

Day of the Week Effect on Stock Return and Volatility: Evidence from Chittagong Stock Exchange

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Abstract

The study focuses on examining the stochastic process of return distribution in the Chittagong stock exchange (CSE) to deliver persistency of weak form of efficiency and time varying risk -return association for an emerging country like Bangladesh. This study used daily series of market index (CASPI) data over the period from January 1st 2004 to September 30th 2014. The OLS, GARCH (1, 1) regression and GARCH (1, 1) with dummy variable models are employed to identify the existence of the day-of-the-week effect on stock market returns and volatility. The empirical findings attained from the models verified that the day-of-the-week effects on stock returns and volatility are persistent in the stock market. Specifically, a negative effect is observed for Sunday while a positive effect occurs on Thursday. Moreover, the highest volatility occurs on Sunday and lowest volatility found in Thursday. All statistically significant results confirm the absence of weak form of efficiency in Chittagong stock exchange in Bangladesh.

Key word: Day-of-the-week effect, stock returns, volatility, GARCH

1. Introduction

The existence of calendar anomalies like January effect, Month end effect and Day of the week effect or Monday effect, Holiday effect ignoring weak form of efficiency an avenue to utilize trading rule to generate abnormal gain found the momentum for extensive research work in financial markets. The most common one, day of the week followed by extensive investigation in different markets covering not only developed countries (Cross 1973, French 1980, Gibbon and Hess 1981, Lakonishok and Levi 1982, Jaffe and Westerfield 1985, Mehdi and Perry 2001, Kiyamaz and Berument, 2003) but also in developing world (Aggarwal and Rivoli 1989, Balaban 1995, Islam and Gomes 1999, Choudhry, 2000, Brooks and Persaud 2001, Aly, et al. 2004, Lian and Chen 2004, Agathe 2008, Rahman 2009) document the persistent abnormal high or low stock returns in one or some days of the week unlike other days of the week. This behavior denies the random walk hypothesis on unpredictability of future price changes forwarded the issue of trading rule and eventually inefficiency prevails in the stock market.

The study focuses on examining the stock return distribution in the Chittagong stock exchange (CSE) to deliver persistency of weak form of efficiency and time varying risk -return association for an emerging country Bangladesh. Specifically the time covers for analysis and the way the methodology used in the study for CSE were not used in any prior studies in Bangladesh. The results of the study will have imperative implications for capital market participants and government and foreign agencies. The remainder of the paper is organized as follows. Section 2 provides literature related to day of the week effect in capital market. Section 3 provides data and methodology in brief. Section 4 discusses empirical results while conclusions takes place in section 5.

2. Literature review:

Day-of-the-Week Effect refers to the observations that mean stock returns are differently distributed among different week days. The First day of the week is usually considered as a week day because the market remains bearish, while on the last day of the week the market is found buoyant.

It can be supported with the explanation given by Mehdiian and Perry (2001), that adverse news mostly announced during the weekend, shake the confidence of the investors; stimulate them to sell their holdings on the coming Monday. Researchers invented the reason for this anomaly. This is because of investors' psychology. Due to the announcement of some adverse news on the weekend, investors lose confidence on the first trading day, whereas they feel optimistic on the last trading day and proceed with further transactions. Lakonishok and Levi (1982) argue that the day-of-the-week effect can be partly derived from the delay between trading and settlements in stocks and in clearing checks.

Studies measure Monday return between the closing price on Friday and the closing price on Monday. Rogalski (1984) responds the question of whether prices fall between Friday close and Monday opening or during the day on Monday. He composes daily returns into trading and non-trading day returns and finds that all of the average negative returns from Friday close to Monday close occur during the non-trading hours. Average trading day returns (open to close) are identical for all days. This effect refers to a phenomenon that the average return of first trading day of the week is significantly lower than the average return for the other days.

