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Structural Changes and the Day-of-the-Week Effect in Indian Stock Market

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Abstract

This paper examines the presence of the day-of-the-week effect on stock returns, trading volume and price volatility at the NSE during the period of 10 years from 1995-2005. To isolate the effect of the structural changes, particularly of the introduction of compulsory rolling settlement, a sub-sample period of three years from April 2002 to March 2005, is also taken. Both the stock prices (at indices level) and the trading volume are analyzed at level as well as in their differenced form. We observe that the Wednesday effect, which was found during earlier weekly settlement regime, has now disappeared. Monday and Tuesday returns are although consistently low; but during the recent sub-period these are not statistically different from the returns of the rest of the week. However, on Monday the average trading volume is significantly low and the price volatility is high consistently across the entire sample period. We also observe that the Friday returns on S&P CNX Nifty are significantly higher in comparison to that on CNX Nifty Junior.

I. Introduction

FOR MANY YEARS, it was believed (particularly, in the academic world) that the stock market is informationally efficient. The general idea behind the Efficient Market Hypothesis (Semuelson, 1965; Fama, 1965) is that the asset prices are determined by demand and supply in a competitive market with rational market players. These rational market players gather relevant information very rapidly and immediately incorporate this information into asset prices. If all the information available at a point of time is incorporationed in asset prices, no any set of known information, but only new information, i.e. news, should cause changes in price. Since, news is unpredictable by definition, price changes are also unpredictable.

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The Efficient Market Hypothesis is simple to state, but its implications are many and subtle. One of the simplest implications of the hypothesis is that the prices should follow 'random walks' and therefore the expected (mean) return should be evenly distributed across the time. However, the empirical research on stock price behaviour shows that the stock prices frequently violate this simple rule. More specifically, we observe seasonalities or calender anomalies in stock returns such as intraday effect, day-of-the-week effect, month-of-the-year effect etc. Among them the day-of-the-week effect is most widely documented across the countries and markets. In context to stock market the majority of research findings, indicates that the stock returns remain low or negative on Monday. However, certain variations in weekly behaviour of stock returns are also observed which are found to be associated with market microstructure and practices.

The emerging stock markets, such as India, where the process of structural changes is going on, provide us a good opportunity to study the dynamics of market efficiency. Particularly, we can learn how shift from weekly settlement system to rolling settlement system changes the behaviour of stock returns across the weekdays and whether this behaviour reflects the efficiency implications of other market reforms such as discontinuation of *badala* in BSE, introduction of derivative products, increasing use of online-trading, change in composition of market participants with increasing number of small investors, mutual funds and foreign institutional investors etc. Keeping this opportunity in view the present study examines the day-of-the-week effect in Indian stock market during the period of a decade from April 1995 to March 2005.

II. Review of Literature

There can be little doubt that the day-of-the-week anomaly is one that has attracted considerable attention in the literature. Early research into this topic was conducted by Cross (1973), French (1980), Gibbons and Hess (1981). The references cited by Chang Pinegar and Ravichandran(1993); Agrawal and Tandon (1994); Maberly (1995) ; Wong, Agarwal and Wong (2004), Agarwal, Wong and Du (2004) and Wong, Agarwal nd Wong (2006) provide a comprehensive review of literature. The studies generally conclude that the stock returns on Monday, all in average, are negative and they are significantly lower than the returns on other days of the week. This effect is widely reported from different countries, however, with certain variations. For example, Jaffe and Westerfield (1985) report negative returns on Tuesday in Australia and Japan. Agrawal and Tandon (1994) find that out of eighteen countries included in their study, in eight countries Tuesday has the lowest average returns. Bildik (2004) and Nath and Dalvi (2004) provide a comprehensive list of research studies who have observed the lowest average daily return for Tuesday. This Tuesday effect is observed outside US, particularly in emerging markets, and often interpreted as a spill-over of Monday effect in US stock market (Condoyanni, O'Hanlon and Ward, 1987).

Conceptually, it is expected that a stock market anomaly must have a short life. Once an anomaly is discovered, it will be exploited by investors to draw its advantage which will eventually correct the demand-supply disequilibrium and the anomaly will disappear. Violating this prior-expectation, the Monday or the weekend effect is showing persistence since more than last three decades of its discovery. However, as Connolly (1989) points out, weekend effect is not stable overtime " it appears in some periods, disappears in certain periods and reappears in other. Moreover, certain studies (e.g. Brusa and Schulman 2000,2003) suggest that in US the weekend effect has reversed recently " whereby Monday returns are significantly positive and they are higher than the returns of the other days of the week. This 'reverse weekend effect' is more prominent in stocks of large firms than those of small firms.

