Research Journal of Finance and Accounting
ISSN 2222-1697 (Paper) ISSN 2222-2847 (Online)
Vol.5, No.19, 2014 

# Presence of Day-of-the-Week Effect in the Karachi Stock Market

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**Abstract**
This study investigates the day-of-the week (DOW) effect and volatility in Karachi Stock Exchange (KSE), from 2009-2013, using all four indices in the exchange. The objective is to assess the reliability of the four indices working at KSE, from investor perspective of portfolio and risk management of KSE. By using OLS and autoregressive technique with lagged value of returns the study shows Tuesday and Thursday effect in case of KSE-100 and KSE-all share respectively. No DOW effect in KSE-30 and in KMI-30 indices found. This is in favour of the free-floating concept of shares in these indices. The GARCH (1,1) technique with student's *t* distribution revealed highly persistent volatility in KSE-100 index, comparatively less persistent shocks in KSE-all share and KSE-30 index and a rapid decay in KMI-30.
**Keywords:** Day-of-the-week effect; KSE-100 index; KSE-30 index; KMI-30 index; KSE-all share index; GARCH (1,1)

## 1. Introduction:

The efficient market hypothesis (EMH) advocates that stock prices fully reflect all information in an efficient market. It emphasizes on indifferent-returns of stocks regardless of start and end of the week or any other specific day. In other words an efficient market is one where returns cannot be exploited by trading in a specific pattern (Fama, 1965). However, in some financial markets, a number of habitual effects may create higher or lower stock returns depending on certain day, month and time periods. This particular phenomenon is being observed in many developed as well as emergent share markets for over two decades. They are called seasonal or calendar anomalies, and traditional asset pricing model is unable to fully explain this phenomenon. Among such patterns the most recurrent are the week-of-the-month effect (Ariel, 1987; Lakonishok & Smidt, 1988) month-of-the-year effect (Rozeff & Kinney, 1976), and day-of-the-week (DOW) effect (Cross, 1973; French, 1980), turn-of-the-month (TOM) effect (Cadsby & Ratner, 1992), and Islamic calendar effect (Mustafa, 2011; Iqbal et al., 2013)

The evidence of such anomalies in the stock market explains the violation of and divergence from the efficient market hypothesis, at least in weak-form market efficiency, because asset prices are no more random but become predictable with any seasonal and calendar variation. This induces investors to build up trading strategies to make abnormal profits in the markets (Yalcin & Yucel, 2006). For example, investors may be willing to buy stocks on one specific day and sell on another based upon certain trends in the market on these specific days in order to take benefit from these effects. These differences in returns may be far above normal or below normal; can affect investors in deciding their investment strategy, portfolio selection and portfolio management (Anwar & Mulyadi, 2012). A normal investor usually does not feel safe or encouraged to invest in the market in the presence of such phenomena. Therefore, uncovering these volatility patterns in returns might benefit risk management and portfolio optimization of valued investors in the market (Engle, 1993).

This paper investigates daily stock market day-of-the-week (DOW) anomaly in the Karachi Stock Exchange; an emerging capital market of Pakistan, using all four types of indices working in the exchange including KSE-100 index, KSE-all share index, KSE-30 index and KMI-30 index. Several studies have been conducted to investigate seasonal anomalies on KSE-100. However, major gaps still exist due to absence of any published work on the other three indices. Amongst these; KSE-30 was introduced as a benchmark to determine the performance of the stock market, KMI-30 consists of firms which strictly meet the Sharia criteria, and KSE-all share index takes all firms into consideration. Hence, it is imperative to determine seasonal anomalies and levels of efficiency in these indices to understand the performance and trading strategies of the largest and most liquid stock market of Pakistan. This study fills the gap and can be a major contributor to the finance literature and can benefit both; investors when choosing any index among the four included in the study or a combination of indices for optimum portfolio and risk management, and also trade analysts, to adopt appropriate trading strategies, if DOW effect is identified in any of the indices.

The selection criteria of listed companies in all four indices are based upon different methodologies. In both KSE-100 index[1] and in KSE-all share index[2]; the chronology is based upon market capitalization. In the former the top 100 companies are selected, while in the latter; all firms are included in the index. On the other hand selection of firms in KSE-30 index[3] and in KMI-30 index[4] is based upon free-float methodology and in KMI-30 index strictly Shariah compliant firms are included. Free-float methodology may reflect the true liquidity of shares in the stock market; and is therefore, is less likely to be handled by manipulators and hedgers and could be more reliable from the investors' point of view. We examined daily stock market returns from January 01, 2009 till February 28, 2013, a period when the political set up in the country was not changed so assuming no broader macroeconomic changes in government policies during the period. This is the first time in the history of politics in the last 30 years when a political government completed its tenure. Political history shows that almost every government in Pakistan adopted financial and fiscal policies of their own interest and mostly independent of the prevalent economic situation in the country (Hasan, 1997). The importance of monetary and fiscal policies and other macroeconomic indicators on stock returns and trading volume cannot be ignored. For example, Rigobon and Sack (2003) revealed the significant respond of monetary policy over stock market movements. The policies regarding financial regulations, money supply tax on capital gains changes and changes in interest rates on bonds plausibly affect earnings on stocks. An increase in tax cut on capital gains on shares increases the returns and volatility in stocks by increasing consumption risk in the economy (Dai et al., 2008). Therefore, this study assumes no broad macroeconomic policy change during the study period that could occur due to different short government setups.