Some of the pioneers who have contributed on this particular area include Cross (1973) and French (1980), studied 50 shares of Standard & Poor's Composite Index to find Day-of-the-Week Effect and claimed higher mean returns on Friday and lower mean returns on Monday. Whereas, Berument and Kiyamaz (2001) reported highest and lowest returns on Wednesday and Monday respectively by studying shares of Standard & Poor's Composite Index using OLS and GARCH Model.

Jaffe and Westerfield (1985) found weekend effect in stock markets of four developed countries: Australia, Japan, UK and Canada. A daily seasonal anomaly is found on their works that negative Monday and positive Friday effect (last trading day of the week) existed in Canadian stock market as observed in the U.S. Stock-market. Aggarwal and Rivoli (1989) revealed the presence of strong Tuesday effect in four Asian emerging markets: Hong Kong, Singapore, Malaysia and Philippines. Gibbons and Hess (1981) and Keim and Stambaugh (1984) studied the Dow Jones Industrial Index and found negative Monday returns. Keim also described the positive correlation between Friday and Monday returns. Similarly, Draper and Paudyal (2002) conducted research on London stock exchange by using OLS and robust regression procedure and explained strong negative Monday returns, indicating that Monday effect is initiated by various factors.

There have also been studies investigating the time-series behavior of stock prices in terms of volatility. Among these, we can mention French et al. (1987), Campbell and Hentschel (1992), Glosten et al. (1993), Nelson (1991), Baillie and DeGennaro (1990), Chan, Karolyi and Stulz (1992), and Corhay and Rad (1994). French et al. (1987) reported that unexpected stock--market returns are negatively associated with unexpected changes in return volatility. Similarly, Campbell and Hentschel (1992) argued that the required rate of return on common stocks increases with an increase in stock--market volatility, thus lowering stock prices. Glosten et al. (1993) and Nelson (1991) reported that positive unanticipated returns decrease the conditional volatility while negative ones increase it.

In the literature, there are numerous explanations for the causes of volatility. Two of these are the "absence of brokers' advice over the weekend" (Miller, 1988) and "high frequency of unfavourable news arriving at the weekend" (Penman, 1987), (Dyl and Maberly, 1988), (Berument and Kiyamaz, 2001). Bell and Levin (1998) further examined three institutional factors in order to understand the underlying sources of volatility: (i) financing discontinuities associated with the account-settlement period, (ii) relative scarcity of funds while finance is held in banks' suspense and transmission accounts on settlement day and (iii) firms' reluctance to hold money during non-trading periods. Kiyamaz and Berument (2003) also considered the influence of public (i.e. macroeconomic and political news) and private information as well as unanticipated returns among the reasons of increased market volatility.

3. Data and Methodology

3.1 Data:

The daily seasonal anomaly has been investigated by the daily all share price index (CASPI-index) of Chittagong stock exchange (CSE). This index is a composite index measured from prices of all common stocks traded in CSE. The data has been drawn from 1st January 2004 to 30th September 2014 producing 2515 observation for study. The daily return has been calculated in the following way:

$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}$$

$R_{i,t}$ is the return of CASPI index i on day t , $P_{i,t}$ is the price of CASPI index i on day t and $P_{i,t-1}$ is the price of CASPI index i on day $t-1$.

3.2 Methodology:

The study is set to analyze the presence of day of the week effect on stock return and stock market volatility in CSE. The stock return data has been used under the following initial ordinary least square model for empirical analysis:

$$R_t = \alpha_S D_{St} + \alpha_M D_{Mt} + \alpha_T D_{Tt} + \alpha_W D_{Wt} + \alpha_{TH} D_{THt} + \sum_{i=1}^p R_{t-1} + \varepsilon_t \quad \varepsilon_t \approx N(0, h_t) \quad (1)$$