Moreover, the day-of-the-week effect is not limited to stock markets. Researchers have documented this effect across the different markets including foreign exchange market (McFarland et al., 1982; So, 1987; Cornett Schwarz and Szakmary, 1995; Aydogan and Booth, 2003; Agarwal, Wong and Wong, 2004; Wong, Agarwal and Wong, 2006), treasury-bills (Gibbons and Hess, 1981; Flannery and Protopapadakis, 1988); gold market (Ball, Torous and Tschoegl, 1982), financial futures and options (Chiang and Tapley, 1983; Cornell, 1985; Dyl and Maberly, 1986; Petorson, 1990; Martikainen and Puttonen, 1996) and commodity futures (Gay and Kim, 1987; Chang and Kim, 1988). Notably, in most of the cases the Monday returns are observed negative or the lowest.

Several hypotheses have been suggested to explain the day-of-the-week effect, specifically the Monday effect. However, none of the hypotheses could gain unanimous acceptability of researches as they provide only a partial explanation of the anomaly. The more prominent among these hypotheses are the settlement regime hypothesis, the information release hypothesis and the information processing hypothesis (Keef and Roush, 2005). *The* settlement regime hypothesis (Gibbons and Hess, 1981; Labonishok and Levi, 1982; Solmik and Bousquet, 1990) suggests that the delay in the cash payment for the security can lead to enhancement of rate of returns on specific days due to extra credit period availability. Under the account period system such effect occurs in the first days of the settlement cycle (Board and Sutcliffe, 1988; Agrawal and Tandon, 1994). Under T+1 rolling settlement Friday prices remains high. While, under T+2 system prices remain high both on Thursday and Friday; hence, high return is observed on Thursday (Agrawal and Tandon, 1994; Bildik, 2004). High price-base on weekend produces negative returns on Monday. But, this cannot explain Monday effect completely as the negative Monday effect is found stronger in comparison to positive weekend effect. Moreover, the economic benefit associated with increased credit is quite small to produce such effect under rolling settlement system. However, under the account period system this benefit is quite substantive to produce a visible effect.

The information release hypothesis (French, 1980; Rogalski, 1984; Penman, 1987; Damodaran, 1989; DeFusco, Mc Cabe and Yook, 1993) suggests that business leaders delay in release of negative information until after the closure of stock exchange on Friday, which is responsible for bearish environment in the stock market on its reopening on Monday. The information processing hypothesis (Miller, 1988; Lakonishok and Maberly, 1990; Abraham and Ikenberry, 1994; Sias and Stark, 1995) argues that the behaviour of individual investors is responsible for observed Monday effect. The crux of this hypothesis is that gathering information during weekdays trading hours is particularly costly for individual investors as most of them are employed with other activities during that period. For them, weekend provide a convenient opportunity to gather and process the information and to reach at an investment decision. They may put some buying orders on weekdays also based on their brokers' recommendations. It has been observed that the broker community produces more buying recommendations than the selling recommendation; hence, for selling decisions the individual investors have to be based on their own information processing. Therefore, there is a clusterisation of selling orders from individuals on Monday (and possibly on Tuesday also). On the other hand, the institutional investors use Monday morning to frame the trading strategy for the coming week (Osborne, 1962), therefore there is less trading from institutional traders on Monday. This situation produces a downward pressure on prices on that day.

In contrary to general unanimity regarding the presence of Monday (in some cases Tuesday) effect internationally, the earlier studies in India with different sample periods, indices and analytical techniques, came with different conclusions regarding the intra-weak behaviour of stock prices. The differences could be mainly because of the changing market mechanism. Chaudhary (1991) examined the behaviour of BSE Sensex from June 1988 to January 1990 using Kruskal-Wallis test and found that Monday returns are significantly negative. Poshakwale (1996) studied the behaviour of BSE National Index from January 1987 to October 1994. He observed a significant weekend positive autocorrelation and negative average Monday returns. Arumugam (1997) observed that the negative Monday returns were occurring only during the bear phase. Goswami and Angshman (2000) examined the prices of seventy individual securities at BSE from 1991 to 1996 and found a significant positive Friday effect which was correlated with the firm size. Choudhry (2000) examined the weekly patterns of stock returns and volatility in seven emerging markets including India. Using a GARCH specification, he obtained a positive Friday effect in returns and a positive Thursday effect in volatility for India. Bhattacharya, Sarkar and Mukhopadhyay (2003) examined the behaviour of BSE-100 from January 1991 to September 2000 using GARCH approach. They obtained more complex fortnightly patterns of returns and volatility which, according to them, were the results of the interaction between banking sector and capital market during early 1990s as well as different settlement cycles in operation in the different stock exchanges of the country. All the studies discussed above are related to the period

