti, and Matarazzo (2019) analyzed the existence of seasonal effect in the returns of Brent and Crude oil prices and found Monday with the negative returns, whereas returns of Thursdays are highest and significant as compared to the remaining days of the week for both markets that proceeded from the returns on Fridays. Findings proved the irrationality of investors and commodity prices are affected by sentiments and biases of investors. The traditional Monday effect is found in Brent oil. The news might reflect over the weekends that were published on weekdays, or the arrival of news caused seasonal variations in returns of oil. The work of (Jain, 2019a) investigated the existence of the anomaly i.e., day-of-the-week effect in the market of India the Multi Commodity Exchange for commodities gold and crude oil where Mondays showed the higher returns for the gold future while Wednesday, turned out to be a day with the lowest returns. Whereas recently Li, Zhu, Wen, and Nor (2022) identified day-of-the-week anomaly in crude oil and analyzed that the abnormal positive return on Wednesdays due to the inventory shock schedule. Findings proved that sometimes on Monday, abnormal negative returns vanished by the reactions of good sentiments.

According to the research of Qadan et al. (2019a) turn-of-the-month effect exists significantly in the less common commodities like palladium, copper, and platinum whereas significant negative returns were observed by natural gas and in heating oil. The returns of the market are higher in each month during the first few trading days by taking the trading last day of each month and the three successive days of the first week of the coming month. On the other hand, Compton, Kunkel, and Kuhlemeyer (2013) investigated the impact of Turn-of-the-Month anomaly in stocks and bonds market of the USA and the Russian Federation. Where, significant TOM effect has been identified. Comparable with a study conducted by Kumar (2015) examined the turn-of-the-month anomaly in the market of currency of India and the turn-of-month anomaly was observed by taking the ending day of trading from the prior month and the first three days from the later month as the turn-of-the-month days. Moreover, Chhabra and Gupta (2022) analyzed the impact of turn of the month effect in aluminum, zinc, and nickel, whereas significant and negative effect was observed in natural gas and concluded that calendar anomalies occurred in energy-based commodities rather than metals.

Qi and Wang (2013) analyzed the monthly effect in returns of Chinese gold and found the returns of the month of February, April, August, and November showed the higher effect in comparison to the other months of the year. This is because of the increase in demand of products like gold before the public 7 days' holidays. However, Musunuru (2013) examined the month-of-the-year anomaly through GAARH models on fourteen different commodities of different U.S commodity market. From eight out of fourteen commodities, mean monthly return for January is negative and significant only for oats. In commodities like corn, coffee, rough rice, soybeans, soybeans, positive shocks of returns can cause more volatility whereas negative shocks presented no effect of leverage. The research by Quayyoun et al. (2019) analyzed the effect of month-of-the-year and found negative coefficients in the month of November and December for both markets and the traditional January effect is absent. The work of Jain (2019a) investigated the impact of the month-of-the-year anomaly for gold and crude oil and the returns of August for gold futures tuned-out to be the highest among all other month of the year whereas crude oil shows no significant monthly anomaly.

Salisu, Akanni, and Raheem (2020) examined the prices of commodity predictability and found positive relationship in the returns of commodity prices and the global fear index proved that in pandemic COVID 19, the returns of the commodities increased as the fear related to COVID 19 increases. Furthermore, according to Meher, Hawaldar, Mohapatra, and Sarea (2020) the volatility of the price of natural gas and crude oil commodities of Multi Commodity Exchange of (MCX) showed asymmetric volatility because of the news of pandemic COVID-19 affected the prices of crude oil and the leverage effect is formed, but price volatility is not found in natural gas.

### **Research Methodology**

This research has utilized daily data of five top traded commodities from PMEX. The research evaluated the pre- and during-pandemic COVID 19 effect and volatility changes on the return of the commodities. The data of gold and oil started from January 1, 2014, to April 7, 2021, whereas the data of silver, platinum and natural gas has been taken from March 3, 2017, to April 7, 2021. The data of platinum, silver and natural gas started from the year of 2017 because PMEX started daily trading in these commodity contracts from the year of 2017. Moreover, for gold and oil the years of 2014 to 2019, whereas, for platinum, silver, and natural gas the years of 2017 to

2019 has been taken to study the impact before COVID period. Considering the data from January 1, 2020, till April 2021 has been taken to analyze the during COVID period because in Pakistan the first COVID case was reported in the start of 2020.

