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An Econometric Analysis of Bombay Stock Exchange: Annual Returns Analysis, Day-of-the-Week Effect and Volatility of Returns

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Abstract

This paper investigates the presence of day-of-the-week effect, returns volatility and analyzes the annual returns of Bombay Stock Exchange. A set of parametric and nonparametric tests is used to test equality of mean returns and standard deviations of the returns across the-days-of-the-week. To supplement this analysis, graphical representation of the index annual percentage changes was explored. The results contradict the presence of the-day-of-the- week but indicate insignificant daily returns volatility in most of these Markets. The stock exchanges experienced enormous growth between 2001 and 2010. The result of the Levenes test value for Bombay Stock Exchange was 0.847 which concludes that the daily return seasonalities are not accompanied by any volatility seasonality and investing on low (high) return weekday does not necessarily mean that risk is also low or high and Index that has marginally significant Levenes statistic.

Key words: Volatility of Returns, Bombay Stock Exchange, Day-of-week effect

1. Introduction

Over the last decade of reforms, one of the things that we could not ignore about India has been the rather dramatic development of our equity market. After the reforms, the markets have become transparent and accessible uniformly to everyone in the country, without bias to caste, religion, gender or location. Over the second half of the nineties, this showed up in an unprecedented growth in the number of trades that took place on the exchanges from all over the country, the fall in the brokerage fees and the number of depository accounts that were opened. Millions of people who were once spectators of the stock market now became participants. The Indian capital market was remain highly volatile and has experienced a number of week effects over a last decade.

2. Literature Review

A paper by Chiaku Chukwuogor investigates the presence of day-of-the-week effect, returns volatility and analyzes the annual returns of five African stock markets. A set of parametric and nonparametric tests was used to test equality of mean returns and standard deviations of the returns across the-days-of-the-week. To supplement this analysis, graphical representation of the indexes annual percentage changes was explored and their correlation determined. The results contradict the presence of the-day-of-the- week but indicate insignificant daily returns volatility in most of these Markets. The stock exchanges experienced enormous growth between 1997 and 2004. There was a high positive correlation of market gains and declines among the markets.

A study of Chiaku Chukwuogor-Ndu, has examine the financial markets' trends such as the annual returns, daily returns and volatility of returns in 15 emerging and developed European financial markets. A set of parametric and non-parametric tests is used to test the equality of mean returns and standard deviations of the returns. Although positive annual index closing price changes were the norm between 1997 and 2004, many of the European indexes experienced negative changes especially in 1998 and 2002. It is important to note that between 1999 and 2000, the Russian MTM and the Turkish XU 100 achieved astronomical growth. There was presence of the day of the week effect during the period 1997-2004. The results of the *Levene's* (1960) test of the equality of standard deviations of the returns at the 5 percent confidence level could not reject the Null Hypothesis that mean returns are equal across the days of the week for all the markets except for MBTEL, Italy.

Klaus Adam, Albert Marcet and Juan Pablo Nicolini found that introducing bounded rationality into a standard consumption based asset pricing model with a representative agent and time separable preferences strongly improves empirical performance. Learning causes momentum and means reversion of returns and thereby excess volatility, persistence of price-dividend ratios, long-horizon return predictability and a risk premium, as in the habit model of Campbell and Cochrane (1999), but for lower risk aversion. This is obtained, even though we restrict consideration to learning schemes that imply only small deviations from full rationality. The .endings are robust to the particular learning rule used and the value chosen for the single free parameter introduced by learning, provided agents forecast future stock prices using past information on prices.

A Study was carried out by Snehal Bandivadekar and Saurabh Ghosh which had found that derivative products like futures and options on Indian stock markets have become important instruments of price discovery, portfolio diversification and risk hedging in recent times. This paper studies the impact of introduction of index futures on spot market volatility on both S&P CNX Nifty and BSE Sensex using

ARCH/GARCH technique. The empirical analysis points towards a decline in spot market volatility after the introduction of index futures due to increased impact of recent news and reduced effect of uncertainty originating from the old news. However, further investigation also reveals that the market wide volatility has fallen during the period under consideration.

