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ABSTRACT

This study investigates extent of market efficiency and presence of day of week effect in stock market indices and volume and volatility in four major SAARC countries, namely Pakistan, Bangladesh, India and Sri Lanka for the period 1999 to 2014. The day of week anomaly is detected by using day of week dummies in return and volume model with ARMA specification estimated by Ordinary Least Square. The day of week effect in volatility is captured by GARCH model with days of week dummies in conditional mean and variance equations. The GARCH-M model is applied to see that investor is getting reward for facing volatility risk. The asymmetry in volatility is estimated by TGARCH-M and EGARCH-M. The evidence shows the presence of day-of-the-week effects in returns and volume in Pakistan, India, Bangladesh and Sri Lanka. The results also indicate that asymmetric volatility behaviour is present in all of four markets. However, day of week effects and asymmetric effects detected in these markets may be possibly to due to over-reaction and under-reaction of investors on particular day of week.

Keywords: Day-of-the-Week Effect, Market Efficiency, Investor Overreaction, Stock Returns, Volume, Asymmetric Volatility, GARCH-M Model

1. INTRODUCTION

The financial theories that are based on nature of stock returns distribution support that stock return distributions are identical, irrespective of time span. Therefore, it is not possible for investor to outperform the market through market timings or any expert stock selection for earning abnormal profit. Therefore, it is useless to devise any trading strategy for gaining profit. Hence, only possible option for investor is to invest in riskier assets to obtain higher returns. However, anomalies in asset returns have been a topic of interest during the past decades, in the academic literature. A lot of anomalies has been observed in asset returns i.e. calendar anomalies, fundamental anomalies and technical anomalies. That is inconsistent with maintained theories of asset pricing behaviour especially Efficient Market Hypothesis. These irregularities in stock returns also termed as calendar anomalies are extensively documented in literature.

Calendar anomalies states that stock returns behave differently on a certain days of week or month of year or turn of month also known as weekend effect, day of week effect, and January effect. These different patterns are commonly termed as 'seasonality'. Seasonality is in fact referred to regular or systematic variation in time series that happens after a certain time period within a year. Existence of seasonality reflects that returns are no more random and hence are predictable on basis of past pattern. This phenomenon gives opportunity to market participant to get excess returns by devising trading strategy.

Capital asset pricing model (CAPM) states that, on average, returns should be same irrespective of day of week. Trading time hypothesis postulates that stock returns are created during a transaction. There is one day investment for each day; hence the average stock returns should be identical for entire days of the week. When this is not fulfilled, an anomaly is observed.

One of the most often analysed seasonality in finance literature is day of week effects. A renowned form of day-of-the-week effect states that average returns on Monday are lower relative to other days of week. Moreover, the average returns on Friday are positive and higher as compared to other weekdays. This conclusion must be held thorough the statistical significance of parameters.

Although, some of stock anomalies has disappeared over time i.e. size effect but it is worthwhile to study whether this specific anomaly still exists or not. Rationality of agent theory that is core of modern economic theory is challenged, if certain anomaly is found. Rationality of agent theory postulated

that there is rational relationship among particular weekday and returns magnitude. As large number of individual investors participates in stock markets with probably irrational strategies, this motivates to investigate the day-of-the-week effect in this study.

From financial perception, examining day-of-the-week effect anomaly is important due to three essential reasons. Firstly, Trading schemes of investors depend on the discovery of abnormal patterns in stock returns, if there are not any abnormal patterns in stock returns then trading scheme is useless. Secondly, for rational decision makers it is important to aware with variations in volatility of stock returns that depend on day of the week and also that either high or low returns are related with correspondingly high or low volatility for that day. If investors can discover particular pattern of volatility, then they can easily make investment decisions based by taking into account both returns and risk associated with that particular stock. Thirdly, if any abnormal patterns are observed then that may be helpful to disclose evidence about the extent of market efficiency.

The present study examines the day-of-the-week effect on daily stock returns for four major SAARC countries following Yalcin and Yycel (2006) and Chia, Liew, and Wafa (2008). This study also incorporates returns as well as volumes as documented by Berument and Kimyaz (2003). Asymmetric GARCH is applied by this study for examining the presence of day of week effect in volatility behavior and motivation is to analyse the impact of bad news and good news on stock returns. For detecting that either investor is being compensated for variance risk the GARCH in Mean model is used.

The main objective of the study investigates extent of market efficiency and presence of day of week effect in return and volume for recent period in major four SAARC countries. This study analyses the time series behavior of stock returns in terms of volatility patterns by using GARCH model. The impact of asymmetric news on stock returns or leverage effect is captured by TGARCH and EGARCH model. The three type of ARCH in mean model are allowed to investigate that the investor is getting the price for facing the volatility risk. This study examines that how day of week effect varies from country to country and either volatility on various days is related to trading volumes [Berumena and Kimyaz (2003)].

The study contributes to the existing literature on efficient market hypothesis in several ways. The anomaly of day-of-the-week effect is tested for four major SAARC countries stock markets by employing daily data of both returns and volumes. As a rational financial decision maker does not only observe the return but also variations in volatility. As it is useful to know that high or low variations in volatility are associated with day of week return or whether higher or lower returns on certain day of week are associated with variation in volatility on that particular day. The GARCH-M model is applied to

examine the effect on volatility and to see that investor is getting reward for facing volatility risk. Moreover, leverage effect is also captured by employing asymmetric GARCH models; TGARCH-M and EGARCH-M models have been used to check asymmetric effect exist in these markets. Although many of studies has been done by employing GARCH, but only handful of scientific articles rely on asymmetric GARCH models, and even there are too few that employed asymmetric GARCH-in-mean models. This study is useful in the context that if inefficiency exists in studies markets regarding the day-of-the-week effect anomaly, then it will be useful for investor to devise some trading strategy to gain profits. This study also contributes to literature as it also examine for trading volume and investigate that either there exist relationship between trading volume and observed volatilities on various days of week by following Berument and Kimyaz (2003).

The structure of this study is as follows. After introduction, Section 2 reviews the theoretical background and relevant literature of the day-of-the-week effect. In Section 3, the properties of the data and the methodology behind the selected models are described. Section 4 analyses results and reliability of the models. Finally, Section 5 provides some concluding remarks.

2. LITERATURE REVIEW

In last three decades, a lot of research has been conducted on day-of-the-week effect in the financial literature. It is researched in many studies covering several countries markets, methods and periods. This section reviews literature on day of week anomaly by classifying it into two sections. First section consists of literature that employed simple linear regression and second section consist of literature that employed ARCH model.

2.1. Tests Based on Linear Regression

One of the most often analysed seasonality in finance literature is day-of-the-week effect as some days of week provide lower or higher return as compared to other trading days, firstly verified in United States. A lot of literature has been documented on day-of-the-week effect anomaly in both developed and developing country. Different return patterns has been observed on different days of week especially highest returns are observed on Friday and the lowest returns are observed on Monday, in case of US [Cross (1973); French (1980)]. Presence of such patterns revealed that stock returns are not independent of day of week, providing evidence against random walk theory. This section represents the empirical research conducted by employing simple methods or OLS regression.

Cross (1973) has analysed more than 40 years of data for Dow Jones and other major indices of America. However, he has employed immature indicators by statistical standards, for example, percentage of positive changes on a certain

day, mean and median percentage changes for detection of day of week anomaly. Results show that S&P 500 has higher returns on Fridays than Monday and to some extent changes in Monday returns are due to changes in Friday returns. French (1980) is among the first who has analysed through statistical point of view for day of week anomaly. By using OLS regressions, two hypotheses are tested about the returns. First one, trading time hypothesis postulates that mean returns are same for all of working day. Secondly, calendar time hypothesis states that returns on Monday should be three times the return on any other day. This paper discloses systematically negative returns on Monday, which is typical for the US market day-of-the-week effect originally. Keim and Stambaugh (1984) have analysed the day-of-the-week anomaly by using longer time period (1928-1982) for S&P 500, and also when New York Stock Exchange is open on Saturday. Even then negative Monday returns are observed consistently. Further studies have revealed that day-of-the-week effect is not present only in case of US, but it has been observed in many of international equity markets. It is concluded that highest returns are observed on Friday (last trading day).

Gibbon and Hess (1981) and Jaffe and Westerfield (1985) have used simple linear regression models and applied F-test, T-test for detection of day of week anomaly in Japanese, Australian, Canadian and US stock markets. Lakonishok and Smith (1988) have used data of Dow Jones Industrial averages for more than 90 years and observed persistent anomalies in returns around end of week, end of month and end of years. Wong, Hui, and Chan (1992) have examined day-of-the-week effect on South-Eastern Asian markets, namely Hong Kong, Thailand, Singapore, Taiwan and Malaysia for period of 1975-1988. As return distribution of all markets is not normal, Kruskal-Wallis non-parametric test has been employed for equality of means instead of the one-way ANOVA. Significantly positive Wednesday returns are observed in Singapore, Taiwan and Hong Kong. Significantly positive Friday returns are found for Singapore, Malaysia and Thailand.