before the introduction of rolling settlement. A more recent study by Nath and Dalvi (2004) examines the impact of the introduction of rolling settlement. They use high frequency data for the period of 1999 to 2003 and analysed the data with robust regression technique. They conclude that there were Monday and Friday effects before introduction of rolling settlement; however, after the introduction of rolling settlement only Friday effect is surviving. They use S&P CNX Nifty to represent the stock prices but in their regression equation CNX Nifty Junior also appears as a regressor. As both the indices represent the same market, the results should be interpreted as differential behaviour of S&P CNX Nifty shares in comparison to CNX Nifty Junior shares.

III. Data and Methodology

This study covers a sample period of ten years from April 1995 to March 2005. The stock prices are represented by two price indices " S&P CNX Nifty Index (hereafter called 'Nifty') and CNX Nifty Junior Index (hereafter called 'Nifty Jr.'). The former index represents the blue chips of Indian stock market while the latter index represents the growth stocks. The closing prices of these indices and the daily trading volume (in terms of Rs.) at National Stock Exchange of India (NSE) were obtained from its website (www.nseindia.com.). There were tradings on certain weekly closing days (i.e. Saturday and Sunday); these days were excluded from the sample. During the above sample period of ten years many structural changes also took place in the market. For example, rolling settlement system was introduced in the place of earlier weakly settlement system. Standardised derivative products were also introduced in the market. The national wide online trading system gradually got popularily and increased the coverage of the market. Individual investors started to take interest in stock market and their participation, directly and through mutual funds gradually increased. Liberalisation policies attracted FII inflow, which significantly increased the liquidity in the market. All these developments widened the depth and breadth of the market and would have certainly improved the market efficiency also. However, from the view point of the day-of-the-week effect, the most relevant among the above changes is the switching over from weekly settlement system to rolling settlement system because the day-of-the-week effect, in a few cases, has been found associated with the settlement system in operation. Since, the compulsory rolling settlement was introduced in India since January 2002; we have taken a sub-sample of three years from April 2002 to March 2005 to study the impact of this change on intra-week behaviour of the market.

We have used two alternative representations of price and volume in this study. Traditionally, these variables are log-transformed and then their first-differences are used in the analysis. The differenced-forms of these variables represent the stock returns and the relative change in trading volume respectively. The comparison is made between average daily returns (or average daily changes in volume) for different days of the week. Since, in this representation only the relative change in price (or volume) on a particular

day over the previous day is taken into account, we can not analyse on which particular day of the week the price (or volume) reaches at its peak and when it is the lowest. To make such analysis possible, and also to examine whether the day-of-the-week effect is sensitive to different representations of the variables, we have used an alternative representation of price and volume in addition to above traditional representation. In this alternative representation, the variables have been taken at level (instead of at differenced form) after making adjustment for trend. More specifically, a 30-day moving average of price (and volume) was obtained and daily price (volume) was divided by this moving average to get the relative price level (or the relative volume level). The Dickey-Fuller unit-root test suggests that both the representations of price and volume produce the stationary time series (results are not produced here). The daily price volatility has been measured using its traditional definition, i.e. the squared daily returns; however, to avoid inconvenience in dealing with very small numbers, these figures have been multiplied by 10,000.

The 'two-sample t-test' and the analysis of variance (ANOVA) are used to detect the presence of day-of-the-week effect in price, volume and volatility. The t-test examines the significance of the difference between the mean of the variable on a particular day of the week and it's mean for the rest of the week; while, the ANOVA (F-Ratio) tests the composite hypothesis that the mean of the variable is not different across the days of the week. To confirm the results of these preliminary examinations, the following regression model with conditional mean and dummy-variable regressors, is estimated separately for different variables with their alternative representations and with different sample periods:

$$Y_t = \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{j=1}^{5} \gamma_j D_j \qquad (1)$$

where, Y is any one of the variables under study (i.e. relative price level, stock returns, relative volume level, change in volume and price volatility). D_j are the five dummy variables representing five days of the week. 'No-intercept model' is used to avoid 'dummy-variable trap'. The number of autoregressive terms in the equation, 'p', are decided on the basis of Akaike Information Criterion (AIC). The significance of the coefficients of the dummy variables is evaluated using their White's heteroscedasticity adjusted standard errors.