The rest of the paper is organized as follows. Section-2 reviews the related work done in both developed and emerging markets including Pakistan. Section-3 provides an overview of the Karachi stock market and all indices working at Karachi Stock Exchange. Section-4 describes the methodology employed and data, and Section-5 presents the empirical results. Finally, Section-6 contains the summary and conclusion.

## 2. Literature Review

Stock prices should be higher on the first day of the week as compared to other days of the week (French, 1980). It implies that daily trading activity should be three times higher on the first day as compared to other days of the week. However, the empirical studies totally negate this theory. For instance, US capital market reflects lowest returns on Monday and highest return on Friday as compared to other trading days.

Cross (1973) found that the mean return on Friday was higher than the mean return on Monday of the S&P 500 index during the period from 1953 to 1970. French (1980) in the study of US stock market used daily returns of the S&P 500 composite index for the period 1953–1977. He found that the average Monday return was significantly negative. Studies that also reported negative mean returns on Monday were conducted by Cross (1973), Gibbons and Hess (1981), Lakonishok and Levi (1982), Keim and Stambaugh (1984), Rogalski (1984), Smirlock and Starks (1986), Harris (1986), Lakonishok and Smidt (1988), Flannery and Protopapadakis (1988), Aggarwal and Tandom (1994) Kohers and Kohers (1995), Kiymaz and Berument (2003) in equity market of US.

Abnormally high returns were observed in different days in different studies. For example French (1980), Gibbon and Hess (1981), Rogalski (1984), Smirlock and Starks (1986), Lakonishok and Smidt (1988), Flannery and Protopapadakis (1988), and Kohers and Kohers (1995), Basher and Sadorsky (2006) determined highest return on Friday. French (1980) also found positive returns on Wednesday.

Similar results were found in other developed countries capital market. Jaffe and Westerfield (1985) determined Tuesday effect in Japanese and Australian capital markets. Solnik and Bousquet (1990) also demonstrated a strong and persistent negative return on Tuesday in case of Paris Bourse. Barone (1990) identified the largest

[1]KSE -100 index was launched on November 1, 1991, with initial base value of 1,000 points. It is a capital weighted index and consists of 100 companies representing about 90% of market capitalization of the exchange.

[2] KSE-all share index was introduced in 1995 and became functional on September 18, 1995; KSE-all index is also based on capitalization criteria.

[3] KSE-30 index was launched and became operational from September 2006. This index is based on free-floating share methodology under which market capitalization of only those shares are taken into account which are available for the purpose of trading in the market and excludes the all shares held by controlling directors, sponsors, promoters and government, and also other locked-in shares not available for trading at a certain point in time.

[4] Karachi Meezan Index-30 (KMI-30) is a free-float index and was introduced in September 2008. It is constituted with thirty Shariah-compliant companies with the base period of June 30, 2008. The index was created as a joint effort by KSE and Al-Meezan investment bank.

decline in Italian stock prices mostly on Tuesday. Balaban (1995) indentified negative Tuesday for emerging stock markets of Turkey. Mills and Coutts (1995) and Arsad and Coutts (1997) also found calendar anomalies in London Stock Exchange; Mills et al. (2000) for Athens stock market; Rodriguez (2012) for Argentina, Brazil, Chile, Colombia, Mexico, and Peru stock markets; Enowbi et al. (2010) for Egypt, Nigeria and South African stock markets; Georgantopoulos et al. (2011) for Greece and Turkey stock markets.

Several studies were performed on emerging markets in Asia. Wong and Ho (1986) conducted a study on the Singapore stock market; Wong et al. (1992) on the stock markets of Malaysia, Hong Kong, Singapore, Thailand and Taiwan. Similarly, Lauterbach and Ungar (1991) conducted study on Israeli Stock Market; Choudhry (2000) on Asian stock markets like India, Indonesia, Malaysia, Philippines, South Korea, Taiwan and Thailand; Poshakewale (1996) on Indian Market; Gao and Kling (2005) on Chinese Stock Market; Anwar and Mulyadi (2012) on Jakarta, Singapore and Kuala Lumpur stock exchanges; Chia et al. (2008) for Hong Kong, Singapore and Taiwan; Almonte (2012) on Philippines stock market. They all demonstrated negative mean returns on Monday and high positive mean returns on Friday.

Conflicting results are reported in case of emergent markets. Aybar (1992) could not observe any weekday effect in stock markets of Saudi Arabia, Kuwait and Turkey. Similarly, Mbululu & Chipeta (2012) did not find DOW effect in South African stock market. Dubois and Louvet (1996), Brooks and Persand (2001) identified the Tuesday effect in Pacific Rim countries. Basher and Sadorsky (2006) observed Monday effect in Philippines stock market and Friday effect in Taiwan stock market. Rahman (2009) investigated positive returns on Thursday and negative returns on Sunday and Monday. Liew and Chia (2010) reported positive Monday and negative Friday for Bombay stock market. Patel et al. (2012) found high returns on Monday in Asian markets including Indian, Japanese, Chinese and Hong Kong markets.

