The Effect of Seasonality over Stock Exchanges in India

Ved Prakash Bansal

Department of Commerce, Satyawati College (Eve.), University of Delhi, Delhi
Email Id: vedbansal1958@gmail.com

Abstract. This study investigated to examine stock market seasonality effect in Indian stock market for Bombay Stock Exchange (BSE) 100. The study has used monthly returns data of BSE 100 for the period from April 2001 to March 2016 for the analysis. The author has examined stationarity in the time series using Correlogram, regression equation & ARIMA model is used to find the monthly effect in stock returns in India. The results confirmed the existence of seasonality in the stock returns in India.

Key Words: Seasonality, Bombay Stock exchange, Correlogram.

Introduction

It is a well-known fact that production and sales of a business can be prone to seasonal variation. Seasonality in a time series occurs with periodicity of an months, quarters or an year and refers to regular and repetitive fluctuations occurring in less than a year. Change in climate is the primary reason behind seasonal variation in time series data. For instance, sale of aerated drinks increases during summers. Economic variables are also affected by customs and traditions like sale of gold increases during wedding season. Likewise, asset returns also show regular fluctuations during the day, week or month. Monthly patterns are one of the most prevalent; returns during some months are better off compared to the other periods i.e. effect of that particular month in the year. Similarly, certain days of the week show lower returns as compared to other trading days i.e. days of the week effect.

Nonetheless, this seasonal prevalence in the market prices of the stocks contravenes the central paradigm in finance i.e. efficient market hypothesis (EMH). EMH is the speed and accuracy with which the market updates and responds to the arrival of new information. Data sets are entered constantly in the market in the form of political statements, company announcements, economic reports or public surveys. When the market prices adjustment rapidly to new information then the market is informationally efficient.

The presence of seasonality makes it possible to predict equity prices based on past pattern as the stock prices are no longer random. This means the weak form of market efficiency is violated. The market participants can now devise a trading strategy that could provide them with abnormal profits.

Review of Literature

The functioning of the stock markets particularly the emerging economies such as in India can be understood well by studying the stock market efficiency. Sunil Poshakwale in his study investigated empirically the weak form efficiency and the effect of the day of the week effect in BSE for the period of seven years from 1987 to 1994. The efficient market hypothesis and capital asset pricing model assumes that stock prices follow a random pattern and consequently the distribution should tend to be normal. The evidence on weak form efficiency and day of the week effect has been presented under the belief that variance is time dependent. The weekday effect was however supported by the BSE. Although there is very limited evidence available on market efficiency and day of the week effect in emerging stock markets.

Kolmogorov Smirnov Goodness of Fitness Test (KS) was used to confirm that the distribution is normal which is also found by the frequency distribution. The Wald-Wolfowitz Test was used for randomness in investigating serial dependence in share price movements. The results of this test indicate non-random nature of the series which means weak form efficiency is violated. Therefore, the weak form efficiency was rejected which implies that investors cannot adopt a 'fair return for risk' strategy while investing in stock market in India.

Lazar. D, Julia Priya. A and Joseph Jeyapaul carried out a study to analyze the seasonality in Indian stock market. The monthly return data of the BSE Index for the period of almost 15 years from April 1991 to March 2005 was used for this purpose. The regression analysis proved the presence of seasonality as the returns were statistically significant in March and June at 5% and in October at 10% level. The statistically significant coefficient for April is consistent with the 'tax-loss selling' hypothesis. The January effect was also supported. Thus, the randomness in the stock returns is not evident and the markets may not perfectly informationally efficient.

Ash Narayan Sah examined the weekday effect, weekend effect and seasonality in the returns of stock market in India. Daily and monthly data sets of S&P CNX Nifty for the period from April 1997 - March 2009 were used to find whether seasonality is present in Nifty and Nifty Junior returns. To check whether the return is stationary AR(1) model, DF and ADF tests was used. To test the presence of day of the week effect, weekend effect and seasonality, ANOVA which is a type dummy variable regression model was used. The results confirm the existence of seasonality (daily and monthly) in Nifty returns. The results also follow that Indian markets are not efficient and investors can improve in gaining more returns with the right timings.

Methodology and Data

The methodology followed is such that the issues of normality, autocorrelation, heteroskedasticity etc. are taken care of. To detect the presence of seasonality market indices or a large portfolio of shares is taken instead of an individual shares as it can be easily detected in the former. The returns of BSE100 are analysed in this project. The study has used continuous compounded monthly change in percentage for calculating the stock returns—

$r_t = (\ln P_t – \ln P_{t-1}) \times 100$ …..…………………………..(1)

where rt is the return in the period t, Pt is the monthly average share price of the Sensex for the period t and ln natural logarithm.

