“Testing event-based day of the week anomaly and trading opportunities: Evidence from Indian sectoral indices”

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TESTING EVENT-BASED DAY OF THE WEEK ANOMALY AND TRADING OPPORTUNITIES: EVIDENCE FROM INDIAN SECTORAL INDICES

Abstract

The study is an attempt to examine the day-of-the-week anomaly of fourteen Indian sectoral indices and identify profitable opportunities, considering multiple positive and negative events. The aim of this study is to analyze the day-of-the-week effect on fourteen Indian sectoral indices and find profitable opportunities while considering multiple events that have positive and negative impacts. The study takes into consideration event-based anomalies, both national and global, and provides timing for trading to generate abnormal returns from the market. At first, dummy variable regression analysis was used to understand the initial anomalies. Later, time-varying symmetrical and asymmetrical volatility models, such as Generalized Autoregressive Conditional Heteroscedasticity (1, 1) and Exponential Generalized Autoregressive Conditional Heteroscedasticity (1, 1) were applied to determine the short-term and long-term volatility persistence. These models capture the leverage effect from various events that occurred during the study. The results showed mixed outcomes during multiple positive and negative shocks. After the recession, anomalies were observed across all sectoral indices, except for commodities, energy, and information technology. During the scam period, anomalies occurred in all sectors, except for consumer durables, financial services, and information technology. However, after the new government took over, anomalies persisted in all sectors. During the pandemic, anomalies persisted in all sectors except for finance, IT, pharmaceuticals, and services. Hence, national and global events have shown varied impacts on the Indian markets. The study provides investors with implications on strategies and timing techniques for planning their investments in different sectors of the Indian economy.

Keywords anomalies, India, day-of-the-week effect, sectoral indices, symmetrical volatility, asymmetrical volatility, UN SDG8

JEL Classification D81, E44, G01, G14

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INTRODUCTION

The stock market is a complex system influenced by various factors, such as economic growth, political stability, and market psychology. Anomalies in stock markets can result in abnormal returns, and many studies have been dedicated to detecting these anomalies. Some of the most common anomalies include calendar anomalies, market anomalies, event-based anomalies, and behavioral anomalies, all of which deviate the markets from efficiency, resulting in fluctuations.

Efficient markets reflect all available information and allow investors to plan their timing of investments to generate abnormal returns. The three forms of efficient markets include weak form, semi-strong form, and strong form. Weak form uses past prices, semi-strong includes public data, and strong form considers all information. According to research, developed countries are efficient markets, and passive investments are more

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popular than active investments. However, emerging economies may still have scope for anomalies, and evidence suggests that they show weak to semi-weak efficiencies. Therefore, there are instances of getting positive returns, and active investors can get positive alpha by timing their investments correctly.

The detection of anomalies across emerging countries is even more crucial and urgent during the onset of volatile markets, where the world economies are facing multiple crises like pandemics, geopolitical crises, and Western countries' headwinds. During such a vulnerable period, investors and regulators must understand the volatility of the markets to make informed investment decisions. In contrast, the Indian economy is showing resilient growth during this vulnerable period, making the study crucial and urgent to identify timings in which investors can generate abnormal returns from the market.

1. LITERATURE REVIEW AND HYPOTHESES

The detection of anomalies and efficiencies is a popular topic in literature, with varying results based on country and asset. Different types of anomalies, such as momentum, value and size effect, mean reversion, seasonal anomalies, post-earnings announcement drift, and market sentiments, have been identified. This paper focuses on seasonal anomalies, such as Day-of-the-week effect under various events.

Several studies have been conducted to investigate the day-of-the-week effect. For instance, Wong and Yuanto (1999) found positive returns on Friday and adverse returns on Tuesday in the Indonesian stock market. Singhal and Bahure (2009) conducted a study in the Indian stock market and found lower returns on Monday and higher returns on Friday than on other days of the week, suggesting these patterns for investors to strategize their trades. However, Gerry and Perez (2018) found no significant Monday effect. Cengiz et al. (2017) studied the Istanbul index and found that the return on Monday was affected by other days of the week, whereas Cinko and Avci (2009) found negative results on Monday and positive results on Thursday and Friday. Boonkrong and Arjrith (2018) found a negative return on Monday and a positive return on Friday in the Thailand market. In the UK, France, and Germany, Jaffe and Westerfield (1985) and Berument and Kiymaz (2001) identified negative effects on Monday and positive effects on Friday. For Indonesia, Wong and Yuanto (1999) captured a positive return on Friday and an adverse return on Tuesday. Nur et al. (2023) and Tadepalli and Jain (2018) found that calendar anomalies prevail in Brazil, India, and Russia markets.

Sector-wise day-of-the-week-effect studies are also essential contributions to the literature on anomalies. Cengiz et al. (2017) studied the markets of Turkey and found that the automotive, cement, and textile sectors had effects of anomaly. The study found that Monday was positive for the food sector, while other sectors had Tuesday, Thursday, and Friday effects. Squalli (2006) observed inefficiencies for almost all sectors in Dubai markets. Sumathy and Das (2022) found the day-of-the-week effect for Indian sectors with varied results on different days. It has been found that there is a Monday effect on Pharma, a Tuesday effect on FMCG, a Thursday effect on Banking, a Friday effect on IT, and no variation on Wednesday.

There are scant studies on sectoral indices within a country, particularly in the Indian market, where few detections of calendar anomalies have been made on sectoral indices. The studies by Sumathy and Das (2022), Tadepalli et al. (2021), and Verma and Kumar (2015) have detected sectoral anomalies in the Indian market. The study found this gap even more relevant during the vulnerable period when the world economies are facing multiple crises. This is the very first attempt in the context of the Indian market to detect the day-of-the-week effect with two decades of coverage backed by international and national events. The study is relevant for Indian active investors to strategize their sectoral strategy and for regulators to understand the behavior of the sectors during various events.

The study intends to investigate the day-wise anomalies for Indian sectoral indices and adds to the literature on anomalies for sectoral indices. The objective of the study is to capture the day-of-

the-week effect and leverage effect during various national and international events, such as post-recession, scams, new government, reforms, and COVID-19. The following hypotheses have been tested to capture the day-of-the-week effect and leverage:

H1: There is no difference between the daily returns of sectoral indices for Indian markets.

H2: There is no difference within the daily returns of sectoral indices of Indian markets.

H3.1: The day-of-the-week effect does not exist during the post-recession period.

H3.2: The day-of-the-week effect does not exist during the scams period.

H3.3: The day-of-the-week effect does not exist during the new government period.

H3.4: The day-of-the-week effect does not exist during the reform period.

H3.5: The day-of-the-week effect does not exist during the COVID-19 period.

H4.1: The leverage effect has not existed due to the recession.

H4.2: The leverage effect has not existed due to scams.

H4.3: The leverage effect has not existed due to the change of the new government.

H4.4: The leverage effect has not existed due to reforms.

H4.5: The leverage effect has not existed due to COVID-19.

2. METHODOLOGY

The study considers the fourteen prominent sectors of Indian markets. The closing prices of all these indices are fetched from www.nseindia.com from January 2012 to December 2022. Table 1 provides the event wise time periods under consideration.

Table 1. Time periods under consideration

Time period	Event
January 2010 – December 2012	Post-recession
January 2013 – December 2013	Scams
January 2014 – July 2016	New Govt
August 2016 – November 2019	Reforms
December 2019 – December 2022	Covid-19

To detect anomalies, the study has applied Ordinary Least Squares, followed by Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models. To capture the short-term and long-term persistence of volatility and leverage effect, the study calculates log returns by applying the formulae as:

$$R_{it} = Ln\frac{(P_t)}{(P_{t-1})}, \quad (1)$$

where, R_{it} is the Daily return, *Ln* is the Log function, P_t is the Current price and $P_{t\text{-}1}$ = Previous price.

2.1. Ordinary Least Squares (OLS)

To identify the day-of-the-week effect, the regression analysis has been done for daily returns of sectoral indices taking dummy variables for all five days of the week (Monday, Tuesday, Wednesday, Thursday, and Friday). The constant has been intentionally skipped from the above equation to avoid the problem of dummy trap. DM is 1 if it is a Monday, or 0 otherwise. Similarly, the other dummies for the respective days have formed (Al-Loughani & Chappel, 2001; Coutts et al., 2000; Agrawal & Tandon, 1994). Normal OLS model may lead to misinterpretation as the stock market return may be surrounded by volatility which varies over time (Connolly, 1989). Thus, the GARCH model has been further added to investigate the results provided by the OLS model. The regression equation is as follows

$$R_{it} = \alpha + \beta_1 D_M + \beta_2 D_T + \beta_3 D_W + \beta_4 D_{Th} + \beta_5 D_F + \varepsilon_t, \quad (2)$$

where, R_{it} is the Daily return, $\beta_{1...5}$ are the coefficient for days of the week, and *D* is the Dummy variable for the respective day of the week, that is Monday to Friday. However, before going for regression and other econometric models, the study first en-

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sures the time series of all sectors is stationary; for this, the Augmented Dickey-Fuller test, popularly known as the ADF test or unit root test (Cheung and Lai, 1995), was used to test stationarity.

