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DO GLOBAL DISRUPTIVE EVENTS INDUCE HERDING BEHAVIOUR DURING UPWARD AND DOWNWARD MARKET MOVEMENTS? EVIDENCE FROM NORDIC AND BALTIC STOCK MARKETS

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Abstract

Over the recent decades, the world has experienced several major disruptive events with far-reaching global impacts on societies, economies and financial systems. This study investigates the financial market reactions to one of the most recent global disruptive events, the COVID-19 pandemic, focusing on the role of investors' herding behaviour during uncertainty. While previous research has mainly explored this on Asian and American markets, our study addresses this gap in understanding Northern European reactions, particularly in rising and falling markets, and aims to explore the existence of herding during the COVID-19 pandemic and to further investigate its occurrence and intensity during the periods of upward and downward movements. It uses Nasdaq Nordic and Baltic daily stock data and employs the cross-sectional absolute deviation method to estimate the reaction of individual Nordic and Baltic stock markets. The results reveal that herding was observed on three out of four Nasdaq Nordic stock markets (Sweden, Denmark and Finland) and one out of three Nasdaq Baltic stock markets (Lithuania). This behaviour persisted throughout the entire COVID-19 period and during market downturns, with no herding observed during upward market movements. This study contributes novel insights into herding on Northern European stock markets, highlighting distinct investor responses to the same global disruption and emphasizing the likelihood of herding during market downturns due to fear and uncertainty. Additionally, the research indicates more pronounced herding behaviour in developed rather than frontier stock markets, suggesting that during global disruptive events, smaller and less liquid stock markets might react more rationally, although more research is needed.

Implications for Central European audience: Acknowledging herding behaviour during global disruptive events is relevant for both investors and policymakers. Investors in Central and Eastern European countries can benefit from their awareness of herding behaviour, especially during market downturns, by taking advantage of mispriced assets. Moreover, understanding the psychological biases driving herding can promote more rational decision-

making, enabling investors to resist panic selling. Meanwhile, policymakers can implement measures to promote market rationality, such as investor education programmes, aimed at building investors' cognitive resilience and understanding of portfolio management strategies during turbulent times. Investors' ability to recognize and mitigate the effects of herding behaviour should enhance their rationality and promote more efficient financial markets.

Keywords: Herding; market movements; global disruptive event; COVID-19; CSAD
JEL Classification: G10, G14, G41

Introduction

Over the last decades, the world has experienced several major disruptive events leading to global implications. In this study, we define a global disruptive event as a significant occurrence or phenomenon that has far-reaching and often unexpected impacts on societies, economies or systems worldwide, causing substantial changes and challenging established norms and routines. It is usually in hindsight that we fully comprehend and interpret the impact of these events, highlighting their multifaceted nature (Aldao et al., 2021). Recent instances of global disruptive events include, but are not limited to, the global financial crisis of 2008-2009, the 2001 terrorist attacks, the COVID-19 pandemic and the Russo-Ukrainian War since 2022. Each of these occurrences has provoked temporary suspensions of regular global activities, while their outcomes and impacts exhibit a diversity of consequences. Certain events, such as global financial crises, wield pronounced environmental, economic and political implications, triggering complex alterations on a worldwide and localized scale. Financial markets are not an exception. During turbulent times, stock markets often crash with sharp drops in trading volumes and sales prices, as well as loss of investors' confidence (Edey, 2009). For example, Bala and Takimoto (2017) documented that the variability of daily returns increases during crises, indicating an increase in market volatility. Other events predominantly exercise their influence on individuals psychology, subsequently striking on the entire economies and other systems. For instance, the COVID-19 pandemic and its associated restrictions primarily affected individual behaviour and psychology before cascading into broader economic and societal effects. Engelhardt et al. (2021) found that on less efficient financial markets, market volatility increased significantly during the COVID-19. Rapid surges or declines in stock prices can lead to bounded rationality or even irrational investor behaviour and affect the efficiency of the entire market.

Bounded rationality, or even irrational investor behaviour, emerges on financial markets when investment decisions deviate from the logical, rational decision-making model incorporating the assessment of risk and return, as well as the use of available information criteria (Legenzova & Leckė, 2024). Such irrational investor decisions are influenced by emotions, psychology and cognitive limitations, with the main focus on behavioural biases (Julmi, 2019). On financial markets, irrational investor behaviour is associated with overreaction and underreaction (Igual et al., 2017), overconfidence (Mushinada & Veluri, 2018), loss aversion (Igual et al., 2017), herding (Teng & Liu, 2014; Zhou & Lai, 2009) and other behavioural biases leading to market inefficiency, instability or even market crashes. For example, Trinugroho and Sembel (2011) found that overconfident investors are more likely to engage in excessive trading, increasing market volatility.