Commodity returns are dependent variable that is measured with help of the natural logarithm formula that is used by previous studies (Musunuru, 2013; Quayyoun et al., 2019).

$$R = \text{Ln}(p_t/p_{t-1})$$

In formula, 'R' represents the returns on the commodities, 'Ln' is the indication of natural logarithm,  $p_t$  signifies the current closing prices of the commodities,  $p_{t-1}$  represents the previous day closing prices of the commodities. The day and month dummy variables are created based on 0 and 1 to measure the three calendar effects. Simple linear regression model (OLS) along with other models of GARCH family i.e., GARCH (1,1), TGARCH and EGARCH models are used to identify the calendar anomaly effect. Simple linear regression (OLS) is used as done in prior studies (Jain, 2019b; Qadan et al., 2019a; Quayyoun et al., 2019). However, Engle (1982) developed the autoregressive conditional heteroscedasticity model. Comparing both models, OLS model can capture only the mean returns while ARCH model is specifically designed to identify the volatility in the stock and commodity market.

The GARCH (1,1) model was developed by Bollerslev (1986) which is commonly used and dependent upon the assumption that predicts the time varying variance relying on the variance of lagged of the stock or commodity. GARCH (1,1) gives the results of conditional mean and conditional variance together used by (Aksoy, 2013; Musunuru, 2013; Qadan et al., 2019a; Qi & Wang, 2013). However, TGARCH model of conditional standard deviation was first applied by Glosten, Jagannathan, and Runkle (1993), as the GARCH model is the updation of ARCH and used by many researchers, but it still lacks the efficiency in managing the financial time series. Whereas, TGARCH is capable of capturing the movement of negative shocks more accurately due to its large impact on volatility as compared to GARCH model. Moreover, the EGARCH model was first applied by Nelson and Cao (1992) and can grab the asymmetries and incorporated in order to capture the unequal changes of volatility.

#### Day-of-the-Week Anomaly

The equations of OLS, GARCH (1,1), EGARCH and TGARCH for day-of-the-week anomaly are:

$$\begin{aligned} R &= \alpha + \beta_1 D1 + \beta_2 D2 + \dots + \beta_4 D4 + \varepsilon \\ \sigma^2 &= \omega + \alpha \varepsilon - 12 + \beta \sigma - 12 + \gamma * D(\text{Monday}) + \dots + D(\text{Friday}) \\ \ln(\sigma^2) &= \omega + \beta \ln(\sigma - 12) + \gamma \varepsilon - 1 \sigma - 1 + \alpha |\varepsilon - 1| \sigma - 1 + \theta * D(\text{Monday}) + \dots \delta \\ &\quad * D(\text{Friday}) \\ \sigma^2 &= \omega + \alpha \varepsilon - 12 + \gamma \varepsilon - 12 I_t - 1 + \beta \sigma - 12 + \theta * D(\text{Monday}) + \dots \delta * D(\text{Friday}) \end{aligned}$$

If the day-of-the-week effect is present, it will reject the null hypothesis. In the above equations,  $\beta$  indicates the mean returns for five days, and D is representing the dummy variables that have been generated for the days. Here, D1 to D5 is equal to 1, if the presence of mean daily returns occurred on that specific day, otherwise it is indicated as 0. The mean daily returns exist and vary in different days indicates the existence of anomaly.

#### Month-of-the-Year Anomaly

The equations of OLS, GARCH (1,1), EGARCH and TGARCH for month-of-the-year anomaly are:

$$\begin{aligned} R &= \alpha + \beta_1 D1 + \beta_2 D2 + \dots + \beta_{11} D11 + \varepsilon \\ \sigma^2 &= \omega + \alpha \varepsilon - 12 + \beta \sigma - 12 + \gamma * D(\text{Jan}) + D(\text{Feb}) + \dots + D(\text{Dec}) \\ \ln(\sigma^2) &= \omega + \beta \ln(\sigma - 12) + \gamma \varepsilon - 1 \sigma - 1 + \alpha |\varepsilon - 1| \sigma - 1 + \theta * D(\text{Jan}) + D(\text{Feb}) + \dots \\ &\quad + D(\text{Dec}) \\ \sigma^2 &= \omega + \alpha \varepsilon - 12 + \gamma \varepsilon - 12 I_t - 1 + \beta \sigma - 12 + \theta * D(\text{Jan}) + D(\text{Feb}) + \dots + D(\text{Dec}) \end{aligned}$$

In the above equation,  $\beta$  signifies the coefficients that are representing the mean daily returns that are produced in each month. D1 to D12 represents the dummies of twelve months of the year where if the specific month generate the returns, then it is indicated by 1 otherwise 0. Error term is also present. If the returns are generated in the specific month; it will reject the null hypothesis.