Agrawal and Tendon (1994) evaluate data in 18 countries for period of 1971-1987. Employed OLS and analysed F-statistics, day-of-the-week effect is reported in all countries. Additionally, stock market behavior is analysed in two sub-samples. In the first sample period Monday and Tuesday effects are significant in seven and nine markets respectfully, while in second period these effects vanish in most of countries. Balaban (1995) has studied Turkish stock market by employing tests for equality of mean returns and find day-of-the-week effect in Istanbul Securities Exchange composite index (ISECI). He also investigates that daily returns are not constant in direction and magnitude. Demirer and Karan (2002) with different data period extend this study. They study Istanbul stock exchange by taking into account economic issues faced by Turkish economy such as inflation, interest rate etc. and used sign transition

between closing and opening of stock for detection of weekend effect. No clear evidence has been found regarding day-of-the-week effect in Turkish stock market.

Ajayi, *et al.* (2002) has observed daily effect in four market out of eleven markets for period of 1990 to 2002. Ally, *et al.* (2004) have analysed day of the week-effects in Egyptian stock market. OLS regression is employed for estimation of day-of-the-week effect and for dealing with size effect log of data is taken. Evidence of day of week effect has been reported implying that Egyptian stock market is weakly efficient. Basher and Sadorsky (2006) examine day-of-the-week effect in 21 emerging stock markets and employed both conditional and un-conditional risk analysis factor in model. And risk is allowed to vary across week days. Different five models employed have produce different results but overall day-of-the-week effects is present for Philippines, Pakistan and Taiwan even after adjusting for market risk. Hourvouliades and Kourkoumelis (2009) investigate existence and nature of days-of-the-week effect during contemporary financial crisis for Turkey, Bulgaria, Romania, Ukraine, Cyprus, and Greece. Different market provided different results. Sutheebanjard and Premchaiswadi (2010) examine day-of-the-week effect on an emerging stock market of Thailand. Analysis is conducted by apply evolution strategies method and found evidence of day-of-the-week with the highest percent of prediction error on Monday and the lowest percent of prediction error on Friday. Muhammad and Rahman (2010) have investigated Malaysian stock Exchange by employing OLS methodology and dividing data into two sub samples. Results find that day-of-the week effect is present in the Malaysian market when full sample is studied but do not exist in case of two sub samples. Kuria and Riro (2013) examine Nairobi securities Exchange for examining day-of-the-week effect, weekend effect and monthly effect. T-test, F-test and ANOVA models are employed. Results show that negative returns for Monday and Sunday while for all other days of week there are observed positive returns.

2.2. Literature Based on ARCH Models

The literature reviewed in this section employ several specifications of ARCH and chiefly GARCH models. General Autoregressive Conditional Heteroskedasticity (GARCH) models for capturing time varying volatility are introduced by Engle (1982) and Bollerslev (1986). Engle (1982) have allowed autocorrelation to occur in the squares of the error term rather than just error term. So for capturing this type of autocorrelation, Autoregressive conditional Heteroskedasticity (ARCH) model is developed. Introduction of GARCH model gives new dimension for detection of seasonal behavior in financial markets. As many of studies raised questions for just relying on OLS, the time series behavior of stock prices in terms of volatility or conditional variance by using GARCH models is investigated by some researchers.

Connolly (1989) is first one who has focused on the statistical robustness of the day-of-the-week effect to different estimation and testing procedures. Results show that day-of-the-week anomaly is present in the whole sample as well as in four subsamples. The first robustness check is regression of stock returns on constant and the Monday dummy just for testing strength of weekend effect. Monday returns react exactly as traditional dummy OLS.

Alexakis and Xanthakis (1995) find existent of Thursday and Friday returns that are significantly positive in Greek stock exchange for 1985 to 1994. This is among the initial studied that employed EGARCH-M model. In the first period positive Monday returns are found significantly for whole period while these disappear in second sample period. Risk premium is significantly positive implying that taking additional risk will be awarded with extra return. Kamath, *et al.* (1998) examine day-of-the-week effect in Securities Exchange of Thailand from 1980- 1994. Study has employed both OLS and GARCH. GARCH model provide the evidence of day-of-the-week effect in Thai stock market while Monday returns are found negative on average and are lower than returns of Friday. Lucey (2000) analyses the Irish stock market by using data from 1973 to1998. He employs modified GARCH-M (4, 4) model and significantly positive Wednesday effect is found. Berument and Kimyaz (2001) analyse the day-of-the-week effect in S&P 500 index by employing OLS as well as GARCH model for period of 1973-1997. The OLS model indicates that only Monday returns are negative, but that are not statistical significant. The GARCH (1, 1) model reports the same days as significant, except Monday returns that emerge positive. Lowest significant volatility is observed for Wednesday while highest volatility in found on Friday.

Kimyaz and Berument (2003) extend their analysis by examining markets of USA, Japan, Germany, UK and Canada over period of 1988-2002. The same methodology OLS, GARCH (1, 1) and modified GARCH (1, 1) are employed. According to GARCH-M (1, 1) model, negative Monday effects are evident in UK, Japan and Canada. When volatility is allowed to vary by the day of week, there are seen negative Wednesday returns in three markets, while negative returns for Thursday and Friday in USA. However, negative Monday effect vanishes in case of UK. The risk premium is also significantly positive for all of studied markets. Variation in Volatility is significant for four markets on Monday and Tuesday, for three on Wednesday and Thursday and for two on Friday. Likelihood ratio tests detect the existence of both day of week effect and volatility in all of markets. They also employed volume in their study and found higher volatility of returns on Friday while lower trading volume on Friday, implying that higher volatility in return results in lower volume on that particular day. Apolinario, *et al.* (2006) explore thirteen developed European stock markets between 1997 and 2004. The analysis is carried out with the help of two GARCH models—a normal GARCH and a TGARCH one. A positive

Monday effect is reported in case of France and Sweden and positive Friday effect is found in Sweden only. Results confirm significant day-of-week effect on volatility for all of countries; however no day-of-week effect is found for Czech Republic and Portugal. In most of them greater volatility is observed on Mondays and Thursdays, while there is lesser volatility on Tuesdays and Fridays. The volatility response to negative shocks demonstrates significant asymmetry in all markets except the Czech Republic. It is concluded that the day-of-the-week effect exist in volatility but not in returns of examined markets.

Yalcin and Yycel (2006) develop the structure of Kiymaz and Berument (2003) by introducing EGARCH-M (1, 1) model. This study incorporates twenty emerging economies throughout the world by using different data period. In both return and volatility, day-of-week effect found is not same across diverse markets. There are found just five effects that are significant at 1 percent level. in Estonia positive Wednesday, in Lithuania negative Monday, in India negative Tuesday and in Poland positive Thursday and Friday. In volatility as well there exists significant volatility at 1 percent level only in these five markets. It is resulted that there exist sign for presence of daily seasonality.

Dimitris and Samitas (2008) document day-of-week effect on return and volatility for indexes of Athens Stock Exchange for period of 2001-2005. They have employed OLS methodology on appropriately defined dummy variables and GARCH specification for checking presence of day-of-week effect in returns and GARCH model for both return and volatility specifications and find presence of day-of-week effect in both models. Chia, Liew, and Wafa (2008) extend their earlier study in the markets of Singapore, Taiwan, Hong Kong and South Korea. They consider the dataset from 2000-2006 by using OLS and EGARCH-M models. Positive Friday effect is found for Taiwan and Hong Kong. But after the employment of the EGARCH-M model only the positive Friday effect remains for Taiwan. This suggests that many daily effects are just due to variation in equity risk. In addition, taking more risk essentially produces negative reward in relations to returns for three of the markets. Asymmetric term in three of variance equation is found to have significant positive values, elaborating that positive returns is due to higher level of the volatility response.

Ullussever, *et al.* (2011) have studies day-of-week effect in developing equity market of Saudi Arabia, Jafri (2012) has examined presence of day-of-week effect on Muscat securities market by using GARCH and asymmetric model i.e. TARCH and EGARCH model. Results provide evidence of no presence of day-of-week effect. Both EGARCH and TARCH models show no significant evidence for asymmetry in stock returns. The study concludes that Muscat securities market as efficient market. Truong Dong Loc (2012) has investigated day-of-week effect in stock returns and volatility for the Ho Chi Minh Stock Exchange by using data from 2002-2011. OLS and GARCH regression models are employed in this study. Results show that on Tuesday,

negative return while there are positive return on Friday. So there exist day-of-week effect on both stock volatility and return in studied market.

2.3. Day-of-the-Week Effect in Pakistani Stock Market

Studies that have been conducted for detection of day-of-the-week effect in Pakistani Equity Market until now are few. Hussain (1999) studies Pakistani equity market and employed OLS method. He does analysis for full sub sample as well as for three sub samples for taking into account impact of liberalisation measures especially opening of market to international investors. Overall result shows no day-of-the-week effect in Pakistani equity market. Study by Nishat and Mustafa (2002) have used data form Dec 1991 to Dec 2001 using mean and median approach and by dividing data into three sub sample. They find no day-of-the-week effect on stock returns and on conditional variance significantly. However for Tuesday and Wednesday there is observed significant positive variance.

