ORIGINAL PAPER

DOI: 10.26794/2587-5671-2024-28-1-43-51
JEL G1, G11, G14, G23, Q51

Sustainability Indices and the Calendar Effect

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ABSTRACT

The investing landscape has undergone a significant shift. Investors are interested in stocks that not only increase shareholder wealth but also give high priority to environmental, social, and governance issues. The purpose of the study is to examine the presence of a calendar effect on the BSE sustainability indices. The daily closing prices of the BSE CARBONEX, BSE GREENEX, BSE 100, BSE Sensex, and Nifty have been collected. The study is using various methods like descriptive statistics, the unit root test, the day of the week return, the ordinary least squares method (OLS), and the GARCH (1, 1) model. It is clear from the study results that sustainability index returns follow the pattern of the BSE 100 and Sensex. There is a high positive and statistically significant Tuesday effect during the full sample period and period II. The GARCH (1, 1) model indicates there is a significant Monday effect on all indices. The result obtained in this paper is useful to investors to frame their investment strategy, for academicians to study the performance of the indices for different periods, and for business people to know the trend and tendencies.

Keywords: Bombay Stock Exchange; calendar effect; BSE CARBONEX; BSE GREENEX; BSE 100; Sensex; Nifty

For citation: **Kalimuthu K., Shaik S. Sustainability indices and the calendar effect.** ***Finance: Theory and Practice*****. 2024;28(1):43-51. DOI: 10.26794/2587-5671-2024-28-1-43-51**

ОРИГИНАЛЬНАЯ СТАТЬЯ

Индексы устойчивости фондового рынка и календарный эффект

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АННОТАЦИЯ

Инвестиционный ландшафт претерпел значительные изменения. Инвесторы заинтересованы в акциях, которые не только увеличивают доход акционеров, но и уделяют первостепенное внимание экологическим, социальным и управленческим вопросам. **Цель** исследования — определить влияние календарного эффекта на индексы устойчивости Бомбейской фондовой биржи (BSE). Были собраны ежедневные цены закрытия торгов по BSE CARBONEX, BSE GREENEX, BSE 100, BSE Sensex и Nifty. В исследовании используются различные **методы**: описательная статистика, тест на единичный корень, доходность по дням недели, метод обыкновенных наименьших квадратов (OLS) и модель GARCH (1, 1). **Результаты** исследования показали, что доходность индексов устойчивости повторяют динамику BSE 100 и Sensex. Наблюдается высокий положительный и статистически значимый эффект вторника в течение полного периода выборки и II периода. Модель GARCH (1, 1) указывает на значительное влияние понедельника на все индексы. Результат, полученный в данной работе, полезен инвесторам для разработки инвестиционной стратегии, ученым для изучения показателей индексов за разные периоды, а бизнесменам для определения тенденций и трендов.

Ключевые слова: бомбейские фондовые биржи; календарный эффект; BSE CARBONEX; BSE GREENEX; BSE 100; Sensex; Nifty

Для цитирования: **Kalimuthu K., Shaik S. Sustainability indices and the calendar effect.** ***Финансы: теория и практика*****. 2024;28(1):43-51. DOI: 10.26794/2587-5671-2024-28-1-43-51**

INTRODUCTION

Anomalies are occasions where the performance of securities or the stock market differs and cannot be explained by any financial theories. These anomalies are simply attributes of stock categories [1] that frequently deliver returns [2] above expected risk. These anomalies contradict the "Efficient Market Hypothesis". Investors can take advantage of these anomalies to outperform the results of the stock market benchmarks. There are numerous anomalies in the market. The three main categories are calendar, fundamental, and technical anomalies. Calendar anomalies are unusual stock return patterns that are based on the calendar year. Anomalies in the stock market provide investors with excellent opportunities to boost their investment returns. The weekend effect, day of the week effect, the turn of the month effect, the half of the month effect, the turn of the year effect, and the January effect are some of the most well-known calendar anomalies.

A stock market is a place where people can buy and sell securities. It provides a platform through which the savings and investments of people are efficiently transformed into productive investment opportunities and aids the economic growth of the country. Stock market indices give investors a simplified view of a large market sector. It would be difficult for an ordinary investor to study the changing patterns of different companies. A sector-wise index can reveal the sector's typical pattern [3].