#### Turn-of-the-Month Anomaly

The equations of OLS and GARCH (1,1) for turn-of-the-month anomaly are:

$$R = \alpha + \beta \text{DTOM} + \varepsilon$$

$$\sigma^2 = \omega + \alpha \varepsilon - 12 + \beta \sigma - 12 + \gamma * D(\text{TOM})$$

The turn-of-the-month anomaly period in this research is taken as the first five and last five trading days present in the month. It is represented as  $\pm 5$ , where last five days vary for each month. In the above equation, the dummy variable TOM becomes 1 when the returns occur in that specific period otherwise it is signified as 0. Error term is also defined in it.

### Descriptive Statistics

Table 1 shows the descriptive statistics of day and month dummies that are processed on the returns of the selected commodity of this research.

## Data Analysis and Results

Table 1. Descriptive Statistics

Gold Returns								
Variable	Dummy	# Obs	Mean	Minimum	Maximum	S. D	Skew	Kur
Friday	D1	370	0.00084	-0.03638	0.04581	0.00909	-0.14336	6.34555
Monday	D2	375	-0.00024	-0.04681	0.03766	0.00866	-0.17973	7.18378
Thursday	D3	376	0.00034	-0.03584	0.04047	0.00860	0.47127	5.50659
Tuesday	D4	377	-0.00006	-0.05883	0.04535	0.00885	-0.53607	10.12011
Wednesday	D5	377	0.00005	-0.03690	0.02376	0.00828	-0.37777	4.15784
Silver Returns								
Friday	D1	208	0.00000	-0.07071	0.05308	0.01594	-0.92524	7.06509
Monday	D2	212	0.00091	-0.13119	0.07822	0.01880	-1.39818	17.22824
Thursday	D3	214	-0.00026	-0.05896	0.07385	0.01555	0.93906	8.60300
Tuesday	D4	212	-0.00041	-0.16130	0.07505	0.02024	-2.13771	23.69286
Wednesday	D5	212	0.00136	-0.06951	0.07795	0.01609	-0.15527	7.09966
Platinum Returns								
Friday	D1	208	-0.00055	-0.05565	0.04144	0.01446	-0.52019	4.48794
Monday	D2	212	0.00100	-0.13600	0.05376	0.01875	-1.70678	16.45178
Thursday	D3	214	-0.00192	-0.12045	0.03489	0.01564	-2.30921	17.94125
Tuesday	D4	212	0.00143	-0.06320	0.09859	0.01622	0.66810	9.94331
Wednesday	D5	212	0.00115	-0.05821	0.05379	0.01588	-0.14397	4.30422
Oil Returns								
Friday	D1	372	0.00065	-0.09971	0.15384	0.02326	0.63587	9.08986
Monday	D2	375	-0.00372	-0.31622	0.11836	0.03162	-3.66853	35.27370
Thursday	D3	377	0.00086	-0.07857	0.18730	0.02581	2.03350	16.20049
Tuesday	D4	377	-0.00065	-0.43511	0.16012	0.03267	-5.86662	86.64605
Wednesday	D5	377	0.00167	-0.17209	0.12037	0.02669	-0.15026	8.87816
Natural Gas Returns								
Friday	D1	208	0.00150	-0.08767	0.11558	0.02422	0.30750	5.74052
Monday	D2	212	0.00218	-0.10476	0.26378	0.04069	1.49574	11.00708
Thursday	D3	214	-0.00500	-0.18390	0.07630	0.02946	-1.23527	10.23202
Tuesday	D4	212	0.00160	-0.10110	0.12423	0.02744	0.20212	5.94649
Wednesday	D5	212	-0.00099	-0.06746	0.17377	0.02728	1.95606	14.09745

The highest mean value of the oil and silver returns were recorded on Wednesday. Whereas, for gold, platinum and gas commodity, the highest mean returns were observed on Friday, Tuesday, and Monday, respectively. Similarly, the months also showed the positive and negative trend on the returns of commodities. Highest mean returns for silver and platinum were recorded for the month December. Whereas, for gold, oil and gas, the highest mean returns were observed in January, April, and August.