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Herding behaviour is a phenomenon among individual investors following the actions of other market participants while ignoring fundamental information or analysis (Spyrou, 2013). It is driven by fear, uncertainty and the human tendency to follow the crowd. Herding behaviour can exacerbate market uncertainty, instability, fluctuations or even extreme volatility and lead to irrational decision-making. It is indeed a critical aspect of efficiency of financial markets that requires discussion, especially in times of global disruptive events. Anagnostidis et al. (2016) proved that during periods of financial instability, herding behaviour exhibited by market participants contributes to price swings, ultimately causing significant levels of market inefficiency. Previous studies have documented the presence of herding behaviour on stock markets during global disruptive events, such as the 2008 financial crisis (Aharon, 2020; Teng & Liu, 2014) and COVID-19 (Ampofo et al., 2023; Bogdan et al., 2022; Jiang et al., 2022; Maquieira & Mendez, 2022; Rubesam & Raimundo, 2022; Vidya et al., 2023) with a very limited scope of studies on Eastern and Northern Europe (Filip et al., 2015). Moreover, some studies have further looked into the situation, aiming to understand whether and how herding behaviour intensified during downward and upward market movements, but mainly on Asian markets (Mishra & Mishra, 2021; Vidya et al., 2023; Zhou & Lai, 2009), arriving at diverse results. The inconclusive nature of findings regarding the occurrence of herding behaviour in periods of upward and downward market movements, especially during disruptive global events, underscores the need for further investigation. The recent COVID-19 pandemic makes it a relevant case for analysis due to its complexity, life-threatening impact on the population and economic and non-economic preventive measures taken at all levels. The COVID-19 pandemic has caused global disruptions, leading to governmental responses aimed at curbing virus transmission and mitigating economic consequences through stimulus packages. On the other hand, it has significantly affected investor psychology, resulting in heightened levels of fear and uncertainty. As a result, behavioural biases such as herding are likely to have played a role during this pandemic. Several studies have already explored herding behaviour during the COVID-19 pandemic on Asian and American stock markets (Dhall & Singh, 2020; Jiang et al., 2022; Maquieira & Mendez, 2022; Rubesam & Raimundo, 2022; Vidya et al., 2023). However, studies on Eastern and Northern European countries are rather limited (Rubesam & Raimundo, 2022), especially questioning the presence and intensity of herding on falling and rising financial markets.

For this study, we have chosen to investigate Nordic and Baltic stock markets, collectively representing the Northern European region. Stock exchanges in this geographical region are operated by Nasdaq, except for the Norwegian stock market, which has been excluded from the scope of this study. The Nasdaq Nordic stock market comprises four countries: Iceland, Denmark, Finland and Sweden, while the Nasdaq Baltic stock market is represented by three countries: Lithuania, Latvia and Estonia. Both markets are renowned for their advanced Nasdaq trading technology, serving as platforms for trading diverse types of securities and hosting trading activities on the main and alternative markets. As of 31 December 2022, a total of 1251 companies were listed on both Nasdaq Nordic and Baltic markets, with 693 companies traded on the main market, which was the primary focus of our study. As of 31 January 2023, the total market capitalization of Nasdaq Nordic and Baltic stock markets amounted to 1,759 trillion euros. Although the Nasdaq Nordic and Baltic stock markets did not hold a position in Europe in terms of market capitalization, they differed significantly from

larger markets due to their size, limited trading activity and potential and the way business is conducted in the Nordic and Baltics (Pilvere-Javorska & Pilvere, 2020), making it an interesting case for herding behaviour analysis.

Herding behaviour during disruptive events has been explored in a few previous studies on both Nasdaq Nordic and Nasdaq Baltic stock markets. Mobarek et al. (2014) found evidence of herding on the Nordic market during the Eurozone and global crises, with stronger herding behaviour observed during the Eurozone crisis. Filip et al. (2015) demonstrated the presence of herding on the stock markets of Latvia and Lithuania during the global financial crisis. Pochea et al. (2017) uncovered evidence of herding on the stock markets of Latvia, Lithuania and Estonia from 2003 to 2013 and noted that herding tends to become more prominent during market downturns. Nevertheless, the research into the occurrence of herding behaviour during disruptive events, especially during COVID-19, on the Nordic and Baltic markets remains insufficient and calls for further investigation. Moreover, to our knowledge, there is no prior research exploring herding behaviour during downward and upward market movements during COVID-19 on the Baltic and Nordic stock markets. The current study is aiming to fill in these research gaps. The purpose of this study is to gather empirical evidence on the existence of herding behaviour on the Nordic and Baltic stock markets within one of the most recent global disruptive events, namely the COVID-19 pandemic, and to further investigate its occurrence and intensity during the periods of upward and downward movements on these markets.