2.2. Generalized Autoregressive Conditional Heteroscedasticity (GARCH - 1, 1)

Further, after analyzing the day-of-the-week effect by the application of OLS, the study further applied time varying econometric models, where volatility is varying according to time. The GARCH (1,1) model, as introduced by Bollerslev (1986), was used to assess the-day-of-the-week effect in sectoral index returns for Indian stock markets in the study. Their application has been sourced as easy but cautious with residual analysis of the model (Drakos et al., 2010). The variance (conditional) has been shown as dependent on its past lag in the standard GARCH (p, q) model where p and q are the ARCH and GARCH terms. The model may be given as below (Brooks et al., 2001). σ_t^2 is the conditional volatility that depends on the lagged squared error term of the mean model and lagged its own conditional volatility. The conditional variance of the series Y_t is explained as:

$$Y_t \mid \varphi_{t-1} \sim N\left(0, \sigma_t^2\right), \tag{3}$$

where σ_t^2 is the conditional volatility, and ϕ_{t-1} is the tangible news available at time *t*.

GARCH (1, 1) model is explained as:

$$\sigma_t^2 = \alpha + \beta_1 \in_{t-1}^2 + \beta_2 \sigma_{t-1}^2 + \mu_t \tag{4}$$

Further, the GARCH (p, q) model can be written as:

$$\sigma_t^2 = \alpha + \sum_{i=1}^{p} \beta_1 \in_{t-1}^2 + \sum_{j=1}^{q} \beta_2 \sigma_{t-1}^2 + \mu_t, \tag{5}$$

where, $\alpha > 0$; $\beta_1 \geq 0$; $\beta_2 \geq 0$.

GARCH (1, 1) model captures both short and long-term volatility. The conditional volatility depends on lagged squared residuals ϵ_{t-1}^2, i.e. also called as the ARCH effect and its own lagged value σ_{t-1}^2, i.e. GARCH effect. Where the ARCH effect is a measure of short-term volatility and the GARCH effect captures the long-term volatility. The ARCH term implies the recent news created volatility in the given financial time series in the short term. The GARCH effect captures the long-term persistence of volatility, which implies the impact of old news on the behavior of prices.

2.3. Exponential Generalized Autoregressive Conditional Heteroscedasticity (E GARCH - 1, 1)

Additionally, the study also captures the leverage effect by applying Exponential GARCH . The leverage effect means that negative news has been more disturbing than positive news for a time series (Nelson, 1991). The ability to locate the asymmetric information in a time series makes this model superior as compared to traditional symmetric GARCH model, which may fail to gauge this effect (Mazviona & Ndlovu, 2015). EGARCH considers that $\alpha > 0$; $\beta_1 \geq 0$; $\beta_2 \geq 0$ restrict the scope of volatility and won't be able to capture the overall dynamic behavior of volatility in the time series. Thus, in the EGARCH model, the conditional variance i.e. σ_t^2 captures the asymmetry in the given equation:

$$\log\log\left(\sigma_t^2\right) = \alpha + \sum_{i=1}^{p} \beta_i \left[\frac{\left|\in_{t-1}\right|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}}\right] + \gamma \frac{\in_{t-1}}{\sqrt{\sigma_{t-i}^2}} + \sum_{i=1}^{p} \beta_j \log\log \sigma_{t-j}^2. \tag{6}$$

In the above equation, α, β, γ, and β_j are the coefficients having no restriction of non-negativity constraints of the conditional variances. Thus, the EGARCH model captures the asymmetry among positive and negative return shocks. This asymmetry is measured by γ. If, $\gamma = 0$, then positive news has the same effect of a negative shock. If, $\gamma < 0$, a positive shock has low volatility, and if $\gamma > 0$, negative news has a greater effect of volatility.

3. RESULTS

Multiple events have been explored in the study as reflected in Table 1. The descriptive statistics of the fourteen sectoral indices undertaken for the examination have been shown in Table 2 for the multiple events. It has been observed that af-

Table 2. Descriptive statistics (mean average)

Auto	Bank	Comm	Cons D	Energy	Fin Serv	FMCG	Infra	IT	Media	Oil & Gas	Pharma	Realty	Services
0.0006	0.0005	-0.0004	0.0010	-0.0003	0.0005	0.0010	-0.0005	-0.0001	0.0002	–0.0002	0.0006	–0.0008	0.0001
0.0003	–0.0004	-0.0004	–0.0007	0.0000	–0.0004	0.0004	-0.0002	0.0018	0.0000	0.0000	0.0009	–0.0018	0.0003
0.0008	0.0007	0.0002	0.0011	0.0001	0.0007	0.0003	0.0002	0.0003	0.0006	0.0003	0.0006	–0.0001	0.0005
–0.0001	0.0007	0.0003	0.0008	0.0008	0.0008	0.0005	0.0002	0.0003	–0.0004	0.0007	–0.0003	0.0005	0.0006
0.0004	–0.0003	0.0002	0.0005	0.0001	0.0000	0.0001	0.0001	0.0016	–0.0009	–0.0001	0.0015	–0.0003	0.0003

ter the US recession, fast-moving consumer goods (FMCG), Pharmaceuticals (Pharma), and Automobiles (Auto) have outperformed the other indices *(H1: There is no difference between the daily returns of sectoral indices for Indian markets)*. The underperformers during this period have been Commodities (Comm), Energy, Infrastructure (Infra), Information Technology (IT), Oil and Gas (Oil & Gas), and Realty Services (Realty).

After the scams were exposed in Indian financial markets, FMCG, IT, and Pharma performed above expectations, especially the IT sector. The sectors that index mean average returns replicated as underperformers were Banking (Bank), Comm, Consumer Durables (Cons D), Financial Services (Fin Serv), Infra, and Realty. *(H2: There is no difference within the daily returns of sectoral indices of Indian markets)*. IT emerged as another opportunist sector for investment purposes by national and global investors. Hence, it indicates that within the sectoral index returns have been different over several events studied. The emergence of the new Government came out as a positive vibe for almost all the sector's performance. The same has been reflected in the mean average returns on their indices during this period. Auto, Bank, Cons D, Fin Serv, Media, and Pharma have been performing at par during this period. The only exception that came out as an underperformer during this period has been the Realty sector. The reforms proposed and implemented by the new Government thereafter had been another positive/negative shock for all the sectors because of which varied performance has been visible. Bank, Cons D, Energy, Fin Serv, Oil & Gas, and Services have performed better as compared to other indices. The COVID period has also shown different mean average returns and observable variations within all sectors. Skewness, Kurtosis, and Jarque-Bera statistics have been observed and express the non-normality of data points, which has been a common characteristic of time series analysis.

The ADF statistic for testing unit root across all the data points for sectoral indices has been found significant at a level and first difference as shown in Table 3 (p-values < 0.05). The primary assumption to run any model on time series analysis was found satisfactory. Hence, the regression analysis has been carried out on the log daily returns of respective indices. Further, the analysis has been done using the Ordinary Least Square (OLS) method, and results have been drawn in Table 4.

Table 3. Unit root results

Sector	Intercept	Trend & Intercept	Without Trend
Bank	–48.632***	–48.623***	–48.605***
	(0.000)	(0.000)	(0.000)
Auto	–49.391***	–49.395***	–49.364***
	(0.000)	(0.000)	(0.000)
Cons D	–48.017***	–48.009***	–47.884***
	(0.000)	(0.000)	(0.000)
Financial Services	–49.383***	–49.376***	–49.338***
	(0.000)	(0.000)	(0.000)
FMCG	–52.321***	–52.334***	–52.207***
	(0.000)	(0.000)	(0.000)
IT	–52.535***	–52.537***	–52.473***
	(0.000)	(0.000)	(0.000)
Media	–50.094***	–50.103***	–50.104***
	(0.000)	(0.000)	(0.000)
Oil & Gas	–52.011***	–52.009***	–52.003***
	(0.000)	(0.000)	(0.000)
Pharma	–49.471***	–49.471***	–49.421***
	(0.000)	(0.000)	(0.000)
Realty	–47.129***	–47.147***	–47.131***
	(0.000)	(0.000)	(0.000)
Energy	–51.826***	–51.838***	–51.823***
	(0.000)	(0.000)	(0.000)
Infra	–49.704***	–49.712***	–49.713***
	(0.000)	(0.000)	(0.000)
Services	–51.02***	–51.015***	–50.974***
	(0.000)	(0.000)	(0.000)
Comm	–51.684***	–51.692***	–51.693***
	(0.000)	(0.000)	(0.000)

Notes: *** denotes the results are significant at the 1% significance level.