### Diagnostics

Table 2 shows the results of the diagnostic tests used to evaluate the impact of normality and autocorrelation in the commodities returns. The ARCH LM test is indicating that ARCH effect in the commodities returns is present. Akaike information criterion and Bayesian information criterion represents that the model is best fit. The p value of dickey fuller test signifies that the returns are stationary and further GARCH model can be applied.

Table 2. Diagnostic Tests and Model Selection Criterion

Commodity	AIC	BIC	Sk Test	Wn test	ARCH LM	Dickey Fuller
Gold	-12466.02	-12438.34	0.0000	0.9158	0.0297	-39.39***
Silver	-5561.624	-5536.804	0.0000	0.0691	0.0011	-31.17***
Platinum	-5708.924	-5684.104	0.0000	0.0032	0.0057	-30.28***
Oil	-8062.376	-8034.687	0.0000	0.0000	0.0000	-41.42***
Gas	-4386.193	-4361.372	0.0000	0.0003	0.0000	-37.24***

This study is based on quantitative in nature because the time series data from 2007 to 2016 was extracted from PSX – 100 index. Purpose of the study is to test the hypothesis developed from the existing literature that do stock market follow the momentum effect in Pakistan stock market of PSX-100 Index or not. This study considered the top 100 companies listed in Pakistan stock market i.e. PSX – 100. The study took top and bottom 25 consistent stocks as a sample for analysis. The basic indicator for the top and bottom stocks was share price return. Daily share prices of top 100 listed companies were considered for the formation of portfolios and analysis. There are many other tools or software’s are available that may be used for the analysis but for this study researcher used a special ASM (A STATA PROGRAM FOR MOMENTUM) software for measuring momentum effect.

**Results for Day-of-the-week anomaly**

Table 3 shows the results of four different models of day-of-the-week anomaly. In this research, the significant negative mean returns are identified on Monday, so there is an existence of day-of-the-week anomaly in silver commodity aligned with the prior researcher (Lucey & Tully, 2006). Thus, null hypothesis is rejected according to the results of GARCH (1,1) and TGARCH model in complete sample period (i.e. before COVID period). Furthermore, oil commodity is significant with negative Monday mean returns, thus rejected the null hypothesis according to the results of all models before COVID period, consistent with several prior studies (M. Qadan, D. Y. Aharon, & R. J. R. P. Eichel, 2019b; Quayyoun et al., 2019). Whereas, during COVID period oil and gas showed the significant Day-of-the-week impact on Monday with negative and positive mean returns by using the method of simple OLS and GARCH (1,1) regression. No impact of day-of-the-week was identified in the specific COVID period through all the used models in this study.

Only OLS capture the negative significant Monday only in crude oil. The crude oil has severely been impacted during the pandemic period due to the complete lockdown imposed by the government that increased the travelling restrictions. As a result, there is a massive decline in the prices of oil commodity and fall in demand and supply. The extreme fluctuations and shocks in oil market led the investors to earn abnormal profits (Mezghani, Hamadou, & Abbes, 2021). However, metals like gold, silver and platinum also faced the declining trend in the prices but they are least affected as compared to oil and gas (Rajput et al., 2021).

Table 3. Summary of Results of Day of the Week Effect (Regression, GARCH (1,1), GJR-GARCH, TGARCH, EGARCH)

Simple Linear Regression for Day-of-the-week anomaly						
Complete Period		Before COVID		During COVID		
Commodities	Days	Returns	Days	Returns	Days	Returns
Silver	No Impact		Thursday	(-)		No Impact
Platinum	Thursday	(-)	No Impact			No Impact
Oil	Monday	(-)	Monday	(-)	Monday	(-)
Gas	No Impact		No Impact		Monday	(+)
GARCH (1,1)						
Silver	Monday	(-)	Monday	(-)		
	Tuesday	(-)	Wednesday	(+)		
	Wednesday	(+)	Thursday	(-)		No Impact
	Thursday	(-)				
Oil	Monday	(-)	Monday	(-)		No Impact
Gas	No Impact		No Impact		Monday	(+)
TGARCH						
Silver	Monday	(-)	Wednesday	(+)		
	Wednesday	(+)	Thursday	(-)		No Impact

