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Table of Contents

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Did Russia's Invasion of Ukraine Induce Herding Behavior in the Indian Stock Market?

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Abstract: *This study empirically examines the herding behavior of the Indian stock market investors during the heightened geopolitical tensions between Russia and Ukraine in 2022.*

An intensified Russia-Ukraine geopolitical event window was constructed, and the high-frequency trading data (intraday) of the Nifty index was analyzed using Multifractal Detrended Fluctuation Analysis (MFDFA) to compute the 5th-order Hurst exponent (Hq (5)) that detects herding behavior.

The study's empirical results revealed the presence of profound herding behavior during the intensified Russia-Ukraine geopolitical event window. The study contributes to the existing literature on herding behavior by examining the impact of a geopolitical event on the Indian stock market. Additionally, the study utilizes MFDFA to compute Hurst exponents, a relatively new approach to detecting herding behavior in financial markets.

The findings of this study may assist investors and policymakers in understanding the impact of geopolitical events on financial markets and the potential for herding behavior among investors during times of heightened uncertainty. The study's results demonstrate the interconnectedness of global events and financial markets, highlighting the need for policymakers to consider the potential social and economic consequences of geopolitical events.

Introduction

Economies and financial markets are more interconnected than ever because of increased cross-border trade and access to financial markets. Market turbulence in one market can have ripple effects on many other financial assets and markets, impacting many global economies. The Contagion effect explains where a shock in one economy, region, or market spreads and affects different regions, economies, and markets. The stock market price changes show a robust response to such market shocks, causing panic among investors. Investors usually imitate others' actions when presented with such uncertainty. This is known as Herding behavior. Shock-based herding is common during various shocks, including economic collapse, currency and commodity devaluations, geopolitical issues, the Central Bank's decision about liquidity management, and pandemics (Khan and Suresh 2022).

Geopolitical conflicts are one of the most striking contemporary issues that nations across the globe are battling during recent times. Some of the most significant geopolitical conflicts witnessed by the world, particularly post-COVID-19, include the India-Pakistan airstrikes of 2019, India-China boundary skirmishes of 2020, Ethiopian-Sudanese clashes of 2020, Afghanistan-Iran clashes of 2021, Israeli-Palestine conflicts of 2021, and the ongoing Russia-Ukraine conflicts of 2022. These events are otherwise termed extreme events as they significantly disturb the performance of the financial markets by inducing abnormal volatility that eventually instigates investors to follow herding behavior to make their investing decisions (Mertzanis and Allam 2018; Dhall and Singh 2020).

The ongoing Russian invasion of Ukraine is not just a geopolitical conflict but an intensified war. Their tensions have prevailed for a long time but intensified out of control only in early 2021. However, amidst their tensions, the President of Ukraine hinted to the President of the US that Ukraine wanted to be a member of NATO in January 2021. NATO, too, agreed to make Ukraine its member. This instantaneously irked Russia as it did not want NATO to permit Ukraine to be a member. The reasons Russia opposed Ukraine's entry into NATO are twofold. Firstly, if Ukraine is given NATO membership, it would enlarge its grouping's footprint to its boundary. Secondly, any member nation of NATO will be entitled to united support by all members in case of any attacks from external countries(BBC 2023). Kyiv, a city in Ukraine, qualms against aggression by Russia as the latter previously invaded Crimea from Ukraine. Being extremely infuriated in this regard, Russia started indulging in massive military expansion activities by deploying its troops across its boundaries with Ukraine. Russia maintained that its military exercises in Eastern Europe aimed to safeguard its security considerations. Nevertheless, Russia deployed close to 1 lakh troops on its boundary with Ukraine. This eventually escalated into a full-scale attack from Russia on Ukraine on February 24, 2022, that caused devastating and disastrous consequences on the performance of the financial markets worldwide.

In this regard, several developed and emerging stock markets across the globe experienced a considerable fall immediately as the President of Russia officially declared war against Ukraine(The Economic Times 2022a). For instance, on February 24, 2022, leading global indices, including the S&P 500 and the American DJIA, recorded an intraday low of 4114.65 and 32,272.64 (a fall of 180 and 997 points), respectively, from its intraday high. Besides, the composite European index, such as the STOXX 600, fell by 3%(Balbaa, Eshov, and Ismailova 2022). In addition, major indices in the Asian markets fell from their intraday open, including Singapore's STI by 2.29%, Hong Kong's Hang Seng index by 1.61%, and the Chinese Shanghai Composite index by 1.30%(The Economic Times 2022b). Moving on to one of the largest emerging Asian stock markets like India, Nifty 50, also significantly fell by 1.80% respectively from its intraday open. The substantial volatility in the global market indices, including the National Stock Exchange, India, during the Russia-Ukraine war of 2022 provides us with an eminent ground to examine the traces of herding behavior in the Indian stock markets.

India's macroeconomic fundamentals were disrupted by geopolitical tensions as prices for food, metals, and crude oil rose significantly after the declaration of the war. The Russia-Ukraine conflict severely damaged the world's supply chain, leading to a global food shortage and, as a result, rising inflation. In April 2022, inflation in India reached a high of 7.8%(The Indian Express 2023). Economic growth will be impacted if inflation stays high. According to the Indian Ministry of Commerce and Industry, as of December 2022, imports and exports from Ukraine have decreased by 83.25% and 69.65% in a single year. Essential imports from Ukraine, such as vegetable oils (-91.91%), iron and steel (-76.22%), chemical products (-97.26%), and electrical machinery and equipment (-97.99%), have been affected. Significant exports to Russia are predicted to suffer due to the conflict. Exports to Russia from India like rubber (-96.83%), plastic (-86.18%), leather(-93.93%) wood(-72.05%) and organic chemicals(-60.45%) have been reduced. This is due to the ongoing war between Russia and Ukraine.

As a result, the respective sector stocks will be impacted. Another impact of the war is on the supply of crude oil. India is one of the Asian countries to which Russia has been exporting crude oil at a discount because of Western sanctions. India's crude imports from Russia increased 9.2% monthly to 1.4 million barrels daily in January 2023, making Russia India's biggest crude oil supplier. The massive trade relations with Russia and Ukraine and the macroeconomic effect of the war drastically impacted the behavior of investors and industries in the Indian stock market. Therefore, this study examines the traces of herding behavior in the Nifty index.

This study tries to investigate the herding behavior of investors when Russia announced the invasion of Ukraine, as investors tend to be more sensitive to such announcements in the initial stages of an event. The study will test if Indian stock market investors demonstrated meaningful herding tendencies attributable to the uncertainty from the Russia-Ukraine conflict. Although few studies have been done on the conflict between Russia and Ukraine, no study analyses investor behavior in the Indian market. This study is unique because it tries to investigate traces of herding behavior using the econophyiscs tool, the Hurst Exponent using MFDFA analysis. The study's findings and outcomes will have far-reaching repercussions for market players such as traders, investors, analysts, and regulatory authorities.

The paper is divided into five sections. The appropriate literature review is examined after the introduction. The data and methodology are presented in the second section. Results are presented in the third section. Discussion and interpretation are the fourth section, and the fifth section gives the conclusion.