IV. Results and Discussion

4.1 *Day-of-the-Week Effect on Stock Prices*

Table I show the average daily relative price level and average daily stock returns on Nifty and Nifty Jr. for different days of the week. In the entire sample period of ten years, the highest average relative level of stock prices is observed on Wednesday, while the lowest level reaches on Tuesday. However, the inter-weekdays differences in relative price level are not statistically significant. On the other hand, the inter-weekdays differences in

average stock returns are significant. The highest average return is observed on Wednesday consistently on both the indices. The average Wednesday returns are significantly different from the average returns for rest of the week. On Nifty, the average return on Wednesday (0.45 percent) is fifteen times higher than the average return for all the weekdays taken together (i.e. 0.03 percent). On Nifty Jr. this difference is about thirteen times. The lowest average return on Nifty is observed on Monday; while, on Nifty Jr. it is observed after a lag of one trading day, i.e. on Tuesday. In both the cases the average return of the day is negative and statistically different from the average return for the rest of the week. However, when we take the sub-sample of recent three years, both the representations of stock prices (i.e. relative price level and returns) on both the indices show the absence of any day-of-the-week effect.

Table I
Relative Stock Price Level and Average Daily Stock Return on Different Week Days.

(Daily Average)

Day of the Week	Entire Sample [1995-2005]				Recent Sub-Sample [2002-2005]			
	NIFTY		NIFTY-Jr		NIFTY		NIFTY-Jr	
	Relative Price Level	Return	Relative Price Level	Return	Relative Price Level	Return	Relative Price Level	Return
Monday	1.0045	-0.0016	1.0094	-0.0009	1.0125	0.0002	1.0199	-0.0002
	[0.32]	[2.58***]	[0.15]	[1.63]	[0.16]	[0.59]	[0.24]	[1.15]
Tuesday	1.0029	-0.0013	1.0070	-0.0017	1.0117	0.0007	1.0210	0.0008
	[1.08]	[2.65**]	[0.93]	[3.01***]	[0.05]	[0.10]	[0.02]	[0.44]
Wednesday	1.0068	0.0045	1.0120	0.0064	1.0111	0.0001	1.0205	0.0021
	[0.76]	[6.46***]	[0.72]	[7.57***]	[0.24]	[0.73]	[0.09]	[0.68]
Thursday	1.0059	0.0002	1.0113	0.0005	1.0111	0.0009	1.0209	0.0027
	[0.36]	[0.21]	[0.49]	[0.02]	[0.25]	[0.08]	[0.01]	[1.24]
Friday	1.0058	-0.0002	1.0094	-0.0017	1.0133	0.0020	1.0222	0.0011
	[0.28]	[0.80]	[0.013]	[2.79***]	[0.39]	[1.23]	[0.30]	[0.14]
All days	1.0052	0.0003	1.0098	0.0005	1.0119	0.0008	1.0209	0.0013
F-Ratio	0.4117	11.4836	0.3311	15.4234	0.0612	0.4519	0.0312	0.7967
(p)	(0.8003)	(0.000)	(0.8572)	(0.7711)	(0.000)	(0.9981)	(0.5275)	(0.9931)

Note: Figures in parentheses [] show the't-values' based on White's heteroscedasticity adjusted standard errors.
*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

The results of the dummy variable regression analysis, presented in Table II also confirm the same findings. After making adjustment for conditional mean (with auto-regressive terms in the regression), both the representations of price show the consistent results. The coefficients associated with Wednesday dummy are positive and statistically significant ($p < 0.01$) for both the Nifty and the Nifty Jr. The coefficients of the Monday and the Tuesday dummies are negative. In case of Nifty these coefficients are significant ($p < 0.01$) for both the days, but in case of Nifty Jr. only the coefficients of Tuesday dummy are statistically significant. The dummy variable regression also

confirms that there is no any day-of-the-week effect during recent sub-sample period as no coefficient of the day-of-the-week dummies is statistically different from zero. However, it is interesting to note that the coefficients of Monday and Tuesday dummies are still consistently bearing negative signs, although these coefficients are statistically non-significant.

Table II
Day-of-the-Week Effect on Stock Returns.