	Thursday	(-)			
<b>Oil</b>	Monday	(-)	Monday	(-)	
<b>EGARCH</b>					
<b>Silver</b>	Tuesday	(-)	Wednesday	(+)	
	Wednesday	(+)	Thursday	(-)	No Impact
<b>Oil</b>	Monday	(-)	Monday	(-)	

**Results for Month-of-the-year anomaly**

Table 4 shows the results of four different models for month-of-the-year anomaly of complete, before and during COVID period. Traditional January effect is present in the gold commodity with the highest mean returns. Month-of-the-year anomaly is observed in gold commodity. The positive mean returns in January for gold is due to the tax loss selling and high trading volume because investors sell the commodities that are traded for almost less than a year and at first bought in the December to realize a loss (Kaiser, 2019). For silver, the null hypothesis is rejected, because month-of-the-year anomaly is identified in months.

Table 4. Summary of Results of Month of the year effect (Regression, GARCH (1,1), GJR-GARCH, TGARCH, EGARCH)

<b>Simple Linear Regression for Month-of-the-year anomaly</b>						
<b>Complete Period</b>			<b>Before COVID</b>		<b>During COVID</b>	
<b>Commodities</b>	<b>Month</b>	<b>Returns</b>	<b>Month</b>	<b>Returns</b>	<b>Month</b>	<b>Returns</b>
Gold	Jan, April, June, Aug, Sep, Dec	(+,+,+,+,-,+)	Jan, Feb, June, Aug, Dec	(+,+,+,+,+)	July	(+)
Silver	Jan, May, July, Aug, Sep, Oct, Dec	(+,+,+,+,-,+)	Aug, Dec	(+,+)	April, May, July, Oct, Dec	(+,+,+,+,+)
Platinum	December	(+)	January	(+)		
Oil	No Impact		No Impact		May	(+)
Gas	December	(-)	December	(-)		
<b>GARCH (1,1)</b>						
Gold	Jan, June, Dec	(+,+,+)	Jan, Feb, June, Aug, Dec	(+,+,+,+,+)	No Impact	
Silver	Jan, May, July, Sep, Dec	(+,+,+,+,-,+)	Jan, Aug, Sep, Dec	(+,+,-,+)	May, July	(+,+)
Platinum	December	(+)	Jan, Sep, Dec	(+,-,+)	No Impact	
Oil	No Impact		July	(-)	Feb, May, Sep, Nov	(+,+,-,+)
Gas	December	(-)	Jan, Dec	(+,-)	April, Aug	(+,+)
<b>TGARCH</b>						
Gold	Jan, April, June, Dec	(+,+,+,+)	Jan, Feb, June, Aug, Dec	(+,+,+,+,+)	No Impact	
Silver	Jan, May, July, Sep, Dec	(+,+,+,+,-,+)	Jan, Aug, Dec	(+,+,+)	April, May, July, Oct, Dec	(+,+,+,+,+)
Platinum	Nov, Dec	(+,+)	Sep, Dec	(-,+)	No Impact	
Oil	No Impact		July	(-)	March, May, Dec	(-,+,-,+)

Gas	December	(-)	January, December	(+,-)	August	(+)
<b>EGARCH</b>						
Gold	Jan, April, June, Aug, Dec	(+,+,+,+,+)	Jan, Feb, April, June, Aug, Dec	(+,+,+,+,+,+)	No Impact	
	Jan, March	(+,+)	Jan, August	(+,+)	No Impact	
Silver	May to Oct	(+,+,+,+,- ,+)	Sep, Dec	(+,+)		
	December	(+)				
Platinum	Nov, Dec	(+,+)	December	(+)	No Impact	
Oil	No Impact	No Impact	July, Nov	(-,-)	May, Sep, Nov, Dec	(+,-,+,- ,+,+)
Gas	December	(-)	December	(-)	August	(+)

With gold and silver commodities investors are more familiar so they can take advantage from the anomaly present in these metals. December with highest mean returns is considered for silver, consistent with the previous study of Kohli (2012). Natural gas is also significant in December and consistent with the result of Borowski (2016). The null hypothesis is also rejected for platinum because significant month-of-year is observed in this commodity aligned with the study of (Jain, 2019a). Before and during COVID period, Crude oil showed negative significant impact of month-of-the-year only in one month i.e., July in before COVID period and in February, May, September, November, and December in during COVID. Due to tax loss selling occurred in November and December, positive returns were observed. No month-of-the-year anomaly was identified in the silver, platinum, and gold commodity during COVID period through EGARCH models and the impact of MOY disappeared from the Platinum Commodity during COVID period. However, the commodities like platinum and gas have positive returns in April and August because investors invest in these commodities and invest in other assets like stocks and bonds than gold.