1.   Literature Review

1.1 Herding Behavior in Financial Markets

When investors imitate other people's actions in response to extreme events, this is herding behavior(Cont and Bouchaud 2000; Sornette 2003). Herding is a process in which investors trade in the same way simultaneously, either because they are imitating one another or because they have converted to the market average. Hwang & Salmon (2004) define herding as the circumstance in which investors disregard their expectations and convictions and imitate the choices made by their peers or market movements. A group of investors engage in herding behavior when they purposefully mimic the actions of other investors they perceive to be more informed rather than acting on their convictions and making their predictions while buying or selling comparable equities over a set period (Chen et al. 2018; Chang et al. 2018). This could result from several factors, including the global economic meltdown, devaluations of currencies and commodities, the Central Bank's choice to manage liquidity, pandemics(Ghosh et al. 2023; Espinosa-Méndez and Arias 2020a; 2020b; Dhall and Singh 2020) and geopolitical concerns(Bougatef and Nejah 2023; Sohag et al. 2022; Krishna and Suresha 2022). In recent years, the geopolitical tensions between the nations have significantly increased. After being battered throughout 2021 by the COVID-19 pandemic, supply chain and logistics disruptions, elevated inflation, and financial market turbulence, the escalation of geopolitical tensions into war from late February 2022 between Russia and Ukraine has given a devastating blow to the global economy. Such warfare impacts not only the participating developed economies but also other countries across the globe. Despite simply being spectators, emerging markets and developing economies suffer the most from such a geopolitical conflict because of their economic integration and trade dependence on developed countries. This has several effects, including sudden, abrupt fluctuations in the financial markets.

1.2 Geopolitical Influence on Financial Markets

Geopolitical conflicts impact the financial markets. Currency spot markets often react fast to adverse events, losing, on average, as much value in two days as they would ordinarily lose over a month. In contrast, equities markets react more evenly to good and bad news (Petrov, Hentov, and Zumbo 2018). Research also indicates that geopolitical developments significantly impact the volatility of oil and commodity markets(Gopal and Munusamy 2016; P. Gong and Dai 2017). Invasions and wars impact stock markets, although the impacts vary by country, and this is well documented in the literature. Hudson and Urquhart (2014) investigated how World War II affected the British stock market. They examined whether severe occurrences, such as wars, significantly impacted stock returns and concluded that such events result in high market volatility and unfavorable market reactions. He et al. (2017) study the financial impact of non-violent diplomatic conflicts between Taiwan and mainland China and demonstrate how political stress is linked to a considerable reduction in stock market return. The MENA (the Middle East and North Africa) area is known for its ongoing conflict and instability. Geopolitical tensions have been shown to negatively impact MENA economies' expansion and hinder financial development and economic growth(Talbi, Chaibi, and Maoueti 2021; Soltani et al. 2021). The diplomatic and economic sanctions against Qatar significantly affected the stock market volatility in Qatar and other Gulf Cooperation

Council nations (Selmi and Bouoiyour 2020). The impact was different across various industries and nations. Arin et al. (2008) explore six different financial markets and demonstrate that conflicts considerably impact stock markets and stock market volatility, with the scale of these effects being more significant in emerging markets. In contrast, Sohag et al. (2022) claimed that geopolitical events in emerging countries have little impact on the global economy since their effects on the assets under examination are mainly temporary and of local importance. Therefore, geopolitical conflicts are perceived to impact returns and volatility in the stock markets worldwide. Furthermore, studies have been conducted to examine the effects of geopolitical risk (GPR) on the economy. The adverse effects on investment, employment, return on equity and bond spread, and stock market volatility indicate that GPR significantly impacts businesses and financial markets. According to a study of the BRICS countries, Russia has the highest risk exposure to Geopolitical risks. At the same time, India was found to have the most negligible impact on geopolitical risks among the BRICS (Balcilar et al. 2017).It was also observed that some sectors and companies see more significant growth because war may increase revenues. Liu et al. (2021) find that geopolitical unpredictability positively affects energy commodities like crude oil and natural gas. Schneider Troeger (2006) states that international markets often react negatively to war rather than positively, but occasionally, "war rallies" are also seen at stock exchanges. Most likely, war rallies are a phenomenon that can be seen in nations whose economies are only slightly affected by intensifying warfare. Guidolin and la Ferrara (2010) examine the effects of conflict commencement on asset markets and discover that conflicts greatly affected stock market indices, currency rates, oil, and commodity prices, with national stock markets exhibiting more positive than adverse reactions to conflict commencement.

1.3 Geopolitics and Herding Behavior in India

Geopolitical events create investor anxiety in India about secondary impacts, even when India is not directly involved(Das, Kannadhasan, and Bhattacharyya 2019). For example, The 1990 Gulf War, despite India's neutrality, shook India's economy and commodity markets due to rising oil prices and trade flows in the Gulf region employing many Indian migrants(Barsky and Kilian 2004). The 2018-20 China-US trade war raised fears among Indian investors about India's export competitiveness with a key trade partner(Fajgelbaum and Khandelwal 2021). Similarly, the 2022 Ukraine-Russia war, increased global uncertainty including inflation and interest rates, spurring investor herding in India(Sanjeev Kumar et al. 2023). Geopolitical uncertainties trigger herding behavior among Indian investors, causing them to mimic others' actions despite limited independent analysis. Increased media focus and social media echo chambers amplify dominant narratives(Fan, Talavera, and Tran 2020), while fear and risk aversion drive investors to imitate established players or follow perceived market trends. This results in correlated investment decisions regardless of individual assessments, as observed during the 2020 India-China border tensions(Krishna and Suresha 2021) and the 2008 Global Financial Crisis(Ferreruela and Mallor 2021).

1.4 Effect of Russia-Ukraine War on Global Economy and India

Whatever the effect of war on financial markets, positive or negative, it is bound to affect the behavior of investors and their investment decisions. Investors begin acting irrationally in such extreme circumstances(Loang and Ahmad 2023). It is well documented that investor sentiment is affected when such news announcements on conflicts between nations are made (Akhtar et al., 2011; Białkowski et al., 2008; Makololo & Seetharam, 2020; Plakandaras et al., 2019). Market participants' tendency to act in groups may cause significant market rallies and sell-offs. Some investors seek safer havens during extreme political and geopolitical unrest, such as buying gold (Akhtaruzzaman et al. 2021), while some imitate investment activities, which is riding behavior. Herding behavior in financial markets is related to behavioral finance (Ricciardi and Simon 2000). Studies in behavioral finance investigate why investors make judgments about their investments that defy the expectations of rational investors (Huang, Shieh, and Kao 2016). There may be various instances of why investors act irrationally in the financial markets. Reputational concerns (Popescu and Xu 2018), political reasons (Białkowski, Gottschalk, and Wisniewski 2008; Mertzanis and Allam 2018), economic reasons (Makololo and Seetharam 2020), or geopolitical reasons like wars(Boubaker et al. 2022) may affect the investment decisions of investors and lead to herding behavior.

While there are numerous existing studies analysing the economic and financial impacts of geopolitical conflicts, as well as some research on investor herding behaviors in general, there remains a significant gap in specifically examining Indian investor herding resulting from the current Russia-Ukraine conflict. This is concerning given both Russia and Ukraine's position as crucial trade partners and sources of resources for the Indian economy. The invasion of Ukraine by Russia in 2022 is believed to be the result of the big powers'

geopolitical rivalry reemerging, which escalates the geopolitical dangers. Pandemic. Such a war could challenge an emerging economy like India's economic prospects, resulting in uncertainty. Wars are primarily perceived as adverse events that surge market volatility (Manela and Moreira 2017; Naimy et al. 2020). They adversely impact the investor's behavior, eventually inducing them to follow the crowd/herd behavior. Therefore, this study examines how the Russia-Ukraine war impacted the herding behavior of investors in the Indian stock markets. For this purpose, the study aimed to identify the patterns of the herding behavior in Nifty 50 of the National Stock Exchange, during the heightened geopolitical tensions between Russia and Ukraine, 2022.

2. Methodology

2.1 Event Date and Event Window

Although the Russian troops conducted their military exercises in the borders of eastern Europe and began inching toward Ukraine in early February 2022, the President of Russia, Vladimir Putin, openly declared war on Ukraine only on February 24, 2022. Therefore, February 24, 2022, is deemed the event day, denoted as (t = 0). Thus, to examine the impact of this extreme event on herding behavior in the Indian stock markets, an event window of 15 trading days prior to and post the event day is employed in this study (Krishna and Suresha 2021). Further, the trading dates indicated from (t = -15) to (t = -01) and from (t = +01) to (t = +15) are set as Pre- and Post-event windows, respectively. A detailed description of the event window of intensified Russia-Ukraine tensions in 2022 is presented in Table 1.