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Table 4. OLS results

Days	Auto	Bank	Comm	Cons D	Energy	FS	FMCG	Infra	IT	Media	O&G	Pharma	Realty	Services
Post-Recession														
M	−0.001 (0.464)	−0.001 (0.431)	−0.001 (0.123)	0.001 (0.395)	−0.001 (0.155)	−0.001 (0.358)	0.001 (0.436)	−0.001 (0.204)	−0.001 (0.510)	−0.001 (0.609)	−0.001 (0.363)	0.000 (0.589)	−0.003** (0.040)	−0.001 (0.342)
T	0.001 (0.200)	0.001 (0.582)	−0.001 (0.534)	0.001 (0.489)	−0.001 (0.517)	0.001 (0.537)	0.001* (0.065)	−0.001 (0.414)	0.001 (0.468)	−0.001 (0.542)	−0.001 (0.330)	0.002** (0.016)	−0.001 (0.734)	0.001 (0.566)
W	0.001 (0.164)	0.002 (0.118)	0.001 (0.506)	0.002** (0.039)	0.000 (0.931)	0.002* (0.098)	0.001 (0.419)	0.001 (0.619)	−0.001 (0.594)	0.002* (0.092)	0.000 (0.977)	0.001 (0.290)	0.000 (0.770)	0.001 (0.385)
Th	0.001 (0.445)	0.000 (0.680)	0.000 (0.669)	0.001 (0.397)	0.000 (0.659)	0.001 (0.606)	0.002** (0.033)	0.000 (0.834)	0.001 (0.422)	0.001 (0.566)	0.000 (0.807)	0.000 (0.780)	0.000 (0.871)	0.000 (0.611)
F	0.000 (0.737)	0.000 (0.793)	−0.001 (0.514)	−0.001 (0.489)	0.001 (0.566)	0.000 (0.879)	0.000 (0.846)	0.000 (0.802)	0.000 (0.795)	−0.001 (0.336)	0.002 (0.212)	0.001 (0.469)	−0.001 (0.752)	0.000 (0.834)
Scams														
M	0.001 (0.399)	0.002 (0.532)	−0.001 (0.640)	−0.002 (0.363)	0.000 (0.979)	0.002 (0.341)	−0.001 (0.664)	−0.001 (0.777)	0.003 (0.173)	0.000 (0.971)	0.000 (0.838)	0.001 (0.391)	−0.003 (0.457)	0.002 (0.246)
T	0.001 (0.562)	−0.001 (0.630)	−0.001 (0.707)	0.000 (0.904)	0.000 (0.883)	−0.001 (0.583)	0.002 (0.347)	−0.001 (0.690)	0.001 (0.786)	−0.002 (0.245)	−0.001 (0.793)	0.001 (0.613)	−0.003 (0.364)	−0.001 (0.734)
W	0.000 (0.896)	0.001 (0.687)	0.002 (0.316)	0.001 (0.573)	0.002 (0.409)	0.001 (0.752)	0.003 (0.121)	0.003 (0.220)	0.004* (0.086)	0.002 (0.419)	0.002 (0.273)	0.001 (0.458)	0.002 (0.523)	0.002 (0.343)
Th	−0.001 (0.736)	−0.002 (0.512)	0.000 (0.856)	−0.001 (0.705)	0.000 (0.908)	−0.002 (0.411)	0.000 (0.882)	0.000 (0.924)	0.001 (0.620)	0.000 (0.970)	0.000 (0.925)	0.000 (0.912)	−0.006* (0.085)	−0.001 (0.585)
F	0.000 (0.962)	−0.002 (0.496)	−0.002 (0.272)	−0.002 (0.294)	−0.001 (0.464)	−0.002 (0.548)	−0.001 (0.491)	−0.002 (0.353)	0.001 (0.677)	0.001 (0.729)	−0.002 (0.300)	0.002 (0.177)	0.001 (0.829)	−0.001 (0.713)
New Government														
M	0.001 (0.247)	0.000 (0.994)	0.000 (0.803)	0.001 (0.459)	0.001 (0.402)	0.000 (0.935)	0.000 (0.984)	0.000 (0.807)	−0.001 (0.620)	0.001 (0.486)	0.001 (0.525)	0.000 (0.993)	0.001 (0.769)	0.000 (0.995)
T	0.001 (0.482)	−0.001 (0.571)	−0.001 (0.645)	0.001 (0.297)	−0.001 (0.335)	0.000 (0.810)	0.001 (0.575)	−0.001 (0.627)	0.000 (0.860)	0.000 (0.776)	−0.001 (0.499)	0.000 (0.961)	−0.001 (0.675)	0.000 (0.819)
W	0.002* (0.066)	0.003** (0.045)	0.002* (0.085)	0.002* (0.065)	0.002 (0.184)	0.003** (0.035)	0.001 (0.157)	0.001 (0.461)	0.001 (0.610)	0.002* (0.083)	0.002* (0.092)	0.002 (0.131)	0.001 (0.769)	0.002* (0.071)
Th	0.001 (0.445)	0.001 (0.407)	−0.001 (0.306)	0.000 (0.683)	−0.001 (0.260)	0.001 (0.547)	0.000 (0.823)	0.000 (0.880)	0.000 (0.678)	0.001 (0.674)	−0.001 (0.283)	0.002* (0.083)	0.000 (0.891)	0.000 (0.612)
F	−0.001 (0.511)	0.001 (0.547)	0.000 (0.784)	0.001 (0.323)	0.000 (0.769)	0.001 (0.612)	0.000 (0.825)	0.000 (0.753)	0.001 (0.403)	−0.001 (0.373)	0.001 (0.513)	−0.001 (0.549)	−0.001 (0.673)	0.001 (0.483)
Reforms														
M	0.000 (0.665)	0.002** (0.038)	0.000 (0.705)	0.001 (0.202)	0.001 (0.417)	0.002** (0.012)	0.001 (0.141)	0.000 (0.976)	0.001* (0.075)	−0.001 (0.314)	0.001 (0.578)	0.000 (0.853)	0.000 (0.901)	0.002** (0.014)
T	0.001 (0.445)	0.002** (0.040)	0.002** (0.030)	0.002** (0.013)	0.002** (0.011)	0.002** (0.040)	0.001 (0.301)	0.002** (0.036)	0.001 (0.498)	0.001 (0.382)	0.002** (0.034)	0.000 (0.680)	0.003** (0.041)	0.001** (0.037)
W	0.000 (0.776)	0.000 (0.968)	0.000 (0.934)	0.000 (0.620)	−0.001 (0.484)	0.000 (0.897)	0.000 (0.537)	−0.001 (0.248)	0.000 (0.708)	−0.001 (0.340)	0.000 (0.588)	−0.001 (0.157)	−0.001 (0.408)	0.000 (0.877)
Th	−0.001 (0.510)	0.000 (0.750)	0.000 (0.809)	0.000 (0.646)	0.000 (0.632)	0.000 (0.866)	0.000 (0.964)	0.000 (0.853)	0.000 (0.954)	0.000 (0.785)	0.000 (0.638)	0.000 (0.639)	−0.001 (0.480)	0.000 (0.979)
F	0.000 (0.863)	0.000 (0.990)	0.000 (0.905)	0.000 (0.964)	0.001 (0.174)	0.000 (0.695)	0.000 (0.999)	0.000 (0.793)	0.000 (0.956)	0.000 (0.795)	0.001 (0.201)	0.000 (0.796)	0.002 (0.141)	0.000 (0.891)
COVID-19														
M	−0.003 (0.409)	−0.005 (0.201)	−0.003 (0.337)	−0.001 (0.629)	−0.004 (0.207)	−0.004 (0.251)	−0.001 (0.614)	−0.003 (0.259)	−0.001 (0.643)	−0.006* (0.073)	0.000 (0.924)	0.001 (0.846)	−0.004 (0.243)	−0.004 (0.227)
T	0.002 (0.501)	0.001 (0.783)	0.001 (0.719)	0.005* (0.061)	0.002 (0.516)	0.001 (0.727)	0.002 (0.357)	0.000 (0.854)	0.005* (0.082)	0.003 (0.395)	0.002 (0.402)	0.002 (0.531)	0.003 (0.459)	0.002 (0.564)
W	−0.002 (0.588)	−0.001 (0.809)	0.000 (0.979)	−0.005* (0.057)	0.000 (0.996)	−0.001 (0.870)	0.000 (0.840)	0.001 (0.679)	0.002 (0.467)	0.000 (0.991)	−0.002 (0.439)	0.000 (0.859)	−0.001 (0.821)	0.000 (0.909)
Th	0.000 (0.907)	0.000 (0.931)	0.000 (0.935)	0.005** (0.041)	0.001 (0.830)	0.001 (0.892)	−0.001 (0.651)	−0.001 (0.851)	−0.001 (0.764)	0.000 (0.967)	0.001 (0.651)	0.001 (0.755)	0.000 (0.896)	0.000 (0.924)
F	0.004 (0.223)	0.004 (0.318)	0.003 (0.361)	−0.001 (0.573)	0.002 (0.607)	0.003 (0.369)	0.001 (0.652)	0.003 (0.325)	0.003 (0.347)	−0.001 (0.790)	−0.002 (0.578)	0.004 (0.141)	0.001 (0.767)	0.003 (0.278)

Notes: *** denotes the results are significant at the 1% significance level, ** denotes the 5% significance level, and * denotes the 10% significance level.

The post-recession period with the OLS model has shown some signs of anomalies in consumer durables, financial services, fast-moving consumer goods, media, pharma, and realty. Wednesday has been a common day where the day-of-the-week effect has been present for consumer durables, financial services, and media (p-values at 10% level, 0.039; 0.098; 0.092) *(H3.1: The day-of-the-week effect does not exist during the post-recession period).*

The model results show that anomalies were present in a few of the sectoral index returns after the US recession ended for world markets. A weak anomaly may have been present, which signals mixed results for inefficiency in Indian markets in the post-recession period.