#### Results for Turn-of-the-Month anomaly

Table 5 shows the results of four different models for turn-of-the-month anomaly of complete sample period. Significant TOM effect was identified in gold, silver, platinum, oil, and gas returns in the first four and last five trading days of the month through all the studied models.

The significant TOM effect with positive returns and oil and natural gas showed the negative significant returns and impact of turn-of-the- month which is consistent with the study of Qadan et al. (2019a). Turn-of-the-month effect showed in all the selected commodities where there is a significant chance that investors make abnormal returns during the first four and last five trading days of the month, thus rejecting the null hypothesis.

However, September is the only month with significant negative mean returns at 5% and 10% level for different commodities except for gas. Less famous commodity platinum showed significant TOM effect identified in gold, silver, platinum, oil, and gas returns in the first four and last five trading days of the month through all the models studied.

Table 5: Summary of Results of Turn of the month Effect (Regression, GARCH (1,1), GJR-GARCH, TGARCH, EGARCH)

<b>Simple Linear Regression for Turn-of-the-Month anomaly</b>			
<b>Complete Period</b>			
Commodities	Days	Months	Returns
<b>Gold</b>	4-Jan	Jan	(+)
	25-31	April, July, Aug, Sep, Nov	(+,+,+,+)
<b>Silver</b>	4-Jan	Sep	(+)
	25-31	Aug, Dec	(+,+)
<b>Platinum</b>	4-Jan	Dec	(+)



	25-31	Aug, Dec	(+,+)
<b>Oil</b>	4-Jan	April	(+)
<b>Before COVID Period</b>			
<b>Gold</b>	25-31	Jan, April, June, July, Aug, Dec	(+,+,+,+,+)
<b>Silver</b>	4-Jan	Feb, March, July, Aug, Sep, Nov	(+,+,+,+,-,+)
	25-31	Jan, May, July, Aug, Sep, Dec	(+,+,+,+,-,+)
<b>Platinum</b>	25-31	Feb, June, Aug, Sep, Oct, Dec	(+,+,+,-,+)
<b>Gas</b>	25-31	Oct	(+)
<b>During COVID Period</b>			
<b>Gold</b>	7-Jan	Aug	(+)
<b>Silver</b>	7-Jan	April, Aug, Nov	(+,+,+)
	7-Jan	April, Aug, Nov, Dec	(+,+,+,+)
<b>Platinum</b>	25-31	Jan, Feb, March, Sep, Oct	(-,,-,+,-)
<b>Oil</b>	7-Jan	April, May	(+,+)
<b>Gas</b>	25-31	Jan, Feb, Sep	(-,,-,+)

#### GARCH (1,1)

<b>Complete Period</b>			
<b>Commodities</b>	<b>Days</b>	<b>Months</b>	<b>Returns</b>
<b>Gold</b>	4-Jan	March	(+)
	25-31	Jan, April, July, Aug, Sep, Dec	(+,+,+,+,-,+)
<b>Silver</b>	4-Jan	Jan, Feb, April, May, July, Sep, Oct, Nov, Dec	(+,-,+,+,+,-,+)
	25-31	Jan, May, Aug	(+,+,+)
<b>Platinum</b>	4-Jan	June, Dec	(+,+)
	25-31	June	(+)
<b>Oil</b>	4-Jan	Jan, Nov	(+,+)
	25-31	Nov	(-)
<b>Gas</b>	4-Jan	Dec	(-)
	25-31	Jan, May, Sep, Nov, Dec	(-,,-,+,-)

#### Before COVID Period

<b>Gold</b>	25-31	Jan April, July, Aug, Dec	(+,+,+,+,+)
<b>Silver</b>	4-Jan	March, May, July, Nov	(+,+,+,+)
	25-31	Jan, March, May, July, Aug, Sep, Dec	(+,+,+,+,+,-,+)
<b>Platinum</b>	4-Jan	March, July, Dec	(+,-,+)
	25-31	June, July, Aug, Dec	(+,+,+,+)
<b>Oil</b>	25-31	Nov	(+)
<b>Gas</b>	25-31	Oct	(+)