The paper by Da Vid Mcmillan, Alan Speight and Owain Apgwilym analyzed the forecasting performance of a variety of statistical and econometric models of UK FTA. All Share and FTSE100 stock index volatility was studied at the monthly, weekly and daily frequencies under both symmetric and asymmetric loss functions. Under symmetric loss, results suggest that the random walk model provides vastly superior monthly volatility forecasts, while random walk, moving average, and recursive smoothing models provide moderately superior weekly volatility forecasts, and GARCH, moving average and exponential smoothing models provide marginally superior daily volatility forecasts. If attention is restricted to one forecasting method for all frequencies, the most consistent forecasting performance is provided by moving average and GARCH models. More generally, results suggest that previous results reporting that the class of GARCH models provides relatively poor volatility forecasts may not be robust at higher frequencies, failing to hold here for the crash-adjusted FTSE100 index in particular.

A study was carried out by M. T. Raju, Anirban Ghosh and found that as expected daily average return and daily volatility across markets vary over time and space. Views differ on what has been behind the decline and what it means for the future. Traditionally, market watchers see high volatility as a sign of investor nervousness which, in the counter-intuitive world of markets, is, of course, bullish. Some of the countries such as the UK, France, Germany and Australia provide low return and higher volatility (compared to the U.S.).

In an anomalous turn-of-the-year study of stock return seasonalities in low-income African emerging markets using monthly market indices for the Ghanaian stock market (1991-1996), Nigerian stock market (1984-1995), and Zimbabwean stock market (1987-1995), Ayadi, (1998) find that the results of both the Kruskal-Wallis and Friedman tests suggest the absence of seasonality in stock returns on the Nigerian and Zimbabwean stock markets while the Friedman test confirms the presence of seasonality in stock returns for Ghana. Furthermore, the Wilcoxon-Mann-Whitney test and the dummy-variable regression analysis show the presence of the "January effect" for Ghana but not for Nigeria and Zimbabwe.

In a more recent study, using weekly index returns adjusted for thin trading as a nonlinear autoregressive process with conditional heteroscedasticity, Appiah-Kusi and Menyah (2003) used the EGARCH-M model to investigate the weak-form pricing efficiency of eleven African stock markets. Their findings reject evidence in prior studies that the Nigerian stock market is weak-form efficient. They confirm ex ante results that the markets in Egypt, Kenya, and Zimbabwe are efficient while that of South Africa is not weak-form efficient. Their findings indicate that stock markets in Mauritius and Morocco may be efficient while the stock markets in Mauritius and Morocco, Botswana, Ghana, Ivory Coast, and Swaziland are not consistent with weak-form efficiency.

3. Data and Methodology

We use the daily closing values of Bombay stock exchange for the period 2001-2010 to determine the daily returns, day-of-the-week effect and volatility of stock returns. There is obvious scholarly merit in studying longer periods of data. However long-term data that encapsulate archaic data that relates to periods of long forgotten good or poor performance can distort the overall results giving a misleading picture and interpretation of recent trends. As a result of these deficiencies in using long-term data, we chose to focus on more recent trends in this study.

We further use the closing index values to depict the annual trends in stock market movements.
The daily stock returns for Bombay stock exchange is calculated as follows:

$$(P_t/P_{t-1})\ ^{\cdot}100$$

(1)

Where Pt is the stock indexes at date t. To determine the nature of the volatility of returns, the distributions of daily returns are analyzed using such measures as mean, median, standard deviations, kurtosis and skewness. We use parametric and nonparametric tests to substantiate these results.

Since the result of the normality test indicates that the distributions of the returns are non-normal, we use the non-parametric test, the Kruskal-Wallis to check for the results on equality on mean returns. The Kruskal-Wallis statistic is as follows:

$$\frac{12}{N(N+1)}\sum_{j=1}^{k}\frac{R_j^2}{n_j}-3(n+1)$$

(2)

Where: k = number of samples; nj = number of values in jth sample; N = nj =total number of values; Rj = sum of ranks in the sample when N values are ranked together (the statistic is approximately Chi-square distributed degrees of freedom equal to k-1).