The scams period is not active for anomalies in all the sectors taken in the study for investigating the efficiency of markets. Only information technology and realty sectoral indices have shown very weak signs of anomalies present on Wednesdays and Thursdays (p-values at 10% level, 0.086; 0.085) *(H3.2: The day of the week effect does not exist during the scams period).* However, the overall output from the OLS model has not shown strong signs of anomalies in Indian markets routed from sectoral index returns. This may be because scams, as a negative shock, may not lead to inefficiency over some time. They may result in inefficiencies for a particular day and thereafter disappear from the market information.

The new Government period referred to the post-period for the Indian stock markets when a new party came into being and a changeover of Government had taken place. Interestingly, as depicted in Table 2, all sectoral index returns have been on the positive side and attractive for investment purposes. A similar interesting result has been obtained with the OLS model wherein Wednesday (middle of the week) has been found to possess a day-of-the-week effect for most of the sectors. Anomalies have been present in daily sector index returns of automobiles, banking, commodities, consumer durables, financial services, media, oil and gas, pharma, and services (p-values at 10% level, 0.066; 0.045; 0.085; 0.065; 0.035; 0.083; 0.092; 0.071) *(H3.3: The day of the week effect does not exist during new Government period*). However, the remaining sectors have not shown any signs of inefficiency and the Indian market as a whole may not be called inefficient during the new Government regime.

The new Government had proposed many changes/reforms to the system, including the Insolvency and Bankruptcy Code, Demonetization, and Goods and Services tax, along with other minor rules and regulations. The post-era from these reforms has been captured for testing anomalies in Indian stock markets. It has been found that the Tuesday effect has been strongly extant for banking, commodities, consumer durables, energy, financial services, infrastructure, oil and gas, realty, and services (p-values at 10% level, 0.040; 0.030; 0.013; 0.011; 0.040; 0.036; 0.034; 0.041; 0.037). Information technology, banking, and financial services have also shown a Monday effect on the daily returns *(H3.4: The day of the week effect does not exist during the reforms period).* It may be drawn those reforms may have resulted in anomalies and inefficiency in trading after they were implemented.

The pandemic generated a crisis-like situation for many industries, especially after the lockdown was imposed to control the number of cases in India in 2020 (Paul & Dhiman, 2021). The inefficiency in markets during this period is rare with only a few cases in consumer durables, information technology, and media index returns (p-values at 10% level, 0.061; 0.082; 0.073). *(H3.5: The day-of-the-week effect does not exist during the COVID-19 period).* It may also be highlighted that this crisis period had been initially a setback for the entire country and the world in terms of production and providing of other services. Gradually, with the first phase of the lockdown ending the industrialists, businessmen, production houses, and other such stakeholders had mended their ways by the operations required during the pandemic crisis.

As OLS suffers from a few limitations that may not enable it to capture the entire volatile behavior of time series data, GARCH (1,1) may provide better estimates. The results obtained with the GARCH (1,1) model show that similar mixed anomalies have been found in a post-recession period as depicted by the OLS model. These results have been presented in Table A1. Wednesday and Thursday effects have been found for most of the index re-

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turns. Thus, the post-recession period has shown some signs of inefficiency for Indian markets but the same does not hold for all sectoral indices uniformly. In addition, the ARCH and GARCH terms have been found significant for all sectoral indices except oil and gas, pharma, and realty. Thus, it may be inferred that US recession spillover effects may be observed in all sectors except these three indices.

The scam period has also depicted similar results to that from the OLS model except that the anomaly for the realty index has not been confirmed by the GARCH (1,1) model. Information technology continued to show signs of anomalies as the Tuesday effect has been observed to be strong from the results shown by the GARCH (1,1) model. However, as discussed in the output of the OLS model, the scams period has not shown signs of an anomaly for most sectoral indices. The cases of scams in the markets may not appear immediately. Once they are declared public, their effect may stay for an inconsiderable time and then disappear from the markets. Hence, the impact may not lead to anomalies or inefficiency in the returns. However, volatility may be present due to the waves that emerge from the information of such scams. Thus, it has been found that ARCH and GARCH terms for scams have been significant for all indices except automobiles, infrastructure, media, oil and gas, realty, and services. This indicated that volatility existed and persisted for these indices during the post-scam period as shown in Table A1.

The OLS results showed anomalies present for automobiles, banking, commodities, consumer durables, financial services, media, oil and gas, pharmaceuticals, and services sectoral index returns. The GARCH (1,1) output has confirmed the results for all these index returns except for commodities during the new Government regime. It may be said that the changeover of the Government brought inefficiencies to a certain extent. However, the same may not hold for the entire Indian market as results have not been strong enough for all fourteen indices. The volatility from the change of the Government for returns of indices has been present for automobiles, commodities, consumer durables, energy, infrastructure, oil and gas, pharmaceuticals, realty, and services. This volatility persisted for a long run as both ARCH and GARCH terms for these indices have been found significant.

The results from OLS have been similar to the one reflected by the GARCH (1,1) model except for infrastructure, which has not been confirmed with this volatility model. However, FMCG has shown some weak anomalies with this model. There have been no signs of anomalies present for automobiles, media, pharmaceuticals, and infrastructure during the reform period. Thus, it may be said that post reforms there have been mixed signs of anomalies for a few sectoral indices. In addition, the ARCH and GARCH terms have been significant for automobiles, commodities, consumer durables, energy, infrastructure, oil and gas, pharmaceuticals, realty, and services (p-value < 0.05). Thus, it may be inferred that reform led to spillover effects for these index returns and persisted for a longer period.

The GARCH (1,1) model has captured some additional inefficiencies for automobiles, consumer durables, energy, fast-moving consumer goods, infrastructure, information technology, and services index return. Though the anomalies for energy and services have not been very strong, their presence has been depicted with this model. COVID-19 has enhanced volatility in returns (ARCH and GARCH terms being significant) for all the index returns (p-value < 0.05). Exceptions have been commodities and pharmaceuticals indices during this period.

The results from the exponential GARCH model have shown the presence of anomalies for automobiles, banking, consumer durables, financial services, fast-moving consumer goods, infrastructure, media, oil and gas, pharma, realty, and services. It may be inferred that the post-recession period has generated inefficiencies for these indices as per the EGARCH model *(H4.1: The leverage effect has not existed due to recession).* The volatility from the US recession, however. has been found for all indices except fast-moving consumer goods. The leverage effect, however, has been observed for all the index returns from this event except for the fast-moving consumer goods index (p-value: 0.737). Overall, the post-recession period has shown trading inefficiencies for different sectors present during the days of the week. As per the AIC and SIC crite-

ria, more reliable results may be drawn from the EGARCH model.

Consumer durables, financial services, and information technology have shown anomalies during the scams period. However, the anomalies replicated by consumer durables and financial services have not been strong enough as shown by information technology. Similar results have been depicted by GARCH (1,1) where the information technology index has shown trading inefficiencies during the scams period. Also, the ARCH and GARCH terms as per the EGARCH model have not been found significant for automobiles, banking, energy, infrastructure, media, oil and gas, pharmaceuticals, realty, and services *(H4.2: The leverage effect has not existed due to scams).* This means that scams have caused volatility in all index returns except these indices and continued for a longer run. The leverage effect however has been present in all index returns except for automobiles, commodities, infrastructure, information technology, media, oil and gas, pharmaceuticals, and realty (p-value < 0.05). However, as per the AIC and SIC criterion GARCH (1,1), results indicating anomalies for only the information technology index may be more reliable.

During the new Government phase, anomalies have been found for banking, commodities, consumer durables, financial services, media, oil and gas, pharmaceuticals, and services. These results varied from that of GARCH (1,1) output where all index returns possessed anomalies except commodities. The volatility has been present (ARCH and GARCH term significance) in all index returns except services, meaning that the new Government and its changed outlook had increased the volatility in the Indian markets. Also, the leverage effect of this event has been found significant for all sectoral index returns except the services sector (p-value: 0.807) *(H4.3: The leverage effect has not existed due to the change of the new Government).* Thus, the changeover of Government had increased the volatility in many of the sectors operative within Indian markets and their impact has been for the long run.

The reform period, as compared to the earlier events (recession, scams, and change of Government), has been the most active phase for anomalies to occur. This might be because due to reforms like demonetization, GST, and IBC, many of the companies had to change their style of operations. It emphasized how reporting has been done in the past and structural changes had taken place during this phase. As per the EGARCH model (Table A2), anomalies were present in banking, commodities, consumer durables, energy, financial services, infrastructure, information technology, media, oil and gas, realty, and services *(H4.4: The leverage effect has not existed due to reforms).* Therefore, most of the index returns have shown signs of trading inefficiencies and, hence, opportunities for abnormal returns. The volatility spillover from these reforms has been seen for all the index returns except for services. The leverage effect has been strong for all the index returns except infrastructure, information technology, and services sectors (p-value: 0.310; 0.688; 0.939; 0.625). Interestingly, the volatility spillover from this global information on COVID-19 has been present for all index returns except consumer durables. The leverage effect also existed for all indices except media (p-value: 0.208). The presence of anomalies has been significant for automobiles, banking, commodities, consumer durables, energy, fast-moving consumer goods, infrastructure, media, oil and gas, and realty *(H4.5: The leverage effect has not existed due to COVID-19).* The inference may be that COVID-19 has led to volatility in Indian markets, and the same persisted for a longer period. The second wave shall have its impact and the future period shall decide its magnitude. This global shock has also caused much more impact than any other event in the past few decades on the Indian market. P-values as shown in Table A2 have been found less than 0.05 indicating significant impact of COVID-19.