#### During COVID Period

<b>Gold</b>	25-31	Feb	(+)
<b>Silver</b>	7-Jan	April, Aug, Nov	(+,+,+)
	25-31	Feb	(-)
<b>Platinum</b>	7-Jan	April, Aug	(+,+)
	25-31	Jan, Feb, March, April, May, Aug, Sep, Oct	(-,,-,-,-,+,-)
<b>Oil</b>	7-Jan	May, Aug	(+,+)
	25-31	Feb, April	(-,,-)
<b>Gas</b>	7-Jan	Aug, Nov, Dec	(+,-,-)
	25-31	Jan, Feb	(-,,-)

#### TGARCH

<b>Complete Period</b>			
<b>Commodities</b>	<b>Days</b>	<b>Months</b>	<b>Returns</b>
<b>Gold</b>	25-31	Jan, April, July, Aug, Sep	(+,+,+,-)
<b>Silver</b>	4-Jan	Feb	(-)
	25-31	Jan, July, Aug	(+,+,+)
<b>Platinum</b>	4-Jan	Jan, March, April, May, June, Aug, Sep, Oct,	(+,+,+,+,+,+)
	25-31	Nov, Dec	(+,+,+,+,+)
<b>Oil</b>	4-Jan	Jan, Aug, Nov	(+,+,+)
	25-31	Nov	(-)

<b>Gas</b>	25-31	Jan, Feb May, Sep, Nov, Dec	(-, -, -, +, -, -)
<b>Before COVID Period</b>			
<b>Gold</b>	25-31	Jan, April, June, July, Aug, Dec	(+, +, +, +, +, +)
<b>Silver</b>	4-Jan	March, July, Oct	(-, -, -)
	25-31	Jan, March, May, July, Aug, Dec	(+, +, +, +, +, +)
	4-Jan	March, July, Dec	(-, -, +)
<b>Platinum</b>	25-31	June, July, Aug, Nov, Dec	(+, +, +, +, +)
<b>Oil</b>	25-31	Aug, Nov	(+, -)
<b>Gas</b>	25-31	Oct, Nov, Dec	(+, +, +)
<b>During COVID Period</b>			
<b>Gold</b>	7-Jan	Jan, April, Aug	(+, +, +)
	25-31	Feb	(-)
<b>Silver</b>	7-Jan	April, Aug, Nov	(+, +, +)
	25-31	Feb	(-)
<b>Platinum</b>	7-Jan	Jan, April, Aug, Sep, Nov	(+, +, +, -, +)
	25-31	Jan, Feb, March, April, May, Aug, Sep	(-, -, -, -, -, -, +)
<b>Oil</b>	7-Jan	May	(+)
	25-31	Feb, April	(-, -)
<b>Gas</b>	7-Jan	Aug, Nov, Dec	(+, -, -)
	25-31	Jan, April, June, Aug, Sep, Nov, Dec	(-, -, -, -, +, -, -)
<b>EGARCH</b>			
<b>Complete Period</b>			
<b>Commodities</b>	<b>Days</b>	<b>Months</b>	<b>Returns</b>
<b>Gold</b>	4-Jan	March, Dec	(+, +)
	25-31	April, July, Aug, Sep, Dec	(+, +, +, -, +)
<b>Silver</b>	4-Jan	Feb, April	(-, -)
	25-31	May, June, July, Aug, Sep, Dec	(+, +, +, +, -, +)
<b>Platinum</b>	4-Jan	June, Dec	(+, +)
	25-31	June, Sep	(+, -)
<b>Oil</b>	4-Jan	Jan, Nov	(+, +)
	25-31	Nov	(-)
<b>Gas</b>	25-31	Jan, Sep	(-, +)
<b>Before COVID Period</b>			
<b>Gold</b>	25-31	Jan, April, July, Aug, Dec	(+, +, +, +, +)
<b>Silver</b>	4-Jan	April, Nov	(-, -)
	25-31	Jan, Feb, March, May, June, Aug, Nov, Dec	(-, -, -, -, -, -, -)
<b>Platinum</b>	25-31	March, May, June, Aug, Nov	(+, +, +, +, +)
<b>Oil</b>	25-31	Nov	(-)
	4-Jan	May, Dec	(-, -)
<b>Gas</b>	25-31	Jan, Feb, March, April, May, June, July, Aug, Oct, Nov, Dec	(+, +, +, +, +, +, +, +, +, +, +)
<b>During COVID Period</b>			
<b>Gold</b>	25-31	Jan, March, May, Sep	(+, +, +, +)
<b>Silver</b>	7-Jan	Jan, March, April, Aug, Sep	(+, +, +, +, -)
<b>Platinum</b>	7-Jan	Feb, March, April, Aug, Sep, Dec	(+, +, +, +, -, +)
	25-31	Jan, Feb, April, May, Aug, Sep	(-, -, -, -, -, +)
<b>Oil</b>	7-Jan	April, May, Aug, Sep, Dec	(+, +, +, -, +)
	25-31	Jan, April, Sep, Dec	(-, -, +, -)
<b>Gas</b>	7-Jan	March, Aug, Nov, Dec	(-, +, -, -)
	25-31	Jan, April, Aug, Sep, Nov, Dec	(-, -, -, +, -, -)