(Regression Coefficients)

Day of the Week	Entire Sample [1995-2005]				Recent Sub-Sample [2002-2005]			
	NIFTY		NIFTY-Jr		NIFTY		NIFTY-Jr	
	Relative Price Level	Return	Relative Price Level	Return	Relative Price Level	Return	Relative Price Level	Return
Lag order of the Auto-regression	11	6	11	10	3	4	5	2
Monday	-0.00204	-0.00238	-0.00132	-0.00153	-0.00059	-0.00074	-0.00115	0.00153
	[6.79***]	[8.62***]	[1.96]	[2.45]	[0.25]	[0.36]	[0.75]	-[1.20]
Tuesday	-0.00228	-0.00220	-0.00307	-0.00294	-0.00033	-0.00002	-0.00101	0.00039
	[8.53***]	[7.37***]	[10.63***]	[9.07***]	[0.08]	[0.00]	[0.58]	-[0.08]
Wednesday	0.00473	0.00510	0.00715	0.00735	-0.00072	-0.00071	0.00095	0.00110
	[36.76***]	[40.03***]	[58.27***]	[57.12***]	[0.37]	[0.33]	[0.51]	[0.61]
Thursday	-0.00044	-0.00041	-0.00085	-0.00111	0.00017	-0.00004	0.000152	0.00123
	[0.01]	[0.025]	[0.81]	[1.28]	[0.02]	[0.00]	[1.32]	[0.77]
Friday	0.00007	-0.00009	-0.00191	-0.00176	0.00149	0.00153	-0.00031	-0.00041
	[0.01]	[0.01]	[3.96**]	[3.11*]	[1.58]	[1.51]	[0.06]	[0.08]

Note: Figures in parentheses [ ] show the't-values' based on White's heteroscedasticity adjusted standard errors.
*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

Certain important conclusions emerge from these observations. The earlier weekly settlement system had produced a very strong Wednesday effect. Under this system Tuesday used to be the weekly settlement day at NSE. Therefore, on Wednesday, being the first trading of the settlement cycle, the securities were traded on the basis of one week's credit. On the other hand, no credit is available on the securities traded on the last day of the trading cycle, i.e. Tuesday. Consequently, the relative prices were the lowest on Tuesday and the highest on Wednesday, producing a very high inter-day return on Wednesday. This Wednesday effect, as expected, disappears after the introduction of rolling settlement. There is also evidence of presence of Monday and Tuesday effects (Tuesday effect seems more robust in comparison to Monday effect as it is present in both the indices). For both of these days the dummy variable regression coefficients are negative. However, during the recent sub-sample period these effects seem to have turned feeble. This may be due to improved efficiency brought in by the structural changes in the market. However, this observation is not conclusive as the week-of-the-day effect has been found to demonstrate inconsistent behaviour, disappearing for certain periods and then reappearing again (Connolly, 1989).

4.2 *Day-of-the-Week Effect on Trading Volume*

Table III show the strong presence of the day-of-the-week effect on volume. The analysis of variance (ANOVA) produces significant F-Ratio to reject the null hypothesis of equality of mean across the days of the week for both the representations of volume in the overall sample period as well as in the recent sub-sample period. The lowest average relative level of volume is observed on Monday. The average level of volume on Monday (0.9568) is about eight percent below the average level of volume for all the days of the week taken together (1.0375). The difference between average volume level on Monday and the average volume for the rest of the week is statistically significant ($p < 0.01$). A statistically significant negative change (decline) in volume is also observed on Monday. It seems that the process of decline in volume starts right from Friday and on Tuesday it takes a reverse turn. The average of the change in volume on Friday is negative; while, on Tuesday it is positive. In both the cases the average change in volume for the day is significantly different from the average change in volume for rest of the week. The recent sub-sample period also shows consistently similar results. However, the highest level of volume is observed on Wednesday in the overall sample period; while for recent sub-sample period it shifts to Thursday.

Table III
Average Relative Volume Level and Average Daily Change in Volume on Different Week Days.