4. DISCUSSION

The results from the existing study during various events in diverse proportions have indicated similar inefficiencies in stock market indices with earlier studies (Gerry & Perez, 2018; Cengiz et al., 2017; Amarnani & Vaidya; 2014; Cinko & Avci, 2009; Squalli, 2006; Verma et al, 2022; Bhatia & Jain, 2021). Findings signaled varied day-of-the-week effects across fourteen sectoral indices. The IT sector, being a prominent contributor to the

http://dx.doi.org/10.21511/imfi.21(2).2024.03

Indian economy, reflected more anomalies during the scam period as it may have been affected the most across other indices. Results demonstrate a cautious approach to investment on account of anomalies. Anomalies may provide a very short-run period for investors to explore. Similar cautious entry and exit from the market surrounding the event time has been shown for investors in earlier studies (Kohers et al., 2004). The results of the study differ from a few existing studies where event-wise study had not been done. This difference in results may be due to the nature of events hand-picked in the present study. In addition, the reaction time of investors may also be different depending on the magnitude of the event (Sumathy & Das, 2022).

However, the results have been similar for the day-of-the-week effect found in similar studies (Cengiz et al., 2017; Sumathy & Das, 2022). Thus, event-wise differentiation may provide further hints to investors for timing their investment and derive benefits from exceptions to efficient market hypotheses as stated in the behavioral biases study by Lo (2005). Reforms have been the most active phase for all sectoral indices in terms of anomalies. Pathak (2013) indicated the impact of global events and media information on such anomalies. During the COVID period (Wong & Yuanto, 1999), which may be regarded as a negative global event, almost all sectors have shown anomalies and volatility.

The thematic indices may be further studied for similar events from the Indian economy and global shocks. The second phase of the pandemic crisis (Omicron) may also be studied in different sectors of the Indian economy. Anomalies may be tested with different innovative methodologies with similar events in Indian and global markets. In addition, bivariate relationships between sectoral indices may be further studied to diversify between stocks of various industries. Anomalies may further be examined, and sectoral diversification for developing buy-sell strategies may be tested with causal linkage methodologies.

CONCLUSION

The study has identified calendar anomalies and their effects on Indian sectoral indices. It focused on five significant events to test their impact and explore strategies for investors to plan their entry and exit from the markets to explore profitable opportunities. The study is especially crucial at a time when world economies are facing multiple crises.

As per the study, anomalies have existed in different magnitudes across the five sub-periods studied. The day-of-the-week effect has been found in mixed approaches for some sectors, while others have not shown any anomalies due to any of the events.

For instance, post-recession has shown anomalies for all sectoral indices except commodities, energy, and information technology. The scam period has shown anomalies for all sectoral indices except consumer durables, financial services, and information technology. The reform period has shown strong anomalies, baring a few sectors such as automobiles, fast-moving consumer goods, and pharmaceuticals. The pandemic crisis has revealed strong anomalies for all indices except financial services, information technology, pharmaceuticals, and services.

The study found that the volatility and its persistence varied across these five events for Indian sectoral index returns. As per the study's outcomes, investors can utilize timing techniques to plan their investments in different sectors of the Indian economy. The presence of anomalies across different days may be tapped for intra-day gains, and buy and sell strategies may be organized based on particular information, tracking the volatility and leverage effect. The study highlights the rare but possible opportunities in Indian markets for timing the investment of particular portfolios across the sectors incorporated in the study. Overall, this study can help investors plan their investments better and explore profitable opportunities in the Indian markets.

AUTHOR CONTRIBUTIONS

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Writing – original draft: Niyati Chaudhary.
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APPENDIX A

Table A1. GARCH results for selected periods

Days	Auto	Bank	Comm	Cons D	Energy	FS	FMCG	Infra	IT	Media	O&G	Pharma	Realty	Services
Post-Recession														
Mean Equation														
M	0.000 (0.725)	0.000 (0.868)	−0.001 (0.225)	0.002** (0.031)	−0.001 (0.293)	0.000 (0.810)	0.001 (0.306)	−0.001 (0.207)	0.000 (0.892)	−0.001 (0.476)	−0.001 (0.652)	0.000 (0.791)	−0.003 (0.303)	0.000 (0.846)
T	0.002 (0.135)	0.001 (0.500)	−0.001 (0.333)	0.001 (0.520)	−0.001 (0.378)	0.001 (0.531)	0.002** (0.020)	−0.001 (0.527)	0.001 (0.395)	−0.001 (0.599)	−0.001 (0.634)	0.002 (0.264)	−0.001 (0.870)	0.001 (0.469)
W	0.002* (0.051)	0.002** (0.046)	0.001 (0.379)	0.002** (0.013)	0.000 (0.913)	0.002** (0.032)	0.001 (0.486)	0.001 (0.352)	0.000 (0.988)	0.002** (0.022)	0.000 (0.989)	0.001 (0.568)	0.000 (0.882)	0.001 (0.237)
Th	0.001 (0.257)	0.002* (0.095)	0.001 (0.387)	0.002** (0.045)	0.001 (0.443)	0.002* (0.072)	0.002** (0.026)	0.000 (0.622)	0.001 (0.371)	0.000 (0.628)	0.000 (0.899)	0.000 (0.885)	0.000 (0.933)	0.001* (0.061)
F	0.000 (0.822)	0.001 (0.742)	0.000 (0.982)	0.000 (0.823)	0.001 (0.339)	0.001 (0.597)	0.000 (0.828)	0.000 (0.790)	−0.001 (0.737)	−0.001 (0.368)	0.002 (0.435)	0.001 (0.731)	−0.001 (0.868)	0.001 (0.577)
Variance Equation														
C	0.000*** (0.008)	0.000** (0.014)	0.000* (0.080)	0.000*** (0.006)	0.000* (0.065)	0.000*** (0.005)	0.000** (0.012)	0.000* (0.052)	0.000** (0.012)	0.000* (0.085)	0.000 (0.329)	0.000 (0.276)	0.000 (0.375)	0.000** (0.010)
A	0.059*** (0.000)	0.085*** (0.000)	0.062*** (0.002)	0.111*** (0.000)	0.069** (0.002)	0.078*** (0.000)	0.107*** (0.003)	0.071*** (0.000)	0.075*** (0.004)	0.060** (0.020)	0.150 (0.275)	0.150 (0.222)	0.150 (0.223)	0.077*** (0.000)
B	0.900*** (0.000)	0.875*** (0.000)	0.913*** (0.000)	0.821*** (0.000)	0.900*** (0.000)	0.878*** (0.000)	0.563*** (0.000)	0.910*** (0.000)	0.809*** (0.000)	0.845*** (0.000)	0.600 (0.109)	0.600* (0.071)	0.600 (0.138)	0.898*** (0.000)
Scams														
Mean Equation														
M	0.002 (0.270)	0.001 (0.536)	0.000 (0.911)	−0.001 (0.563)	0.000 (0.837)	0.002 (0.284)	−0.001 (0.756)	0.000 (0.873)	0.003 (0.141)	−0.001 (0.603)	0.000 (0.958)	0.001 (0.233)	−0.001 (0.837)	0.002 (0.174)
T	0.001 (0.628)	−0.002 (0.420)	−0.002 (0.287)	0.000 (0.756)	−0.001 (0.749)	−0.002 (0.276)	0.001 (0.315)	−0.003 (0.163)	0.006*** (0.000)	−0.002 (0.309)	0.000 (0.879)	0.001 (0.608)	−0.004 (0.256)	0.000 (0.764)
W	−0.001 (0.615)	0.000 (0.972)	0.002 (0.229)	0.002 (0.245)	0.002 (0.230)	0.000 (0.918)	0.002 (0.290)	0.003 (0.219)	0.001 (0.565)	0.001 (0.692)	0.002 (0.270)	0.001 (0.661)	0.003 (0.420)	0.002 (0.225)
Th	0.000 (0.751)	−0.002 (0.398)	0.000 (0.822)	0.001 (0.369)	0.000 (0.981)	−0.002 (0.294)	−0.002 (0.339)	0.000 (0.830)	0.001 (0.552)	0.001 (0.488)	0.000 (0.903)	0.000 (0.871)	−0.005 (0.114)	−0.001 (0.562)
F	0.000 (0.934)	0.000 (0.997)	−0.002 (0.284)	−0.002 (0.163)	−0.001 (0.524)	0.000 (0.875)	−0.001 (0.621)	−0.003 (0.162)	−0.001 (0.476)	0.000 (0.832)	−0.001 (0.489)	0.002 (0.378)	0.001 (0.798)	−0.001 (0.598)
Variance Equation														
C	0.000 (0.100)	0.000* (0.058)	0.000 (0.140)	0.000 (0.224)	0.000 (0.225)	0.000 (0.100)	0.000 (0.152)	0.000 (0.237)	0.000*** (0.000)	0.000** (0.019)	0.000 (0.311)	0.000 (0.150)	0.000 (0.128)	0.000* (0.087)
A	0.036 (0.257)	0.040** (0.024)	0.077** (0.030)	0.164*** (0.008)	0.064* (0.093)	0.042** (0.034)	0.163*** (0.005)	0.061 (0.118)	0.876*** (0.000)	0.339*** (0.008)	0.081 (0.102)	0.068* (0.057)	0.050 (0.232)	0.034 (0.159)
B	0.907*** (0.000)	0.953*** (0.000)	0.886*** (0.000)	0.817*** (0.000)	0.886*** (0.000)	0.949*** (0.000)	0.804*** (0.000)	0.905*** (0.000)	0.321*** (0.000)	0.205 (0.397)	0.849*** (0.000)	0.874*** (0.000)	0.878*** (0.000)	0.951*** (0.000)
New Government														
Mean Equation														
M	0.001 (0.279)	0.000 (0.860)	0.000 (0.853)	0.000 (0.984)	0.000 (0.722)	0.000 (0.738)	0.000 (0.880)	0.000 (0.942)	−0.001 (0.792)	0.001 (0.615)	0.000 (0.746)	0.001 (0.356)	−0.001 (0.671)	0.000 (0.810)
T	0.001 (0.245)	0.000 (0.774)	−0.001 (0.659)	0.002 (0.237)	−0.001 (0.452)	0.000 (0.953)	0.001 (0.647)	0.000 (0.738)	0.000 (0.932)	0.001 (0.681)	−0.001 (0.598)	0.000 (0.893)	−0.001 (0.740)	0.000 (0.999)
W	0.002** (0.013)	0.003* (0.066)	0.002 (0.168)	0.002* (0.085)	0.001 (0.360)	0.003** (0.036)	0.001 (0.214)	0.001 (0.393)	0.001 (0.786)	0.002* (0.092)	0.001 (0.254)	0.002 (0.170)	−0.001 (0.728)	0.002** (0.042)
Th	0.001 (0.364)	0.001 (0.408)	−0.001 (0.398)	0.001 (0.626)	−0.001 (0.387)	0.001 (0.500)	0.000 (0.790)	0.000 (0.810)	0.000 (0.859)	0.001 (0.579)	−0.001 (0.591)	0.003** (0.022)	0.003 (0.128)	0.000 (0.610)
F	0.000 (0.717)	0.001 (0.414)	0.001 (0.369)	0.001 (0.180)	0.001 (0.381)	0.001 (0.506)	0.000 (0.765)	0.000 (0.825)	0.001 (0.645)	−0.001 (0.614)	0.002* (0.088)	−0.001 (0.208)	0.000 (0.987)	0.001 (0.181)
Variance Equation														
C	0.000*** (0.003)	0.000 (0.332)	0.000* (0.085)	0.000** (0.015)	0.000** (0.044)	0.000 (0.230)	0.000 (0.451)	0.000** (0.033)	0.000 (0.339)	0.000 (0.385)	0.000** (0.042)	0.000*** (0.000)	0.000*** (0.000)	0.000* (0.096)
A	0.229*** (0.000)	0.033 (0.167)	0.057*** (0.007)	0.069*** (0.005)	0.058*** (0.001)	0.031 (0.109)	−0.020 (0.129)	0.083*** (0.000)	0.150 (0.216)	0.026 (0.200)	0.082*** (0.001)	−0.028*** (0.000)	0.203*** (0.000)	0.044** (0.025)
B	0.372** (0.021)	0.835*** (0.000)	0.839*** (0.000)	0.788*** (0.000)	0.860*** (0.000)	0.869*** (0.000)	0.759** (0.025)	0.749*** (0.000)	0.600 (0.102)	0.825*** (0.000)	0.817*** (0.000)	1.019*** (0.000)	0.481*** (0.000)	0.861*** (0.000)