Haroon (2005) has documented day-of-the-week effect in KSE and employed OLS method to analyse data from 2004-2011 and by dividing it into two sub samples. He has employed five different models and results show Monday effect in KSE by refusing the weak form efficiency of KSE. Ali and Akbar (2009) examine Pakistani stock market by taking data from 1991-2006 by employing different tests. They find no weekly or monthly effect in Pakistani equity market; however there exist inefficiencies in market in short run. The study conducted by Hussain, *et al.* (2011) examine returns for KSE 100 index from 2006-2010. They have employed OLS method for detection of day-of-the-week effect in Pakistani equity market. They find that returns on Tuesday are higher than other day-of-the-week effect and there exist day-of-the-week effect in Pakistani equity market.

2.4. Day-of-the-Week Effect in Indian Stock Market

Poshakwale (1996) has examined presence of day-of-the-week effect as well as weak form of efficiency in Bombay stock exchange. Descriptive statistical test, parametric and non-parametric test are applied. There are observed higher returns on Friday than rest of days, confirmed with the studies conducted for US. Choudhry (2000) explores the day of week anomaly in seven Asian emerging markets for data period of 1990 and 1995–India, Philippines, Indonesia, Malaysia, Thailand, Taiwan and South Korea. He has used GARCH-t model, which can effectively deal with non-normal error terms. All of daily dummies are incorporated in the variance equation to test for daily changeability in the volatility. The selected model for all of seven markets is GARCH (1, 1), but tests for different order combinations are done and results support day-of-the-week effect in these markets.

Bhattacharya, *et al.* (2003) have studied Indian capital market for examining presence of day-of-the-week effect in return and volatility. They have used both GARCH and OLS with lagged returns models. There is difference in results that are obtained by employing GARCH and those through OLS. Nath and Dalvi (2004) have examined day-of-the-week effect in Indian equity market from 1999 to 2003 using both high frequency and end of day data. Study finds that before introduction of rolling settlement, Monday and Friday are significant days. However, after introduction of rolling settlement, Friday has become significant.

Chander, *et al.* (2008) have employed regression analysis and documented evidence on day-of-the-week effect in Indian stock markets and provided positive return on Friday and negative returns on Monday. Patel and Patel (2011) have explored day-of-the-week effect on stock returns in Bombay Stock Exchange by using Kruskal Wallis test. Their results do not support the existence of day-of-the-week effect. Kalaivani and Srinivasan (2013) have investigated day-of-the-week effect by employing GARCH (1, 1), EGARCH (1, 1) and TGARCH (1, 1) from July 1, 1997 to June 29, 2012. Results indicate that Tuesday effects have negative impact on volatility after controlling persistence and asymmetric effects.

2.5. Day-of-the-Week Effect in Sri Lanka's Stock Market

Fernando and Pathirawasam (2006) have employed ordinary least square (OLS) method to investigate the anomalous pattern in Colombo stock exchange from 1985 to 2004. No particular day of week effect has been discovered in conducted study. Thilakerathne, *et al*. (2007) have observed existence of anomalous pattern in Colombo stock exchange with highest or positive returns are observed on Friday while lowest and negative returns are observed on Monday from 1st January 1994 to 31st March 2007. Das and Aria (2009) have also investigated the presence of daily anomaly in Colombo Stock Exchange from 1985 to 2004. Results indicate that Friday has higher and statistically significant returns; this is inconsistent with the developed market behaviour.

2.6. Day-of-the-Week Effect in Bangladesh Stock Market

Islam and Gomes (1999) examine the day of week effect in Dhaka stock Exchange. They argue that there are different contributing factor that results in positively significant weekend effect. This effect can be due to discontinuous and thin trading, insufficient information regarding stocks, to rely on price momentum for manipulation by market participants for gaining profit. Therefore, regulative authorities should come forward to deal with this anomaly leading to efficient market system. Rahman (2009) investigated day of week anomaly in three official indices for Dhaka stock Exchange by employing linear regression and GARCH (1, 1) with dummy regressor. There are observed

statistically negatively significant coefficients for Monday as well as for Sunday. Also there are observed statistically positive coefficient for Thursday.

3. THEORETICAL FRAMEWORK, METHODOLOGY AND DATA

This section presents the theoretical background, methodological framework, data and data sources.

3.1. Theoretical Framework

3.1.1. *Efficient Market Hypothesis*

In modern portfolio theory, market efficiency is one of most contested and disputed topic. According to Efficient Market Hypothesis current stock prices gives all available information of market and hence there is no chance of gaining profit. EMH follows random walk, so stock returns prices are unpredictable or change in prices are independent to each other. To understand the working of capital markets, stock market efficiency is vital concept. Fama (1970) explained Market efficiency by categorising it into three types; strong form of efficiency, semi strong form of efficiency and weak form of efficiency.

Efficient market hypothesis, in case of weak form of efficiency, states that stock prices are uncorrelated implying that returns are random and hence future stock prices cannot be predicted on basis of past data trends, because current prices disclose all information contained in historical trends in prices. Therefore, investor cannot formulate any trading strategy based on past return patterns to earn abnormal profit. In semi strong form, abnormal returns cannot be earned by investors using the publicly available information because stock prices reflect all the information that is publicly available. While, in strong form of efficiency, no investor can earn abnormal profit on the basis of any type of information because stock prices reflect all the information either that is private information or publicly available. Efficient market hypothesis has a lot of impact on investment strategy of investor for analysing and managing the investment portfolio. The advocators of efficient market hypothesis believe that stock returns are stationary for all days of week.

Rutherford (1983) has asserted that market efficiency has an impact on investor's investment strategy. As efficient market instantaneously incorporate new information into prices. Hence, knowledge of information set at any point in time cannot be used to get 'excess returns'. Then it will be just waste of time to devise strategy for making profit. Later, Sharpe, *et al.* (1999) have explained market efficiency concept, in a way, that in the efficient Market:

> *"the security's price will be a good estimate of its investment value, where the investment value is the present value of the security's future prospects, as estimated by well-informed and skilful analysts who use the*

> *information that is currently at hand"* [Sharpe, *et al.* (1999), p. 93].This definitions logical consequence implies that "Market is efficient with respect to a particular set of information if it is impossible to make abnormal profits (other than by Chance) by using this set of information to formulate buying and selling decisions." [Sharpe, *et al*. (1999), p. 93].

The concept of market efficiency has been observed in extremes i.e. either market is efficient or is inefficient. Academics are supporter of market efficiency while practitioners are commonly observing market inefficiency. So a wide range of literature has been presented on Efficient Market Hypothesis (EMH).

Contrary to the Fama's (1970) Efficient Markets Hypothesis (EMH), the behavioral anomalies indicate the presence of financial phenomena including the 'overreaction' and/or 'underreaction'. These were stimulated by the cognitive psychology researches and are considered to be one of the primary challenges to the market efficiency [Shiller (2003)]. The extent of absorption of new information and events relevant to the stock of a company in terms of price change also includes the perception of the financial decision maker regarding the particular news. This may result in overreaction or under reaction by the investor creating market volatility based on the probable future performance of the stock.

During decision making, the investors under the influence of the heuristic of representativeness are inclined to create extreme predictions, or overreaction, in which earlier losers tend to be winners in the future and vice-versa. It is an ability to over emphasise the most recent that may cause overreaction, creating excessive volatility e.g. continuing trends, then reversals. On the other hand, the heuristic of anchoring proposes that investors frequently relate themselves to elements or points of reference in order to make decisions. This results in excessive moderation, highlighting the under reaction phenomenon, in which case lower returns are observed on Mondays. The under reaction is caused due to the conservatism bias. As generally people tend to be slow in adapting to new information, so the new information is priced-in gradually (stepwise) rather than at a single step.

3.2. Data

The data used in this study is the daily closing market index value for the major four SAARC countries: Pakistan, India, Bangladesh and Sri Lanka. The data are obtained from official website of yahoo finance for India and Sri Lanka. Data for Pakistan and Bangladesh is taken from their official web sites. Data comprise daily observations between August 1, 1999 to July 1, 2014 for all investigated markets except Bangladesh.[1] All of three markets except Dhaka

[1]Data for Bangladesh is from 2 Feb 2006 to 12 Dec 2012.

Stock exchange work from Monday to Friday; While DSE works from Sunday to Thursday. Volumes are also obtained for Pakistan, India and Sri Lanka from the same source. The indices included for each country are: Pakistan's KSE-100, India's BSE 30 (BSESN), Bangladesh's DSEGEN, Sri Lanka CSE

Returns are calculated by taking the first difference of natural log of daily market indices of four SAARC countries.

$$R_{mt} = \ln (P_t / P_{t-1}) * 100 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

Where R_{mt} represent return on respective index on day t. P_t represents closing price on day t and P_{t-1} represent closing price on day t-1.