Table 1. The intensified Russia-Ukraine Tensions 2022 event window

Dates	Event window (t)	Event Description
03-Feb-22	-15	Russia continued its military exercises with 6,000 troops and 60 jets near Crimea and Ukraine.
10-Feb-22	-10	Military training for ten days began in Russia and Belarus.
17-Feb-22	-5	The rebel-held areas of eastern Ukraine saw an increase in fighting.
18-Feb-22	-4	After weeks of warnings that a Russian assault on Ukraine was possible, the Biden administration concluded that Putin had decided to invade. The American Defence Secretary claimed Russian forces were "uncoiling and prepared to attack."
21-Feb-22	-3	Tensions increased when Vladimir Putin publicly recognized the independence of Ukraine's two pro-Russia regions (Donetsk and Luhansk).
22-Feb-22	-2	The Russian parliament permitted Putin to use force. Full blockade sanctions were in place from the US against the Kremlin-controlled VEB and PSB banks. Germany unexpectedly halted the approval of the Nord Stream 2 pipeline.
23-Feb-22	-1	The European Union froze the assets of 351 Duma members.
24-Feb-22	0	Vladimir Putin declares war on Ukraine, launching a three-front assault with the Russian army. According to the Russian President, the invasion is a "special military operation" aimed at "demilitarising and denazifying" Ukraine. Volodymyr Zelensky, the President of Ukraine, writes on Twitter that "Russia has chosen a road of evil, but Ukraine is defending itself."
25-Feb-22	+1	Russian forces advanced on Kyiv while blocking a United Nations Security Council resolution calling for their departure from Ukraine.
28-Feb-22	+2	The first negotiations between Ukrainian and Russian officials ended without a resolution.
02-Mar-22	+3	The United Nations General Assembly voted on a non-binding resolution denouncing Russia's invasion of Ukraine and calling for a total withdrawal. India and China both choose not to cast a ballot.
03-Mar-22	+4	Russia and Ukraine agreed to provide humanitarian channels to evacuate civilians during the second round of negotiations.
04-Mar-22	+5	The largest nuclear power facility in Europe, located in Zaporizhzhia, was seized by Russian soldiers. NATO declined Ukraine's request for no-fly zones because of concern that the crisis may worsen.
07-Mar-22	+6	Russian forces reportedly took Vasylivka, Tokmak, and Polohy, according to Ukrainian military forces. The Russian Defence Ministry announced the opening of six humanitarian corridors. The Ukrainian Government questioned the statement since only two links went to Ukrainian territory; the others all went to Russia or Belarus.

08-Mar-22	+7	Numerous international companies, including McDonald's, Visa, MasterCard, and Starbucks, suspended their activities in Russia in response to the United States of America's total prohibition on all imports of Russian energy.
09-Mar-22	+8	Russia denies attacking a maternity facility in Mariupol as claimed by Ukraine, who claimed Ukrainian fighters had taken over the structure.
10-Mar-22	+9	According to the Russian Defence Ministry, Russian soldiers will begin opening daily humanitarian corridors at 10:00
11-Mar-22	+10	Russia requests a cease-fire so that residents of Kyiv, Kharkiv, Mariupol, Chernihiv, and Sumy can evacuate. Nevertheless, the West and Ukraine accuse Russia of breaking the cease-fire deal.
14-Mar-22	+11	According to the Russian Defence Ministry, 23 persons were allegedly killed. The Ukrainian military, however, claims that Russian troops were behind the assault.
15-Mar-22	+12	Czech, Polish, and Slovenian Prime Ministers head to Kyiv to meet Volodymyr Zelensky. Furthermore, according to Zelensky, Ukraine should not join NATO.
16-Mar-22	+13	Russia accused Ukraine of bombing a Mariupol theatre where hundreds of civilians sought refuge.
17-Mar-22	+14	Russia captured the eastern Ukrainian cities of Izium and Rubizhne.
21-Mar-22	+15	The chemical plant Sumykhimprom in Sumy, Ukraine, had an ammonia leak.

Source: Authors' Construction.

2.2 Data and Sources

The study considered the major stock exchange Nifty 50 of the National Stock Exchange, India, to examine the traces of herding behavior under the impact of the Russia-Ukraine geopolitical conflicts. The high-frequency trading data (intraday data), called the tick-by-tick data during their regular trading timings, i.e., between 09:15 am and 3:30 pm, was obtained from the Bloomberg terminal. The list of the trading days and the respective number of observations for the Nifty index as per the Russia-Ukraine geopolitical event window is presented in the upcoming sections of the study.

2.3 Model Description

The study aims to examine the traces of herding behavior in the Indian stock market during the Russia-Ukraine geopolitical tensions in 2022. Conventional models frequently undervalue the multifractal characteristics of financial time series. For example, the CSSD method is more conservative, and herding behavior is occasionally overestimated in CSAD method (W. Gong, Li, and Yu 2022). The multifractal analysis is regarded as a reliable and standard technique to study complex systems, such as financial markets(Ghosh et al. 2018; Ghosh and Kozarevic 2019; Ghosh et al. 2020;Thompson and Wilson 2016). Therefore, to examine and measure the level of herding behavior in the Russia-Ukraine geopolitical event window, 2022, the Multifractal Detrended Fluctuation Analysis, also known as the MFDFA model, is employed in the study. The Kantelhardt et al. (2002) model of MFDFA is the most established, influential and prominent technique that computes and generates the values of the Hurst exponent (H_q), (Hurst 1951), in a non-stationary financial time series. Furthermore, the Hurst exponent (H_q) enables to examine the presence and measure the level of herding behaviour in the stock market time series (Sunil Kumar and Deo 2009), (Aslam, Mohti, and Ferreira 2020) and (Ghosh, Le Roux, and Verma 2020). The steps in the MFDFA approach are as follows:

The normal log returns for the Nifty broad index prices are computed in tick-by-tick frequency as follows:

$$T(i) = Ln(R_t/R_{t-1}) \tag{1}$$

T(i) denotes the tick-by-tick time series returns. Of the sectoral indices, which are non-stationary by nature, R_t represents the sectoral index price on tick t while R_{t-1} represents the sectoral index price at tick t-1. The following are the primary formulas for the Kantelhardt et al. (2002) model of MFDFA analysis:

Step 1: Construction of the Profile, $Y(p)$:

$$Y(p) \equiv \sum_{i=1}^{P} [T(i) - \bar{T}], i = 1, \dots, N \tag{2}$$

489

In the equation, $T(i)$ for $i = 1..., N$ denotes the possible non-stationary time series that resulted from the sectoral index returns of equation (1), where N represents the series length and $\bar{T}$ its mean.

Step 2: The second step in the MFDFA analysis is to divide the previously built profile *Y(p)* into overlapping segments. In this step, $N_s \equiv$ int (*N/s*) i.e., non-overlapping segments of equal length *s*. Because the total length of the series N is usually not a multiple of the considered length s. As a result, a brief section of the profile *Y(p)* is ignored, and the sub-division is realised from the opposite end as a result of this step, a total of $2N_s$ segments are obtained.

Step 3: The third step in the methodology section is to compute the local trend for each separately generated $2N_s$ segment using a least-square fit of the series. This is accomplished by estimating the profile in each window using a polynomial of degree *m*. Furthermore, the variance is calculated using the following formulas:

$$F^2(s, v) \equiv \frac{1}{s} \sum_{p=1}^{s} \{Y[(v-1)s + p] - y_{v(p)}\}^2 \tag{3}$$

For each segment v, v = 1, ..., N_s and

$$F^2(s, v) \equiv \frac{1}{s} \sum_{p=1}^{s} \{Y[(v - N_S)s + p] - y_{v(p)}\}^2 \tag{4}$$

For $v=N_{s+1},..., 2N_s$. Here, y_v(p) is the polynomial fit in segment *v*.