Various studies have been conducted on week-day effect in context of Pakistan. Khilji (1994) found monthly returns are time dependent. Hussain (1999) indicated no significant differences in stock returns across days. Ali and Mustafa (2001) determined Monday is the best day in which high returns are obtained but Friday reflected losses. Their study was based on the arrival of the new public information. The study supports the Monday effect because the time between closing day of the week and opening day of the next week has three days of accumulated information which have a greater impact on Monday. Nishat and Mustafa (2002) investigated the day of the week effect in Pakistani stock market. Their analysis indicated that there is no pattern in mean return on week days, however, a pattern is found in trading volume. Basher and Sadorsky (2006) established Tuesday effect in Pakistani stock market. Husain et al. (2011) used OLS regression and concluded that stock market returns for Tuesday are higher and more volatile than other days of the week. Bashir et al. (2011) refuted efficient market hypothesis in banking sector of Pakistan

## 3. Overview of Karachi Stock Exchange

Karachi Stock Exchange (KSE) is the largest exchange market of Pakistan. Exchange growth is remarkable both in terms of expansion and operations since its inception. From five companies at the time of establishment in 1949, exchange has reached to 569 listed companies in 2012. The market capitalization increased from PKR 1.2 billion to PKR 5.2 trillion in 2012.

In the 1990's financial liberalization and openness developed international linkages which raised the market capitalization to PKR 382.7 billion by 2000. Table-1 and Table-2 show the performance of KSE, decade wise and yearly, respectively. In 2002 the market was announced as the best stock market of Asia. In 2002, Karachi Automated Trading (KAT) system was introduced, which increased not only capacity of trades per day, but at the same time contributed in reducing the uncertainty in the index. Internet trading started in 2005.The settlement period reduced from T+5 to T+3, during 2001-2007 and to T+2, since August, 2007.

In 2008, due to tight monetary policy and increased insurgency of terrorist groups in the country the exchange experienced a sharp decline, and in August 2008, KSE set a floor to stop further decline. By December index had fallen up to 62 percent and practically ceased. However, after the removal of price-floor, trading resumed on December 15, 2008. The recovery period started from 2009 and by 2012 record performance was witnessed and exchange emerged as one of the best markets and ranked amongst the top 10 markets in world in 2013.

**Table-1. Market summary of KSE index:**

| | 1950 | 1960 | 1970 | 1980 | 1990 | 2000 | 2010 |
|---|---|---|---|---|---|---|---|
| Listed Company | 15 | 81 | 291 | 314 | 487 | 702 | 644 |
| Listed Cap. (Rs. Billions) | 0.12 | 1.0 | 3.9 | 7.6 | 28.0 | 236.5 | 919.1 |
| Market Cap (Rs. Billions) | N/A | 1.9 | 5.7 | 9.8 | 61.7 | 382.7 | 3268.9 |

Source: Karachi Stock Exchange.

**Table 2. Market summary of KSE index during last five years (2009-2013)**

| | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|
| Listed Company | 651 | 644 | 638 | 573 | 569 |
| Listed Cap. (Rs. Billions) | 814.5 | 919.2 | 1048.4 | 1094.4 | 1116.0 |
| Market Cap (Rs. Billions) | 2705.9 | 3268.9 | 2945.8 | 4242.2 | 5154.7 |

Source: Karachi Stock Exchange

## 4. Methodology and Data

The methodology of Ariel (1987), Lakonishok and Smidt (1988), Jaffe and Westerfield (1989), Mehdian, and Perry (2001) is used here to investigate the day-of-the-week effect. To proceed with the investigation of day of week effect, first we calculate the return of stock prices i.e.

$$R_t = LnP_t - LnP_{t-1} \tag{1}$$

Where $R_t$ = Return on share prices of KSE Indices

$P_t$ = Stock prices

For investigation of day of the week effect stock returns $(R_t)$ are regressed on Monday, Tuesday, Wednesday, Thursday, and Friday.

$$R_t = \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 D_{3t} + \beta_4 D_{4t} + \beta_5 D_{5t} + \varepsilon_t \tag{2}$$

Where $D_{1i}$ to $D_{5i}$ are dummy variables at time $t$ such that; if $t$ is a Monday, then $D_1$=1 and $D_1$ =0 for all other days; if $t$ is a Tuesday $D_2$= 1 and $D_2$= 0 for all other days, and so forth. The OLS technique is applied however, it has two shortcomings. Firstly, the error terms might be autocorrelated, which may lead to misleading results. Therefore, we also used lagged values of the return as one of the deterministic variables (Autoregressive model) Kiymaz and Berument (2003).

$$R_t = \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 D_{3t} + \beta_4 D_{4t} + \beta_5 D_{5t} + \sum_{i=1}^{n} \alpha_i R_{i,t-1} \tag{3}$$