3.3. Methodological Framework

3.3.1. *Day-of-the-Week Effect for Market Return Model*

The analysis begins with the standard methodology applied to examine the day-of-the-week effect by using the daily dummies. This model is extended in this study by introducing the ARMA terms in the model to take into account the data generating process of the returns series. OLS method is employed in this study that is based on estimating a simple regression model. In this model returns are regressed, with constant term and daily four dummies[2]. The dummy coefficients denote the average returns for each day of the week. Model can be written in following Ajayi, *et al*. (2002) given below:

$$R_{mt} = \alpha_0 + \sum_{i=2}^{5} \alpha_i D_{it} + \sum_{j=1}^{m} \beta_j R_{mt-j} + \sum_{k=1}^{n} \gamma_k \varepsilon_{t-k} + \varepsilon_t \quad \ldots \quad \ldots \quad (2)$$

Where R_{mt} is return on index *i* in period *t*, β and γ capture the ARMA process in market return, αi captures the four day of the week effect by dummies relative to base category. For selection of ARMA term is based on collerogram and for the model specification selection Schwarz Bayesian information criteria are used.

D_{Mt} = dummy variable for Monday (D_{Mt} =1 if observation is on Monday, otherwise 0)

D_{Tt} = dummy variable for Tuesday (D_{Tt} =1 if observation is on Tuesday, otherwise 0)

D_{Wt} = dummy variable for Wednesday (D_{Wt} = 1 if observation is on Wednesday, otherwise 0)

D_{Tht} = dummy variable for Thursday (D_{Tht} = 1 if observation is on Thursday, otherwise 0)

D_{Ft} = dummy variable for Friday (D_{Ft} = 1 if observation is on Friday, otherwise 0).

[2]The intercept term is excluded in order to avoid the dummy variable trap of perfect multi-collinearity when all the possible dummy variables plus an intercept are included. Brooks (2008).

Using OLS regression to detect day-of-the-week effect in case of market returns data, leads to violation of many assumptions of OLS i.e. auto correlated returns, non-normal distribution of residuals, leptokurtosis and heteroskedasticy. Autocorrelation can be solved by including the lagged value of proper lagged value of returns as independent variable. [Bhattacharya, *et al.* (2003)]. But as error variances may not be constant over time, so a model that can control time varying variances needs to be used.

Equality Tests

Equality tests are employed on daily descriptive statistics to identify effect for all week days in both returns as well as the volatility. However, ANOVA F-test is not valid, as it assumes normal distribution that rarely holds in case of stock returns. Therefore, Welch's modified F-statistics (1951) is employed. The non-parametric Kruskal-Wallis test (1952) does not assume any of distribution. It is one-way ANOVA test that tests sub-groups for same distribution and just compare medians. Therefore, both Welch F- statistics and Kruskal-Wallis test is used rather than plain F-test.

Bartlett's test (1983) is employed to test that either sub-sample has same variance or not across the group. While alternative hypothesis test that at least two groups have un-equal variances. As Bartlett test is sensitive to data that is not normal. Therefore, Levene's (1-960) test is also used that is less sensitive to normality assumption to test that either there is significant variation in across days of week or not. If there is no significant variation in variances across sample, then it is called homogeneity of variances.

3.3.2. *GARCH Models*

For testing the variability in variances, ARCH considered as best model as these models ARCH (q) is suggested by Bollerslev (1986) and makes the conditional variance to follow ARMA process in previous volatility and previous error square terms known as GARCH (p, q) model.

GARCH model contain one of mean equation and other one variance equation. According to literature, mean equation is taken same as with OLS equation day of week dummies along with ARMA terms. The day of week effect in term of volatility is also taken into account by including the daily dummies into the conditional variance equation. Both mean and variance equations are estimated jointly, but model is tested for ARCH effects initially. If ARCH effects are present in model, then GARCH (p, q) model is applied. In normal GARCH (p,q) model the conditional mean equation remains the same as ARMA-OLS model (2), the conditional variance equation takes the following form:

$$R_{mt} = \alpha_1 + \sum_{m=2}^{5} \alpha_i D_{mt} + \sum_{j=1}^{m} \beta_j R_{mt-j} + \sum_{k=1}^{n} \gamma_k \varepsilon_{t-k} + \varepsilon_t$$

$$h_t = \omega + \sum_{j=1}^{p} \beta_j h_{t-j} + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{m=2}^{s} \delta_m D_{mt} \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where, R_{mt} is Stock return, h_t is conditional variance and ε_t is error term that depends on previous information.

The normal GARCH model can be extended to GARCH-in-Mean i.e., GARCH-M model which allows the compensation of facing volatility risk in conditional mean equation [Kamath, *et al.* (1998)]. The conditional mean equation remains the same as with original OLS model, GARCH-M model is applied for conditional variance equation. One of common conception in financial literature is that taking higher risk should be rewarded by higher return. GA-RCH-M model capture risk by adding the conditional variance term in the mean equation. If given coefficient of expected risk is significantly positive, it implies that higher risk will result in higher returns. In the GARCH(p, q)-M model conditional mean equation includes conditional variance term as well. The conditional mean and conditional variance equation are given as follows:

$$R_{mt} = \alpha_1 + \sum_{m=2}^{5} \alpha_m D_{mt} + \sum_{j=1}^{m} \beta_j R_{mt-j} + \sum_{k=1}^{n} \gamma_k \varepsilon_{t-k} + \varphi h_t + \varepsilon_t \quad \ldots \quad (4)$$

$$h_t = \omega + \sum_{j=1}^{p} \beta_j h_{t-j} + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{m=2}^{s} \delta_m D_{mt}$$

Where all the variables remains the same as defined above.

GARCH model captures the symmetric to volatility effect both for good news and bad news. Asymmetric effects are characteristics of stock returns time series on asset prices and imply that bad news tends to increase volatility more than good news or negative shocks results in higher peaks in volatility rather than positive shocks. This is referred as leverage effect, whereby a fall in the stock value results in company's debt to equity ratio to increase. So, shareholders evaluate their future cash flows, which depend on the residual value after debt is paid, as extra risky. Therefore, to absorb possible asymmetric effect of stock market behaviour TGARCH-M and EGARCH-M models are applied to investigate that either asymmetric effect exist in studies markets.

To detect the presence of asymmetric response of volatility to negative shocks, Engle and Ng (1993) introduced diagnostics test for capturing the asymmetry in volatility. Three data sets have been presented by Engle and Ng (1993) to evaluate that either asymmetric model can be employed for particular data set. These tests are then conducted on residuals of standard GARCH (p, q) model with a constant in mean equation. They evaluate the forecasting influence of variables observed in the previous prices that are not part of GARCH model.

If these variables can forecast the normalised squared residual, then the variance model is miss-specified.

The Sign Bias test examines both negative and positive price shocks of the uniform magnitude yield the same volume of volatility. For this reason, dummy variable S_{t-1}^{-} is taken as indicator. It take value = 1 if $\hat{\varepsilon}_{t-1} < 0$ and 0 otherwise. Negative sign bias test examine that either negative returns shock of different magnitude has different impact on volatility. While positive sign bias test investigate different influences of small and large positive return shocks on volatility. Engle and Ng (1993) presented then a joint test for both size and sign bias. General test of sign and size bias examine that either volatility depends on both of size and sign of past shocks. Test is based on following regression:

$$\varepsilon_t^2 = \alpha + \beta_1 S_{t-1}^{-} + \beta_2 S_{t-1}^{-}\varepsilon_{t-1} + \beta_3 S_{t-1}^{+}\varepsilon_{t-1} + e_t \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

$$S_{t-1}^{+} = 1 - S_{t-1}^{-}$$

Null hypothesis of no sign and size bias holds. Test statistics for these three types of bias are three coefficients of t-ratios. Joint test statistics of both sign and size bias is explained in term of Lagrange Multiplier (LM) taken equal to nR^2. It trails the chi-square distribution with 3 degrees of freedom.

As investor is interested in getting the compensation of variance risk, for this purpose, GARCH-M model is applied in asymmetric GARCH model. Therefore, it takes the form of EGARCH-M and TGARCH-M model. These models has been applied by Yalcin and Yycel (2006), Chia, Liew, and Wafa (2008) etc. TGARCH or Threshold GARCH models are presented independently by Zakoian (1994) and Jaganathan, Glosten, and Runkle (1993) called GJR. Additional term is added to the GARCH model for capturing the asymmetries in TGARCH so it is extension of GARCH model. The conditional mean equation of the TGARCH-M model is same as GARCH-M model (3), the conditional variance equation for TGARCH model is as follow:

$$h_t = \beta_1 + \sum_{j=1}^{p} \lambda_j h_{t-j} + \sum_{i=1}^{q} \eta_i \varepsilon_{t-i}^2 + \psi \varepsilon_{t-1}^2 I_{t-1} + \sum_{m=2}^{5} \delta_m D_m \quad \ldots \quad \ldots \quad (6)$$

Where Monday is base while D_m represents dummy variables from Tuesday to Friday that is exogenous and threshold order is fixed at 1. Here, I_t=1 if $\varepsilon_t < 0$ and otherwise it is zero. This implies that $\varepsilon_{t-k} < 0$ that represent bad shocks in returns and $\varepsilon_{t-k} > 0$ that represent positive shocks at returns, has different effect on conditional variance. A bad shock has an effect of $\eta_i + \psi$, while good shock in returns has effect of η_i. If $\psi \neq 0$, it is concluded that shock effect in not symmetric. However, if $\psi > 0$, negative news raises variance or volatility implying that leverage effect is present.