Step 4: The fourth step in the analysis involves averaging all segments from step (2) to obtain the qth -order fluctuation functions.

$$F_q(s) \equiv \{ \frac{1}{2N_s} \sum_{v=1}^{2N_s} [F^2(S,V)]^{q/2}\}^{1/q} \tag{5}$$

In this case, the variable *q* can have any real value other than zero.

Step 5: The fifth and last stage in the MFDFA model is to find the scaling exponent of the fluctuation function for each *q* in order to obtain the relationship between F_q(s) and *s*. If f_q(s) is power-law correlated, the series for that *q* is in the log-log scale.

$$f_q(s) \sim s^{h(q)} \tag{6}$$

Table 2. Range of Hurst values H_q(5) and their respective interpretation

Hurst range	*Interpretation for the level of herding behavior*
0 < H < 0.5	Absence of herding behavior
H = 0.5	Markets follow random-walk behavior
0.5 < H < 0.64	Mild herding
0.65 < H < 0.71	High level of herding behavior
0.72 < H < 1.00	Higher level of herding behavior

Source: Ghosh, Le Roux, and Verma 2020

In equation (6), $h_{(q)}$ is regarded as the generalized form of Hurst exponent (Hurst 1951). Hurst values usually vary between 0.5 and 1.00. In the time series, the same is used to measure herding behaviour. The 5th-order Hurst exponent, i.e., $H_q(5)$, is calculated through the MFDFA analysis for each broad market index for tin he intensified Russia-Ukraine geopolitical event window, 2022. Further, the MFDFA codes established by Ihlen (2012) were used in the MATLAB software and ran to obtain the Hurst values ,i.e. $H_q(5)$. Table 3 depicts the Hurst exponent value range and its interpretation for herding behaviour.

3. Research Results

This section of the study presents the empirical results obtained from the Multifractal detrended fluctuation analysis. The values of the 5th-order generalised Hurst exponent, i.e., $H_q(5)$ for Nifty 50 are computed. The results are displayed appropriately for each trading day in the intensified Russia-Ukraine tensions event window, 2022.

Table 3: Depicting the 5th-order Hurst exponent, i.e., $H_q(5)$ for the Nifty 50 index

Date	Event Window (t)	No. of observations	Hurst values $H_q(5)$
03-Feb-22	-15	4092	0.67888
04-Feb-22	-14	2780	0.59660
07-Feb-22	-13	6031	0.56562
08-Feb-22	-12	4615	0.66674
09-Feb-22	-11	2074	0.58066
10-Feb-22	-10	3433	0.57028
11-Feb-22	-9	2776	0.58891
14-Feb-22	-8	4516	0.28278
15-Feb-22	-7	7697	0.47579
16-Feb-22	-6	4246	0.52214
17-Feb-22	-5	3381	0.65125
18-Feb-22	-4	2679	0.50605
21-Feb-22	-3	4838	0.75296
22-Feb-22	-2	4681	0.54284
23-Feb-22	-1	2915	0.63762
24-Feb-22	**0**	**7001**	**0.72917**
25-Feb-22	+1	3624	0.63785
28-Feb-22	+2	6427	0.46614
02-Mar-22	+3	3553	0.65182
03-Mar-22	+4	4525	0.67098
04-Mar-22	+5	5776	0.62871
07-Mar-22	+6	4018	0.33802
08-Mar-22	+7	5749	0.71770
09-Mar-22	+8	5942	0.68807
10-Mar-22	+9	4878	0.60294
11-Mar-22	+10	2997	0.59314
14-Mar-22	+11	4628	0.64605
15-Mar-22	+12	5712	0.50622
16-Mar-22	+13	2244	0.57339
17-Mar-22	+14	2755	0.50622
21-Mar-22	+15	3927	0.41506

Source: Authors' Calculations using MATLAB software

Figure 1: The MFDFA output depicting the $H_q(5)$ for the Nifty 50 index on t = 0
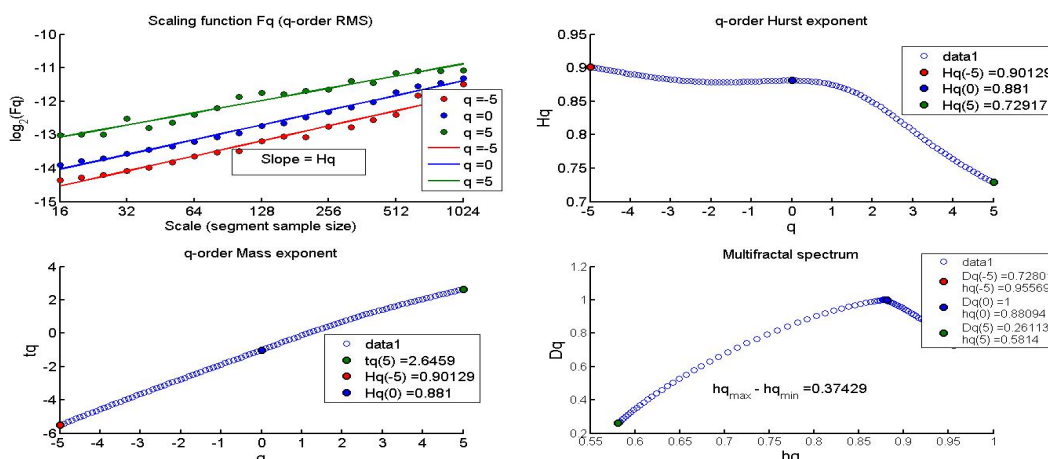
Source: From Author's using MATLAB software

Figure 2: The $H_q(5)$ values for Nifty 50 throughout the event window

Source: Authors' Construction

Table 3 exhibits the $H_q(5)$ Nifty 50 broad index values for each trading day in the event window during the intensified Russia-Ukraine tensions, in 2022. It can be observed from Figure 2 that the $H_q(5)$ values recorded more than 0.5 most days in the intensified Russia-Ukraine geopolitical event window. This indicates a profound presence of herding behavior traces in the Nifty 50 broad index. The index recorded the highest Hurst value of 0.75296 on (t = -3) in the pre-event window, signifying the higher level of herding by the investors. 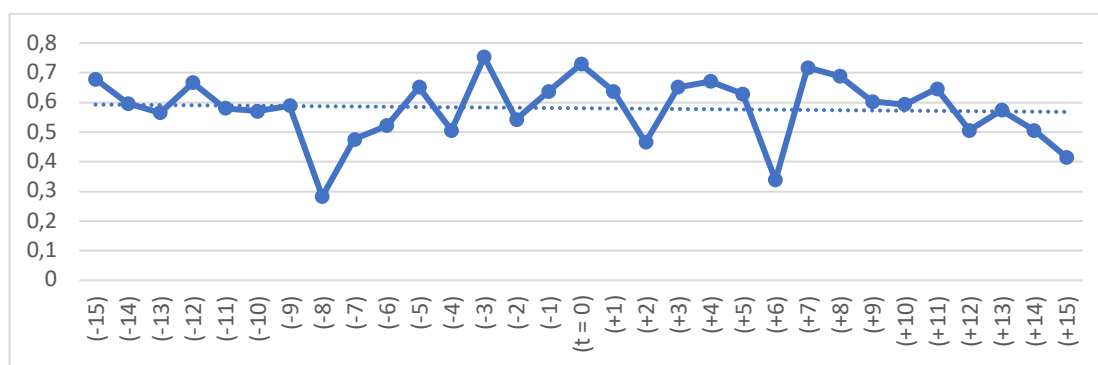Subsequently, on the event day, i.e., on (t = 0), the hurst value $H_q(5)$, clocked at 0.72917, as depicted in Figure 1, demonstrates higher herding levels in the Nifty 50 index. In addition, the overall average Hurst value traced in the index during the pre-and post-event windows of the intensified Russia-Ukraine tensions, 2022 being 0.574608 and 0.576154, respectively, confirms the existence of significant herding behavior.

