Original Article

Effect of Russia-Ukraine Conflict on Sectoral Indices; A Pragmatic Investigation of Indian Stock Market

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Abstract - Current research aims to examine the implications of the fresh Russian invasion of Ukraine on the sectoral indices of the Indian stock exchange based on the daily data from January 1, 2021, to June 30, 2023. The result of the t-test signifies that there is no substantial impact on the sectoral indices. Alternatively, the consequence further reveals that the emergence of the Russia-Ukraine war has created some level of uncertainty among the energy, oil and gas, real estate, IT, and FMCG sectors of the Indian stock exchange, as the return volatility of these indices is significantly different during the pre-and post-conflict periods. Finally, the regression analysis results reveal that the news about the current crisis significantly negatively impacts the auto and banking indices. At the same time, other sectors seem to be unaffected. The policy implications of the present article suggest that the recent Russia-Ukraine crisis leads to uncertainty in India's energy, oil and gas, real estate, IT, and FMCG sectors; hence, investors in these sectors should be cautious while investing during such a crisis. On the other hand, investors do not need to panic due to such an event, which seriously impacts the average return of sectoral indices.

Keywords - Sectoral indices, Russian ukraine crisis, Indian stock exchange, Volatility.

1. Introduction

The roots of the Russian-Ukraine war began in 2013 when Ukraine was about to make an agreement of association with the Nordic nations, especially the European Union, which would have strengthened its economic and political ties with Europe. However, this move was met with strong opposition from Russia, who realised it threatened its regional influence. In retaliation, Russia pressured Ukraine to reject the agreement and instead join a Russian-led customs union. To add more pressure, Russia also annexed Crimea, a move that was widely condemned by the international community. Since then, the conflict has escalated into a full-scale war, with both sides engaging in military action and shelling of civilian areas. The battle has caused the casualties of thousands of people and the migration of millions number of public. Since the war began in Ukraine, the Russian Army has already lost more than 178,820 soldiers and spent more than $17,505,120,405 in their ongoing war effort, while Ukraine has suffered 124,500-131,000 total casualties[1](Reuters). The battle has also had extensive geopolitical consequences, with Russia's retaliation leading to amplified tensions with the Western countries, the imposition of economic sanctions on Russia, and worldwide inflation in oil prices and certain food grains such as sunflower and maize. In Economic terms, this war has had severe ramifications for the warring countries and the rest of the world. As a result of this invasion, the United States of America imposed heavy economic sanctions on Russia, which have had an acute effect on the prices of various commodities such as oil and natural gas: Since the start of the war, the price of these two commodities has increased by over 50%[2](New York Times). This war has also caused multiple supply chain disruptions, which in turn have caused almost global inflation; The United States is currently going through a 40-year high of inflation of prices[3](Economic Times). This war has resulted in sharp and major stock price swings, making stocks highly risky. This war has caused global economic growth to only 3.1%, and experts have predicted it to slow further down to 2.2%[4]

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[1]Reuters: https://www.reuters.com/world/europe/ukraine-war-already-with-up-354000-casualties-likely-drag-us-documents-2023-04-12/

[2]New York Times
[3]Economic Times
[4]OECD: https://www.oecd.org/newsroom/russia-s-war-of-aggression-against-ukraine-continues-to-create-serious-headwinds-for-global-economy.htm