Where $R_{t-1}$ is the lag value of the returns and $i$ is the lag order up to $n$ , $\alpha_i$ is the coefficient of the estimator. Equation (3) is adjusted to lag 1, based on the minimum Akaike-Information Criterion (AIC).
Secondly, the variance of error terms may not be constant over time (presence of heteroscedasticity). Different models are suggested in the literature to deal with that problem. Engle (1982) suggested the estimated variances of return to change the squared lagged values of the error terms; Autoregressive Conditional Heteroscedastic model (q) (ARCH (q)) of the previous period. ARCH (q) model is expressed in equation (4)

$$V_t^2 = \delta_0 + \sum_{i=1}^{q} \delta_i \mu_{t-1}^2 \tag{4}$$

Where $\delta_0 > 0$ and $\delta_1 \geq 0$ for $i > 0$

The above (ARCH (q)) equation is used extensively in the literature by Connolly (1989) Baillie and Bollerslev (1990), Baillie and Bollerslev (1991), Kiymaz and Berument (2003), Yalcin and Yucel (2006).

Bollerslev (1986) extended the work done by Engle (1982) and introduced Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model which allows lagged conditional variance to be included in the function to cater to the serial correlation in volatility due to volatility spillover effect over time and leptokurtic error distribution (Connolly, 1989).

$$R_t = \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 D_{3t} + \beta_4 D_{4t} + \beta_5 D_{5t} + \partial V_t^2 + \varepsilon_t \quad (5)$$

$V_t^2$ is the variance of the error term $\varepsilon$ at time $t$. Conditional variance depends not only on the squared error term in the previous time period as in ARCH (1,) but also on its conditional variance in the previous time period. GARCH (p,q) model is given by following equations:

$$V_t^2 = \delta_0 + \sum_{i=1}^{p} \delta_i \mu_{t-1}^2 + \sum_{i=1}^{q} \gamma_i \mathrm{V}_{\mathrm{t-1}}^2 \quad (6)$$

$$R_t = \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 D_{3t} + \beta_4 D_{4t} + \beta_5 D_{5t} + \sum_{i=1}^{p} \delta_i \mu_{t-1}^2 + \sum_{i=1}^{q} \gamma_i V_{t-1}^2 + \varepsilon_t \quad (7)$$

Apolinario et al. (2006) investigated day-of-the-week effect in major stock exchanges of the world and found that GARCH (1, 1) framework to be the most appropriate GARCH model for testing the DOW effect. Furthermore, investigation of conditional volatility is sensitive to the specification of underlying distribution therefore, GARCH (1,1) in conjunction with the student's *t* distribution is the best performing model in leptokurtic financial data (Hsieh, 1990; Hamilton and Susmel, 1994; Gregoriou et al., 2004 ; Wilhelmsson, 2006; Baker et al., 2008; Rodriguez, 2012). Prior to this Bollerslev (1987) and Nelson (1991) pointed out that GARCH model with normal distribution is unable to account for the high kurtosis in financial returns. Bollerslev used student's *t* distribution and Nelson (1991) used generalized error distribution. Therefore following their work GARCH (1,1) model with student's *t* distribution is used here.

$$V_t^2 = \delta_0 + \delta_1 \mu_{\mathrm{t-1}}^2 \quad + \gamma_1 \mathrm{V}_{\mathrm{t-1}}^2$$

The daily data used in this study covers the period from January 2009 to February 2013. The data for KSE-100 index, KSE-30 index, KSE-all share index and KMI-30 index are taken from Karachi Stock Exchange. The return is calculated by the difference of two successive log stock prices.

## 5.Empirical Results

### 5.1 Descriptive statistics:

Table-3 reports the descriptive statistics for returns of KSE-100, KSE-30, KMI-30 and KSE- all-share indices for the entire sample and for each day. The returns on Monday are negative for KSE-100 index, KSE-all share and for KMI-30 index which supports the findings of developed markets. However, the evidence of positive Monday return is found in KSE-30 index. The average returns on Tuesday to Friday are positive in all indices. But lowest returns are evident on Thursday in all indices which is unusual (Jaffe and Westerfield, 1985). This result is contradictory to developed markets. The highest returns found on Friday for KSE-100, and for KSE-all share index revealing typical Monday and Friday effect, which can call the investor to buy on Friday and sell on Monday to acquire above average returns. However, highest Tuesday in KSE-30 and KMI-30 index contradicts the result of Nishat and Mustafa (2002). Ali and Mustafa (2001) discovered positive Monday and negative Friday, which is explained by T+5 settlement period[1].

The majority of studies in developed markets reported that Wednesday is the second highest return day after Friday. In the case of Pakistan this is not true. Moreover, the standard deviation is the highest on Monday in all indices and lowest in Tuesday for KSE-100, Friday for KMI-30 index and Thursday for KSE-30 and KSE-all share index. The reason for largest standard deviation on Monday is due to the fact that on Monday the closing price reflects the effects of information and events that happened over previous three days. The coefficient of variation is also calculated and is a more appropriate tool of dispersion. The lowest coefficient of variation was found on Friday for KSE-100, KSE-all share and for KMI-30 index and Tuesday for KSE-30 index.