4. Discussion

The findings of the empirical investigation carried out through the MFDFA analysis for Nifty 50 during the intensified geopolitical event window are discussed in this section.

The Nifty 50 index comprises companies from 13 crucial sectors of the Indian economy, and they provide a suitable representation for effective equity market analysis. (Bharti and Kumar 2021). The impact of Russia's invasion of Ukraine was evident in the major sectors of the Indian economy. A total of $177 billion was wiped out from the Indian stock market in the first hour of trade when Russian President Vladimir Putin officially declared war on Ukraine, i.e., on the event day(Business Insider 2022). Generally, in such times of uncertainty, investors enter into a state of panic. This negative market sentiment eventually contributed to a decline in the performance of the Indian index. This study unveiled the presence of the herding behavior traces among the investors of the Nifty index during the intensified Russia-Ukraine tensions in 2022. The appearance of herding behavior among the investors of Nifty can be for several reasons, including heightened geopolitical uncertainty,

disturbances in trade relations, supply chain disruptions, and anticipated increases in the cost of the commodities. An important trade partner, India has active trade relations with both nations. India exports commodities worth $2.5 billion to Russia(The Economic Times 2022c). India also imports several commodities from Russia, including mineral fuels, accounting for 34% of all imports, along with natural pearls and semi-precious stones (14%), fertilizers (10% of all imports), petroleum oils, and crude (5.6%). 84% of India's sunflower oil comes from Russia(Middle East Business 2022).

Furthermore, the trade relationship between India and Ukraine is also non-negligible. The international trade between India and Ukraine amounted to $2.35 billion between April 2021 and December 2022(Fortune India 2022). Such considerable trade dependency of India on Russia and Ukraine is bound to impact the Indian economy during the uncertain period of Russia-Ukraine geopolitical tensions. In addition, Russia and Ukraine are also major wheat producers worldwide, accounting for more than 18% of global exports(The Economic Times 2022d). As a result, the geopolitical conflict has harmed the Indian agro-based industries, impacting its sector stocks. One of the major suppliers of generic medicines to Russia is India. Due to a general market slowdown brought on by the war, the growth of branded generic markets was hindered in Russia. Pharmaceutical companies in several Indian states claimed they were not paid for the medicines exported to Russia. Shipment to Russia and Ukraine was halted at Indian ports. Payment delays prevented manufacturers from having enough money for regular operations, which disrupted production cycles. The Indian pharmaceutical sector relies on raw materials like crude oil, natural gas, etc., which directly affect transportation costs and reduce the competitiveness of Indian exports. As a result, the geopolitical crisis's effects on several other businesses, such as the oil and gas sector, could indirectly affect the pharmaceutical sector.

The auto industry's operating earnings significantly decreased. Stocks in the automotive industry fell once the war was declared. The cost of raw materials for construction, particularly cement supplies, also increased due to a spike in crude oil prices. Stocks in the real estate sector experienced notable drops after the announcement. The conflict also had an impact on the financial sector. The State Bank of India (SBI) ceased processing transactions from Russian firms under sanctions from Western nations. Concerning the metals industry, as most metals are either produced or refined in Russia or Ukraine, the war has significantly impacted the price of metal commodities(Business Standard 2022). The global electronic economy has suffered greatly due to the chip crunch. Sanctions on Russia contributed to the issue because of its significant involvement in the chip-making business. Electronic goods can become more expensive in India if the world economy keeps contracting and global supply chains come under more pressure. Hindrances in the supply chain have raised the manufacturing industry's input cost, caused unexpected production delays, and decreased industry profits. The interdependence of nations' export and import industries brought the fear of supply chain disruptions and shortages. No industry appears unaffected due to the tensions between Russia and Ukraine.

Petrol and diesel costs reached their high due to this ongoing conflict. The cost of transportation and logistics also increased along with the price of petrol and diesel, raising the cost of local and imported commodities. As India imports over 80% of its oil requirements, it will hugely impact the Indian economy. It is well known that inflation occurs due to rising fuel costs. The anticipated increase in the inflation rates is also one of the prominent factors that increased market volatility, causing panic among Indian investors. As a result, considerable traces of herding behavior were evident throughout this period of escalated geopolitical tensions in the Indian broad indices. Even before Russia attacked Ukraine, some previous incidents, such as Joe Biden's warning about the possibility of war and Vladimir Putin's recognition of the independence of Ukraine's states, had already created anxiety and uncertainty among the investors in the Indian stock market. This is substantiated by the high Hurst values on February 21, i.e., (t = -3), and February 23, i.e., (t = -1) in the pre-event window. The Hurst values recorded 0.75296 and 0.63762, respectively, depicting a higher-level herding behavior. On the event day, i.e., (t = 0), when the Russian forces invaded Ukraine, a higher Hurst value of 0.72917 was observed, which also depicted a high-level herding behavior. Russian forces attacked the Ukrainian capital city of Kyiv the following day. The investors of Nifty anticipated the war would continue for an extended period and were panic-stricken. It is difficult for investors to demonstrate their rational investment behavior during heightened geopolitical uncertainty. Consequently, this encourages them to behave in a panicked herding manner to protect their financial investments from losses caused by increasing geopolitical tension. This is evident by the high Hurst values on the same day (t = 2). This shows clear evidence of herding behavior among the investors during the Russian invasion of Ukraine.

The Government can take prudent measures to reduce the uncertainty in the market during such times. The Indian foreign trade policymakers should take preventive measures to de-risk the supply chain disruptions and curb inflation rates to reduce the panic and uncertainty among investors, eventually helping the markets

regain normalcy. The study is limited in terms of its focus on a single geopolitical event and using a specific method to detect herding behavior. The results may not be generalizable to other events or markets and may differ if alternative methods were used.

5. Conclusion and Further Research

This study investigated herding behavior in the Nifty 50 index of the Indian Stock market during the intensified Russia-Ukraine geopolitical conflict in 2022. An intensified Russia-Ukraine geopolitical event window was constructed, and the high-frequency trading data of the Nifty index was considered. Multifractal detrended fluctuation analysis (MFDFA) was employed to compute the 5th-order Hurst exponents, i.e., the $H_q(5)$ values to detect and measure herding behavior levels during the intensified Russia-Ukraine geopolitical conflict. The study revealed significant herding behavior in the examined Nifty index throughout the intensified Russia-Ukraine geopolitical event window, 2022. The findings of this study have some practical implications for investors, the Government, regulatory bodies, and policymakers. Herding causes the assets to be mispriced and the markets inefficient, creating market bubbles. Investors should be highly cautious when making investment decisions during such geopolitical unpredictability. Investor education programs can be conducted to make decisions based on long-term fundamentals over emotions. Additionally, financial regulators could enact transparent mechanisms like warning systems and trading limits during conflicts to improve stability. Furthermore, policymakers' clear communication of economic trajectories, regardless of uncertainties, can reassure markets. Using collaboration with finance experts, specific actions for informing retail investors, empowering regulators to enact preventative frameworks, and aligning state policies to stability can mitigate risks of tension-fuelled herding in Indian capital markets. The Indian Government must closely watch, assess, and react to the current situation for this ongoing conflict to potentially have a favorable conclusion in many sectors. The war is also impacting the flow of commodities, and hence the Indian Government must carefully control exports and the country's overall domestic stock availability. This study has mainly emphasized herding behavior during the Russia-Ukraine geopolitical tensions 2022 of the Indian stock market. Further studies can be conducted to examine herding behavior across different Nifty sectoral indices of the Indian stock market and stock market indices of emerging economies. Researchers can also consider examining herding behavior while considering the size and liquidity of stocks.