(OECD). In the stock market sector, we have seen tumultuous price swings. According to a sample taken in a study by the SEP, the aggregate stock market index fell by 1.53% for the average country due to linkages with Russia after the onset of the war (Economics Observatory)[5]. The movement of commodity prices, bonds and the stock markets to oil and the euro-dollar exchange rate climbed due to the 24 February Russian invasion of Ukraine, causing uncertainty in global markets (Reuters)[6]. This war significantly impacted Europe, where economic growth stalled to just 0.3%. In India, the economic impact was hard to judge as the GDP growth increased by 13.5% in the first quarter of financial year 2022-23. However, it slowed to 6.3%, showing the far-reaching impact of the war on the Indian economy[7](Times of India). The biggest effect of the war was on the Indian economy's inflation. Due to the supply chain disruptions caused by the war, India's retail inflation rose to an 8-year high of 7.8% in April 2022 and has continued to be irregular, with spikes in January 2023. Another Economic impact has been the slowing down of Indian exports in the global trade market, as, since 2022, Indian export growth has been stalling and becoming negative. It can be inferred that most of the research material linked to the implication of the Russian-Ukraine crisis on the stock market appears to be skewed towards the Western economies, and there have been minor reports from the Indian perspective. Additionally, the conclusion of the impact of the war by the studies related to the war's impact on the stock market seems inconclusive in terms of their research conclusion. [6] analyzes the geopolitical impact on the Asian stock markets. The author investigated six major Asian stock markets to understand their volatility and fluctuations. The author found that the ongoing Ukrainian crisis hugely impacted only one out of the six countries. [1], investigates the impact of the Ukrainian conflict on the European Stock Markets. They aim to verify the link between political instability and the negative growth of the stock market by collecting data from "STOXX Europe 600". They analyzed its trends to conclude. They concluded that European investors took the war seriously, and stock prices fell rapidly on and around the event day. [2], aims to determine the Ukraine crisis's impact on crude oil prices and stock returns. The author uses data from major stock markets worldwide and analyses their daily data and closing prices. The paper concluded that the crude oil and stock markets are significantly correlated; the Ukraine crisis also

affected the Indonesian market the most compared to other markets. [3], examine volatility spillover during the Russia-Ukraine conflict, revealing varied effects on international markets. They have researched data from 3 major markets (US, Europe and China) and researched them before and after the conflict. Their analysis indicates increased connectivity and volatility spillovers during the Russia-Ukraine war, with the US market having the highest spread. [4], aims to assess the financial effects of the Russia-Ukraine conflict on stock markets, risk management, and policy actions. Their data includes Caldara and Iacoviell's geopolitical risk index and E7 and G7 stock market closing prices from 24-Feb-2022 to 25-Jul-2022. Their findings show that the effect is market-specific in countries. [7], examine the correlation between clean and dirty energy indices, investment risk, and the efficacy of renewable energy hedging. The author considers Asia, Europe, and the USA to confirm volatility spillovers between energy and stock indices, resulting in 12 variables across stock markets, renewable energy, crude oil, and gas. The research highlights the US stock central role. It reveals changes in volatility transmission patterns over time, emphasizing the integration of emerging market stocks with developed markets and their vulnerability to spillover during crises. [5], offers an initial investigation into the impacts of the Russia-Ukraine war on stock markets by examining the financial market effects of wars. All countries in the MSCI market classification are included in their analysis. The authors observe that while global stock markets generally experience negative cumulative effects, the Asian, Middle Eastern & African, and Pan-American markets deviate from this pattern. [13], ponders to examine how the military conflict impacts energy sector firms' profitability by analyzing stock returns. They analyze data from an international stock market that includes all firms in the economic sector of energy, which has over 1630 firms. Their findings revealed that energy firms witnessed positive and abnormal returns surrounding the event. Additionally, analysis suggests that market participants anticipate profitability in conventional energy sectors, like uranium technology, in the future. [12], endeavours to scrutinize the financial impact of Russia's invasion by investigating if firms from 95 countries encounter substantial changes in abnormal returns. They analyze the daily stock prices of the countries to derive data. Their findings show that the oil and gas firms experience a positive return, whereas the finance and services sector faces a negative abnormal return. [11], investigates the impact of the Ukraine crisis on food inflation in India. The study found that the current crisis significantly impacted food inflation. After reviewing the ample literature on the impact of the Russian-Ukraine crisis on the stock market, most of the investigation on the related theme is associated with the developed and Western economies. It is also evident that those studies that focus on the impact of the Ukraine crisis on Asian stock exchanges directly investigate the stock market performance. However,

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[5] Economic Observatory:
https://www.economicsobservatory.com/how-has-the-russian-invasion-of-ukraine-affected-global-financial-markets

[6] Reuters: https://www.reuters.com/markets/europe/how-ukraine-russia-war-rattled-global-financial-markets-2022-08-24/

[7] Times Of India:
https://timesofindia.indiatimes.com/business/india-business/one-year-of-russia-ukraine-war-how-the-conflict-impacted-indian-economy/articleshow/98214568.cms?from=mdr

none of the investigations quest for impact on sectoral indices. Hence, the current study strives to contribute to the above literature in two ways. First of all, we endeavour to examine the current Russian-Ukraine crisis, specifically the Indian stock market, which the previous studies have not done as they have investigated this issue with comprehensive time series data with multiple variables. Secondly, we also contribute to the above theme by investigating the sectoral indices-wise impact of the current crisis. We are hopeful that the outcome of our current research will be helpful for effective policy initiatives.