To test for the equality of variance across the days of the week, we employ the Bartletts homogeneity test. The test criterion is as follows (Snedecor and Cochran, 1970).

$$M = v\left(a \ln \bar{s}^{2} - \sum \ln s_i^2\right)$$

(3)

Where a = the number of samples, *v* = degree of freedom, $s^{-2} = \sum s_i^2 / a, s_j^2$ = estimate of the σ^2 from sample I, then, the quantity M/C is distributed approximately as a Chi-square distribution with degrees of freedom equal to (a-1).

The above test is for the case when all groups have the same degrees of freedom. When the degrees of freedom differ, as with samples of unequal sizes, the test criterion is as follows as follows:

$$M = \left(\sum V_i\right)\ln \bar{s}^{-2} - \sum\left(v_i \ln s_i^2\right)$$

(4)

$$C = 1 + \left\{\frac{1}{[3(a-1)]}\right\}\left(\sum \frac{1}{v_i} - \frac{1}{\sum v_i}\right)$$

(5)

Where $s^{-2} = \sum\left(v_i s_i^2\right) / \sum v_i, s_i^2$ is an estimate of the σ^2 from sample I, a = the number of samples, *v*i = the degree of freedom of samples i.

The quantity M/C is distributed approximately as a Chi-square with degrees of freedom equal to (a-1). In our case, as we have five weekdays in a week, degrees of freedom are four.

However, as Bartletts test of homogeneity of variance is sensitive to non-normality in stock return distribution, the Levenes (1960) test is also employed to check the results on equality of variance. In measuring the variation within a class, Levenes test uses the average of the absolute deviations instead of the mean square of deviations. This avoidance of squaring makes the test criterion much less sensitive to non-normal distributions (Snedecor and Cochran, 1976). The Levenes statistic is as follows:

$$F = \left[\sum_{j=1}^{J} n_j (D_{.j} - D_{..})^2 / \sum_{j=1}^{J} \sum_{i=1}^{n_j} (D_{ij} - D_{.j})^2\right] x \left[\frac{(N-J)}{(J-1)}\right] \quad (6)$$

Where $D_{ij} = \left|R_{ij} - M_j\right|, R_{ij}$ is the return for week I and weekday j for j =1, 2… J and J =5 if the last trading day of the week is a Friday.

4. Empirical Results

4.1 Daily Returns Analysis

As shown in table 1, mean score values for Monday, Tuesday, Wednesday, Thursday & Friday are 9661.727, 9636.081, 9639.188, 9667.389 & 9622.954. Median values for Monday, Tuesday, Wednesday, Thursday & Friday are 8747.43, 8773.78, 8853.21, 8843.21 & 8739.24.Standard Deviation values for Monday, Tuesday, Wednesday, Thursday & Friday are 5605.841, 5594.583, 5587.074, 5601.446 & 5575.065. Skew is a measure of symmetry. Here, in test, it was found that Skeness of distribution is a greater than 0.00. A normal distribution has skew=0. So it can be said that our distribution is not symmetric. Kurtosis is a measure of peakedness and the fat-tails that associate with less density in the middle; a normal distribution has kurtosis = 3.0 or excess. Here kurtosis is less than 3.00. So it can be said that our distribution is not symmetric. Table 2 shows that the BSE has Maximum return of -0.31% on Monday, whereas on Thursday market has maximum Standard deviation of returns from average. Index has Minimum return of -0.33% on Tuesday & on same day index has Minimum Standard deviation of returns from average.

4.2 The day-of-the-week effect

To test the day of the week effect using the *Kruskal-Wallis* test, the following null and alternate hypotheses are tested for each market.

Ho: There is no difference in the returns across the days of the week;

H1: There is a difference in the returns across the days of the week.