1 Literature Review

Herding refers to the illogical behaviour of investors who, despite their knowledge and expertise, mimic the decisions made by other investors whom they perceive as more knowledgeable (Blasco & Ferreruela, 2008). It is individuals' behaviour on financial markets influenced by the actions and choices of other investors instead of adhering to fundamental investment rules (Bekiros et al., 2017). Keynes (1937), one of the first to analyse herding behaviour, described it as investors' actions based on uncertainty, panic and fear, when individuals are dominated by their instinct and their actions are influenced by their sentiment and impulse, leading to irrational investor behaviour that can escalate into a market bubble or even crashes. For example, Philippas et al. (2013) investigated US REIT market data and found that herding is more likely to occur when fear prevails on the market. Similarly, Huang and Wang (2017) proved evidence that investors' herding behaviour increased with the increase of investors' fear on the Taiwan stock market.

During periods of market disturbances, it is common for investors to act together to increase the market (Bogdan et al., 2022; Jirasakuldech & Emekter, 2021; Clements et al., 2017; Filip et al., 2015) and stock return volatility (Marbun & Haryetti, 2020), which could potentially undermine market efficiency. It is argued that herding behaviour among investors leads to an increased level of stock return volatility because investors become more willing to take on additional risk (Marbun & Haryetti, 2020). During periods characterized by pronounced fluctuations in stock prices, investors are inclined to suppress their personal beliefs and instead adhere to the prevailing market consensus (Santi & Zwinkels, 2023). The impact of herding poses a threat to market efficiency and hinders investment diversification opportunities (Bouri et al., 2021). Herding on the stock market can lead not only to increased market volatility but also to the formation of bubbles (Ayoub & Balawi, 2022). On emerging

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stock markets, herding is a factor contributing to these bubbles, as investors tend to make trading decisions that can cause stock prices to deviate from their intrinsic value (Filip et al., 2015). Such deviations can then trigger overshooting tendencies and potentially lead to stock market crashes. While most research emphasizes the negative impact of herding on markets, there are differing viewpoints regarding its effects. The negative influence of herding on stock prices may not apply universally (Komalasari et al., 2022). As discussed by Jabeen et al. (2022), herding can be viewed as a useful tool to generate returns. Similarly, Chen et al. (2012) proved that herding behaviour among foreign institutional investors on the Taiwan stock market has a favourable effect on future industrial returns during both tranquil periods and turbulent times. This is especially true when institutional investors possess more advanced information compared to individual investors. In addition, a study conducted on GCC markets concluded that the presence of herding may be related to investors' greater interest in portfolio diversification (Youssef & Mokni, 2018).

Herding behaviour on stock markets has been documented in times of multiple global disruptive events. Occurrences of herding during the 2008 financial crisis on the American, European and Asian stock markets were identified in multiple previous studies. For instance, Filip et al. (2015) discovered evidence of herding in Croatia, Hungary, Latvia, Lithuania and Slovenia during the 2008 financial crisis when these markets experienced substantial fluctuations. Similarly, Aharon (2020) provided evidence of more pronounced herding during the 2008 financial crises within 10 size-ranked portfolios constructed of stocks traded on the NYSE, AMEX and NASDAQ stock markets. Teng and Liu (2014) not only found herding within four Greater China stock markets (Taiwan, Hong Kong, Shanghai and Shenzhen) but also proved herding to be contagious across the markets. Other research has proved the presence of herding behaviour during the COVID-19 pandemic. Ampofo et al. (2023) observed herding on the UK and US stock markets during the COVID-19 pandemic, a behavioural bias being absent in the pre-pandemic period. Aslam et al. (2021) found that Spain exhibited herding behaviour as it was heavily affected by COVID-19. Fang et al. (2021) demonstrated that European stock markets experienced increased herding because of COVID-19. However, the manifestation of herding behaviour during such volatile times is not uniform across all global stock markets. Rubesam and Raimundo (2022) conducted a study on stock markets including Australia, Belgium, Brazil, China, France, Italy, Japan, Sweden, the UK and the US during the COVID-19 pandemic. Their research discovered that herding effects were only observed on the stock markets of Italy, Sweden and the US. Interestingly, their findings indicated a relationship between the intensity of government actions implemented to control the pandemic, such as closing schools and workplaces and imposing travel restrictions, and the occurrence of herding. On the other hand, measures aimed at boosting the economy were found to increase the prevalence of herding behaviour. On the Spanish and Portuguese stock markets, Ferreruela and Mallor (2021) discovered herding behaviour before and after but not during the 2008 global financial crisis and the COVID-19 pandemic.