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Table A1 (cont.). GARCH results for selected periods

Days	Auto	Bank	Comm	Cons D	Energy	FS	FMCG	Infra	IT	Media	O&G	Pharma	Realty	Services
Reforms														
Mean Equation														
M	0.000 (0.902)	0.002*** (0.003)	0.000 (0.573)	0.001 (0.181)	0.001 (0.468)	0.003*** (0.000)	0.001* (0.072)	0.000 (0.987)	0.002** (0.042)	−0.001 (0.577)	0.001 (0.540)	0.000 (0.761)	0.000 (0.861)	0.002*** (0.001)
T	0.001 (0.253)	0.001** (0.042)	0.002** (0.021)	0.002** (0.012)	0.002*** (0.006)	0.001* (0.065)	0.000 (0.584)	0.002 (0.305)	0.000 (0.703)	0.001 (0.364)	0.002** (0.022)	0.000 (0.648)	0.003** (0.023)	0.001** (0.022)
W	0.000 (0.526)	0.001 (0.218)	0.001 (0.298)	0.001* (0.079)	0.000 (0.573)	0.001 (0.211)	0.001 (0.253)	−0.001 (0.498)	0.000 (0.602)	−0.001 (0.605)	0.001 (0.460)	−0.001 (0.166)	0.000 (0.972)	0.001 (0.244)
Th	0.000 (0.677)	0.000 (0.648)	0.000 (0.665)	0.001 (0.435)	0.000 (0.935)	0.000 (0.760)	0.000 (0.921)	0.000 (0.926)	0.000 (0.701)	0.000 (0.635)	0.000 (0.864)	0.000 (0.741)	−0.001 (0.407)	0.000 (0.655)
F	0.001 (0.297)	0.001 (0.395)	0.000 (0.710)	0.000 (0.946)	0.001 (0.135)	0.001 (0.286)	0.001 (0.240)	0.000 (0.901)	0.000 (0.982)	0.000 (0.887)	0.001 (0.227)	0.000 (0.978)	0.002 (0.114)	0.001 (0.399)
Variance Equation														
C	0.000*** (0.000)	0.000*** (0.003)	0.000*** (0.009)	0.000*** (0.004)	0.000*** (0.000)	0.000*** (0.001)	0.000*** (0.000)	0.000 (0.183)	0.000*** (0.008)	0.000*** (0.003)	0.000*** (0.000)	0.000 (0.063)	0.000** (0.016)	0.000** (0.012)
A	0.144*** (0.000)	0.086*** (0.000)	0.073*** (0.000)	0.092*** (0.000)	0.103*** (0.000)	0.087*** (0.000)	0.212*** (0.000)	0.150 (0.205)	0.034*** (0.002)	0.029*** (0.000)	0.145*** (0.000)	0.022 (0.035)	0.077*** (0.005)	0.088*** (0.000)
B	0.823*** (0.000)	0.867*** (0.000)	0.866*** (0.000)	0.598*** (0.000)	0.723*** (0.000)	0.854*** (0.000)	0.335*** (0.001)	0.600** (0.026)	0.912*** (0.000)	0.967*** (0.000)	0.434*** (0.000)	0.949 (0.000)	0.728*** (0.000)	0.859*** (0.000)
COVID-19														
Mean Equation														
M	−0.002 (0.408)	−0.003 (0.285)	−0.003 (0.692)	0.002 (0.136)	−0.003 (0.175)	−0.002 (0.398)	0.000 (0.936)	−0.001 (0.435)	0.003 (0.113)	−0.004 (0.139)	0.000 (0.832)	−0.001 (0.561)	0.000 (0.995)	−0.001 (0.505)
T	0.007*** (0.007)	0.003 (0.324)	0.001 (0.890)	0.004** (0.037)	0.003* (0.064)	0.004 (0.204)	0.003** (0.020)	0.002 (0.202)	0.004** (0.028)	0.003 (0.392)	0.003 (0.314)	0.003 (0.209)	0.005 (0.130)	0.003 (0.187)
W	−0.002 (0.152)	−0.002 (0.538)	0.000 (0.991)	−0.002 (0.133)	−0.001 (0.743)	−0.001 (0.660)	−0.001 (0.576)	0.001 (0.712)	0.003 (0.235)	0.000 (0.894)	−0.002 (0.229)	0.001 (0.730)	−0.001 (0.838)	0.000 (0.979)
Th	0.001 (0.662)	0.001 (0.608)	0.000 (0.974)	0.005** (0.015)	0.001 (0.622)	0.002 (0.293)	−0.002 (0.310)	−0.001 (0.724)	−0.001 (0.748)	0.000 (0.901)	0.001 (0.718)	0.000 (0.825)	0.001 (0.872)	0.001 (0.478)
F	0.003 (0.132)	0.002 (0.290)	0.003 (0.657)	0.000 (0.808)	0.003 (0.219)	0.002 (0.293)	0.001 (0.499)	0.005** (0.011)	0.001 (0.423)	0.000 (0.910)	0.000 (0.906)	0.000 (0.961)	0.002 (0.449)	0.003* (0.087)
Variance Equation														
C	0.000** (0.048)	0.000* (0.063)	0.000 (0.220)	0.000* (0.085)	0.000** (0.025)	0.000** (0.038)	0.000** (0.011)	0.000*** (0.006)	0.000** (0.041)	0.000* (0.089)	0.000*** (0.003)	0.000 (0.137)	0.000** (0.010)	0.000** (0.044)
A	0.146*** (0.000)	0.147*** (0.000)	0.150 (0.161)	0.146*** (0.000)	0.156*** (0.000)	0.143*** (0.000)	0.176*** (0.000)	0.300*** (0.000)	0.264*** (0.000)	0.136*** (0.000)	0.161*** (0.000)	0.127 (0.000)	0.072*** (0.000)	0.158*** (0.000)
B	0.832*** (0.000)	0.851*** (0.000)	0.600** (0.048)	0.853*** (0.000)	0.803*** (0.000)	0.850*** (0.000)	0.803*** (0.000)	0.613*** (0.000)	0.745*** (0.000)	0.828*** (0.000)	0.768*** (0.000)	0.874 (0.000)	0.888*** (0.000)	0.824*** (0.000)

Notes: *** denotes the results are significant at the 1% significance level, ** denotes the 5% significance level, and * denotes the 10% significance level.