We aim to reach a beneficial conclusion in this field and act as a research that can be used as a reference in the future from an Indian perspective. The remaining paper is structured as follows. A literature discussion is exhibited in the section, and a team presents the data and methodology. On the other hand, section four includes the result analysis. Finally, the department deals with the conclusion of the current investigation.

2. Data and Methods
2.1. Data
The principal aim of the ongoing pragmatic examination is to divulge the impact of the Russian-Ukraine crisis on the sectoral indices of the Indian stock market. Henceforth, the present investigation depends on National Stock Exchange (NSE) daily time-series data. We have meticulously gathered data covering the entire period that accurately depicts the invasion's initial start to the current time. Our study encompasses daily data from January 2021 to June 2023, focusing on eight pivotal sectoral indices within the Indian stock market. These indices comprise AUTO, BANK, FMCG, ENERGY, IT, METAL, OIL and GAS, and REALTY. All the pertinent data variables are readily accessible through the National Stock Exchange database, conveniently available via online platforms, https://www1.nseindia.com/products/content/equities/indices/historical_index_data.htm.

On the other hand, to calibrate the Russia-Ukraine event, we have considered the Google broadcast exploration sizes associated with the Russia-Ukraine battle (counting words such as war, conflict, Putin, Russia, Vladimir, Ukraine, and Ukraine-–Russia conflict) in India from trending in India from 1 Jan 2021 to 30 June 2023. This data is freely accessible on the Google India website https://news.google.com/topics/CAAqJQgKIh9DQkFTRVVFvSUwyMHZNRE55YXpBU0JXVnVVMVWRDS0FBUAE?hl=en-IN&gl=IN&ceid=IN%3Aen . To conduct our current research, we are utilizing day-to-day data on firms from January 1, 2021, to June 30, 2023, which covers all working days during this period. We define the starting point of the conflict as February 24, 2022. We categorize the time from January 1, 2021, to February 23, 2022, as the "pre-conflict period," spanning thirteen months. Subsequently, we label

the period from February 24, 2022, to June 30, 2023, as the "post-conflict period," spanning eighteen months. To select a subset of the post-conflict period for analysis, we will focus on the time from February 24, 2022, to May 23, 2022. This analysis will compare the stock market performance during this three-month post-conflict period with the performance during the twelve-month pre-conflict period and the remaining eighteen months of the post-conflict period.

2.2. Methods
The primary goal of current research is to reveal the consequence the Russian incursion on Ukraine has on the sectoral indices of India's stock market. The recent article applies the following two relevant econometric and statistics techniques to achieve this objective.

2.2.1. Two-Sample Z-test
A two-sample test is employed to assess the significance of the difference between the average of two populations when population variabilities are known and dissimilar. However, both distributions are normal and independently distributed. This research consists of an independent random sample of size n and m, including the pre-Russia Ukraine Crisis data and other random sample sizes, including the data set post-Russia Ukraine War outbreak. With the Z test's help, we intend to calibrate the difference in mean return of sectoral indices due to the Ukraine War in the Indian context.

$$Z = \frac{(\bar{X} - \bar{Y}) - (\mu_X - \mu_X)}{\sqrt{\frac{s_X^2}{n} + \frac{s_Y^2}{m}}} \qquad (1)$$

Where n is the sample size of the prewar period, and m is the sample size of the post war period. On the other hand, $\bar{X}$ is the sample mean of the prewar period and $\bar{Y}$ is the sample mean of the post war period. Our null hypothesis in this case is that the Ukraine war has no impact on the mean return of sectoral indices of the Indian stock exchange. On the other hand, the alternative hypothesis rejects the claim of null and states that war significantly impacts the mean return of sectoral indices. We decide the above postulation based on the Z value and corresponding P- value. If the p-value is less than 0.05, we will reject the null claim and vice versa.