Day of the Week	Entire Sample [1995-2005]		Recent Sub-Sample [2002-2005]	
	Relative Volume Level	Change in Volume	Relative Volume Level	Change in Volume
Monday	0.9568	-0.0992	0.9389	-0.1027
	[7.37***]	[10.16***]	[6.53***]	[8.31***]
Tuesday	1.0563	0.1188	1.0074	0.0822
	[1.79*]	[11.78***]	[0.78]	[6.36***]
Wednesday	1.0706	0.0162	1.0298	0.0217
	[2.98***]	[1.37]	[1.16]	[1.91*]
Thursday1	.0587	-0.0077	1.0761	0.0440
	[1.94*]	[0.98]	[4.89***]	[3.30***]
Friday	1.0451	-0.0175	1.0332	-0.0397
	[0.68]	[2.33**]	[1.30]	[3.12***]
All days	1.0375	0.0022	1.0170	0.0014
F-Ratio	14.1144	51.1927	14.3190	28.5342
(p)	(0.000)	(0.000)	(0.000)	(0.000)

Note: Figures in parentheses [ ] show the't-values' based on White's heteroscedasticity adjusted standard errors.
*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

The regression analysis also confirms the above findings. The results presented in Table IV show that there is a significant decline in the volume on Monday followed by a recovery on Tuesday. The coefficients of Monday dummy are consistently negative for both the representations of the volume during both the sample periods. Similarly, Tuesday's coefficients are

consistently positive and significant. In overall sample period, Wednesday also shows a significant increase in volume, but in the recent sub-sample period this effect has shifted to Thursday. The Monday and the Tuesday effects are actually the reflections of the same phenomenon; the volume level comes down on Monday and comes again at normal level on Tuesday. Therefore, there is a significant negative change in volume observed on Monday, and because of the low base volume on Monday, a significant positive change is observed on Tuesday.

Table IV
Day-of-the-Week Effect on Trading Volume.
(Regression Coefficients)

Day of the Week	Entire Sample [1995-2005]		Recent Sub-Sample [2002-2005]	
	Relative Volume Level	Change in Volume	Relative Volume Level	Change in Volume
Monday	-0.09343	-0.11430	-0.10964	-0.11573
	[88.56***]	[105.23***]	[74.50***]	[66.33***]
Tuesday	0.06099	0.07421	0.03079	0.04271
	[36.15***]	[42.40***]	[5.05**]	[7.82***]
Wednesday	0.02782	0.03263	0.01846	0.02168
	[7.37***]	[7.97***]	[1.82]	[2.03]
Thursday0	.01201	0.01624	0.07316	0.07113
	[1.42]	[2.03]	[30.62***]	[25.39***]
Friday	-0.00544	-0.00631	-0.00855	-0.01374
	[0.28]	[0.30]	[0.39]	[0.82]

Note: Figures in parentheses [ ] show the't-values' based on White's heteroscedasticity adjusted standard errors.
*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

The above finding is consistent to the international trend. Liquidity in market place on Monday is found lower than on other days of the week. Jain and Joh (1988) report that the average volume on Monday in New York Stock Exchange is approximately 90 percent of the mean trading volume for the rest of the weekdays. According to Osborne (1962), this decrease in liquidity is the consequence of low institutional trading activity on Monday. It is an industry-wide practice that the institutional investors use early hours of Monday to plan strategy for upcoming week, therefore there are less trading orders from them on Monday. Lokonishok and Marberly (1990) observe that block-trades are lower on Monday than other trading days. That is also an indication of low institutional trading activities on Monday. Bildik (2004) also observes that in Istanbul stock exchange on Monday the liquidity is at the lowest level of the week and declines substantially relative to the previous trading day.

4.3 *Day-of-the-Week Effect on Price-Volatility*

Table V shows that the price volatility (mean daily squared returns) is highest on Monday consistently for both the indices during the overall sample period as well as the recent sub-sample period. The differences between average Monday volatility and average volatility for the rest of the week are significant at one percent level of significance (i.e. $p < 0.01$) except for the

volatility on Nifty during recent sub-sample period where it is significant only at ten percent level (i.e. $p<0.10$). For the overall sample, ANOVA produces F-ratio significant enough to reject the null-hypothesis of equality of mean volatility across the weekdays. However, this null-hypothesis cannot be rejected during the recent sub sample period.

Table V
Stock Price Volatility on Different Week Days.
(Average Index of Daily Squared Returns)

Day of the Week	Entire Sample [1995-2005]		Recent Sub-Sample [2002-2005]	
	Nifty	Nifty Jr.	Nifty	Nifty Jr.
Monday	3.6517	4.9717	2.7785	3.6924
	[12.43***]	[17.45***]	[3.08*]	[9.25***]
Tuesday	2.1161	3.1124	1.8031	2.6689
	[9.05***]	[4.96**]	[0.54]	[0.02]
Wednesday	2.6002	3.7186	1.1993	1.9536
	[0.00]	[0.31]	[5.95**]	[0.92]
Thursday2	.1612	2.7228	1.6216	1.5653
	[0.27]	[4.90**]	[0.08]	[2.11]
Friday	2.4595	3.5819	2.2443	2.7323
	[1.08]	[0.24]	[1.11]	[0.57]
All days	2.5964	3.6174	1.9295	2.5221
F-Ratio	4.1259	4.2412	0.9888	1.1799
(p)	(0.003)	(0.002)	(0.4128)	(0.3183)

Note: Figures in parentheses [ ] show the't-values' based on White's heteroscedasticity adjusted standard errors.
*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

Table VI
Day-of-the-Week Effect on Price Volatility.