The exponential GARCH (EGARCH) is firstly presented by Nelson (1991). In this model the leverage effects are exponential, not quadratic, because dependent variable is log of the conditional variance, therefore, there is no need of imposing constraint of non-negativity on the variance parameters.

The EGARCH-M model and TGARCH-M model both has same mean Equation (3), while the variance equation is presented as follow:

$$\log h_t = \delta_1 + \sum_{j=1}^{p} \lambda_j \log h_{t-j} + \sum_{i=1}^{q} \eta_i \left| \frac{\varepsilon_{t-i}}{\sqrt{h_{t-i}}} - \sqrt{\frac{2}{\pi}} \right| + \psi \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \sum_{m=2}^{5} \delta_m D_m \qquad (7)$$

To detect the leverage effect the hypothesis that $\psi_k < 0$ can be tested. However, if $\psi_k \neq 0$ still there exists asymmetric behaviour. For choosing the order of GARCH model Schwarz Bayesian information criteria are used.

If there are significant dummy variables in mean equation of GARCH, it implies that day of week effect in not correlated with equity risk. However if there are observed insignificant dummy variables in mean equation, but are significant in variance equation it confirms the existence of market risk effect. Conversely, if dummy variables that are insignificant in case of OLS model are now significant in mean equation as well as in variance equation, then it confirms the presence of day of week anomaly.

4. EMPIRICAL RESULTS

The empirical results and discussion is presented in this section. The analysis begins with descriptive statistics

4.1. Descriptive Statistics per Day-of-the-Week and Equality Tests

Table 4.1 Panel A and Panel B, present descriptive statistic for each day of week for returns and volumes. Panel A of Table B reports daily mean returns, skewness, kurtosis and standard deviation. Except India, there are observed negative returns on Monday for Pakistan, Sri Lanka and Bangladesh. But only in case of Sri Lanka they are significantly negative on Monday. In case of Pakistan, highest returns are observed on Wednesday while lowest returns are observed on Monday. For India, highest returns are reported on Wednesday while lowest returns are reported on Friday. While for Sri Lanka, there are highest returns Friday while there are lowest returns on Tuesday. Finally in case of Bangladesh, highest returns are observed on Thursday and lowest returns are observed on Monday.

So from descriptive statistics analysis it's evident that there are negative returns for first trading day of week except India. Also skewness and Lepto-kurtosis are present for all days of week across all of the markets. The non-normal behaviour of return series is additionally confirmed through Jarque-Bera

statistics, that is significant always. In this analysis any of country in the analysis does not display any specific pattern.

Panel B of Table 4.1 reviews the descriptive statistics on volumes. There are observed lower volumes on Monday in India and Pakistan, while in Sri Lanka lower volumes are observed on Friday. Highest volumes are reported on Thursday and Friday in Pakistan, on Wednesday in India and on Thursday in Sri Lanka. Negative skewness and high-kurtosis are also present in all market for each day of week.

Table 4.1 C depicts the some commonly used equality tests for detecting the overall day-of-the-week effects in both of returns and volatility. According to F-tests, only for Bangladesh and Sri Lanka, there is statistically significant difference in means between groups. While Kruskal-Wallis test's result vary slightly from ANOVA F-test. As this reports Pakistan as well along with Bangladesh and Sri Lanka for having significant difference in mean. According to Levene test, Bartlett test, there is evidence that there is variation in volatilities or null hypothesis of homogeneity of variances is rejected for all countries except Sri Lanka.

Table 4.1

Summary Statistics for each Day of Week

Panel 4.1 A: Returns

	Monday	Tuesday	Wednesday	Thursday	Friday
Pakistan					
Mean	–0.023	0750.	0.194	0.072	0.132
Std. Dev.	1.678	1.394	1.397	1.327	1.402
Skewness	–0.159	–0.324	–0.243	–0.572	–0.084
Kurtosis	5.276	6.83	5.921	6.711	8.033
Jarque-Bera (p value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
India					
Mean	0.030	0.056	0.095	0.057	0.006
Std. Dev.	1.827	1.505	1.469	1.496	1.713
Skewness	0.155	1.713	–0.061	–0.104	–0.497
Kurtosis	14.213	7.014	5.575	5.363	7.803
Jarque-Bera (p value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sri Lanka					
Mean	–0.02003***	–0.16088**	0.198348**	0.139686*	0.385979*
Std. Dev.	2.321	5.733	3.547	2.737	2.050
Skewness	10.940	12.333	5.066	0.631	13.318
Kurtosis	244.574	334.312	151.158	159.630	255.194
Jarque-Bera (p value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bangladesh					
Mean	–0.150	0.19265**	0.263313*	0.061	0.30987*
Std. Dev.	2.024	2.017	1.829	1.674	1.412
Skewness	–0.277	2.551	2.118	–1.578	–0.322
Kurtosis	6.362	36.349	15.817	20.220	10.119
Jarque-Bera (p value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Panel 4.1 B: Volumes

	Monday	Tuesday	Wednesday	Thursday	Friday
Pakistan					
Mean	2.123	2.151	2.153	2.154	2.154
Std. Dev.	0.465	0.458	0.453	0.459	0.454
Skewness	–3.776	–3.385	–3.092	–3.717	–3.654
Kurtosis	27.081	22.972	20.918	27.413	25.747
Jarque-Bera (p value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
India					
Mean	4.209	4.235	4.256	4.255	4.254
Std. Dev.	0.226	0.231	0.219	0.233	0.212
Skewness	0.222	0.108	0.195	0.413	0.379
Kurtosis	3.972	4.863	2.735	4.427	2.730
Jarque-Bera (p value)	(0.000)	(0.000)		(0.000)	(0.000)
Sri Lanka					
Mean	7.225	7.211	7.231	7.251	7.185
Std. Dev.	0.557	0.561	0.544	0.556	0.567
Skewness	–0.125	–0.712	–0.173	0.012	–0.162
Kurtosis	2.792	6.337	2.866	2.983	2.791
Jarque-Bera (p value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bangladesh					
Mean					
Std. Dev.					
Skewness					
Kurtosis					
Jarque-Bera (p value)					

Table 4.1 C: Tests of equality for mean and Variance in Simple OLS model

	Pakistan	India	Bangladesh	Sri Lanka
ANOVA F-stat	2.299***	0.317	5.293*	6.63*
Kruskal-Wallis H-stat	11.767**	0.396	26.467*	9.629*
Levene test W-stat	7.039*	4.817*	5.563*	0.735
Bartlett	51.872*	57.389*	54.818*	6.150

Note: ***, ** and * denote statistical significance at 1, 5 and 10 percent level respectively in Table A, B and C. The null hypothesis of all tests is equality of returns for F-test and Kruskal Wallis test. While for Levene test and Bartlett test's null hypothesis is equality of variances in Table C.

4.2. Results of Day-of-the-Week Effecting Returns and Volume Models

The day of week effect is checked by simple OLS model with four dummies taking Thursday as base. Table 4.2 reports the results of OLS regression for four SAARC markets and ARMA(1,0) term is used after analysing the collerogram. Results suggest that, although, there are negative returns on Monday for all countries except India. But significantly negative returns are only observed for Sri Lanka. For Tuesday there are observed significantly positive returns for Bangladesh. On Wednesday, there are reported significant positive returns for Pakistan and Sri Lanka. There are seen significant positive returns on Thursday for

Sri Lanka and Bangladesh. While there are observed significant positive returns for Friday only for Pakistan and Sri Lanka. It concludes that there are significant returns for all day of week only in case of Sri Lanka.

Table 4.2

Day of the Week Effect in Returns and Volumes by AR Model with Daily Dummies

A: Returns				
Parameters	Pakistan	India	Bangladesh	Sri Lanka
Mon	-0.041	0.027	–0.046	–0.088**
Tue	0.075	0.029	0.410*	–0.046
Wed	0.194*	0.068	0.211	0.194*
Thu	0.072	0.030	0.459*	0.244*
Fri/sun	0.132*	–0.021	–0.149	0.405*
AR(1)	0.017*	–0.002*	0.013*	–0.009
B: Volumes				
Parameters	**Pakistan**		**India**	**Sri Lanka**
C	2.213*		4.209*	7.224*
Mon	–0.043		0.025***	–0.013
Tue	–0.034		0.046*	0.007
Wed	–0.160*		0.045*	0.027
Thu	–0.046		0.044*	–0.039

Note: *, ** and *** denote significance at 10, 5 and 1 percent level respectively.

The Table 4.2 B presents OLS results for logarithmic volumes for three explored market. Results show that negative Monday returns in Pakistan and Sri Lanka while Positive on Friday, represented as constant for all of markets. There are reported significant Friday (positive) and Wednesday (negative) effect is found in Pakistan. In India significant positive results are reported for all days of week with lowest volume on Monday and highest volume on Friday. While in Sri Lanka Friday (positive) is reported significant. The inertia is observed in all markets in returns and volume as indicated by significant AR(1) term.