2.2.2. Two-Sample F-test
We also rely on the F test to reveal the difference in the return variability of sectoral indices due to the current Russia-Ukraine war. To calibrate the impact of war on the return volatility, we apply the F test, which can reveal such a fact. It helps to make inferences about a population variance or the sampling distribution of the sample variance from an average population; many researchers have applied such a technique to find out the differences in the variability

under two different events; see [8], [9], [10]. The F statistics have been exhibited below.

$$F = \frac{S_X^2/\sigma_X^2}{S_Y^2/\sigma_Y^2} = \frac{S_X^2}{S_Y^2} \sim F_{n-1,m-1} \qquad (2)$$

Where $n - 1$ is the degree of freedom of the prewar period, and $m - 1$ is the degree of freedom of the postwar period. On the other hand, S_X^2 is the sample variance of the prewar period and S_Y^2 is the sample variance of the post war period. Our null hypothesis in this case is there is no impact of the Ukraine war on the return variability of sectoral indices of the Indian stock exchange, which means $\sigma_X^2 = \sigma_Y^2$. On the other hand, the alternative hypothesis rejects the claim of null and states that war significantly impacts the return volatility of sectoral indices. We decide the above postulation based on the F and corresponding P-value. If the p-value is less than 0.05, we will reject the null claim and vice versa.

2.3. Regression Analysis

We also apply the regression model to assess the effect of the Russian-Ukraine war on the return of sectoral indices of the Indian stock market. We use the OLS technique to determine the coefficient, and we have developed linear regression equations as follows:

$$Return_i = \alpha + \beta NewsSearch_i + \gamma D + \varepsilon_i \qquad (3)$$

In the above model, $Return_i$ exhibit the return of the sectoral index, β is the coefficient of new search related to Russia Ukraine war in India. On the other hand, γ is the coefficient of a time dummy variable, which showcases the Russian-Ukraine war. The value 0 has been given for the pre-crisis period, and the value of 1 has been given for the post-crisis period, which starts from 24 February 2022.

3. Results and Discussion

Based on the descriptive statistics outcome, the average (mean) of the returns of the sectoral indices are as follows: - For the energy sector, the average is 0.11; for the oil and gas sector, it is 0.01. For real estate, it is 0.12, and for the metal index, it is 0.19. For other indices, such as IT, it is 0.14; for FMCG, it is 0.04; for the auto sector, it is 0.05; and for the banking industry, it is 0.03. We observe that the metal index has the highest mean, and the lowest average is for the oil and gas sectoral index. On the other hand, the variability outcome based on the energy sector data is 1.45. For the oil and gas sector, it is 1.96. The result for the real estate sector is 4.48, and for the metal sectoral index, it is 3.95. For the IT sector, it is 1.62; for the FMCG sector, it is 0.78; the auto sectoral index has a variance of 1.80; and the bank sectoral index is 1.89. We observe that the highest variance belongs to the real estate sectoral index; hence, it is the most volatile index, whereas the FMCG sectoral index has the lowest and least volatile sectoral index. Based on the outcome of the skewness of each sectoral index, we observe that the energy, oil and gas sector, FMCG, metal, banking, and auto sectoral indices are leftward skewed, as the value of skewness of these sectoral indices is negative. At the same time, the real estate sector is rightward skewed.

Table 1. Descriptive statistics prewar period

Statistics	Energy	Oil & Gas	Realty	Metal
Mean	0.11	0.01	0.12	0.19
Variance	1.45	1.96	4.48	3.95
Kurtosis	0.90	0.98	2.43	1.02
Skewness	-0.49	-0.36	0.14	-0.43
Minimum	-4.41	-5.18	-7.50	-6.60
Maximum	3.16	4.83	8.66	5.33
Statistics	IT	FMCG	Auto	Bank
Mean	0.14	0.04	0.05	0.03
Variance	1.62	0.78	1.80	1.89
Kurtosis	0.35	1.10	1.91	1.78
Skewness	-0.39	-0.32	-0.10	-0.20
Minimum	-3.55	-3.19	-5.11	-5.10
Maximum	3.16	2.43	4.39	4.01