Results

Table 1 depicts the descriptive statistics mean, median, minimum and maximum for the each month and the entire period. The results show wide variations across the periods. Returns for the month of April, September, November and December are higher than that of other months. The maximum average return occurs in the month of December. Returns in the month of January and February are negative. Findings show that stock returns are -ve skewness for eight months and +ve for the remaining four months. They also show high peakedness (flatter tails than the normal) in the curve and hence suggests leptokurtic (kurtosis>3) distribution for seven months. The test of normality 'Jarque-Bera' confirms the normality in the average returns of all months except January. The average monthly returns (1.154) for the entire period are positive and depicts high dispersion (deviations) and high kurtosis (leptokurtic curve).

Table 1: Descriptive Statistics of stock returns (2001-2016)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2001-16
Mean	-1.784	-0.693	1.367	2.091	0.912	0.356	1.574	1.114	2.208	0.382	2.765	3.556	1.154
Median	-3.908	0.580	0.916	0.120	0.834	1.408	1.200	0.740	4.947	1.431	4.288	3.471	1.162
Maximum	12.350	6.999	10.202	16.066	27.225	10.290	7.687	16.326	13.211	14.736	11.406	16.992	27.225
Minimum	-16.676	-9.057	-13.311	-4.957	-18.057	-21.124	-9.137	-8.869	-15.641	-30.065	-9.892	-4.953	-30.065
Std. Dev.	7.165	4.761	6.954	5.766	11.120	7.366	4.811	6.099	8.483	10.377	6.570	5.288	7.240
Skewness	-0.0736	-0.379	-0.483	1.093	0.461	-1.656	-0.537	0.786	-0.889	-1.660	-0.415	0.787	-0.521
Kurtosis	3.020	2.059	2.394	3.441	3.486	5.990	2.670	3.979	2.750	6.100	2.182	4.025	5.390
Jarque-Bera	0.013	0.913	0.813	3.110	0.680	12.446	0.791	2.146	2.015	12.900	0.848	2.209	51.031
Probability	0.993	0.633	0.665	0.211	0.711	0.001	0.673	0.341	0.364	0.001	0.654	0.331	0.000
Observations	15	15	15	15	15	15	15	15	15	15	15	15	180