Day of the Lag order of Autocorrelation	Entire Sample [1995-2005] NIFTY 3	NIFTY Jr. 1	Recent Sub-Sample Week [2002-2005] NIFTY 1	NIFTY Jr. 1
Monday	1.39611	1.73209	0.95733	1.47395
	[18.14***]	[16.35***]	[2.90*]	[4.94**]
Tuesday	-0.93231	-1.19408	-0.81163	-0.71296
	[8.00***]	[7.73***]	[2.83]	[1.16]
Wednesday	0.07752	0.18209	-0.83777	-0.94546
	[0.05]	[0.19]	[2.19]	[2.01]
Thursday	-0.56159	-1.13869	0.09538	-0.78138
	[2.94*]	[7.15***]	[0.03]	[1.39]
Friday	0.19890	0.44371	0.55654	0.97705
	[0.00]	[1.05]	[1.12]	[2.14]

Note: Figures in parentheses [ ] show the't-values' based on White's heteroscedasticity adjusted standard errors.
*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

The results of regression analysis (Table VI) also confirm the above findings. Monday's coefficients are consistently positive and significant which implies that the volatility is higher on Monday. In view of the low return observed on Monday, this finding does not fit in the framework of risk-return trade-off hypothesis proposed by Ho and Cheung (1994).

The observed high volatility on Monday is consistent with similar observations in other countries. For example Fama (1965) and Gibbons and Hess (1981) have documented higher price variance for US stocks on Monday than that on other days. It is also consistent to the earlier findings on Indian stock market (Bhattacharya, Sarkar and Mukhopadhyay, 2003, Nath and Dalvi, 2004). Foster and Viswanathan (1990) propose a model to explain this behaviour of price-volatility. In their analytical framework there is highest information asymmetry on Monday when market opens after weekly holidays and some market participants possess more private information than others. This situation produces high price variance. Variance declines through the week and reaches to the lowest level on Friday. Foster-Vishwanathan model produces high volatility with low volume on Monday. Empirical findings also support this hypothesis (Kiymaz and Berument, 2003). However, as Bhattacharya, Sarkar and Mukhopadhyay, (2003) note, the market microstructure and stock exchange regulations also produce unique pattern of price volatility. During pre-rolling settlement regime different settlement days in different stock exchanges used to allow arbitrage opportunities producing different patterns of price and volatility behaviour. For example, at NSE on Tuesday, being the settlement day, the volatility used to be low. This effect disappeared after the introduction of rolling settlement system.

4.4 *Comparison of the Day-of-the-Week Effect on Blue Chips and Growth Stocks*

Generally it is believed that the week-of-the-month effect is more prominent in small capitalisation companies in comparison to the large capitalisation companies. To examine this hypothesis we have taken two indices in our study. Nifty represents fifty first-largest stocks selling at NSE. These stocks are highly liquid 'blue chips' of Indian stock market. Nifty Jr. is constituted by fifty second-largest stocks which are predominantly the growth stocks (www.nseindia.com/indices/Nifty Jr.). However, our analysis so far does not reveal any significant difference between these two indices regarding the pattern of the intra-week behaviour of stock prices and volatility. Therefore, here we make a direct comparison between these two groups of shares, represented by above two indices, through including the return or volatility on one index as regressor in the regression equation of return or volatility of another index. The motivation for this analysis also comes from an earlier study by Nath and Dalvi (2004) that includes return on Nifty Jr. in the regression equation of return on Nifty and observes the presence of a Friday effect. This observation implies that the Nifty behaves differently in comparison to Nifty Jr. on Friday, but on other days of the week their behaviour remains the same. Extending this line of analysis, we estimate the following equations:

$$R_t(B) = \beta R_t(G) + \sum_{j=1}^{5} jD_j + e_t \quad (2)$$

$$R_t^2(B) = \beta R_t^2(G) + \sum_{j=1}^{5} \gamma_j D_j + e_t \quad (3)$$

$$R_t(G) = \beta R_t(B) + \sum_{j=1}^{5} \gamma_j D_j + e_t \quad (4)$$

$$R_t^2(G) = \beta R_t^2(B) + \sum_{j=1}^{5} \gamma_j D_j + e_t \quad (5)$$

where, 'B' is used to show 'blue chips' represented by Nifty and 'G' shows 'growth stocks' represented by Nifty Jr. The results obtained from above system of equations have been presented in Table VII.