Source: Autor Estimation

Table 2. Descriptive statistics Post-War period

Statistics	Energy	Oil & Gas	Realty	Metal
Mean	-0.03	-0.01	-0.04	0.02
Variance	1.86	2.16	4.81	3.95
Kurtosis	1.09	6.51	1.56	1.77
Skewness	-0.51	-1.56	-0.25	-0.36
Minimum	-5.12	-5.60	-7.17	-8.14
Maximum	3.11	1.92	5.34	6.86
Statistics	IT	FMCG	Auto	Bank
Mean	-0.04	0.10	0.06	0.04
Variance	2.24	0.96	1.74	1.61
Kurtosis	1.13	0.95	2.48	2.26
Skewness	-0.37	0.02	-0.44	-0.48
Minimum	-5.74	-3.33	-6.26	-5.79
Maximum	3.88	3.03	4.39	4.00

Source: Autor Estimation

Based on the descriptive statistics of the outcome of the post-Russia-Ukraine crisis, the average (mean) returns of the sectoral indices are as follows: For the energy sector, the average is -0.03, and for the oil and gas sector, it is -0.01. For real estate, it is -0.04; for the metal index, it is 0.02. For other indices, such as IT, it is -0.04; for FMCG, it is 0.10; for the auto sector, it is 0.06; and for the banking industry, it is 0.04. We observe that the FMCG index has the highest mean, and the lowest average is for the Realty and IT sectoral index. On the other hand, the variability outcome based on the energy sector data is 1.86. For the oil and gas sector, it is 2.16. The result for the real estate sector is 4.81, and for the metal sectoral index, it is 3.95. For the IT sector,

it is 2.24; for the FMCG sector, it is 0.96; the auto sectoral index has a variance of 1.74; and the bank sectoral index is 1.61. We observe that the highest variance belongs to the real estate sectoral index; hence, it is the most volatile index, whereas the FMCG sectoral index has the lowest and least volatile sectoral index. Based on the outcome of the skewness of each sectoral index, we observe that the energy, oil and gas sector, real estate, metal, banking, and auto sectoral indices are leftward skewed, as the value of skewness of these sectoral indices is negative. At the same time, the FMCG sector is rightward skewed.

To estimate the differences between the average value of the sectoral indices between the pre and post-Russian Ukraine crisis, we apply the student's t-test. This t-test gives accurate results when we do not have evidence about the variances in the actual population. The results of Table No. 3 show the consequences of t test. Based on the impact of test statistics, we cannot discard the claim of the null hypothesis, which states equality means the return of the sectoral indices between the pre and post-Russian Ukraine crisis. The t statistics of all the sectoral indices are insignificant at a five or even 10% significance level. Hence, it can be inferred that the emergence of the RussiaUkraine crisis does not have a noteworthy consequence on the average return of the sectoral indices of the Indian stock market. The outcome exhibits the resilient capability of the Indian stock market from external shocks. After concluding the average return, we present the result of the return variability of sectoral indices in Table no 4.

Table 3. The outcome of statistics

Statistics	Energy	Oil & Gas	Realty	Metal
t Statistics	-1.23	-0.03	0.83	-0.87
P Value	0.21	0.97	0.40	0.38
Statistics	IT	FMCG	Auto	Bank
t Statistics	-1.37	0.74	0.18	-0.005
P Value	0.16	0.45	0.85	0.99

Source: Autor Estimation

The outcome of Table No. 4 reveals the investigation of sectoral indices return volatility between the pre and post-Russian Ukraine crisis. Based on the result, it can be realized that F statistics are significant for the Energy, Oil & Gas, Realty, IT and FMCG sectors, which signify that the return volatility of these indices is significantly different between the pre and post-Russian Ukraine crisis. This implies that the Russia Ukraine war has created some uncertainty among these sectors of the Indian economy. On the other hand, the relevant outcome indicates that the emergence of war does not have a consequential effect on the return variability of other indices such as Metal, Auto and Banking sectors. We can surmise that the F statistics of

these sectors are not significant. Compared to the outcome average return based on t statistics, where we find no difference in average return across the sectoral indices, the F statistics unearth the impact of the current war on the return volatility of some sectors while others remain unaffected.