Thus, turn-of-the-month anomaly is significantly identified in all the selected commodities of PMEX is this research before COVID period. However, during COVID period, the significant TOM effect is detected in the first and last five trading days of silver in the months through OLS, GARCH (1,1) and TGARCH and EGARCH model. In the same way, all other commodities showed the significant turn-of- the-month effect on the returns.

This study aims to get an answer what impact reveals by the selected stocks of Pakistan stock exchange 100 index and to test hypotheses there is no momentum effect exist in Pakistan stock exchange of 100-index. Table 3 is about 16 momentum strategy with overlapping holding period. Table 3 is based on 16 momentum strategies with formation and holding period which show where momentum effects exist in PSX. Momentum effect is not present in all winner's firm some of the strategies of winner stocks have a negative return but in overall basis study can say momentum effect is present on average in Pakistan stock exchange in PSX-100 index.

#### **Conclusion and Future Research Directions**

There is a considerable evidence of calendar anomalies in the future market of Pakistan showing that the investors can earn abnormal profit and abnormal returns on the commodities. PMEX, however started its functions in 2007, but this market is not efficient and clearly contradicting the theory of efficient market hypothesis. All the three identified anomalies proved the rational behavior of investors and their behavior according to the market movements.

The day-of-the-week effect is identified in the oil and silver commodity because there is a huge fluctuation in the prices of oil as compared to the gold. Most of the investors consider gold as a safe haven as the prices of the gold do not fluctuate continuously. Furthermore, negative Monday effect in oil can be observed due to the arrival of news in the market which is similar with the prior studies (Lucey & Tully, 2006; Quayyoun et al., 2019). Moreover, the same negative trend of Monday returns has been followed in the COVID period and before the COVID period indicates that COVID period do not stop the investors from earning abnormal returns. Traditional January effect is also present in gold where, the highest mean returns were observed in it. This is indicating that the impact of tax loss selling, or the effect bonuses at the year-end do not only cause the stock market to generate abnormal returns but it also effects the mercantile exchange. In the complete timeframe of the study, the anomaly in the returns of oil vanished but it reappeared in the COVID period. The turn-of-the-month effect varied according to the commodity, where each commodity showed the presence of this effect.

The study by Tang and Xiong (2012) argued that the prices of commodity correspond with each other. The financialization of commodities explained that the price of individual commodity cannot be determined by its demand and supply and the number of commodities have been increased and added in the investor's portfolio which can boost the trading volume of products like natural resources. Moreover, around 2008 there is a large expansion in the volatility of prices for the commodities of non-energy resources. Furthermore, Aharon and Qadan (2018) determined the effect of investors' confidence, their sentiments, effect the announcements that happened in the macroeconomic world and total economic uncertainty in the prices of commodities like gold, oil, palladium, zinc, silver, copper, and platinum. The shocks in the prices of commodities persuade investors to search for more information. In addition to this, the possible day of the week effect showed that the investors' demand for information vary and deviated towards weekdays. The information privately assessable all over the week, on the other hand, public information is available on weekdays induces the investors to become careful with the changes at the starting of the week and the variance in the changes of prices are higher at the starting or opening of the week rather in the ending of the week when the trading is closed. The results are stronger for the common and familiar commodities and not strong or weak for less common products like copper and platinum, etc. According to Shahid, Latif, Chaudhary, and Adil (2020), there is a significant presence of seasonality and volatility can be identified on the returns of commodity. Other commodities of PMEX cannot be included in this research due to unavailability of data. Future recommendation for this research would be to analyze the other calendar effects and volatility in returns that causes the investors to earn abnormal profits. Some other calendar anomalies like week-of-the-month or turn-of-the-year can be included in the research.

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