Table VII
Comparative Effect of The-Day -of-the -Week on the Blue-Chips and the Growth-Stocks

Panel A: Blue Chips

Day of the Week	Return Over	Recent Sub-sample	Volatility Overall Sample	Recent Sub-sample
Monday	0.0001	-0.0001	0.3116	-0.0073
	[2.11**]	[0.94]	[1.52]	[0.03]
Tuesday	0.0000	0.0000	-0.2353	-0.2927
	[0.08]	[0.49]	[1.53]	[1.03]
Wednesday	0.0000	-0.0015	-0.0639	-0.3931
	[0.04]	[2.14**]	[0.31]	[1.37]
Thursday	0.0000	0.0000	0.1539	0.4914
	[0.41]	[0.490]	[0.76]	[1.72*]
Friday	0.0013	0.0017	-0.1703	0.2008
	[2.68***]	[2.42**]	[0.83]	[0.70]

Panel B : Growth Shares

Day of the Week	Return Over	Recent Sub-sample	Volatility Overall Sample	Recent Sub-sample
Monday	0.0000	-0.0012	0.2164	0.2688
	[0.71]	[1.52]	[0.82]	[0.76]
Tuesday	0.0001	0.0001	-0.0470	0.3623
	[1.53]	[0.65]	[0.18]	[1.02]
Wednesday	0.0024	0.0017	0.1086	0.3173
	[4.28***]	[2.11**]	[0.41]	[0.88]
Thursday	0.0000	0.0017	-0.5256	-0.7649
	[0.33]	[2.10**]	[2.00**]	[2.16**]
Friday	-0.0021	-0.0017	0.1670	-0.1798
	[3.71***]	[2.09**]	[0.63]	[0.50]

Note: Figures in parentheses [ ] show the't-values' based on White's heteroscedasticity adjusted standard errors.
** Significant at 1% level
* Significant at 5% level
*** Significant at 10% level

In conformity to earlier findings (Nath and Dalvi, 2004) we also observe that the Friday is a significant day of the week in the comparison of the price behaviour of blue chips and growth stocks. The coefficients of Friday dummy are positive in the return equations of the blue chips; while, in the return equations of the growth stocks, these coefficients are negative. All these coefficients are statistically significant (i.e. different from zero) for the overall sample period as well as for the recent sub-sample period. Other observations do not show such consistency. This observation implies that on Friday the prices of blue chips tend to remain relatively higher in comparison to the prices of growth stocks.

V. Conclusion

In this study we have examined weekly behaviour of stock prices, trading volume and price volatility at National Stock Exchange of India, NSE, for the period of ten year from April 1995 to March 2005. We observed that due to earlier weekly settlement system, the average Wednesday return was 15 times higher than the average weekly return. But this Wednesday effect disappears after introduction of rolling settlement. We also observed that Monday and Tuesday returns were significantly negative but this pattern of average daily returns for weekdays also disappears after the introduction of rolling settlement. Thus, we do not observe any day-of-the-week effect in stock-prices after the introduction of rolling settlement. The settlement system has certainly a significant implication for weekly behaviour of stock price. However, many other reform measures were also accompanied with the introduction of rolling settlement system. These measures may have improved market efficiency. The dilution of the week-of-the-effect may also be a reflection of this improved efficiency. Recently Kohers et al. (2004) have observed that in leading equity markets of the world the day-of-the-week effect is disappearing with improvement in market efficiency. This trend may spill-over to Indian stock market also. But it will be a pre-mature to take it as a final conclusion. It can not be taken conclusive also because of the fact that although the week-of-the-day effect is absent in stock prices during recent period of time, we found a robust day-of-the-week effect on volume and volatility. On Monday the average daily volume is only 92 percent of the average level of the volume for all the days of the week taken together. This observation is true for recent sample period (2002-2005) also. Similarly, the price- volatility is found consistently higher on Monday in comparison to other days of the week. However, certain other effects, which may have their roots in weekly settlement procedure (such as higher volume on Wednesday, lower volatility on Tuesday), have disappeared now.

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