The LM ARCH test confirms the presence of ARCH effect. After founding for ARCH effect in markets that leads to violation of null hypothesis of no ARCH effect justified use of GARCH model.

4.3. Results of Day-of-the-Week Effect in Returns and Volatility Model

GARCH models order is selected via the Schwarz information Criteria. If ARCH-LM test and square of residual points out the existence of ARCH effects in errors, then family of ARCH models are applicable. The model that has minimum SIC is selected.

Table 4.3

Day-of-the-Week Effect on Returns and Volatility Using GARCH-M Model

A: Returns				
Parameters	Pakistan	India	Bangladesh	Sri Lanka
Monday	–0.019	0.062	–0.319***	–0.127*
Tuesday	0.079	0.083	0.252*	0.008
Wednesday	0.198*	0.099**	0.061	0.153*
Thursday	0.078	0.077***	0.389*	0.320*
Friday	0.176*	0.077	0.023	0.348*
AR(1)	–0.019*	0.063	0.019	0.061*
GAECH-M	0.079*			
Variance Equation				
Monday	0.421*	0.115*	0.658*	0.005*
Tuesday	–0.046	–0.031*	–0.187**	–0.017*
Wednesday	–0.111*	–0.043*	–0.185**	0.006
Thursday	–0.091*	–0.016	–0.138***	–0.017*
Friday				
GARCH(1)	0.642*	0.850*	0.616*	0.828*
ARCH(1)	0.199*	0.116*	0.281*	0.170*

B: Volumes			
Parameters	Pakistan	India	Sri Lanka
C	2.247*	4.216*	7.189*
Mo	–0.008	–0.028*	0.065*
Tuesday	–0.095*	–0.008	0.150*
We	–0.094*	0.027*	0.109*
Thursday	0.033**	0.017***	0.055***
C	0.027*	0.004*	0.044*
AR(1)	0.582*	0.261*	0.332*
GARCH-M	0.175*	0.661*	0.535*
Variance Equation			
Monday	0.220*	0.127*	0.735*
Tuesday	–0.032	–0.042*	–0.172**
Wednesday	–0.124*	–0.055*	–0.176**
Thursday	–0.072*	–0.013	–0.145***
Friday			
GARCH(1)	0.554*	0.545*	0.554*
ARCH(1)	0.173*	0.212*	0.222*

Note: *, ** and *** denote significance at 10, 5 and 1 percent level respectively.

Empirical results shows that lowest volume occur on Tuesday and highest volume occur on Friday in Pakistan, in India lowest volume occur on Monday and highest on Friday and in Sri Lanka highest on Friday and lowest is reported on Thursday. There are observed some same result by both OLS and GARCH as positive returns on Friday for all three countries, negative Wednesday effect in Pakistan and positive Wednesday effect in India. However there are some unique results reported by GARCH (1, 1)-M that are not reported by OLS. These are Tuesday (negative) and Thursday (positive) effect in Pakistan, Monday (negative) and Friday (positive) effect in India and Positive and significant volume returns for all days of week in Sri Lanka.

Mean equation of GARCH (1, 1)-M shows the positive returns for Wednesday and Friday in case of Pakistan significant at 1 percent significance level, in Bangladesh there are found negative returns on Monday significant at 10 percent level, while positive returns are reported on Tuesday and Thursday significant at 1 percent level. In Sri Lanka, there are observed negative returns for Monday while positive returns for Wednesday, Thursday and Friday all significant at 1 percent level. In India there has been found significant returns on Wednesday and Thursday.

Some effects exist that are unique in case of GARCH (1, 1) model as compared to OLS AR model. These comprise negative returns on Monday in case of Bangladesh, but it is significant at 10 percent level, so results need precaution for interpretation.

GARCH (1, 1)-M equation in volatility also detect day of week effect in volatility for all countries, with mostly terms significant at 1 percent level. Both of ARCH term with order one are significant for all studied countries as well as GARCH term. However in case of Bangladesh mostly terms are significant at 5 percent and 10 percent level. The sum of both ARCH and GARCH terms is greater than 0.8, but no one term has sum greater than unity. For Pakistan, it is 0.841, for India it is 0.966, for Bangladesh it is 0.897 and for Sri Lanka it is 0.998. It implies that shocks have persistent influence on the conditional variance. As no one has sum equal to unity however, Sri Lanka has approximately, so in case of Sri Lanka shocks has permanent effect.

4.4. Results from the Tests for Asymmetries in Volatility

Table 4.4

Engle-Ng Tests for Asymmetries in Volatility

	Pakistan	India	Bangladesh	Sri Lanka
Sign Bias	1.259*	1.426*	2.146**	0.209***
Negative Size Bias	–0.141	–0.512***	–0.956**	0.885**
Positive Size Bias	–1.018*	–1.838*	–1.887*	–0.988**
Joint Bias	0.798*	0.627*	0.871**	1.221*

Note: *, ** and *** denote significance at 10, 5 and 1 percent level respectively.

Except Pakistan all market exhibit negative sign bias implying that negative news has greater impact on volatility than the positive shocks. In case of Pakistan there is observed positive sign bias implying that positive shocks has more impact on volatility than negative shocks as compared to GARCH effect under normal condition. The joint sign bias result reject the null hypothesis of no asymmetric effect in case of all markets significant at 1 percent level except Bangladesh that is significant at 5 percent level. So this sign and size bias test proposed by Engle-Ng validates the usage of asymmetric GARCH-M models.

4.4.1. *Results from the TGARCH-M Model*

Table 4.5 presents the results for the TGARCH-M mean equation:

Table 4.5

Day of the Week Effect on Returns in the TGARCH-M Equation

	Pakistan	India	Bangladesh	Sri Lanka
GARCH-M	–0.028	0.012	–0.174**	0.088***
Monday	0.013	0.045	–0.093	–0.182*
Tuesday	0.084	–0.003	0.194***	0.016
Wednesday	0.191*	0.011	–0.005	0.150*
Thursday	0.074	–0.013	0.318*	0.2998
Friday	0.175*	–0.020	0.267***	0.337*
AR(1)		0.028	0.009	0.035**
GARCH-M				0.044*
Variance Equation				
TGARCH	0.036*	0.181*	0.213*	0.220*
Monday	0.540*	0.271*	0.963*	0.055*
Tuesday	–0.032	–0.067*	–0.238*	–0.011**
Wednesday	–0.102**	–0.086*	–0.213*	0.007
Thursday	–0.073**	–0.038	–0.222*	–0.005
Friday	–0.143*	–0.014	0.187*	–0.005
GARCH(–1)	1.303*	0.065**	0.732*	0.836*
GARCH(–2)	–1.232*	0.616*	–0.456*	
GARCH(–3)	0.463*		0.573*	
ARCH(–1)	0.179*	0.064*	0.171*	0.220*
ARCH(–2)	0.126	0.080*		
ARCH(–3)	0.178			

Note: *, ** and *** denote significance at 10, 5 and 1 percent level respectively.

The results indicate that day of week effect is present for the countries markets for which there is found by ARMA-OLS method, except for Sunday in Bangladesh and in Sri Lanka on Thursday. It implies that this day of week effect is not because of variance in equity risk especially for half of investigated

markets. While other results are same that is reported by ARMA-OLS, GARCH and TGARCH-M(3,3) methodology. In case of Pakistan positive Wednesday and Friday effect in ARMA (1,0)-OLS are most probably due to lower volatility on these day. That leads to the fact that taking into account for volatility would be useful for revealing new patterns. One other result is that some of daily dummies coefficients are found as significant in TGARCH-M(3,3) equation, while those were not significant in case of ARMA (1,0)-OLS. Significant negative returns for Thursday and Monday are discovered through this method, for Sri Lanka and Bangladesh respectively.

No particular pattern has been seen in any of the studied market, however there are observed negative Monday returns for Sri Lanka and Bangladesh while positive returns for Pakistan and Sri Lanka on Friday significantly. The coefficient of risk is significant only for Sri Lanka proposing that taking higher volatility risk is rewarded with higher returns. However its coefficient is negative in case of Bangladesh that signifies that taking additional risk can result in lower returns. The insignificant term in case of Pakistan and India suggest that variance risk is not rewarded.

Above Table 4.5 for TGARCH-M (3, 3) in variance equation also reports the presence of day of week effect in return's variance in all of studied countries markets. Asymmetric term is positive consistently and significantly. So it confirms the presence of leverage effect- bad news produce bigger pikes in volatility than of good news. In Pakistan highest risk is observed on Friday, which falls lowest on Monday. However there are observed significant results for all days of week in case of Pakistan, India, Sri Lanka and Bangladesh. Pakistan exhibit higher risk on Monday while lowest risk is observed on Friday. India reports higher risk on Monday while lower risk is observed on Tuesday and Wednesday respectively. In case of Bangladesh, higher risk is observed on Monday and Friday while lower risk is observed on Tuesday, Wednesday and Thursday. While for Sri Lanka, higher returns are observed on Monday while lower risk is observed on Tuesday.