In a Gaussian distribution, it would expect that coefficient of skewness is zero which indicates that the series is symmetrical around the mean. When coefficient of skewness is negative it reveals that most values are concentrated on the right of mean with extreme values to the left. If the coefficient of skewness is positive it indicates that most values are concentrated on left on the mean with extremes to the right. The returns series of all four indices show asymmetry and returns are positively and negatively skewed on different days showing absence of normal behavior of series (Figure 1., 2., 3., 4.,). In KSE-100 index, the coefficients of skewness of

[1] The settlement period during the study period was T+ 5, where payment is made on Friday.

 

returns are negative on Wednesday, Thursday, and Friday, indicating the returns series to be skewed left on these days and are positive Monday and Tuesday reflecting the return series to be skewed right on these days. In KSE-30 index, the returns series is negatively skewed on Wednesday, and Friday and positively skewed on Monday, Tuesday and Thursday. In KSE-all share index, the returns are negatively skewed on Monday, Wednesday, and Thursday, and are positively skewed on Tuesday and Friday. In KMI-30 index, the returns are negatively skewed on Monday, and are positively skewed on Tuesday, Wednesday, Thursday, and Friday. The kurtosis coefficient for the series to be normally distributed is 3. The value of kurtosis higher and lower than 3 indicates the series to be leptokurtic and platykurtic respectively. The coefficient of kurtosis greater than 3 in all indices on all individual days shows leptokurtic nature of the return series of all indices in Karachi stock exchange. However, according to Aggarwal and Schatzberg (1997), an investor prefers to buy on days with positive higher skewness and higher kurtosis. Based on this criterion Tuesday in KSE-100 and KMI-30, Monday in KSE-30, and Friday in KSE-all share index are the preferred days to invest.

Jarque-Bera (JB) is another good indicator of normality of distribution. The value equal to zero indicates that the series is normally distributed. A much higher value of Jarque-Bera than zero is reflecting the greater deviation from normal behavior of the return series in case of all indices in KSE.

The coefficient of variation is used to compare the variability of two series. The series with a large coefficient of variation indicates higher volatility in the series. The highest coefficient of variation can be observed on Monday in KSE-100 index and on Thursday in the rest of the indices, indicative of less stable returns on these days.

### 5.2 OLS analysis

Table - 4 shows Tuesday effect at 5% in KSE-100, indicating people may purchase on Tuesday, also due to least volatile and the symmetrically skewed return series. While analyzing KSE-30 index we observed no day-of-the-week effect. In KSE-all share we observed Thursday effect at 1% level of significance along with low volatility which can also increase the confidence of the investor to invest on that day. KMI-30 index shows typical Monday and Friday effect.

### 5.3 OLS analysis with lagged returns series

Table-5 shows positive but statistically different returns across five days in KSE-100 index with highest on Tuesday. Tuesday and Friday returns are significant at 5% and 10% respectively. These results are not consistent with the results seen in the previous financial literature. Ali & Mustafa (2001) found typical highest Monday and lowest Friday and Basher and Sadorsky( 2006) found negative Tuesday during 1992-2003. The fact that the day-of-the-week changes with different settlement periods was noted by Nishat and Mustafa (2002). Settlement period during the study period is T+2, which was T+3 till July 2007. Tuesday effect in KSE-100 can be attributed to T+2 settlement period. KSE-all share shows Thursday highest and significant returns. However, KSE-30 and KMI-30 indices reveal no day-of-week effect. Absence of day-of-the-week effect anomaly in KSE-30 and KMI-30 indices is credited to the free-floating nature of the stocks. Statistically significant coefficient of lag variable of dependent variable indicates existence short run relationships and short run future returns can be predicted in the market.

### 5.4 ARCH analysis

After OLS regression, we conducted ARCH Lagrange Multiplier (LM) test, using five lags of the squared series (Table-6) with null hypothesis that there is no heteroscedasticity (there are no ARCH disturbances) in the model. This test rejected the null hypothesis in favour of presence of heteroscedasticity. For this reason the GARCH (1,1) results are more relevant as they accommodate the changing variances.

### 5.5 GARCH (1,1) analysis

Table- 7 shows GARCH (1,1) results with student's *t* distribution. The sum of the coefficients of conditional variance and square of error term $(\delta_1 + \gamma_1) < 1$, with value closer to 1, implies high volatility clustering with slow mean reversion (slow decay). $(\delta_1 + \gamma_1) < 1$, with values considerably less than unity implies fast decay. And $(\delta_1 + \gamma_1) > 1$, implies non-stationary returns series. GARCH models of all four indices are stationary and mean reverting with a comparatively fast decay in KMI-30 index with $(\delta_1 + \gamma_1) = 0.67$. In KSE-100, the value of coefficient $\delta_1$ = 0.098, and $\gamma_1$ = 0.89, show that the index is somewhat jumpy and unstable and volatility effects die down slowly. In KSE-all share and KSE-30 the value of coefficients $\delta_1$ are greater than 0.1 depicting less spiky peaks in the market and comparatively lower values of $\gamma_1$ shows less persistent shocks. In KMI-30 index the value of coefficient $\delta_1 = 0.67$, $\gamma_1 = 0$, reveals that the index is least volatile, shocks are temporary and will die out very quickly.