Financial markets experience fluctuations over both good and turbulent times due to many reasons. Upward and downward movements in trading volumes and stock prices are common practices on financial markets. However, such fluctuations become more pronounced during global disruptive events when not only fundamentals but also sentiments and cognitive human reactions tend to exaggerate market movements. For example,

downward market movements during the COVID-19 pandemic on 15 Asian stock markets primarily affected the sentiments of individual investors (Mishra & Mishra, 2021) and subsequently influenced the behaviour of the entire market. Instead of relying on fundamentals and their investment strategies on rising or falling markets, investors often imitate the actions of others whom they consider to be better informed (Ah Mand et al., 2021), giving rise to herding behaviour. Zhou and Lai (2009) found a prevalence of herding behaviour on the Hong Kong equity market during financial crises, particularly on declining markets. Vidya et al. (2023) observed signs of herding among investors on Vietnamese, Indonesian, Indian and Singaporean stock markets during the COVID-19 period, especially when the markets were growing. Ampofo et al. (2023) provided evidence of herding behaviour on both UK and US stock markets during the COVID-19 period when the markets were expanding. Interestingly, Dhall and Singh (2020) detected herding behaviour on the stock market throughout the COVID-19 period, regardless of whether it was experiencing downward or upward movements. The evidence of herding in both upward and downward market movements during global disruption is limited and inconclusive. The existing research has yielded varying results which could be explained by the variations observed in stock markets and their levels of development.

2 Methodology

This study employs daily data on closing stock prices for 477 companies listed on the main markets of Nasdaq Nordic and Baltic stock exchanges for at least the past seven years. Our analysis examines herding behaviour separately for each country's stock market. Daily closing prices of the main regional indices (OMX Baltic Benchmark GI and OMX Nordic 40) are used as benchmarks. The study period covers the stretch from 1 December 2019, to 23 February 2022. The chosen data period inception aligns with the first reported instances of COVID-19 in China on 19 December 2019 and the end of the study period precedes the Russian invasion of Ukraine on 24 February 2022, which we consider a new global disruptive event.

To investigate herding on the Nasdaq Nordic and Baltic stock markets, the cross-sectional absolute deviation (CSAD) methodology, along with the ordinary least squares (OLS) estimation method, is employed. Herding research commonly employs calculations of two measures – the cross-sectional standard deviation (CSSD) proposed by Christie and Huang (1995) and the cross-sectional absolute deviation (CSAD), introduced by Chang et al. (2000). The CSSD quantifies the dispersion of asset returns across sections in relation to the mean market return (Christie & Huang, 1995). Its purpose is to determine whether herding behaviour leads investors to converge towards market consensus, thereby maintaining similarity between returns and market returns. On the other hand, Chang et al. (2000) proposed the CSAD as a strict alternative measure based on the work of Christie and Huang (1995). Existing scientific literature suggests that the CSAD measure provides an assessment of herding prevalence compared to CSSD. For instance, Purba and Faradynawati (2012), using the CSSD measure, concluded that there is no herding on the stock market. However, their study employing the CSAD measure revealed evidence of herding behaviour among capitalization and highly liquid stocks. The enhanced validity of CSAD over CSSD has also been supported by Adem & Sarıoğlu (2020). Their study indicated that, according to the CSSD measure, herding, aligned with market consensus, only occurs

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during the upward market. However, by employing the CSAD measure, their study illustrated the persistence of herding on the Istanbul stock market, regardless of market movement.

Considering the findings of previous research, the CSAD measure is chosen for our analysis as it has proven to be effective in capturing the subtleties of herding behaviour on stock markets. The coefficient of dispersion is calculated as follows:

$$CSAD_t = \frac{1}{N}\sum_{i=1}^{N}\left|R_{i,t} - R_{m,t}\right| \quad (1)$$

where $R_{i,t}$ is the return of the stock *i* at the time *t*, $R_{m,t}$ is the average return of the market at the time *t* and *N* denotes the number of stocks in the sample at the time *t*.