Over the past few years, the importance of sustainable investing has increased [4, 5]. Researchers are paying more attention to sustainable investment [6–8]. Sustainable investing is an investment concept in which an investor considers a company's environmental, social, and corporate governance (ESG) aspects [9]. This can be deployed as a strategy to encourage meaningful social contribution [10] and company responsibility without compromising investors' long-term financial returns. Investors believe that sustainable investments will perform better than traditional ones [11].

There have been several studies relating to anomalies and stock returns. The present study provides new insights into the day-of-the-week effect on the Indian stock market sustainability indices.

LITERATURE REVIEW

Sustainable investing is a way of investing that considers society and the natural environment in a responsible way [12]. The term "sustainable investment" refers to an investing strategy that takes into account ESG factors while choosing and monitoring a portfolio. C. C. Benson et al. [13] state that sustainable stocks provide steady returns for a long period of time. L. Delsen and A. Lehr [14] examined sustainable investments in pension funds. They analyzed 2486 pension funds in the Netherlands using socio-demographic test factors. They concluded that there is a demand for sustainability investment across developed economies. For the past ten years, investments in sustainable funds have increased in the USA [15]. Researchers are examining and comparing the performance of sustainable funds with traditional ones in Spain. The result shows that socially responsible funds reduce volatility [16].

Some of the researchers, Y. Belghitar et al., H. H. Lean and D. K. Nguyen, O. Hawn et al. [17–19] evaluated a variety of sustainability indices in advanced economies, while others, like W. R. Ang, A. Wai Kong Cheung, R. Ur Rehman et al., E. Ortas et al. concentrated on developing nations [12, 20–22]. F.A.F. De Souza Cunha and C.P. Samanez [4] examined the performance of sustainability indices in the Brazilian Mercantile, Futures and Stock Exchange's (BM&FBOVESPA) Corporate Sustainability Index (ISE) from December 2005 to December 2010. They compared the performance with the market portfolio (IBOVESPA) and other BM&FBOVESPA sectoral indices. They concluded that restrictions placed on this type of investment might affect the risk and return.

Sustainable investment has steadily increased over the past few years (Global Sustainability Investment Review 2020). Banks [7, 23, 24], companies [25, 26], stock exchanges [4, 5], mutual funds [27], regulators [28], and other agents interested in sustainable investment participation and promoting initiatives to speed the growth of these investments.

P. T. Chan and T. Walter [29] used 748 green company samples listed on U.S. stock exchanges to examine how socially responsible investing (SRI) affects stock investment returns, Initial Public Offerings (IPOs), and Equity Offers. The result shows positive and statistically significant excess returns for environmentally friendly enterprises their IPOs and Equity Offers. Another researcher, K. Lesser et al. [8] revealed that there is solid evidence in terms of financial performance and risk that green investments differ significantly from SRI investments. But F. Silva and M.C. Cortez [1] study indicates that green indices underperformed when compared to market indices. As per their study results, in times of crisis, US green funds outperform other socially conscious funds, but

Table 1

Descriptive statistics

Full period	CARBONEX	GREENEX	BSE 100	Sensex	Nifty 50
Mean	0.045	0.045	0.045	0.045	0.044
Standard Deviation	1.084	1.085	1.082	1.087	1.086
Kurtosis	17.809	12.686	17.443	18.817	17.721
Skewness	–1.307	–1.035	–1.309	–1.238	–1.237
Minimum	–13.961	–12.587	–13.881	–14.102	–13.904
Maximum	8.312	8.056	8.143	8.595	8.400
Count	2475	2475	2475	2475	2475
Period – I					
Mean	0.065	0.069	0.067	0.065	0.064
Standard Deviation	0.954	0.927	0.955	0.936	0.957
Kurtosis	1.517	1.697	1.503	1.715	1.843
Skewness	–0.217	–0.095	–0.220	–0.126	–0.151
Minimum	–4.178	–4.020	–4.177	–4.054	–4.169
Maximum	3.558	4.398	3.542	3.703	3.738
Count	617	617	617	617	617
Period – II					
Mean	0.029	0.015	0.027	0.018	0.023
Standard Deviation	0.898	0.932	0.901	0.875	0.886
Kurtosis	4.838	3.453	4.947	4.419	4.236
Skewness	–0.829	–0.575	–0.867	–0.696	–0.702
Minimum	–6.424	–6.099	–6.489	–6.120	–6.097
Maximum	3.331	3.650	3.257	3.324	3.312
Count	619	619	619	619	619
Period – III					
Mean	–0.028	–0.042	–0.026	–0.010	–0.021
Standard Deviation	1.250	1.215	1.247	1.262	1.253
Kurtosis	33.210	25.236	32.645	34.279	33.007
Skewness	–2.938	–2.593	–2.888	–2.923	–2.901
Minimum	–13.961	–12.587	–13.881	–14.102	–13.904
Maximum	5.980	4.866	5.888	6.747	6.415
Count	617	617	617	617	617
Period – IV					
Mean	0.115	0.135	0.114	0.107	0.110
Standard Deviation	1.188	1.221	1.182	1.221	1.201
Kurtosis	5.428	4.231	5.272	5.550	5.418
Skewness	–0.078	–0.075	–0.126	0.024	–0.020
Minimum	–5.686	–5.013	–5.773	–6.122	–5.916
Maximum	8.312	8.056	8.143	8.595	8.400
Count	622	622	622	622	622