Table 4. The outcome of t statistics

Statistics	Energy	Oil & Gas	Realty	Metal
t Statistics	1.28**	2.20***	1.59**	1.00
P Value	0.05	0.00	0.03	0.96
Statistics	IT	FMCG	Auto	Bank
t Statistics	1.39***	1.24*	1.03	1.17
P Value	0.00	0.08	0.78	0.20

*Note: *, ** and *** consist of the level of significance at 10%, 5% and 1% correspondingly.*
Source: Autor Estimation

Table 5 exhibits the consequences of regression analysis of all the sectoral indices. The outcome of regression analysis shows that the Russia Ukraine crisis dummy variable does not have any consequential effect on the return of the Energy, Oil & Gas, Realty, Metal, IT and FMCG sectors. This is so because the coefficient of stimulus variables is insignificant, at 5% significance level. Thus, the Russian-Ukraine conflict does not affect the return of these stock indices. On the other hand, regression analysis results further reveal that the Ukrainian crisis news index coefficient is not significant for the Energy, Oil and gas, Realty, Metal, IT and FMCG sectors, which further indicates the insignificant impact of the current crisis on these sectoral indices.

Table 5. Outcome of Regression Analysis

Statistics	Energy	Oil & Gas	Realty	Metal
Constant	0.10 (0.20)	0.04 (0.95)	0.14 (0.24)	0.18 (0.13)
News	0.01 (0.54)	-0.01 (0.69)	-0.04 (0.24)	0.02 (0.63)
Dummy	-0.17 (0.16)	0.02 (0.87)	-0.08 (0.63)	-0.22 (0.24)
F Statistics	0.95 (0.38)	0.70 (0.92)	1.67 (0.31)	0.67 (0.51)
Statistics	IT	FMCG	Auto	Bank
Constant	0.15* (0.09)	0.05 (0.37)	0.07 (0.39)	0.05 (0.49)
News	-0.02 (0.46)	-0.03 (0.09)	-0.07** (0.01)	-0.05** (0.04)
Dummy	0.14 (0.29)	0.11 (0.21)	0.13 (0.39)	0.09 (0.47)
F Statistics	1.30 (0.27)	1.69 (0.19)	3.18 (0.39)	2.18 (0.12)

*Note: *, ** and *** consists of the level of significance at 10%, 5% and 1% correspondingly.*
Source: Autor Estimation

However, it can be noticed that the Ukrainian crisis news index coefficient is significant for the Auto and Banking sectoral indices at a 5 percent level of significance. Based on the above outcome, it can be concluded that a 1 index point increase in war news leads to a fall in return by 0.07 units for the auto sector and 0.05 for the banking sector. These outcomes imply that the Ukrainian crisis news index negatively impacts the banking and auto sectors of the Indian stock exchange.

The outcome unearths the resilient attribute of India's Energy, Oil & Gas, Realty, Metal, IT and FMCG sectors. On the other hand, the Auto and Banking sectoral indices seem sensitive to negative news about the Russia Ukraine crisis. The outcome reveals that the news coefficient is negative and significant for the Auto and Banking sector indices indicate that current crisis news results in a fall in the return of these indices of the Indian stock market.

4. Conclusion

As already disclosed, the primary goal of the present examination is to empirically scrutinise the consequences of the Russia-Ukraine crisis on Indian stock markets by pondering eight relevant stock indices. These stock indices include the energy, oil and gas, real estate, metal, IT, FMCG, auto, and banking sectors. Moreover, to accomplish the relevant objective, the current investigation relies on various statistical tests, including the student t, F, and linear regression models. The relevant empirical result can be summarised below. Firstly, based on the result of the student t test, it can be inferred that the emergence of the Russia-Ukraine crisis did not significantly impact the average return of the sectoral indices of the Indian stock market.

The outcome demonstrates the resilient capability of the Indian stock market to withstand external shocks. Secondly, based on the development of the F test, it can be realised that the return volatility of these indices is significantly different between the pre-and post-Russian Ukraine crisis in the energy, oil and gas, real estate, IT, and FMCG sectors. This implies that the emergence of the Russia-Ukraine war has created uncertainty among these sectors of the Indian economy.

In contrast, the metal, auto, and banking sectors seem unaffected. Finally, the regression analysis results reveal that the dummy variable Russia-Ukraine crisis does not significantly impact any of the sectoral indexes. On the other hand, the development of the regression analysis further shows that the coefficient of the Ukrainian crisis news index is not significant for the energy, oil and gas, real estate, metal, IT, and FMCG sectors. However, it can be noticed that the Ukrainian crisis news index coefficient is significant for the auto and banking sectoral indices. These outcomes imply that the Ukrainian crisis news index has a negative impact on the performance of the banking and auto sectors of the Indian stock exchange.

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