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Credit Authorship Contribution Statement

Tabassum Khan: (Conceptualization, Investigation, Project administration, Software, Formal analysis, Writing – original draft, Data curation, Validation, Writing – review and editing, Visualization).
Natchimuthu Natchimuthu: (Conceptualization Investigation, Project administration, Software, Supervision, Validation, Writing – review and editing, Visualization).
Krishna TA: (Conceptualization, Investigation, Methodology, Project administration, Software, Formal analysis, Writing – original draft, Writing – review and editing, Visualization

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1]	Akhtaruzzaman, Md, Sabri Boubaker, Brian M. Lucey, and Ahmet Sensoy. 2021. "Is Gold a Hedge or a Safe-Haven Asset in the COVID–19 Crisis?" *Economic Modelling* 102 (June): 105588. DOI:https://doi.org/10.1016/j.econmod.2021.105588.

[2]	Arin, K. Peren, Davide Ciferri, and Nicola Spagnolo. 2008. "The Price of Terror: The Effects of Terrorism on Stock Market Returns and Volatility." *Economics Letters* 101 (3): 164–67. DOI:https://doi.org/10.1016/j.econlet.2008.07.007.

[3]	Aslam, Faheem, Wahbeeah Mohti, and Paulo Ferreira. 2020. "Evidence of Intraday Multifractality in European Stock Markets during the Recent Coronavirus (Covid-19) Outbreak." *International Journal of Financial Studies* 8 (31): 1–13. DOI: https://doi.org/10.3390/ijfs8020031.
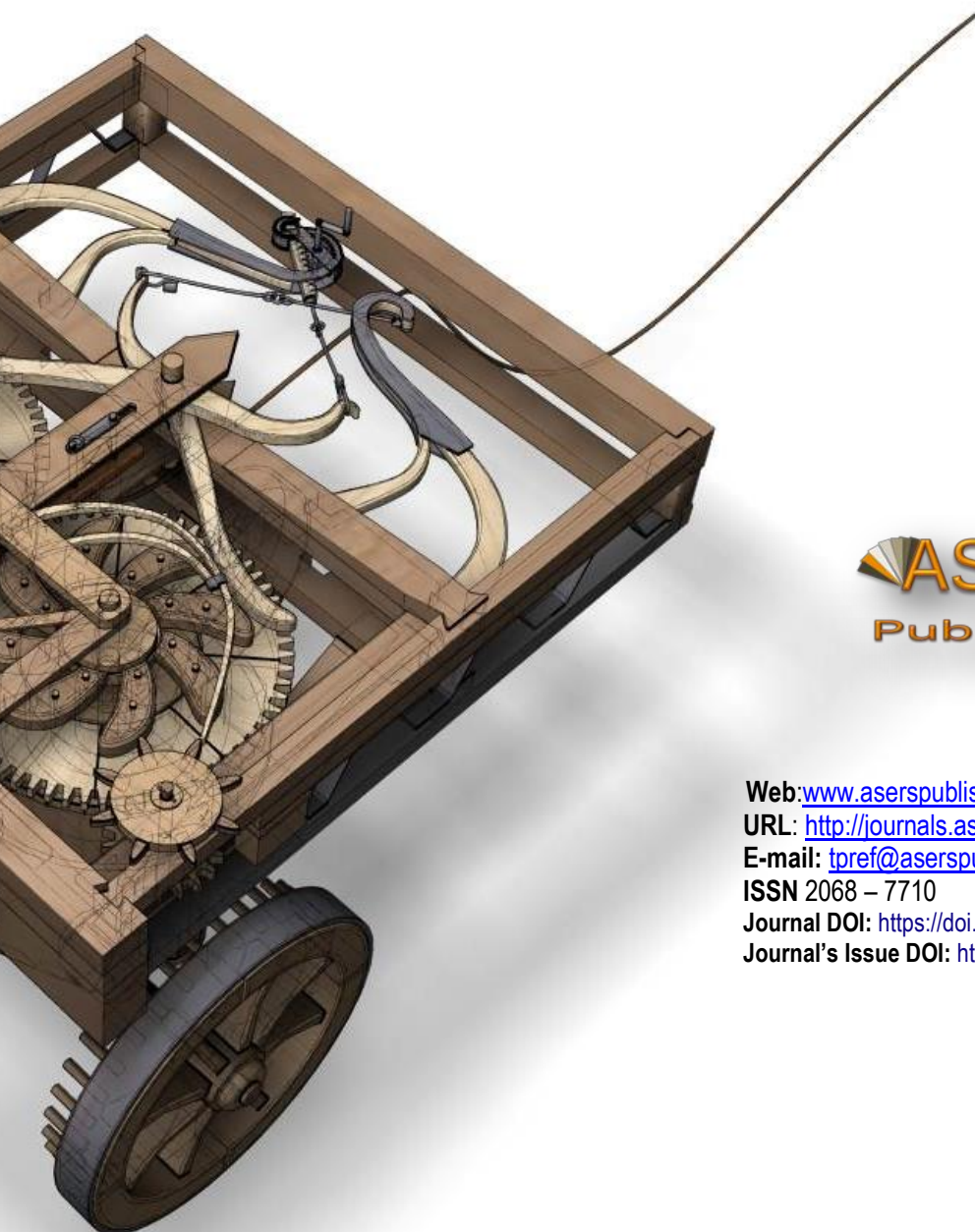
[4] Balbaa, Muhammad, Mansur Eshov, and Nilufar Ismailova. 2022. "The Impacts of Russian-Ukrainian War on the Global Economy." *Advance Online Publication*.

[5] Balcilar, Mehmet, Matteo Bonato, Riza Demirer, and Rangan Gupta. 2017. "PT." *Economic Systems*. DOI:https://doi.org/10.1016/j.ecosys.2017.05.008.

[6] Barsky, Robert B, and Lutz Kilian. 2004. "Oil and the Macroeconomy Since the 1970s." *Journal of Economic Perspectives* 18 (4): 115–34.

[7] Bharti, and Ashish Kumar. 2021. "Exploring Herding Behaviour in Indian Equity Market during COVID-19 Pandemic: Impact of Volatility and Government Response." *Millennial Asia*, 1–19. DOI:https://doi.org/10.1177/09763996211020687.

[8] Białkowski, Jedrzej, Katrin Gottschalk, and Tomasz Piotr Wisniewski. 2008. "Stock Market Volatility around National Elections." *Journal of Banking and Finance* 32 (9): 1941–53. DOI:https://doi.org/10.1016/j.jbankfin.2007.12.021.

[9] Boubaker, Sabri, John W. Goodell, Dharen Kumar Pandey, and Vineeta Kumari. 2022. "Heterogeneous Impacts of Wars on Global Equity Markets: Evidence from the Invasion of Ukraine." *Finance Research Letters* 48 (May). DOI: https://doi.org/10.1016/j.frl.2022.102934.

[10] Bougatef, Khemaies, and Imen Nejah. 2023. "Does Russia Ukraine War Generate Herding Behavior in Moscow Exchange ?" *Review of Behavioral Finance* 2021. DOI: https://doi.org/10.1108/RBF-01-2023-0014.

[11] Chang, Eric C., Joseph W. Cheng, Ajay Khorana, Abhijit Dutta, Padmabati Gahan, Sangram Keshari Pana, Viktoria Dalko, et al. 2018. "The COVID-19 Pandemic and Herding Behaviour: Evidence from India's Stock Market." *Review of Behavioral Finance* 5 (1): 279–310. DOI: https://doi.org/10.1177/0976399620964635.

[12] Chen, Yi-Chang, Kai-Sheng Chen, Housen Wang, Chunxiu Qiu, and Xinyi Ma. 2018. "Non-Economic Events in China and Herding Behavior." *Advances in Social Science, Education and Humanities Research* 184 (Icesem): 1243–46. DOI: https://doi.org/10.2991/icesem-18.2018.290.

[13] Cont, rama, and Jean-Philipe Bouchaud. 2000. "Herd Behavior and Aggregate Fluctuations in Financial Markets." *Macroeconomic Dynamics*, 170–96. DOI: https://doi.org/10.1017/S1365100500015029

[14] Das, Debojyoti, M Kannadhasan, and Malay Bhattacharyya. 2019. "Do the Emerging Stock Markets React to International Economic Policy Uncertainty , Geopolitical Risk and Financial Stress Alike ?" *North American Journal of Economics and Finance* 48 (January): 1–19. DOI: https://doi.org/10.1016/j.najef.2019.01.008.