Where D_{st} , D_{Mt} , D_{Tt} , D_{Wt} , D_{THt} are the dummy variable for the start of the week of Bangladesh Sunday, followed to Monday, Tuesday, Wednesday, Thursday respectively. Here, we integrated the lagged return (R_{t-1}) variable to eliminate the possibility of having auto-correlated errors. But, the existence of time varying variance may lead this equation to provide inefficient estimates. Therefore, we assume that the disturbance term of the return equation is normally distributed with zero mean and time varying conditional variance of h_t ($\varepsilon_t \sim N(0, h_t)$). Although, there are various literature covers the model for conditional variance, Engle (1982) recommended a model with systematic time variant variance of return where conditional variance, h_t , is the function of previous squared residuals from the return (R_{t-1}), known as auto-regressive conditional heteroskedastic model (ARCH). Later, Bollerslev (1986) generalised the ARCH models as GARCH that extends the dependence of conditional variance on its earlier lagged value and that is the generalization of ARCH model (GARCH). Here in our study GARCH model prescribed by Bollerslev (1986) is applied as benchmark. Now we have to set p and q in the GARCH (p, q). As Brooks (2009) defines GARCH (1,1) model as adequate model for conditional variance analysis. Therefore the simplest form of GARCH (1,1) has been used to analysis day of the week effect on the market return and the equation follows:

$$R_t = \alpha_S D_{St} + \alpha_M D_{Mt} + \alpha_T D_{Tt} + \alpha_W D_{Wt} + \alpha_{TH} D_{THt} + \sum_{i=1}^p R_{t-1} + \varepsilon_t \quad \varepsilon_t \approx N(0, h_t)$$

$$h_t = \omega + \delta h_{t-1} + \gamma \varepsilon_{t-1}^2 \quad (2)$$

A number of literatures (Karolyi, 1995, Heish 1988, Truong Dong Loc 2012) suggest the inclusion of weakly exogenous variables into the GARCH model. Accordingly, this study utilizes the GARCH (1,1) with dummy variables respective to each day of the week in the conditional variance equation to identify the existence of day-of-the-week effect on stock volatility studied by Berument and Kiyamaz (2001) and Kiyamaz and Berument (2003). More specifically, we allow the constant term of the conditional variance equation to change for each day of the week. The model becomes as follows:

$$R_t = \alpha_S D_{St} + \alpha_M D_{Mt} + \alpha_T D_{Tt} + \alpha_W D_{Wt} + \alpha_{TH} D_{THt} + \sum_{i=1}^p R_{t-1} + \varepsilon_t \quad \varepsilon_t \approx N(0, h_t)$$

$$h_t = \omega + \alpha_S D_{St} + \alpha_M D_{Mt} + \alpha_T D_{Tt} + \alpha_W D_{Wt} + \delta h_{t-1} + \gamma \varepsilon_{t-1}^2 \quad (3)$$

Equations 1, 2 and 3 by using the Full Information Maximum Likelihood estimation technique in order to test the presence of the day of the week effect in both the return and the volatility equations.

4. Results and Discussion

4.1 Descriptive statistics

Table 1: Summery Statistics for daily market return of CSE

CASPI	SUN	MON	TUE	WED	THUR	ALL Days
Observations	492	507	508	510	494	2515
Mean	-0.13002	-0.08704	0.324297	0.104265	0.300307	0.101528
Median	-0.08444	-0.12286	0.215833	0.094461	0.224534	0.082804
Maximum	8.35518	4.93388	13.9634	6.18202	5.54221	13.9634
Minimum	-6.95521	-8.5646	-6.00644	-5.20128	-6.75115	-8.5646
Std. Dev.	1.738311	1.454178	1.529313	1.283455	1.161475	1.457124
Skewness	-0.20228	-0.82657	1.875822	0.185512	0.201646	0.193497
Kurtosis	5.730284	8.173277	17.46609	6.187489	8.195899	10.07624
Jarque-Bera	156.1715	623.0962	4727.419	218.8271	559.0436	5262.947