Source: Author's calculation.

Table 2

Results of Unit Root Test Values at 5% Level

Indices	Tests	Intercept	Trend & Intercept	None
CARBONEX	ADF test	–49.072	–49.062	–48.997
	PP test	–49.123	–49.113	–49.083
GREENEX	ADF test	–48.362	–48.354	–48.292
	PP test	–48.467	–48.459	–48.429
Sensex	ADF test	–11.835	–11.838	–11.783
	PP test	–49.636	–49.627	–49.577
BSE 100	ADF test	–49.072	–49.062	–17.467
	PP test	–49.117	–49.107	–49.075
Nifty	ADF test	–17.623	–17.619	–17.512
	PP test	–49.469	–49.46	–49.411

Source: Author's calculation.

Note: ADF: Augmented Dickey-Fuller Test, PP: Phillip-Perron test.

European green funds underperform during the non-crisis period. Another author, C.E. Chang et al. [27] reveals that lower returns have been produced by green mutual funds compared to conventional mutual funds in their respective categories.

The existence of calendar anomalies has been extensively studied over a long period of time in the financial market. The Day of the Week Effect is the most prevalent one. There are several studies relating to the existence of the day-of-the-week effect on emerging markets, to name a few J. Zhang, E.C. Hui and K.K.K. Chan, R. Islam and N. Sultana, M. Chaiah [30–33].

M. Bolek et al. [34] examined the effect of the day of the week effect anomaly during the pandemic period in OMX exchange. The result ensured that there is a pandemic impact on market efficiency.

METHODOLOGY

This study is about how the sustainable indices are performing in comparison with the BSE 100, SENSEX, and Nifty indices. The study applied descriptive statistics and calendar anomalies such as the day-of-week effect to check the returns of the CARBONEX, GREENEX, BSE 100, SENSEX, Nifty indices. It also checks the volatility of these indices during the study period. The daily closing price of the indices was collected from BSE and NSE India for the span of October 1, 2012, to September 30, 2022. The study period covers 2475 observations. Daily returns are calculated as follows:

$$R_t = \ln\left(\frac{P_t}{p_{t-1}}\right)*100,$$

where P_t is the present day return and P_{t-1} is the previous day's return.

To test the stationarity of the return of indices, the study applied the Augmented Dicky-Fuller test (ADF test) and Phillips Perron test (PP test 1988). For study purpose the analysis is classified into four equal periods.

The distribution of stock returns is not the same for all days, due to the existence of some calendar anomalies in the Indian stock market. A calendar anomaly is a pattern of stock returns that is unpredictable. The study aims to know about the presence of the day-of-the-week effect of these indices. The total period is divided into two equal periods and the following Ordinary Least Squares (OLS) model is used for empirical analysis.

$$R_t = \beta_1 + \beta_2 D_1 + \beta_3 D_2 + \beta_4 D_3 + \beta_5 D_4 + \varepsilon_t,$$

where R_t — is the daily return of the indices; D_1 to D_4 — dummy variables, and ε_t — is the random error term.