[15] Dhall, Rosy, and Bhanwar Singh. 2020. "The COVID-19 Pandemic and Herding Behaviour: Evidence from India's Stock Market." *Millennial Asia*. DOI: https://doi.org/10.1177/0976399620964635.

[16] Espinosa-Méndez, Christian, and Jose Arias. 2020a. "COVID-19 Effect on Herding Behaviour in European Capital Markets." *Finance Research Letters*, no. September: 101787. DOI:https://doi.org/10.1016/j.frl.2020.101787.

[17] Espinosa-Méndez, Christian, and José Arias. 2020b. "Herding Behaviour in Asutralian Stock Market: Evidence on COVID-19 Effect." *Applied Economics Letters* 28 (21): 1898–1901. DOI:https://doi.org/10.1080/13504851.2020.1854659.

[18] Fajgelbaum, Pablo, and Amit Khandelwal. 2021. "THE ECONOMIC IMPACTS OF THE US-CHINA TRADE WAR." *NBER Working Paper Series*. DOI: https://doi.org/10.1146/annurev-economics-051420-110410.

[19] Fan, Rui, Oleksandr Talavera, and Vu Tran. 2020. "Social Media, Political Uncertainty, and Stock Markets." *Review of Quantitative Finance and Accounting* 55 (3). DOI: https://doi.org/10.1007/s11156-020-00870-4.

[20] Ferreruela, Sandra, and Tania Mallor. 2021. "Herding in the Bad Times: The 2008 and COVID-19 Crises." *North American Journal of Economics and Finance* 58 (August): 101531. DOI:https://doi.org/10.1016/j.najef.2021.101531.

[21] Ghosh, Bikramaditya, Kazouz Hayfa, Trina Saha, and Kumari Anisha. 2023. "Long Memory amidst Crisis : ASEAN Evidence Long Memory amidst Crisis : ASEAN Evidence." *Empirical Economics Letters*, no. July. DOI: https://doi.org/10.5281/zenodo.8146746.

[22] Ghosh, Bikramaditya, and Emira Kozarevic. 2019. "Multifractal Analysis of Volatility for Detection of Herding and Bubble : Evidence from CNX Nifty HFT ' Multifractal Analysis of Volatility for Detection of Herding and Bubble : Evidence from CNX Nifty HFT .'" *Investment Management and Financial Innovations* 16 (September). DOI: https://doi.org/10.21511/imfi.16(3).2019.17.

[23] Ghosh, Bikramaditya, M. C. Krishna, Shrikanth Rao, Emira Kozarević, and Rahul Kumar Pandey. 2018. "Predictability and Herding of Bourse Volatility: An Econophysics Analogue." *Investment Management and Financial Innovations* 15 (2): 317–26. DOI: https://doi.org/10.21511/imfi.15(2).2018.28.

[24] Ghosh, Bikramaditya, Corlise Le Roux, and Anjali Verma. 2020. "Investigation of the Fractal Footprint in Selected EURIBOR Panel Banks." *Banks and Bank Systems* 15 (1): 185–98. DOI:https://doi.org/10.21511/bbs.15(1).2020.17.

[25] Ghosh, Bikramaditya, J. S. Saleema, Aniruddha Oak, K. S. Manu, and R. Sangeetha. 2020. "Long Memory Investigation during Demonetization in India." *Investment Management and Financial Innovations* 17 (2): 297–307. DOI: https://doi.org/10.21511/imfi.17(2).2020.23.

[26] Gong, Pu, and Jun Dai. 2017. "Monetary Policy, Exchange Rate Fluctuation, and Herding Behavior in the Stock Market." *Journal of Business Research* 76: 34–43. DOI: https://doi.org/10.1016/j.jbusres.2017.02.018.

[27] Gong, Weili, Silin Li, and Hongxin Yu. 2022. "Herding Behavior in China's Stock Market under the Background of Implementation of the SHKSC Policy." *Discrete Dynamics in Nature and Society* 2022. DOI:https://doi.org/10.1155/2022/7278023.

[28] Gopal, Suresh, and Jothi Munusamy. 2016. "Causal Relationship between Gold, Crude Oil & US Dollar Rates and S&P BSE 100 in India: An Experimental Study." *International Journal of Financial Management* 6 (2). DOI: https://doi.org/10.26643/gis.v11i5.3414.

[29] Guidolin, Massimo, and Eliana la Ferrara. 2010. "The Economic Effects of Violent Conflict: Evidence from Asset Market Reactions." *Journal of Peace Research* 47 (6): 671–84. DOI:https://doi.org/10.1177/0022343310381853.

[30] He, Yinghua, Ulf Nielsson, and Yonglei Wang. 2017. "Hurting without Hitting: The Economic Cost of Political Tension." *Journal of International Financial Markets, Institutions and Money* 51: 106–24. DOI:https://doi.org/10.1016/j.intfin.2017.08.011.

[31] Huang, Jim Yuh, Joseph C.P. Shieh, and Yu Cheng Kao. 2016. "Starting Points for a New Researcher in Behavioral Finance." *International Journal of Managerial Finance* 12 (1): 92–103. DOI:https://doi.org/10.1108/IJMF-05-2015-0111.

[32] Hudson, Robert, and Andrew Urquhart. 2014. "War and Stock Markets: The Effect of World War Two on the British Stock Market." *International Review of Financial Analysis* 40: 166–77. DOI:https://doi.org/10.1016/j.irfa.2015.05.015.

[33] Hurst, Harold edwin. 1951. "Long-Term Storage Capacity of Reservoirs." *Transactions of the American Society of Civil Engineers* 6: 770–799.

[34] Hwang, Soosung, and Mark Salmon. 2004. "Market Stress and Herding." *Journal of Empirical Finance* 11 (4): 585–616. DOI: https://doi.org/10.1016/j.jempfin.2004.04.003.

[35] Ihlen, Espen A.F. 2012. "Introduction to Multifractal Detrended Fluctuation Analysis in Matlab." *Frontiers in Physiology* 3 JUN (June): 1–19. DOI: https://doi.org/10.3389/fphys.2012.00141.

[36] Kantelhardt, Jan W., Stephan A. Zschiegner, Eva Koscielny-Bunde, Shlomo Havlin, Armin Bunde, and H. Eugene Stanley. 2002. "Multifractal Detrended Fluctuation Analysis of Nonstationary Time Series." *Physica A: Statistical Mechanics and Its Applications* 316 (1–4): 87–114. DOI: 10.1016/S0378-4371(02)01383-3.

[37] Khan Tabassum, and G. Suresh. 2022. "Do All Shocks Produce Embedded Herding and Bubble? An Empirical Observation of the Indian Stock Market." *Investment Management and Financial Innovations* 19 (3): 346–59. DOI: https://doi.org/10.21511/imfi.19(3).2022.29.

[38] Krishna T. A., and B. Suresha. 2021. "Do Geopolitical Tensions Instigate Mindless Following in Stock Markets? An Empirical Enquiry into the Indices of CNX Nifty HFT." *Investment Management and Financial Innovations* 18 (2): 335–49. DOI: https://doi.org/10.21511/imfi.18(2).2021.27.

[39] Krishna T.A., and B.Suresha. 2022. "Intensified Geopolitical Conflicts and Herding Behavior: An Evidence from Selected Nifty Sectoral Indices during India-China Tensions in 2020." *Investment Management and Financial Innovations* 19 (1): 300–312. DOI: https://doi.org/10.21511/imfi.19(1).2022.23.

[40] Kumar, Sanjeev, Reetika Jain, Faruk Balli, and Mabruk Billah. 2023. "Interconnectivity and Investment Strategies among Commodity Prices , Cryptocurrencies , and G-20 Capital Markets : A Comparative Analysis during COVID-19 and Russian-Ukraine War." *International Review of Economics and Finance* 88 (April): 547–93. DOI: https://doi.org/10.1016/j.iref.2023.06.039.