## 6. Summary and Conclusion

This study investigated the day-of-the-week effect on Karachi stock market, using all four indices i.e., KSE-100 index, KSE-30 index, KSE-all share index, and KMI-30 index in order to test reliability of the indices from the perspective of investor as to which index could be relied upon for optimum portfolio and risk management. First OLS technique was used to examine the extent to which DOW effects can be estimated without addressing the return volatility. Then DOW effects were investigated with the inclusion of lagged return value in the deterministic variable to address the problem of autocorrelation in the error terms. And finally, in order to cater for the presence of heteroscedasticity and to determine the decay time in returns, GARCH (1,1) model with student's *t* distribution was used. In KSE-100 index we have found Tuesday effect in both OLS and lagged return technique, which is consistent with T+2 settlement period. In KSE-all share index Thursday returns were significant which is consistent with OLS results. However, there existed no DOW effects in both KSE-30 and KMI-30 indices. This is in favour of the free-floating concept of shares in these indices. Consequently, it is unlikely to earn abnormal returns on any predetermined specific day in the week by an investor in KSE-30 index and KMI-30 index and all days can be regarded as equally good from the perspective of the investor.

KSE-100 index is regarded as the representative index of Karachi Stock Exchange therefore, its trust-worthiness in the market is imperative. Hence it is concluded that the DOW anomaly can be removed in KSE-100 index if free-floating shares methodology is adopted in the market.

The GARCH (1,1) with student's *t* distribution revealed highly persistent volatility in KSE-100 index, less persistent shocks in KSE-all share and in KSE-30 index with least persistent shocks in KMI-30 index; concluding a rapid decay in KMI-30 index.

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**Table-3. Descriptive Statistics for Daily Returns in Karachi Stock Market**

In this table we calculated mean value, maximum value, minimum value, standard deviation, skewness, Kurtosis, Jarque-Bera and coefficient of variation of KSE-100 index returns, KSE-30 index returns, KSE-all share index returns and KMI-30 index returns during sample period.

| | Obs | Mean | Max | Min | S.D | Skewness | Kurtosis | Jarque-Bera | CV |
|---|---|---|---|---|---|---|---|---|---|
| **KSE-100 Index** | | | | | | | | | |
| Monday | 206 | -0.0007 | 0.0530 | -0.0444 | 0.0127 | 0.0247 | 5.61 | 58.4201 | 18.1429 |
| Tuesday | 206 | 0.0013 | 0.0427 | -0.0329 | 0.0112 | 0.1962 | 4.36 | 17.2616 | 8.3143 |
| Wednesday | 208 | 0.0016 | 0.0384 | -0.0513 | 0.0119 | -0.5299 | 5.89 | 82.0205 | 7.3907 |
| Thursday | 212 | 0.0016 | 0.0384 | -0.0513 | 0.0118 | -0.5337 | 5.99 | 88.8292 | 7.3344 |
| Friday | 200 | 0.0030 | 0.0432 | -0.0472 | 0.0117 | -0.0874 | 6.40 | 96.7130 | 3.9270 |
| All Days | 1032 | 0.0011 | 0.0530 | -0.0513 | 0.0117 | -0.1036 | 5.68 | 311.4867 | 10.4583 |
| **KSE-30 Index** | | | | | | | | | |
| Monday | 206 | 0.0011 | 0.3246 | -0.0518 | 0.0269 | 8.4462 | 102.87 | 88062.6800 | 25.1026 |
| Tuesday | 206 | 0.0016 | 0.0475 | -0.0385 | 0.0131 | 0.3922 | 4.52 | 25.22 | 8.2658 |
| Wednesday | 208 | 0.0014 | 0.0488 | -0.0529 | 0.0139 | -0.2129 | 5.62 | 61.11 | 9.6319 |
| Thursday | 212 | -0.0000 | 0.0443 | -0.0531 | 0.0120 | 0.0488 | 6.09 | 84.60 | 4066.96 |
| Friday | 200 | 0.0009 | 0.0511 | -0.3407 | 0.0279 | -9.1919 | 113.79 | 105096.90 | 31.3539 |
| All Days | 1032 | 0.0010 | 0.3246 | -0.3407 | 0.0199 | -0.7233 | -0.72 | 963704.30 | 20.0867 |
| **KSE-all share Index** | | | | | | | | | |
| Monday | 206 | -0.0023 | 0.0501 | -0.3661 | 0.0282 | -10.4129 | 135.09 | 153476.00 | 12.2609 |
| Tuesday | 206 | 0.0011 | 0.0400 | -0.0318 | 0.0107 | 0.1847 | 4.29 | 15.53 | 9.8283 |
| Wednesday | 208 | 0.0017 | 0.0356 | -0.0487 | 0.0114 | -0.6230 | 5.79 | 80.94 | 6.6932 |
| Thursday | 212 | 0.0003 | 0.0393 | -0.0429 | 0.0100 | -0.0346 | 5.84 | 71.40 | 35.7929 |
| Friday | 200 | 0.0046 | 0.3539 | -0.0439 | 0.0273 | 10.5600 | 136.39 | 151992.40 | 5.9476 |
| All Days | 1032 | 8.9435 | 9.4487 | 8.2017 | 0.2597 | -0.3895 | 2.99 | 26.10 | 0.0290 |
| **KMI-30 Index** | | | | | | | | | |
| Monday | 206 | -0.0073 | 0.0538 | -0.9373 | 0.0764 | -10.4733 | 119.16 | 119586.00 | 10.4658 |
| Tuesday | 206 | 0.0067 | 0.9452 | -0.0331 | 0.0667 | 13.6147 | 192.08 | 313221.30 | 9.9379 |
| Wednesday | 208 | 0.0043 | 0.5706 | -0.0516 | 0.0414 | 12.3974 | 170.59 | 248746.40 | 9.5500 |
| Thursday | 212 | 0.0006 | 0.0434 | -0.0482 | 0.0106 | 0.0162 | 6.45 | 104.95 | 16.9076 |
| Friday | 200 | 0.0032 | 0.0475 | -0.0519 | 0.0131 | 0.0765 | 6.05 | 77.78 | 4.0955 |
| All Days | 1032 | 0.0015 | 0.9452 | -0.9373 | 0.0497 | 0.2857 | 280.59 | 3313483.00 | 33.1079 |