For all studied markets, a rise in volatility in absolute terms results in correspondingly lower returns in mean equation. While a fall in volatility results in correspondingly higher returns in mean equation. For other markets, as it can be seen from India, negative volatility that is significant for many days of week has negative mean return for more days of weeks although insignificant. As in case of Pakistan for Wednesday and Friday there are observed negative volatilities, while positive returns are observed in mean equation. Hence it is confirmed that declined volatility leads to resultant positive returns in mean equation. Hence, this presents evidence for the risk-return trade-off relationship for studied markets. An increase in risk drops the returns, while a drop in risk, raises them.

There are found significantly positive GARCH terms in each country that are close to unity except Bangladesh implying that volatility fluctuations are soundly persistent. Just in case of Pakistan the first order GARCH term is greater than unity, which infers explosive effect of the last day variation. As sum of coefficients of GARCH terms is less than unity for India and Bangladesh while greater than unity for Sri Lanka and Pakistan indicating that shocks has persistent impact on volatility for conditional variances. ARCH terms with first order are all significant. Sum of all terms for GARCH and ARCH coefficient is greater than 0.9 for all studied markets except India. It is 1.017 for Pakistan, in India 0.76, Bangladesh 1.02 and Sri Lanka 1.056. It specifies long persistence effect for volatility- response to shocks fade away sluggishly.

4.4.2. *Results from the EGARCH-M Model*

Results obtained from EGARCH-M mean equation and results from TGARCH-M model are mostly alike. They designate the presence of strong volatility day-of-the-week effect, except in Bangladesh on Monday and Sunday and in Sri Lanka on Thursday in comparison to TGARCH-M(3,3) while in case of OLS AR and GARCH (1,1) only in case of Bangladesh there are observed negative returns for Monday, same like GARCH (1,1) but not according to ARMA-OLS. All other results coincide with the ARMA-OLS and GARCH (1, 1).

There are observed some impact that are significant in case of GARCH (1, 1), EGARCH-M and TGARCH-M models but are not significant in case of OLS AR. This is observed Monday and Sunday effect in Bangladesh. Interestingly, the estimates of Pakistan in both of the models are significant at 5 percent level marginally, while are significant at 1 percent for Bangladesh in case of Bangladesh. So it is quite easy to draw the conclusion about all these return patterns.

Interestingly, reward to variance risk behaves differently in case of Bangladesh and India that is not significant now implying that there is no return of facing variance. In Table 4.6, day of week effect is observed in variance of return for all studied markets. These effects occur for Pakistan, where risk is high on Monday, lower on Wednesday and Thursday and lowest on Friday. In India, lowest risk is on Monday and lowers on Tuesday, Wednesday, Thursday and Friday. Bangladesh also exhibit higher risk on Monday and Friday while lower on Wednesday, Tuesday and Friday. There is observed lower risk in Sri Lanka for Monday, Tuesday and Thursday. Results are same as obtained through TGARCH-M method, that an increase in volatility results in corresponding negative returns in means equation, except Bangladesh. While decrease in volatility leads to correspondingly higher returns in mean return equation. So for all countries except Bangladesh, an increase in risk lowers the returns, while decline in risk raises returns. The asymmetry is observed in all the markets except Sri Lanka implying that negative shock has more effect compared to positive shock.

Table 4.6

Day-of-the-Week Effect on Returns in the EGARCH-M Equation

	Pakistan	India	Bangladesh	Sri Lanka
GARCH-M	–0.106***	–0.008	0.009	0.089***
Monday	0.166***	0.041	0.001*	–0.149*
Tuesday	0.060	0.018	–0.601*	–0.027
Wednesday	0.155*	0.037	0.254	0.149*
Thursday	0.053	0.013	0.039*	0.283*
Friday	0.156**	0.026	0.409	0.349*
AR(1)	–0.106		0.021	0.051
GARCH-M	0.175*	0.046*	0.035*	0,003
Variance Equation				
EGARCH	–0.018*	–0.105*	–0.052*	0.058*
Monday	0.114*	–0.221*	0.166*	–0.181*
Tuesday	–0.033	–0.033**	–0.086**	–0.020*
Wednesday	–0.061***	–0.046*	–0.071**	0.005
Thursday	–0.046*	–0.039*	–0.090**	–0.019*
Friday	–0.055*	–0.030**	0.147*	0.004
GARCH(–1)	1.728*	0.234*	0.813*	0.953*
GARCH(–2)	–1.709*	0.682*		–
GARCH(–3)	0.793*	–		–
ARCH(–1)	0.336*	0.272*	0.813*	0.296*
ARCH(–2)	–0.281*	0.147*	–	–
ARCH(–3)	0.316*	–	–	–

Note: *, ** and *** denote significance at 10, 5 and 1 percent level respectively

Comparing both asymmetric GARCH models, in some aspects EGARCH looks suitable choice. As Engle and Ng (1993) point out that EGARCH model can over-estimate the effect of outlier on volatility due to exponential structure. Thus resulting in higher variances forecast as compared to TGARCH. EGARCH seems better choice because it requires lowers ARCH and GARCH term orders.

4.5. A Summary and Comparison of the Results of the Regression Models

Table 4.7

Summarises all the Results for the Returns So Far

	Monday	Tuesday	Wednesday	Thursday	Friday	Sunday
Pakistan	–	–	–	–	–	–
ARMA(0,1)-OLS	–	**–**	**Positive**	**–**	**Positive**	**–**
ARMA-GARCH-M	**–**	–	**positive**	**–**	**Positive**	**–**
ARMA–TGARCH-M	–	–	positive	–	Positive	–
ARMA-EGARCH-M	**negative**	**–**	**positive**	**–**	**positive**	
India						
ARMA(0,1)-OLS	–	–	**–**	–	–	–
ARMA-GARCH-M	–	**positive**	**positive**	–	–	–
ARMA-TGARCH-M	–	–	–	–	–	–
ARMA-EGARCH-M	**–**	**–**	**–**	**–**	**–**	**–**
Bangladesh						
ARMA(0,1)-OLS	**–**	**positive**	**–**	**positive**	**–**	**–**
ARMA-GARCH-M	**negative**	**positive**	**–**	**positive**	**–**	**–**
ARMA-TGARCH-M	–	**positive**	**–**	**positive**	**–**	**negative**
ARMA-EGARCH-M	**negative**	**positive**	**–**	**positive**	**–**	–
Sri Lanka						
ARMA(0,1)-OLS	**negative**	**–**	**Positive**	**positive**	**Positive**	–
ARMA-GARCH-M	**negative**	**–**	Positive	**positive**	**Positive**	–
ARMA-TGARCH-M	**negative**	**–**	Positive	positive	**Positive**	–
ARMA-EGARCH-M	**negative**	**–**	Positive	**positive**	**Positive**	–

This Table 4.7 reports day of week effect in returns and significant day of week effect is found in all of countries except India. In Pakistan, there are found negative Monday and positive Wednesday and Friday returns. While in case of Bangladesh, it reports negative returns for Monday and positive returns for Tuesday and Thursday. In Sri Lanka, results show negative returns for Monday and positive returns for Wednesday, Thursday and Friday. No Significant seasonality pattern is seen in case of India, so there exist no significant day of week effect in BSE.

Table 4.5 B: Summary of Models Results for Volatility

Table 4.8

Summarises all the Results for the Returns So Far

	Monday	Tuesday	Wednesday	Thursday	Friday	Sunday
Pakistan						
GARCH-M	positive	–	negative	negative	Negative	
TGARCH-M	positive		negative	–	Negative	
EGARCH-M	positive		negative	negative	negative	
India						
GARCH-M	positive	negative	negative	–	–	
TGARCH-M	positive	negative	negative	–	–	
EGARCH-M	negative	negative	negative	–	–	
Bangladesh						
GARCH-M	positive	–		negative		
TGARCH-M	positive	–	–	Negative		positive
EGARCH-M	positive	–		negative		positive
Sri Lanka			–			
GARCHM	positive	negative		negative	–	
TGARCH-M	positive	Negative				
EGARCH-M	negative	negative		negative	–	

In summary, the highest volume occur for Friday in all of the studies markets, while lowest volumes occur for Tuesday, Monday and Thursday for Pakistan, India and Sri Lanka respectively. In Pakistan, there are observed positive volatilities on Monday while negative volatilities on Wednesday, Thursday and Friday. In case of India, interestingly, although no day of week effects was found but there are seen positive volatilities on Monday while negative volatilities on all other days of week except Friday. In Bangladesh there are seen positive volatility effects on Monday and Sunday and on all other day negative volatility. In Sri Lanka there are found positive Monday effect while negative on Tuesday and Thursday. One common effect is positive Monday and negative Friday volatilities in all markets.

(1) For Pakistan

(a) In this study, Negative Monday returns are found just by EGARCH-M while positive returns are reported for Friday and Wednesday. While in literature there has been found negative Monday and positive Friday effect by Haroon (2013) and positive return on Tuesday by Hussain, *et al.* (2011).