Table A2. EGARCH results for selected periods

Days	Auto	Bank	Comm	Cons D	Energy	FS	FMCG	Infra	IT	Media	O&G	Pharma	Realty	Services
Post-Recession														
Mean Equation														
M	−0.001 (0.166)	0.000 (0.711)	−0.001 (0.117)	0.002* (0.085)	−0.001 (0.134)	0.000 (0.674)	0.001 (0.386)	−0.002* (0.085)	0.000 (0.852)	−0.001 (0.474)	−0.001 (0.239)	0.000 (0.736)	0.000** (0.030)	−0.001 (0.543)
T	0.001 (0.210)	0.000 (0.856)	−0.001 (0.235)	0.000 (0.697)	−0.001 (0.181)	0.000 (0.919)	0.001* (0.040)	−0.001 (0.260)	0.000 (0.684)	−0.001 (0.581)	−0.001* (0.093)	0.002** (0.012)	−0.001 (0.695)	0.000 (0.774)
W	0.002* (0.063)	0.002* (0.087)	0.000 (0.679)	0.002** (0.013)	0.000 (0.961)	0.002* (0.059)	0.001 (0.460)	0.000 (0.759)	0.000 (0.821)	0.002** (0.033)	0.000 (0.889)	0.001* (0.063)	0.001 (0.351)	0.001 (0.530)
Th	0.001 (0.290)	0.001 (0.197)	0.001 (0.468)	0.002** (0.025)	0.000 (0.563)	0.002 (0.126)	0.002** (0.023)	0.000 (0.815)	0.001 (0.401)	0.001 (0.590)	0.000 (0.964)	0.000 (0.720)	0.001 (0.749)	0.001* (0.089)
F	−0.001 (0.586)	0.000 (0.803)	0.000 (0.632)	0.000 (0.860)	0.001 (0.390)	0.000 (0.828)	0.000 (0.811)	0.000 (0.754)	−0.001 (0.717)	−0.001 (0.441)	0.002 (0.118)	0.000 (0.712)	0.000 (0.963)	0.000 (0.832)
Variance Equation														
C	−0.522*** (0.000)	−0.650*** (0.000)	−0.322*** (0.005)	−1.173*** (0.000)	−0.470*** (0.007)	−0.732*** (0.000)	−9.223 (0.796)	−0.271*** (0.002)	−1.331*** (0.001)	−0.902* (0.090)	−0.639*** (0.004)	−0.806** (0.019)	−0.987** (0.050)	−0.612*** (0.000)
A	0.092*** (0.001)	0.132*** (0.000)	0.105*** (0.004)	0.251*** (0.000)	0.135*** (0.001)	0.097*** (0.008)	0.010 (0.838)	0.110*** (0.001)	0.151*** (0.001)	0.112** (0.012)	0.152*** (0.002)	0.053 (0.163)	0.157*** (0.002)	0.127*** (0.003)
Γ	−0.105*** (0.000)	−0.097*** (0.000)	−0.060*** (0.000)	−0.067** (0.014)	−0.073*** (0.005)	−0.110*** (0.000)	0.010 (0.737)	−0.052*** (0.000)	−0.116*** (0.000)	−0.018 (0.443)	−0.094*** (0.001)	−0.076*** (0.004)	−0.045** (0.037)	−0.100*** (0.000)
B	0.949*** (0.000)	0.935*** (0.000)	0.973*** (0.000)	0.888*** (0.000)	0.959*** (0.000)	0.923*** (0.000)	0.010 (0.998)	0.979*** (0.000)	0.859*** (0.000)	0.907*** (0.000)	0.943*** (0.000)	0.920*** (0.000)	0.888*** (0.000)	0.943*** (0.000)
Scams														
Mean Equation														
M	0.002 (0.368)	0.000 (0.805)	0.000 (0.754)	−0.001 (0.570)	−0.001 (0.665)	0.004* (0.070)	0.000 (0.977)	−0.001 (0.585)	0.003 (0.169)	0.000 (0.997)	0.000 (0.967)	0.001 (0.315)	0.001 (0.875)	0.000 (0.990)
T	0.001 (0.578)	−0.002 (0.341)	−0.001 (0.537)	0.000 (0.751)	−0.001 (0.697)	−0.002 (0.524)	0.001 (0.348)	−0.002 (0.433)	0.005*** (0.000)	−0.001 (0.640)	0.000 (0.861)	0.001 (0.625)	−0.003 (0.270)	−0.001 (0.646)
W	0.000 (0.995)	0.000 (0.922)	0.003 (0.184)	0.002 (0.366)	0.002 (0.453)	0.000 (0.838)	0.001 (0.406)	0.003 (0.304)	0.001 (0.602)	0.001 (0.511)	0.002 (0.322)	0.001 (0.472)	0.003 (0.467)	0.000 (0.865)
Th	−0.001 (0.628)	−0.002 (0.418)	0.000 (0.769)	0.001 (0.505)	0.000 (0.951)	−0.004 (0.105)	−0.001 (0.387)	0.000 (0.911)	0.002 (0.526)	0.002 (0.274)	0.000 (0.995)	0.000 (0.887)	−0.005 (0.112)	−0.001 (0.264)
F	0.000 (0.897)	0.000 (0.836)	−0.002 (0.174)	−0.003* (0.058)	−0.002 (0.218)	−0.003 (0.130)	0.000 (0.950)	−0.002 (0.303)	−0.001 (0.544)	0.001 (0.724)	−0.003 (0.125)	0.002 (0.201)	0.001 (0.839)	−0.002 (0.205)
Variance Equation														
C	−12.914*** (0.008)	−0.037 (0.321)	−14.441*** (0.000)	−0.497** (0.029)	−9.191*** (0.008)	−13.582*** (0.000)	−0.645* (0.050)	−12.624*** (0.000)	−3.233*** (0.000)	−5.894** (0.017)	−11.852*** (0.000)	−9.255 (0.345)	−0.941** (0.028)	−0.108** (0.035)
A	−0.131 (0.232)	−0.064 (0.148)	0.281** (0.011)	0.232** (0.020)	0.289** (0.027)	−0.250*** (0.004)	0.291*** (0.004)	0.088 (0.441)	0.687*** (0.000)	0.547*** (0.003)	0.373*** (0.005)	0.010 (0.925)	0.144 (0.116)	−0.079 (0.247)
Γ	−0.002 (0.982)	−0.087*** (0.001)	0.111* (0.070)	−0.120** (0.023)	0.148* (0.096)	0.145*** (0.009)	0.037** (0.399)	0.152 (0.129)	0.116 (0.111)	0.083 (0.475)	0.029 (0.701)	0.010 (0.880)	−0.050 (0.313)	−0.135*** (0.004)
B	−0.484 (0.385)	0.988*** (0.000)	−0.617*** (0.000)	0.964*** (0.000)	−0.040 (0.920)	−0.685*** (0.000)	0.952*** (0.000)	−0.503 (0.181)	0.676*** (0.000)	0.361 (0.201)	−0.344 (0.329)	0.010 (0.992)	0.889*** (0.000)	0.980*** (0.000)
New Government														
Mean Equation														
M	0.001 (0.442)	−0.001 (0.569)	0.000 (0.840)	0.000 (0.618)	0.000 (0.683)	−0.001 (0.572)	0.000 (0.858)	0.000 (0.747)	−0.001 (0.506)	0.001 (0.671)	0.000 (0.726)	0.000 (0.900)	0.000 (0.882)	0.000 (0.995)
T	0.001 (0.304)	−0.001 (0.435)	−0.001 (0.487)	0.001 (0.341)	−0.001 (0.254)	−0.001 (0.522)	0.001 (0.493)	0.000 (0.789)	0.000 (0.997)	0.000 (0.836)	−0.001 (0.297)	0.001 (0.479)	−0.002 (0.475)	0.000 (0.817)
W	0.002 (0.113)	0.002 (0.107)	0.002 (0.154)	0.002** (0.042)	0.001 (0.305)	0.002* (0.083)	0.001 (0.164)	0.001 (0.412)	0.000 (0.697)	0.002** (0.048)	0.001 (0.281)	0.002 (0.187)	−0.001 (0.729)	0.002** (0.048)
Th	0.001 (0.368)	0.001 (0.271)	−0.001 (0.517)	0.001 (0.656)	−0.001 (0.629)	0.001 (0.320)	0.000 (0.902)	0.000 (0.828)	0.000 (0.809)	0.000 (0.746)	0.000 (0.721)	0.002* (0.051)	0.002 (0.144)	0.000 (0.617)
F	0.000 (0.792)	0.002** (0.045)	0.002* (0.087)	0.001 (0.479)	0.001 (0.335)	0.002* (0.075)	0.000 (0.879)	0.001 (0.273)	0.001 (0.134)	−0.001 (0.416)	0.002** (0.044)	−0.001 (0.238)	0.000 (0.813)	0.001 (0.430)
Variance Equation														
C	−1.596*** (0.001)	−0.943** (0.021)	−0.974** (0.047)	−10.027*** (0.001)	−0.689** (0.035)	−0.868** (0.010)	−13.576*** (0.000)	−2.409** (0.010)	−3.286*** (0.009)	−1.874*** (0.005)	−1.002** (0.030)	−0.237*** (0.006)	−3.122*** (0.000)	−9.149 (0.790)
A	0.110* (0.062)	0.023 (0.554)	0.134*** (0.001)	−0.206*** (0.003)	0.124*** (0.000)	0.032 (0.417)	−0.133** (0.035)	0.251*** (0.000)	0.082 (0.249)	−0.018 (0.728)	0.168*** (0.000)	0.038* (0.052)	0.382*** (0.000)	0.010 (0.879)
Γ	−0.191*** (0.000)	−0.092*** (0.000)	−0.055*** (0.004)	−0.104* (0.072)	−0.029** (0.034)	−0.103*** (0.000)	−0.160*** (0.000)	−0.030 (0.214)	−0.149*** (0.000)	−0.154*** (0.000)	−0.047** (0.014)	0.025** (0.038)	−0.084** (0.032)	0.010 (0.807)
B	0.831*** (0.000)	0.892*** (0.000)	0.901*** (0.000)	−0.155 (0.632)	0.932*** (0.000)	0.903*** (0.000)	−0.507** (0.016)	0.742*** (0.000)	0.639*** (0.000)	0.779*** (0.000)	0.899*** (0.000)	0.976*** (0.000)	0.629*** (0.000)	0.010 (0.998)