**Table - 4. OLS results for day-of -the-week effect.**

$R_{it} = \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 + \beta_5 D_5$

| | KSE-100 Index | KSE-all share Index | KSE-30 Index | KMI-30 Index |
|---|---|---|---|---|
| $\beta_1^{Monday}$ | | | | |
| Coefficient | **0.0011** | **0.0009** | **0.0012** | **0.0096*** |
| t-statistics | 1.3725 | 0.6603 | 0.8901 | 2.7653 |
| Std. Dev. | 0.0008 | 0.0013 | 0.0014 | 0.0035 |
| P-value | 0.1702 | 0.5092 | 0.3736 | 0.0058 |
| $\beta_2^{Tuesday}$ | | | | |
| Coefficient | **0.0020**** | **0.0021** | **0.0019** | **0.0118** |
| t-statistics | 2.4756 | 1.5649 | 1.3892 | 0.5231 |
| Std. Dev. | 0.0008 | 0.0014 | 0.0014 | 0.0034 |
| P-value | 0.0135 | 0.1179 | 0.1651 | 0.6010 |
| $\beta_3^{Wednesday}$ | | | | |
| Coefficient | **0.0001** | **0.0000** | **-0.0002** | **0.0005** |
| t-statistics | 0.1107 | -0.0231 | -0.1446 | 0.1583 |
| Std. Dev. | 0.0008 | 0.0013 | 0.0014 | 0.0034 |
| P-value | 0.9118 | 0.9816 | 0.8850 | 0.8742 |
| $\beta_4^{Thursday}$ | | | | |
| Coefficient | **0.00221*** | **0.00376***** | **0.0000** | **0.0029** |
| t-statistics | 2.7609 | 2.8260 | 0.0196 | 0.8445 |
| Std. Dev. | 0.0008 | 0.0013 | 0.0014 | 0.0034 |
| P-value | 0.0059 | 0.0048 | 0.9843 | 0.3986 |
| $\beta_5^{Friday}$ | | | | |
| Coefficient | **-0.0001** | **-0.0018** | **0.0017** | **-0.0075**** |
| t-statistics | -0.1655 | -1.3275 | 1.2014 | -2.1394 |
| Std. Dev. | 0.0008 | 0.0014 | 0.0014 | 0.0035 |
| P-value | 0.8686 | 0.1846 | 0.2299 | 0.0326 |
| $R^2$ | 0.0060 | 0.0092 | 0.0016 | 0.0118 |
| DW | 1.8146 | 2.6289 | 2.4045 | 2.9306 |

* 10 % level of significance. ** 5% level of significance. *** 1% level of significance.

 

**Table-5. OLS results for day-of -the-week effect with one lag of daily returns.**

$R_{it} = \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 + \beta_5 D_5 + \alpha_1 R_{t-1}$