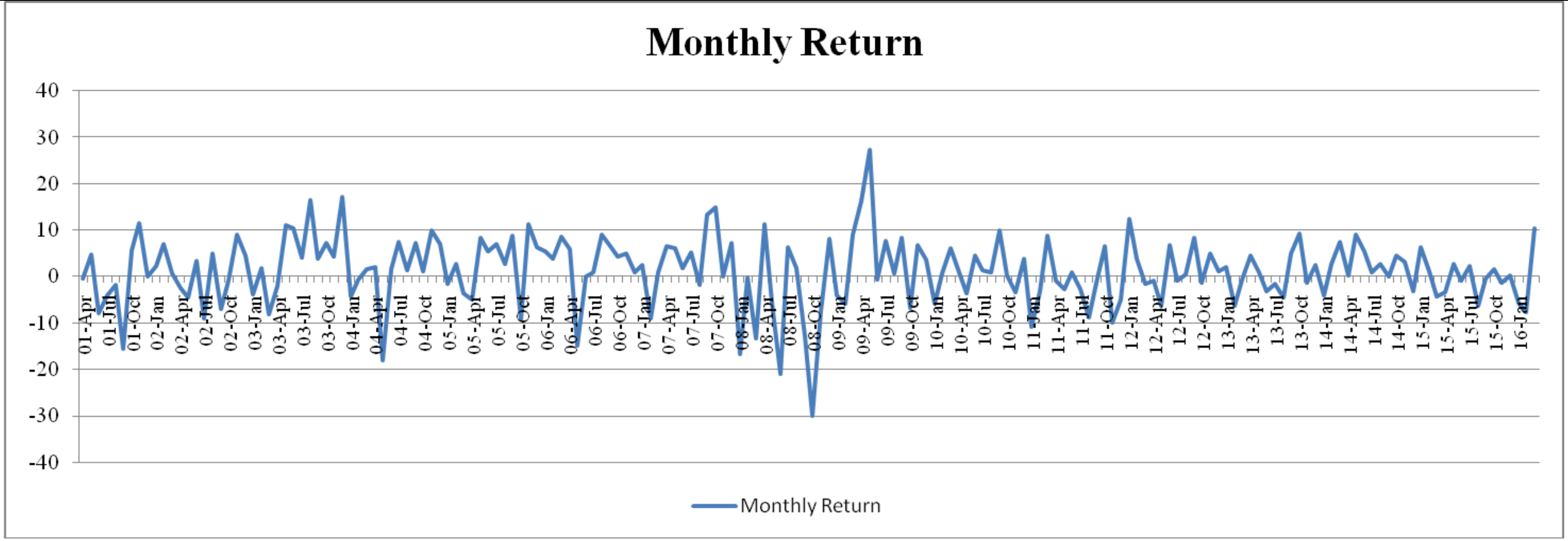

Figure 1: Monthly stock returns (2001-2016)

Figure 1 shows the plot of returns series for BSE100, which depicts variations in monthly returns. The returns hover between -10% and 10% for most of the sample period. A fall below -10% can be seen on September 2001, May 2004 and May 2006 but the returns recovered quickly. The BSE100 returns fell sharply between January 2008 and October 2008 because of the stock market crash in the backdrop of mortgage crisis in the US followed by economic slowdown round the world. The returns cross the 10% mark in August 2003 and December 2003 while the highest return occurs in May 2009 during the sample period.

In Table 2 the result of the ADF test has been presented. The ADF statistic value is -12.025 and the associated one-sided *p-value* (for a test with 179 observations) is 0.0000. The t-Statistic for ADF is lesser than the critical values. The null hypothesis is r_t (returns) has a unit root which means that the series is non-stationary. The probability value is 0.0000 which is less than 0.05. So we reject the null hypothesis. Thus the ADF test proves that the BSE100 return series is stationary at level.

Table2: Augmented Dickey-Fuller Stationarity (ADF) Test

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.02545	0.0000
Test critical values:	1% level	-3.466994	
	5% level	-2.877544	
	10% level	-2.575381	

*MacKinnon (1996) one-sided p-values.

Table 3: Regression Model for Returns

	Slope Coefficients	Standard Error	t Stat	P-value	Lower CL	Upper CL
Time Period Index	-0.010	0.010	-1.027	0.306	-0.029	0.009
M2	0.147	2.061	0.072	0.943	-3.922	4.217
M3	2.218	2.065	1.074	0.284	-1.859	6.295
M4	2.952	2.069	1.427	0.155	-1.132	7.037
M5	1.782	2.073	0.860	0.391	-2.310	5.874
M6	1.236	2.077	0.595	0.553	-2.864	5.335
M7	2.464	2.081	1.184	0.238	-1.644	6.571
M8	2.014	2.085	0.966	0.335	-2.101	6.129
M9	3.117	2.089	1.493	0.137	-1.006	7.240
M10	1.302	2.093	0.622	0.535	-2.829	5.433
M11	3.694	2.097	1.762	0.080	-0.445	7.834
M12	4.495	2.101	2.140	0.034	0.347	8.642

Table 3 shows the regression model for BSE100 returns. The intercept of coefficients comes out as zero because of checking the box ‘Constant is zero’ which is done to avoid getting erroneous results as we have large number of x variables. Each time period the return is getting lower by 0.00977. The results indicate the presence of seasonal effect in the returns series. The significance value of M12 ($p<0.05$) implies that the coefficient is statistically significant and confirms the presence seasonal effect.

The results are reported in table 4 below. The coefficient of determination R-square which indicates the change in the dependent variable due to the explained variable is reported 0.038 and the Durban Watson statistics is close to 2. The results show that the residuals have no serial correlation.

Table 4: The Regression Model to Test Seasonality

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.784950	1.892540	-0.943151	0.3470
M2	1.091718	2.676456	0.407897	0.6839
M3	3.152444	2.676456	1.177843	0.2405
M4	3.876923	2.676456	1.448529	0.1493
M5	2.696960	2.676456	1.007661	0.3151
M6	2.140951	2.676456	0.799920	0.4249
M7	3.359147	2.676456	1.255073	0.2112
M8	2.899471	2.676456	1.083325	0.2802
M9	3.993050	2.676456	1.491917	0.1376
M10	2.167896	2.676456	0.809988	0.4191
M11	4.550527	2.676456	1.700206	0.0909
M12	5.341300	2.676456	1.995661	0.0476
R-squared	0.038237	Mean dependent var		1.154249
Adjusted R-squared	-0.024736	S.D. dependent var		7.240769
S.E. of regression	7.329776	Akaike info criterion		6.886107
Sum squared resid	9025.904	Schwarz criterion		7.098971
Log likelihood	-607.7497	Hannan-Quinn criter.		6.972415
F-statistic	0.607193	Durbin-Watson stat		1.727938
Prob(F-statistic)	0.821010			

The study has applied ARIMA (6,0,2) model to the time series. Table 5 present he results.