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Table A2 (cont.). EGARCH results for selected periods

Days	Auto	Bank	Comm	Cons D	Energy	FS	FMCG	Infra	IT	Media	O&G	Pharma	Realty	Services
Reforms														
Mean Equation														
M	0.000 (0.874)	0.002** (0.017)	−0.001 (0.115)	0.001 (0.458)	0.000 (0.925)	0.002** (0.011)	0.001 (0.141)	0.000 (0.951)	0.001* (0.096)	−0.002** (0.014)	0.000 (0.988)	0.000 (0.842)	−0.001 (0.572)	0.002*** (0.006)
T	0.001 (0.152)	0.001 (0.121)	0.002** (0.031)	0.002** (0.015)	0.002*** (0.005)	0.001 (0.192)	0.000 (0.834)	0.002** (0.024)	0.000 (0.657)	0.001 (0.353)	0.002** (0.011)	0.000 (0.629)	0.003** (0.037)	0.001** (0.043)
W	0.000 (0.553)	0.000 (0.592)	0.000 (0.662)	0.001* (0.050)	0.000 (0.814)	0.000 (0.620)	0.001 (0.381)	−0.001 (0.145)	0.000 (0.790)	0.000 (0.735)	0.000 (0.741)	−0.001 (0.231)	0.000 (0.700)	0.000 (0.864)
Th	−0.001 (0.267)	0.000 (0.751)	0.000 (0.668)	0.000 (0.548)	0.000 (0.849)	0.000 (0.682)	0.000 (0.949)	0.000 (0.843)	0.000 (0.922)	0.002* (0.067)	0.000 (0.944)	0.000 (0.793)	−0.001 (0.689)	0.000 (0.976)
F	0.000 (0.953)	0.000 (0.691)	0.000 (0.849)	0.000 (0.965)	0.001 (0.147)	0.000 (0.566)	0.001 (0.381)	0.000 (0.980)	0.000 (0.890)	−0.001 (0.391)	0.001 (0.262)	0.000 (0.861)	0.002 (0.119)	0.000 (0.888)
Variance Equation														
C	−11.564*** (0.000)	−0.420*** (0.000)	−1.002*** (0.000)	−1.368*** (0.000)	−1.292*** (0.000)	−0.385*** (0.001)	−5.105*** (0.000)	−10.644*** (0.006)	−7.855*** (0.002)	−0.393*** (0.000)	−1.572*** (0.000)	−1.254*** (0.002)	−1.472*** (0.000)	−9.670 (0.657)
A	0.514*** (0.000)	0.125*** (0.000)	0.109*** (0.001)	0.150*** (0.000)	0.130*** (0.000)	0.107*** (0.000)	0.407*** (0.000)	0.176** (0.015)	0.173** (0.014)	0.092*** (0.000)	0.153*** (0.000)	0.117** (0.017)	0.102** (0.014)	0.010 (0.767)
Г	−0.039 (0.310)	−0.070*** (0.000)	−0.159*** (0.000)	−0.113*** (0.000)	−0.136*** (0.000)	−0.079*** (0.000)	−0.078*** (0.004)	0.017 (0.688)	−0.003 (0.939)	−0.139*** (0.000)	−0.167*** (0.000)	−0.121*** (0.000)	−0.121*** (0.000)	0.010 (0.625)
B	−0.258*** (0.003)	0.965*** (0.000)	0.900*** (0.000)	0.861*** (0.000)	0.869*** (0.000)	0.967*** (0.000)	0.488*** (0.000)	−0.139 (0.741)	0.155 (0.578)	0.962*** (0.000)	0.839*** (0.000)	0.869*** (0.000)	0.830*** (0.000)	0.010 (0.996)
COVID-19														
Mean Equation														
M	−0.004*** (0.005)	−0.004* (0.054)	−0.006*** (0.000)	0.002 (0.321)	−0.006*** (0.000)	−0.003 (0.125)	−0.001 (0.548)	−0.006*** (0.000)	0.002 (0.366)	−0.004* (0.073)	−0.002* (0.083)	−0.003 (0.191)	−0.004* (0.063)	−0.002 (0.154)
T	0.005*** (0.005)	0.001 (0.728)	0.002 (0.220)	0.003 (0.132)	0.001 (0.384)	0.002 (0.295)	0.002* (0.093)	0.001 (0.238)	0.003 (0.111)	0.004 (0.268)	0.001 (0.719)	0.003 (0.283)	0.003 (0.251)	0.001 (0.497)
W	−0.002 (0.361)	−0.001 (0.631)	−0.001 (0.596)	−0.003 (0.100)	−0.002 (0.255)	0.000 (0.871)	−0.001 (0.424)	0.000 (0.889)	0.003 (0.174)	−0.001 (0.762)	−0.004** (0.020)	−0.001 (0.584)	0.000 (0.966)	0.000 (0.989)
Th	0.002 (0.528)	0.002 (0.523)	0.002 (0.281)	0.004** (0.041)	0.000 (0.914)	0.002 (0.329)	−0.001 (0.334)	−0.001 (0.501)	−0.001 (0.636)	0.000 (0.955)	−0.001 (0.564)	0.001 (0.517)	−0.003 (0.429)	0.001 (0.454)
F	−0.003* (0.069)	0.001 (0.517)	0.002 (0.181)	−0.001 (0.670)	0.000 (0.919)	0.003 (0.191)	0.000 (0.933)	0.001 (0.479)	0.000 (0.949)	0.000 (0.971)	−0.006*** (0.000)	0.001 (0.803)	0.001 (0.669)	0.002 (0.243)
Variance Equation														
C	−0.091** (0.021)	−0.325*** (0.002)	−0.112** (0.010)	−0.318*** (0.000)	−0.082** (0.018)	−0.340*** (0.002)	−0.326*** (0.001)	−0.106*** (0.002)	−0.657*** (0.006)	−0.579** (0.027)	−0.077*** (0.004)	−0.340*** (0.002)	−0.191*** (0.000)	−0.317*** (0.001)
A	−0.096* (0.069)	0.192*** (0.004)	−0.091* (0.072)	0.069 (0.246)	−0.072* (0.095)	0.161*** (0.008)	0.157*** (0.006)	−0.083*** (0.048)	0.351*** (0.000)	0.289*** (0.000)	−0.063* (0.054)	0.186*** (0.000)	−0.141*** (0.000)	0.140** (0.022)
Г	−0.182*** (0.000)	−0.126*** (0.000)	−0.204*** (0.000)	−0.163*** (0.000)	−0.199*** (0.000)	−0.140*** (0.000)	−0.179*** (0.000)	−0.234*** (0.000)	−0.144*** (0.001)	−0.048 (0.208)	−0.192*** (0.000)	−0.093** (0.011)	−0.142*** (0.000)	−0.163*** (0.000)
B	0.978*** (0.000)	0.976*** (0.000)	0.978*** (0.000)	0.969*** (0.000)	0.981*** (0.000)	0.972*** (0.000)	0.977*** (0.000)	0.978*** (0.000)	0.951*** (0.000)	0.954*** (0.000)	0.982*** (0.000)	0.974*** (0.000)	0.961*** (0.000)	0.975*** (0.000)

Notes: *** denotes the results are significant at the 1% significance level, ** denotes the 5% significance level, and * denotes the 10% significance level.