| Coefficient | KSE-100 Index | KSE-all share Index | KSE-30 Index | KMI-30 Index |
|---|---|---|---|---|
| $\beta_1$ *Monday* | | | | |
| Coefficient | **0.0002** | **0.0002** | **0.0011** | **0.0060** |
| t-statistics | 0.3359 | 0.1207 | 1.2839 | 1.9790 |
| SD | 0.0006 | 0.0013 | 0.0009 | 0.0031 |
| P-value | 0.7370 | 0.9040 | 0.1995 | 0.0481 |
| $\beta_2$ *Tuesday* | | | | |
| Coefficient | **0.0016**** | **0.0024** | **0.0017** | **0.0049** |
| t-statistics | 2.7395 | 1.8964 | 1.9656 | 1.6060 |
| SD | 0.0006 | 0.0013 | 0.0009 | 0.0031 |
| P-value | 0.0063 | 0.0582 | 0.0496 | 0.1086 |
| $\beta_3$ *Wednesday* | | | | |
| Coefficient | **0.0010** | **0.0006** | **0.0008** | **0.0026** |
| t-statistics | 1.6457 | 0.4632 | 0.8709 | 0.8394 |
| SD | 0.0006 | 0.0013 | 0.0009 | 0.0030 |
| P-value | 0.1001 | 0.6433 | 0.3840 | 0.4015 |
| $\beta_4$ *Thursday* | | | | |
| Coefficient | **0.0010** | **0.0037***** | **-0.0002** | **0.0031** |
| t-statistics | 1.6457 | 2.9315 | -0.2224 | 1.0482 |
| SD | 0.0006 | 0.0013 | 0.0009 | 0.0030 |
| P-value | 0.1001 | 0.0034 | 0.8241 | 0.2948 |
| $\beta_5$ *Friday* | | | | |
| Coefficient | **0.0015*** | **-0.0003** | **0.0014** | **-0.0060** |
| t-statistics | 2.4637 | -0.2394 | 1.5465 | -1.9300 |
| SD | 0.0006 | 0.0013 | 0.0009 | 0.0031 |
| P-value | 0.0139 | 0.8108 | 0.1223 | 0.0539 |
| $\alpha_1$ | | | | |
| Coefficient | **0.5020** | **-0.3166** | **0.5000** | **-0.4644** |
| t-statistics | 29.2997 | -10.6551 | 39.2954 | -16.8138 |
| SD | 0.0171 | 0.0297 | 0.0127 | 0.0276 |
| P-value | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| $R^2$ | **0.4590** | **0.1080** | **0.6017** | **0.2254** |
| DW | **0.8713** | **2.0519** | **1.2432** | **2.2613** |

*10 % level of significance. ** 5% level of significance. *** 1% level of significance.

**Table-6. ARCH (5) Analysis**

$$V_t^2 = \delta_0 + \sum_{i=1}^{q5} \delta_i \ \mu_{t-5}^2$$

| Coefficient | KSE-100 Index | KSE-All Share Index | KSE-30 Index | KMI-30 Index |
|---|---|---|---|---|
| $\delta_0$ | | | | |
| Coefficient | **0.0001*** ** | **0.0002** | **0.0002** | **0.0012** |
| t-statistics | 5.168 | 1.379 | 1.6840 | 1.2198 |
| Std. Dev. | 0.00001 | 0.00014 | 0.0001 | 0.0010 |
| P-value | 0.0000 | 0.1682 | 0.0923 | 0.2051 |
| $\delta_1$ | | | | |
| Coefficient | **0.1223*** ** | **0.8186*** ** | **0.8058*** ** | **0.8298*** ** |
| t-statistics | 3.9600 | 26.493 | 26.0410 | 26.8769 |
| Std. Dev. | 0.0309 | 0.0309 | 0.0309 | 0.0309 |
| P-value | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| $\delta_2$ | | | | |
| Coefficient | **0.1648*** ** | **-0.6460*** ** | **-0.6254*** ** | **-0.6642*** ** |
| t-statistics | 5.305 | -16.618 | -16.1310 | -17.0348 |
| Std. Dev. | 0.0310 | 0.0389 | 0.0388 | 0.0390 |
| P-value | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| $\delta_3$ | | | | |
| Coefficient | **0.0809** ** | **0.4819*** ** | **0.4635*** ** | **0.4957*** ** |
| t-statistics | 2.5800 | 11.7140 | 11.3220 | 11.9831 |
| Std. Dev. | 0.0313 | 0.0411 | 0.0409 | 0.0414 |
| P-value | 0.0100 | 0.0000 | 0.0000 | 0.0000 |
| $\delta_4$ | | | | |
| Coefficient | **0.0556** | **-0.3190*** ** | **-0.3027*** ** | **-0.3312*** ** |
| t-statistics | 1.7900 | -8.205 | (-7.808) | -8.4954 |
| Std. Dev. | {0.0310} | 0.0389 | {0.0388} | 0.0390 |
| P-value | [0.0736] | 0.0000 | [0.0000] | 0.0000 |
| $\delta_5$ | | | | |
| Coefficient | **0.1607*** ** | **0.1590*** ** | **0.1502*** ** | **0.1638*** ** |
| t-statistics | 5.2120 | 5.1450 | 4.8540 | 5.3065 |
| Std. Dev. | 0.0308 | 0.0309 | 0.0309 | 0.0309 |
| P-value | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

* 10 % level of significance. ** 5% level of significance. *** 1% level of significance.

**Table-7. GARCH (1,1)**

| | KSE-100 Index | KSE-All Share Index | KSE-30 Index | KMI-30 Index |
|---|---|---|---|---|
| $\delta_0$ | | | | |
| Coefficient | **1.56E-06** | **9.20E-06** | **8.10E-06** | **1.75E-04** |
| z-Statistic | 2.0695 | 3.7098 | 3.4485 | 4.6243 |
| $\delta_1$ | | | | |
| Coefficient | **9.85E-02** | **2.58E-01** | **2.30E-01** | **6.71E-01** |
| z-Statistic | 4.4622 | 5.1136 | 5.5345 | 3.1369 |
| $\gamma_1$ | | | | |
| Coefficient | **8.94E-01** | **7.19E-01** | **7.59E-01** | **1.02E-05** |
| z-Statistic | 44.0804 | 20.3499 | 25.7991 | 0.0030 |