[41] Kumar, Sunil, and Nivedita Deo. 2009. "Multifractal Properties of the Indian Financial Market." *Physica A: Statistical Mechanics and Its Applic ations* 388 (8). DOI:https://doi.org/10.1016/j.physa.2008.12.017.

[42] Liu, Yang, Liyan Han, and Yang Xu. 2021. "The Impact of Geopolitical Uncertainty on Energy Volatility." *International Review of Financial Analysis* 75 (March). DOI: https://doi.org/10.1016/j.irfa.2021.101743.

[43] Loang, Ooi Kok, and Zamri Ahmad. 2023. "Economic and Political Factors on Herding in Islamic GCC Stock Markets during COVID-19 Pandemic." *International Journal of Islamic and Middle Eastern Finance and Management*. DOI: https://doi.org/10.1108/IMEFM-01-2022-0019

[44] Makololo, Prudence, and Yudhvir Seetharam. 2020. "The Effect of Economic Policy Uncertainty and Herding on Leverage: An Examination of the BRICS Countries." *Cogent Economics and Finance* 8 (1). DOI:https://doi.org/10.1080/23322039.2020.1821482.

[45] Manela, Asaf, and Alan Moreira. 2017. "News Implied Volatility and Disaster Concerns." *Journal of Financial Economics* 123 (1): 137–62. DOI: https://doi.org/10.1016/j.jfineco.2016.01.032.

[46] Mertzanis, Charilaos, and Noha Allam. 2018. "Political Instability and Herding Behaviour: Evidence from Egypt's Stock Market." *Journal of Emerging Market Finance* 17 (1): 29–59. DOI:https://doi.org/10.1177/0972652717748087.

[47] Naimy, Viviane, José María Montero, Rim El Khoury, and Nisrine Maalouf. 2020. "Market Volatility of the Three Most Powerful Military Countries during Their Intervention in the Syrian War." *Mathematics* 8 (5): 1–21. DOI:https://doi.org/10.3390/MATH8050834.

[48] Petrov, Alexander, Elliot Hentov, and Fabrizio Zumbo. 2018. "How Does Geopolitics Affect Financial Markets?" https://bc.edu/matteo-iacoviello/gpr.htm#home.

[49] Plakandaras, Vasilios, Periklis Gogas, and Theophilos Papadimitriou. 2019. "The Effects of Geopolitical Uncertainty in Forecasting Financial Markets: A Machine Learning Approach." *Algorithms* 12 (1). DOI:https://doi.org/10.3390/a12010001.

[50] Popescu, Marius, and Zhaojin Xu. 2018. "Mutual Fund Herding and Reputational Concerns." *Journal of Economics and Finance* 42 (3): 550–65. DOI: https://doi.org/10.1007/s12197-017-9405-y.

[51] Ricciardi, Victor, and Helen K. Simon. 2000. "What Is Behavioral Finance?" DOI:https://doi.org/10.1002/9780470404324.hof002009.

[52] Schneider, Gerald, and Vera E. Troeger. 2006. "War and the World Economy: Stock Market Reactions to International Conflicts." *Journal of Conflict Resolution* 50 (5): 623–45. DOI:https://doi.org/10.1177/0022002706290430.

[53] Selmi, Refk, and Jamal Bouoiyour. 2020. "Arab Geopolitics in Turmoil: Implications of Qatar-Gulf Crisis for Business." *International Economics* 161: 100–119. DOI: https://doi.org/10.1016/j.inteco.2019.11.007.

[54] Sohag, Kazi, Rogneda Vasilyeva, Alina Urazbaeva, and Valentin Voytenkov. 2022. "Stock Market Synchronization: The Role of Geopolitical Risk." *Journal of Risk and Financial Management* 15 (5). DOI:https://doi.org/10.3390/jrfm15050204.

[55] Soltani, Hassen, Mohamed Bilel Triki, Mohamed Ghandri, and Fouzi Tahar Abderzag. 2021. "Does Geopolitical Risk and Financial Development Matter for Economic Growth in MENA Countries?" *Journal of International Studies* 14 (1): 103–16. DOI: https://doi.org/10.14254/2071-8330.2021/14-1/7.

[56] Sornette, D. 2003. "Critical Market Crashes." *Physics Reports* 378 (1): 1–98. DOI:https://doi.org/10.1016/S0370-1573(02)00634-8.

[57] Talbi, Dorra, Hasna Chaibi, and Aymen Maoueti. 2021. "Political Uncertainty, Financial Crises, and Stock Market Volatility: Evidence from MENA Region." *Journal of Public Affairs*, no. November. DOI:https://doi.org/10.1002/pa.2783.

[58] BBC. 2023. "What Is Nato and How Is It Helping Ukraine?" BBC. 2023. https://www.bbc.com/news/world-europe-18023383.

[59] Business Insider. 2022. "As Russia Declares War on Ukraine, $177 Billion Wiped out from Indian Markets in the First Hour of Trade." *Business Insider*, February 2022. https://www.businessinsider.in/stock-market/news/india-stock-market-down-sharply-as-russia-declares-war-on-ukraine/articleshow/89791440.cms#:~:text=hour of trade-,As Russia declares war on Ukraine%2C %24177 billion wiped out,the first hour of trade&text=S

[60] Business Standard. 2022. "Russia-Ukraine Crisis: NSE FMCG Index Hits 9-Month Low, Metal Firms Soar." *Business Standard*, 2022. https://www.business-standard.com/article/markets/russia-ukraine-crisis-nse-fmcg-index-hits-9-month-low-metal-firms-soar-122030200060_1.html.

[61] Fortune India. 2022. "Russia-Ukraine War: Indian Stocks That Took a Beating." *Fortune India*, 2022. https://www.fortuneindia.com/investing/russia-ukraine-war-indian-stocks-that-took-a-beating/107239.

[62] Middle East Business. 2022. "Revise down Indian Economy Growth Forecast for 2022 amid Russia-Ukraine Crisis." *Middle East Business*, 2022. https://middleeast-business.com/revise-down-indian-economy-growth-forecast-for-2022-amid-russia-ukraine-crisis/.

[63] The Economic Times. 2022a. "All Fall down after Russia Uses Putin Option." *The Economic Times*, 2022. https://economictimes.indiatimes.com/markets/stocks/news/all-fall-down-after-russia-uses-putin-option/articleshow/89813611.cms.

[64] The Economic Times 2022b. "China Stocks Close Lower as Russia Attacks Ukraine." *The Economic Times*, 2022. https://economictimes.indiatimes.com/markets/stocks/news/china-stocks-close-lower-as-russia-attacks-ukraine/articleshow/89797125.cms.

[65] The Economic Times. 2022c. "Cloud over $500 Million Exports to Russia, CIS Countries." *The Economic Times*, 2022. https://economictimes.indiatimes.com/news/economy/foreign-trade/cloud-over-500-million-exports-to-russia-cis-countries/articleshow/89881627.cms.

[66] The Economic Times. 2022d. "Wheat and Poultry Exports May Rise." *The Economic Times*, 2022. https://economictimes.indiatimes.com/news/economy/foreign-trade/wheat-and-poultry-exports-may-rise/articleshow/89810400.cms.

[67] The Indian Express. 2023. "One Year of Russia-Ukraine War: The Impact on Indian Economy, Domestic Markets." *The Indian Express*, 2023. https://indianexpress.com/article/business/economy/russia-ukraine-war-anniversary-indian-economy-domestic-markets-8462853/.

[68] Thompson, James R., and James R. Wilson. 2016. "Multifractal Detrended Fluctuation Analysis: Practical Applications to Financial Time Series." *Mathematics and Computers in Simulation* 126: 63–88. DOI:https://doi.org/10.1016/j.matcom.2016.03.003.

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