The summery statistic for each day wise return and all day return has been reported in table 1. The Jarque-Bera test statistics fails to reject the null hypothesis of normal distribution of each variable, which substantiates the normality of the series. The highest average return of 32.43% observed in Tuesday (third working day of the week), and second highest average return found in Thursday (last working day of the week), that is 30.03%. The negative average return found in first two working days, Sunday (-13%) and Monday (-8.7%). The highest return found in the third trading day of the week is in the line of similar result found by Rogalski (1984), Jaffe and Westerfield (1985), Berument and Kiymaz (2001) and Kiymaz and Berument (2003) where Wednesday was the third trading day of the week. And the negative return in first trading day of the also pronounce the findings of different literature (Cross 1973; Lakonishok and Levi 1982; Rogalski1984; Keim and Stambaugh 1984; Harris 1986a, 1986b; Berument and Kiymaz 2001 and Kiymaz and Berument 2003) where Monday act as first trading day of the week. However the average return for entire study is 10.15% suggesting a positive return prevails over negative return over average irrespective to each day of the week. The Standard deviation for all the series is below 150 percent. Only Sunday and Monday returns are negatively skewed and Tuesday is highly positively skewed and highest level of kurtosis is for Tuesday return. Again, we conduct the Bartlett's test and Levene's test where the calculated value of 93.16 and 12.04 respectively rejects the null hypothesis of homoscedasticity of the variance at 1 percent level of significance.

The overall result of day of the week effect and stock market volatility from January 2004 to September 2014 has been shown in table 2 under three unlike models (standard OLS, GARCH (1, 1) and GARCH (1, 1) with dummy variable). The results of model 1 suggest that the highest average return observed in Tuesday (i.e. 35.4%) and second highest in Thursday (i.e. 29.5%) whereas lowest in Sunday (i.e. -14%) and second lowest in Monday (i.e.-8%). This result follows the findings showed in table 1. Like Cosimano and Jansen (1988), Kiymaz and Berument (2003), we examine time variant conditional variance by Ljung-Box Q test and we found that null hypothesis of first order serial correlation cannot be rejected at 10, 40 and 100 lags. Then we conduct Lagrange Multiplier (LM) Autoregressive Conditional Heteroskedastic test recommended by Engle (1982) and found that null hypothesis of no ARCH effect rejected at 1 lags. Therefore we can identify time variant conditional variance across the days of the week return in the study.

Table 2: Day of the week effect and stock market volatility during January 2004 to September 2014 in Chittagong Stock Exchange (CSE)

		Model 1	Model 2	Model 3
Return Equation	SUN	-0.141* (-2.155)	0.005 (0.127)	-0.005 (-0.103)
	MON	-0.082 (-1.279)	0.010 (0.223)	0.030 (0.641)
	TUES	0.324** (5.044)	0.258** (5.607)	0.261** (5.867)
	WED	0.095 (1.485)	0.135** (2.723)	0.131** (3.168)
	THUR	0.295** (4.501)	0.272** (4.965)	0.278** (6.546)
	CASPI(-1)	0.034 (1.718)	0.089** (4.469)	0.084** (4.242)
Volatility Equation	Constant (w)		0.058** (5.798)	
	ARCH (δ)		0.158** (12.733)	0.191** (12.603)
	GARCH (γ)		0.821** (61.799)	0.758** (41.009)
	($\delta + \gamma$)		0.979	0.949
	SUN			0.734** (9.003)
	MON			0.005 (0.057)
	TUES			0.050 (0.654)
	WED			0.053 (0.569)
	THUR			-0.062 (-1.234)
	Log likelihood	-4491.252	-4062.498	-4018.205
	LQ(10)	14.5	36.99	33.6
LQ(40)	61.47	58.48	58.52	
LQ(100)	121.56	105.05	106.16	
LM Test	320.39	2.450612	2.049241	

Note : *And ** indicates 5% and 1% level of significance respectively

We use model 2 that is conditional variance equation by GARCH (1,1) and re-estimate the return equation along with conditional variance equation because of the existence of ARCH effect in OLS estimates. Here we found significant positive return in Tuesday, Wednesday, and Thursday. Highest return observed in Thursday (i.e. 27.2%) and lowest return observed in Sunday (i.e. 0.5%). Again the sum of the coefficients of GARCH model except constant term ($\delta + \gamma$) is .979 that is less than 1 and positively significant indicate stationarity of the variance in the model. Hence, the mean returns are time variant that is the existence of persistent variance and

how far the price moves and how much time it takes stock volatility process returns to its mean. Again Ljung-Box Q statistics significantly rejects the serial correlation at first 10, 40 and 100 orders and LM test results cannot reject any ARCH effect at 11% level of significance. Both test results clearly postulates the improvement of estimates of GARCH(1,1) from OLS estimates.