(b) In this study there is observed higher variance for Monday while lower variance for Wednesday, Thursday and Friday. And in literature variance for Tuesday and Wednesday is reported by Nishat (2002).

(c) This study reports highest trading volume on Friday and lowest trading volume on Tuesday, in line with the findings of Nishat (2002). He has reported lowest trading volume on first trading day of week than other days of week, while highest trading volume is observed on last trading day of week by simple mean and median approach.

(2) For India

(a) There is found Tuesday and Wednesday effect in returns. In India, higher returns on Friday than rest of days Poshakwale (1996). Nath and Dalvi (2004) examined significant Monday and Friday returns. Chander, *et al.* (2008) positive returns on Friday and negative returns on Monday.

(b) In variance Higher Monday and lower Tuesday and Wednesday effect is found. Kalaivani and Srinivasan (2013) Tuesday have negative impact on volatility after controlling asymmetric effect. This study finds highest trading volume on Friday while lowest and negative trading volume on Monday. In literature recently there is found Tuesday and Monday effect in return equation while Tuesday and Wednesday effect in volatility equation.

(3) In Bangladesh

(a) There are found negative returns on Monday while positive returns on Tuesday and Thursday. While in literature Islam and Gomes (1999) reported large positive returns on last trading days of week (Thursday). While Rahman (2009) has reported negative returns for Sunday and Monday while for other days it was found positive.

(b) There are found positive variance for Monday, negative variance for Tuesday and Thursday. While in literature day of weeks are not reported in variance equation.

(4) In Sri Lanka

(a) There are found negative Monday and positive Wednesday, Thursday and Friday returns. While in literature there is found Wednesday, Thursday and Friday effect. Highest or positive returns are observed on Friday while low or negative returns are observed on Monday by Thilakerathne, *et al.* (2007) in Sri Lanka.

(b) While daily variance are not reported in variance equation of GARCH (1, 1). There is found positive variance for Monday while lower variance for Tuesday and Thursday is found in this study.

(c) Highest trading volume is observed on Monday, while lowest trading volume is observed on Thursday.
(d) Some of the results obtained through this study diverge from the literature results. Different reasons may be contributing factor regarding this: as impact of updated sample, new methodology because it is not employed in literature of studied markets, development of day of week effect during the ongoing financial crisis and many other reasons that are not revealed yet.

Possible Explanations for the Anomalies Found

Rationale behind this study is to confirm that the day-of-the-week effects still exist and there is asymmetry effect present in studied market. Some of the anomalies found in this study are not detected already in previous literature for SAARC countries.

Role of settlement period hypothesis has been tested most frequently in the previous literature while testing for causes of day of week effect. It states that stock settlement take place after particular working days trading period. But if this period has weekend, it leads to contraction on value of stock because interest cannot be earned on cash by sellers in this period. Then seller try to incorporate premium in selling price of their share that leads to rise in price on certain day by amount of forgone interest of one or two days resulting in higher index return. For example, in case of settlement length of one-day would infer greater returns on Friday (last working day), because on weekend interest is abolished; while settlement regime of two-days implies more returns on Thursday and Friday etc. Shortcoming of settlement period hypothesis is that it can explain only high return but cannot explain lower returns.

As in study of Agrawal and Tendon (1994) four-day settlement period is reported having high returns on Wednesday and Tuesday for one of studied markets. In case of Bangladesh on Monday and Tuesday there are observed significantly positive returns, this may be due to four day settlement period. Because in case of Bangladesh Monday and Tuesday are second and third days respectively.

Choudhry (2000) has reported three-day settlement period in Thailand implying high returns on Wednesday and Thursday. While in case of Sri Lanka there are observed significant positive returns on Wednesday and Thursday, maybe there is three-day settlement regime in Sri Lanka's stock market. But Choudhry (2000) also reported two day settlement period for Korea on Thursday and Friday. So in Sri Lanka there may be two-day settlement period or three-day settlement period, because there are positive significant effect of Wednesday-Thursday and Thursday-Friday.

Behavioural Finance and Explanation of Anomalies

One of the claim levelled at behavioural finance is that it predicts over-reaction and on other times under-reaction. Over-reaction hypothesis occur when stock prices rise or fall too much in response to good or bad news. As this study analyse the day of week effect in stock return and also the asymmetry behaviour of stock returns that are observed in studied markets. These over-reaction and under-reaction anomalies that are unplanned [He and Tan (2009)] are due to investor behaviour on particular day of week. On certain day, as observed in studied markets, with good news stock price usually overshoot because the investors misjudge. And when investors realise that they were over optimistic they tend to trade in opposite direction leading to price reversal, sometimes resulting in under-reaction. Therefore, different day of week effects and asymmetric effects in SAARC countries markets may possibly be due to over-reaction and under-reaction of investors.

Comparing the results of the four models, day-of-the-week effects in returns are present on the markets of Pakistan, Bangladesh and Sri Lanka. However, in case of India there are observed positive returns for Tuesday and Wednesday reported by GARCH (1, 1)-in-Mean model. In Pakistan, daily returns are positive on Wednesday and Friday, in India, positive returns are reported on Tuesday and Wednesday, in Bangladesh negative on Sunday and Monday, positive on Tuesday and Thursday. In Sri Lanka—positive returns on Wednesday, Thursday, Friday and negative returns on Monday.

There are observed fluctuations in volatility across week days in Pakistan, India, Bangladesh and Sri Lanka. On the Pakistani and Indian market, risk is significantly high on Monday than other day of week and lowest on Friday. In Bangladesh, Monday and Friday exhibit higher risk and Tuesday lower risk. In Sri Lanka higher and significantly positive returns are observed on Monday while lower risk is observed on Tuesday.

Highest trading volume is observed on Friday in all of three studied markets. While lowest volumes occur for Tuesday, Monday and Thursday for Pakistan, India and Sri Lanka respectively. Some of the reported results are not in line with the results reported in literature of respective markets. There may be many of reason for such results, for example, different model and up-dated sample period.

5. CONCLUSION AND IMPLICATIONS

Day of week effect is a calendar anomaly in which some days have relatively high or relatively low returns than other days of week. This is interesting due to relationship between day of week and magnitude of return associated with that particular day of week. Day-of-the-week effect was initially recognised in US market as Monday effect—lower or negative returns on Monday and higher or positive returns on Friday. Different patterns have been

identified through other markets and on different time periods. Different attempts are made to elaborate them with statistical errors, volatility variations, settlement procedures and repetitive influx of unfavourable updates at definite points of time. Strategies taken by investors due to this news resulting in different patterns may be one of the reasons.

Objective of this study is to find out that either there still exist day of week effect and asymmetric behaviour in studies markets by using daily returns data. The examined markets include Pakistan, India, Bangladesh and Sri Lanka. While daily volumes are also taken for Sri Lanka, Pakistan and India, just for checking day of week in volume and symmetric response of volatility in volumes. The sample period starts from August 1, 1999 to July 1, 2014 for all investigated markets except Bangladesh. Data for Bangladesh is from February 2006 to Dec 12 2012. Data for returns and volume is taken for analysing day of week effect.

Five models are employed for detecting of day of week effect and asymmetry effect in return series of observed markets. Two are linear regression- simple OLS regression with five dummies and modified OLS model with AR terms, just for detection of day of week effect. One is symmetric GARCH-M, having mean equation of OLS AR and variance equation for all-days of week. The other two model incorporated are Asymmetric GARCH-M models includes, TGARCH-M and EGARCH–M model. These both models use mean equation of ARMA-OLS terms or modified OLS. These both model account for response of volatility to bad shocks. Moreover, in variance equation, volatility is allowed to vary by day-of-the-week.

Results reported day-of-the-week effect in return and volumes for all markets. In Pakistan, there are found negative Monday and positive Wednesday and Friday returns. While in case of Bangladesh, it reports negative returns for Monday and positive returns for Tuesday and Thursday. In Sri Lanka, it shows negative returns for Monday and positive returns for Wednesday, Thursday and Friday. No Significant seasonality pattern is seen in case of India, so there exist no significant day of week effect in BSE.

In Pakistan, there are observed positive volatilities on Monday while negative volatilities on Wednesday, Thursday and Friday. In case of India, interestingly, although no day of week effects is found but there are seen positive volatilities on Monday while negative volatilities on all other days of week except Friday. In Bangladesh there are seen positive volatility effects on Monday and Sunday and on all other day negative volatility. In Sri Lanka there are found positive Monday effect while negative on Tuesday and Thursday. One common effect is positive Monday and negative Friday volatilities in all markets. The highest volume occur for Friday in all of the studies markets, while lowest volumes occur for Tuesday, Monday and Thursday for Pakistan, India and Sri Lanka respectively. Some of the reported results are not in line with the results reported in literature of respective markets. The reason may be different model and up-dated sample period.

Implication of this study is that presence of particular patterns in the stock returns is useful for making investment decision. While examining volatility patterns helps to take into account the risk and return associated with that particular day. The investor can make decision by taking into account both risk and return and how good news and bad news impacts the stock returns.

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