Table 5: Residual equations of ARIMA Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.169564	0.410039	0.413532	0.6798
AR(1)	0.830026	1.205182	0.688715	0.4920
AR(2)	0.000426	1.158968	0.000367	0.9997
AR(3)	0.060040	0.149241	0.402298	0.6880
AR(4)	0.091023	0.128689	0.707309	0.4804
AR(5)	-0.165037	0.138619	-1.190578	0.2355
AR(6)	-0.057636	0.255260	-0.225795	0.8216
MA(1)	-0.743264	1.209214	-0.614667	0.5396
MA(2)	-0.078334	1.051882	-0.074470	0.9407
R-squared	0.086152	Mean dependent var		-0.021616
Adjusted R-squared	0.041844	S.D. dependent var		7.156644
S.E. of regression	7.005313	Akaike info criterion		6.781553
Sum squared resid	8097.279	Schwarz criterion		6.944953
Log likelihood	-580.9951	Hannan-Quinn criter.		6.847838
F-statistic	1.944391	Durbin-Watson stat		1.998162
Prob(F-statistic)	0.056632			

The study has used auto-regressive moving average models and the parameters are estimated accordingly. The coefficient of determination R-square which indicates the change in the dependent variable due to the explained variable is reported 0.12 and the Durban Watson statistics is close to 2. The results show that the residuals have no auto-correlation.

Table 6: The Time Series and Regression Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.949959	1.922715	-1.014169	0.3121
M2	0.850867	2.677248	0.317814	0.7511
M3	3.416750	2.845302	1.200839	0.2317
M4	4.241969	2.734948	1.551024	0.1229
M5	2.624483	2.581329	1.016718	0.3109
M6	2.875186	2.856977	1.006374	0.3158
M7	3.992764	2.952995	1.352107	0.1783
M8	3.454073	2.823149	1.223483	0.2230
M9	4.454127	2.551371	1.745778	**0.0828**
M10	2.685141	2.698572	0.995023	0.3213
M11	4.993932	2.803619	1.781245	**0.0768**
M12	5.679497	2.639399	2.151814	**0.0330**
AR(1)	0.825606	1.193435	0.691790	0.4901
AR(2)	0.001826	1.145568	0.001594	0.9987
AR(3)	0.059700	0.149994	0.398017	0.6912
AR(4)	0.091553	0.130541	0.701331	0.4842
AR(5)	-0.163815	0.140443	-1.166423	0.2452
AR(6)	-0.059517	0.254036	-0.234287	0.8151
MA(1)	-0.739055	1.197823	-0.616999	0.5381
MA(2)	-0.078727	1.039823	-0.075712	0.9397
R-squared	0.126140	Mean dependent var		1.159507
Adjusted R-squared	0.018326	S.D. dependent var		7.312978
S.E. of regression	7.245659	Akaike info criterion		6.906464
Sum squared resid	8084.933	Schwarz criterion		7.269574
Log likelihood	-580.8624	Hannan-Quinn criterion		7.053764
F-statistic	1.169981	Durbin-Watson stat		1.998092
Prob(F-statistic)	0.289991			

Table reports the estimated coefficients and show significant changes in the dummy variables on account of the serial correlations in the residuals. The results indicate the dummy variables for month of September, November and December are statistically significant and confirms the presence of seasonality in the BSE 100 returns.

Conclusion

The outcome of data analysis shows that the month of December observes the maximum positive returns and the month January the lowest (negative). The returns continue negative for two months, while positive average returns continued in for next ten months. The results are significant at 5% level ($p<0.05$). The regression analysis depicts the presence of seasonality in the stock returns selected in the current study. The investors thus required to invest with correct timing to improve the returns from the securities. The results can be further studied and improved by taking a larger sample and including more indicators of BSE index. There is a need to make efforts for conducting more research on the weekly and the intra-week day effects. The long term capital gain which was ignored in the current study can also make effect and provide a new dimension for the investors in future.

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