As we found heteroscedastic variance Bartlett's test and Levene's test in our preliminary analysis, we include five dummy variables (no constant term to avoid dummy variable trap) representing each day into the GARCH (1, 1) model that is model 3 to identify the day of the week effect on the market volatility as well as to re-estimate the return equation following Berument and Kiyamaz (2001). In our third model, Thursday has the highest return and Tuesday has the second highest return whereas lowest return observed in Sunday (i.e.-0.5%). Here Tuesday, Wednesday and Thursday is significant that also reported in model 2. In volatility equation found lowest volatility in Thursday (i.e.-6.2%) and highest volatility observed in Sunday (i.e.73.4%). The volatility of Sunday is significant. Again here $(\delta + \gamma) > 1$ confirms the persistent variance in model 3. Ljung-Box Q statistics significantly rejects the serial correlation at first 10, 40 and 100 orders and LM test results cannot reject any ARCH effect at 15% level of significance. Both test results shows a marginal the improvement of estimates of model 3 over model 2. From above three models, GARCH (1, 1) with dummy variable is the best in terms of log likelihood ratio too.

5. Conclusion

This paper investigates the existence of day of the week effect in stock return and market volatility during January 2004 to September 2014 periods by utilizing CSE all share price (CASPI) Index. Three different equations are employed. The first equation, OLS, assumes the constancy of the error term's variance. The results based on this model shows that day of the week effect is present in the stock return equation. The highest return is observed on Tuesday, while the lowest return is observed on Sunday. In the second equation, we let volatility to change across time. Although this model provides more efficient estimates of parameters (lower standard errors of the estimates), the lowest return is observed on Sunday, while the highest return is observed on Thursday. In addition, a strong and persistent effect on volatility is detected. Finally, the third equation employed is the GARCH with dummy variable, in which the explanatory power of the variance equation has been increased. The findings confirm that the presence of day of the week effect in both volatility and return equation. Here, the highest and lowest returns are observed on Thursday and Sunday respectively and the highest and lowest volatility are observed on Sunday and Thursday respectively. All of these findings are statistically significant except the effect of Thursday return on market volatility.

There are several reasons why market volatility is higher on first day of the week that is on Sunday and volatility is lower on the last day of the week that is on Thursday. There is a negative relationship between unexpected stock--market returns and unexpected changes in return volatility. But the required rate of return on common stocks increases with an increase in stock--market volatility, thus lowering stock prices. That's why the average return on Sunday is lower than other week days. Optimistic unanticipated returns decrease the conditional volatility while pessimistic ones increase it. Due to having scarcity of fund after consuming for the whole week, reluctance on the utilization of fund and financial discontinuities volatility becomes lower during the weekend. Opposite occurs at the beginning of the week or other week days. Again, Stock market volatility is positively related to volatility in economic variables, such as debt levels, inflationary pressure, and industrial production condition.

During the period under review there were various anomalies, economic and political events, legislative changes and structural reforms that have affected the equity markets. The days confronted increased violence, political fights, sky rocketing inflation and gigantic budget deficits, energy crises, accelerating unemployment and climbing oil prices in international market. Above all, the incidence of stock market crash at 2010 all together resulted in overall steep decay of the stock market during those periods.

In summary, we identify the day of the week anomaly in terms of market return and volatility. The findings of specific pattern would initiate investors to utilize trading rule to manage their portfolio to generate abnormal return. It also brings the issue of market inefficiency which in turn would provoke the regulators and policymakers conscious effort for informational and operational efficiency.

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