Table 3

Day-wise Return of Indices

Days/Indices	CARBONEX	GREENEX	Sensex	BSE 100	Nifty
Full period					
Monday	–0.039	–0.020	–0.041	–0.039	–0.044
Tuesday	0.137*	0.126	0.144*	0.138*	0.142*
Wednesday	0.099	0.066	0.104	0.099	0.104
Thursday	0.091	0.078	0.092	0.090	0.090
Friday	0.100	0.054	0.095	0.098	0.108
Period – I					
Monday	0.091	0.078	0.072	0.092	0.074
Tuesday	–0.139	–0.105	–0.117	–0.141	–0.124
Wednesday	–0.033	–0.018	–0.015	–0.033	–0.012
Thursday	–0.017	0.003	0.008	–0.020	0.003
Friday	–0.032	–0.058	–0.030	–0.035	–0.018
Period –II					
Monday	–0.172*	–0.119	–0.157*	–0.173*	–0.164*
Tuesday	0.419*	0.360*	0.406*	0.419*	0.410*
Wednesday	0.234*	0.151	0.224*	0.234*	0.222*
Thursday	0.202	0.153	0.178	0.202	0.178
Friday	0.233*	0.167	0.223*	0.233*	0.235*

Source: Author's calculation.

Note: * Statistically significant at 5% level.

To test the volatility of the indices during the study period GARCH (1, 1) model is used. The basic GARCH model (1, 1) equation is:

$$\sigma t^2 = a_0 + \beta_1 U_{t-1^2} + \beta_1 \sigma_t - 1^2.$$

The variance of the ARCH and GARCH model is the same. But in the GARCH model the error term (σ_{t-1}^2) is used to predict the previous time period error term.

EMPIRICAL RESULTS AND DISCUSSION

The analysis of the study is carried out in three ways. First, the descriptive statistics indicate the mean, standard deviation, kurtosis, skewness, minimum and maximum values of the indices. Then OLS is applied to check the day-of-the-week effect on BSE CARBONEX, BSE GREENEX, BSE 100, Sensex, and Nifty. A further GARCH (1, 1) model is used to check the volatility of these indices.

The study period is divided into four equal sub-periods for analysis purposes. Descriptive statistics for BSE CARBONEX, BSE GREENEX, BSE 100, Sensex, and Nifty were presented in *Table 1*. As can be observed in *Table 1* (full period), the maximum mean return occurred in all indices except Nifty 50. These results suggest that sustainability index returns follow the pattern of the BSE 100 and Sensex [11]. The standard deviation of Sensex was greater when compared to other indices. These results indicated that volatility in Sensex was greater compared with other indices. The value of skewness returns was found to be negative in all indices during the study period. The values of Kurtosis of all indices indicate that the dataset has heavier tails than a normal distribution.

This study is further classified into four sub-periods. Period I (October 1, 2012 to March 31, 2015), Period II (April 1, 2015 to September 30, 2017), Period III (October 1, 2017 to March 31, 2020), and Period IV (April 1 2020 to September 30, 2022). During

Table 4

Volatility of the Indices

Variables	CARBONEX	GREENEX	BSE 100	Sensex	Nifty 50
Mean equation					
Monday	0.068*	0.063	0.067*	0.074*	0.068*
Tuesday	0.013	0.012	0.016	0.015	0.020
Wednesday	−0.016	−0.020	−0.013	−0.013	−0.010
Thursday	0.005	−0.003	0.006	0.001	−0.001
Friday	−0.016	−0.042	−0.017	−0.029	−0.014
Indices return (−1)	0.083*	0.079*	0.084*	0.072*	0.074*
Var. equation					
Intercept	0.027*	0.036*	0.028*	0.022*	0.023
RESID(−1)^2	0.091*	0.091*	0.093*	0.089*	0.091
GARCH(−1)	0.883*	0.876*	0.880*	0.890*	0.887
R 2	−0.005	−0.001	−0.005	−0.005	−0.005
D−W test	2.138	2.103	2.141	2.138	2.135

Source: Author's calculation.

Note: Indices return (−1) indicates respective lag values of the selected indices.

the period, GREENEX got the maximum mean return. The Nifty standard deviation is high compared to other indices. The year 2014 has had a positive impact on the stock market. Some events, like general elections, positive macroeconomic indicators (GDP & Inflation), and the Make in India Movement, have a positive impact on the capital market. This could be the reason for the positive return of these indices.