If the null hypothesis is rejected, this means that there is presence a day-of-the-week effect in the stock returns pattern. As shown on Table 4, the values of Chi-square statistics are not significant at the 5 percent level for market. These results do not support the existence of the day-of the week effect on stock returns in Bombay Stock Exchange.

4.3 Annual Returns Analysis

The table 3 shows the percentage changes in annual return over a period of 2001 to 2010. The annual return of BSE Market in year 2002 was changed by 5.88%, in year 2003 it was grown by 54.03%, in year 2004 it was grown by 11.79%, in year 2005 it was grown by 35.72%, in year 2006 it was grown by 39.12%, in year 2007 it was grown by 23.05%. In year 2008, BSE Market has given negative annual return of -58.75%. Whereas in year 2009 & 2010, BSE Market has given annual return of 59.35% & 13.92%, respectively. Among all years, in year 2008 BSE Market has given maximum negative return of -58.75% & in year 2009 BSE Market has given maximum Positive return of 59.35%. During this period Bombay stock market was remain highly volatile.

4.4 Homoskedasticity

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The Table 4 shows result of Levenes test employed to test the equality of the standard deviations across the day-of-the-week is contained in Table 4. Bombay Stock Exchange has 0.847 test value and it can be concluded that the

daily return seasonalities are not accompanied by any volatility seasonality and investing on low (high) return weekday does not necessarily mean that risk is also low or high and Index that has a marginally significant Levenes statistic, the lowest return occurs on Monday when the market experiences the lowest standard deviation. This observation seems compatible with the normal risk return trade-off of higher return and higher risk relationships and vice versa.

5. Conclusion

This paper examined the daily and annuals patterns, characteristics and the volatility of daily returns of Bombay Stock Exchange. The data are not symmetric BSE has Maximum return of -0.31% on Monday, whereas on Thursday market has maximum Standard deviation of returns from average. Index has Minimum return of -0.33% on Tuesday & on same day index has Minimum Standard deviation of returns from average. The values of Chi-square statistics are not significant at the 5 percent level for Bombay stock market. These results do not support the existence of the day-of the week effect on stock returns in Bombay Stock Exchange. In year 2008, BSE Market has given maximum negative return of -58.75% & in year 2009 BSE Market has given maximum Positive return of 59.35%. During this period Bombay stock market was remain highly volatile. Levenes test value for Bombay Stock Exchange was 0.847 test value and it can be concluded that the daily return seasonalities are not accompanied by any volatility seasonality.

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7. Annexure

Table 1 Basic Statistics of Daily Returns of the 2001-2010

Descriptive Statistics	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Mean	9661.727	9636.081	9639.188	9667.389	9622.954
Median	8747.43	8773.78	8853.21	8843.21	8739.24
Standard Deviation	5605.841	5594.583	5587.074	5601.446	5575.065
Kurtosis	-1.32318	-1.31334	-1.31558	-1.32244	-1.31899
Skewness	0.337325	0.340927	0.338914	0.333641	0.338602
Count	495	493	494	497	495

Table 2 Summary of Maximum/Minimum Returns/Standard Deviations of the BSE Market for the Period January 1st 2001- December 27, 2010.

Index	Minimum return/ Standard deviation	Days of occurrence	Maximum return/ Standard deviation	Days of occurrence
BSE	-0.33%*	Tuesday	-0.31%*	Monday
	3.78%**	Tuesday	4.10%**	Thursday

* = Mean returns, ** = Standard deviation of return

Table 3: Annual Closing Index Values

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Percentage changes in annual return	6%	54%	12%	36%	39%	23%	-59%	59%	14%

Table 4: Results of Test of Normality, Equality of Means/Variance across Day-of-the-Week Effect for the Period 2001-2010

Index	Kruskal-Wallis		W Test for Normality		Levene's Test		Bartlett's Test	
	Chi square	P Value	Statistics	R	Statistics	P Value	Statistics	P Value
Bombay Stock Exchange	0.855*	0.922	0.921	0.540	0.847	0.348	948.20	0.000

* Reject the Null hypothesis, not significant at 5 percent level

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