The descriptive statistics of Period II reveal that the CARBONEX return is greater when compared to other indices. The standard deviation of GREENEX is high. It denotes the high volatility of GREENEX compared to other indices. The country's stock markets are extremely volatile and actively respond to political and economic actions. Some major events like Demonetization (BSE Sensex crashed nearly 1,689 points and the Nifty by 541 points) and GST Bill passage might have an impact on the stock market indices during this period.

During Period II, there was the COVID-19 pandemic period, and the financial markets have also become completely volatile. This pandemic period not only had a negative impact on public health but also severely damaged the economy and business sector. All economies have trembled as a result of the government's implementation of lockdowns, travel limits, and closing of workplaces, shopping malls, trade, and businesses [35]. During this period, all the indices had a negative return. The benchmark indices, i.e Sensex and Nifty were highly volatile.

Period IV witnessed a rise in all indices, but the highest was observed in GREENEX (0.135) followed by CARBONEX (0.115) and BSE 100 (0.114). The initial time of the year 2020 had a fall in indices return due to COVID-19 impact, but later the indices moved to the recovery zone because of government initiatives.

The unit root test result of the indices is presented in *Table 2*. The study applied the Augmented Dicky-Fuller test (ADF test) and the Phillips Perron test to test the stationarity of the time series data. The test result indicates that the series is stationary at level. So, the alternative hypothesis is accepted.

In the stock market, there is a belief that certain days' returns are higher than other days in the week. *Table 3* indicates that the Tuesday effect is present (except GREENEX) and statistically significant throughout the full period of the study. Since Tuesday is the second day of the week, there are

naturally additional trading days before and after every transaction. Investors, therefore, have more time to react to Tuesday's information because they have information sets for Monday as well as forecasts for the following three days. Further analysis period I indicate that there is a Monday effect on these indices. But period II indicates a statistically significant Tuesday effect on all indices. On the other hand, it shows there is a statistically significant negative Monday effect on all indices.

GARCH (1, 1) model is used to check the volatility of the BSE CARBONEX, BSE GREENEX, BSE 100, Sensex, and Nifty during the days of the week. In *Table 4,* the overall result of the mean equation shows that a significant mean return was observed on Monday (except GREENEX) for all indices. The sum of the coefficients of the GARCH model (except the error term) is 0.974, which is less than 1, and there is volatility in BSE CARBONEX, BSE GREENEX, BSE 100, Sensex, and Nifty. RESID (–1) ^ 2 (GARCH variable) is positive and statistically significant at a 5% level for all indices. It is observed that the previous day's return influences the present-day return.

CONCLUSION

Sustainability indices are tools for evaluating a company's social and environmental responsibility. This research paper analyses the day-of-the-week effect in the sustainable indices for the period of October 1, 2012, to September 30, 2022. The study first applied descriptive statistics to learn about their mean return during the full study period, period I, period II, period III, and period IV. It is clear from the descriptive statistics that sustainability index returns follow the pattern of the BSE 100 and Sensex during the whole period. During Period I, GREENEX got the maximum mean return. Period II reveals that the CARBONEX return is greater than that of other indices. Period IV witnessed a rise in all indices, particularly in GREENEX.

The day-wise OLS results indicate an optimistic and statistically significant Tuesday effect during the full sample period and period II. There is a Monday effect on Period I. GARCH (1, 1) model indicates there is a significant Monday effect on all indices. This research study's results indicate that socially responsible investing is developing in India. The growing awareness on the part of investors and companies in the areas of environmental issues and governance problems would expect more investments in sustainability stocks in the upcoming years.

The result obtained in this paper is useful to investors to frame their investment strategy, for academicians to study the performance of the indices for different periods, and for business people to know the trend and tendencies. This study's scope could be expanded to include the comparison of the sustainability indexes for the Indian stock market with those for other countries and for different periods of time.

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Conflicts of Interest Statement: The authors have no conflicts of interest to declare.
Конфликт интересов: авторы заявляют об отсутствии конфликта интересов.

The article was submitted on 03.12.2022; revised on 04.01.2023 and accepted for publication on 26.01.2023.
The authors read and approved the final version of the manuscript.
Статья поступила в редакцию 03.12.2022; после рецензирования 04.01.2023; принята к публикации 26.01.2023.
Авторы прочитали и одобрили окончательный вариант рукописи.