The first step of data analysis examines the occurrence of herding behaviour separately on each stock market. To estimate herding on stock markets, the following equation is used:

$$CSAD_t = \alpha + \lambda_1 \left|R_{m,t}\right| + \lambda_2 {R_{m,t}}^2 + \varepsilon_t \quad (2)$$

where $CSAD_t$ is cross-sectional absolute deviation calculated according to Equation (1), $R_{m,t}$ is the average return of the market at the time *t* and $\mathcal{E}_t$ is the error term. The negative and statistically significant ($p < 0.05$) λ_2 value indicates the presence of herding on the stock market under investigation.

The next step of our analysis involves a separate examination of upward and downward market movements on all individual stock markets. It scrutinizes disparities in the occurrence and intensity of herding between these two directions of market movements. Upward market movements are indicated in the periods of positive daily market returns, whereas downward movements are characterized by negative daily market returns. To examine the presence of herding during upward and downward market movements, the following equation is used:

$$CSAD_t = \alpha + \lambda_1 \left|R_{m,t}\right| + \delta_1 D^{down}\left|R_{m,t}\right| + \lambda_2 (R_{m,t})^2 + \delta_2 D^{down}(R_{m,t})^2 + + \varepsilon_t \quad (3)$$

where $CSAD_t$ is cross-sectional absolute deviation calculated according to Equation (1), $R_{m,t}$ is the average return of the market at the time *t*, D^{down} is the dummy variable equal to 1 when $R_{m,t} < 0$ and $\mathcal{E}_t$ is the error term.

Before constructing the OLS models, the data are checked for time series stationarity using the Dickey-Fuller test. A result with $p < 0.05$ in both tests (with and without trend) indicates that the time series is stationary. This stationarity testing is applied to all dependent and independent variables: the absolute values ($|R_{m,t}|$) and squares ($R_{m,t}^2$) of CSAD, OMX Baltic Benchmark GI and OMX Nordic 40 returns. Once time series stationarity is confirmed, we proceed with further analysis and construct OLS models for each stock market. Then, the fit of the OLS models is assessed by examining the autocorrelation criterion. Positive autocorrelation is assessed using the Durbin-Watson statistic (when the indicator value is below 2). As the Durbin-Watson test yields positive autocorrelation at $p < 0.05$, we reject Hypothesis H1 (autocorrelation exists in the model), implying the absence of autocorrelation. In such a case, there is no need to construct a model with lagged variables. Instead, the established OLS model is used for analysis and evaluation. Alternatively, a model with lagged variables would have to be used (which is not needed in our research).

The OLS models, which are derived from Equation (3), are used for cross-country analysis to evaluate the values of the coefficients λ_2 and δ_2 as well as their statistical significance ($p < 0.05$). In our study, the coefficient λ_2 indicates herding behaviour during upward market movement, while δ_2 represents the variations in herding between downward and upward market movements. As δ_2 represents the disparity between market movements downward and upward, the sum of δ_2 and λ_2 coefficients reflects the presence of herding during the periods of downward market movements. When the sum of the two coefficients is less negative than λ_2 and statistically significant ($p < 0.05$), the conclusion is drawn that the stock market exhibits stronger herding behaviour during upward market movements compared to downward movements.

3 Results

Table 1 reports the descriptive statistics of CSAD for individual Nasdaq Nordic and Nasdaq Baltic stock markets. The Dickey-Fuller statistics are significant for both the market returns and the CSAD, indicating that both series are stable over time. The highest mean values for CSAD are estimated for the stock markets of Finland (M = 0.02005, SD = 0.00950) and Sweden (M = 0.01849, SD = 0.00551).

Table 1 | Descriptive statistics of CSAD

Country	Mean	Std. dev.	Min	Max
Lithuania	0.01201	0.00647	0.00001	0.05126
Latvia	0.01721	0.01542	0.00045	0.15895
Estonia	0.01239	0.00638	0.00004	0.04909
Sweden	0.01849	0.00551	0.01031	0.05552
Iceland	0.01787	0.01673	0.00122	0.11795
Denmark	0.01723	0.00596	0.00843	0.05790
Finland	0.02005	0.00950	0.00449	0.06623

Source: Authors

The findings for the evaluation of herding on Nasdaq Nordic and Baltic stock markets during the COVID-19 pandemic are presented in Table 2. The OLS analysis reveals that herding behaviour is observed on four of the sample stock markets: Lithuania ($\lambda_2 = -2.526$), Sweden ($\lambda_2 = -1.211$), Denmark ($\lambda_2 = -1.931$) and Finland ($\lambda_2 = -4.018$). The results fulfil all criteria ($\lambda_2 < 0$ and $p < 0.05$) to support this assertion. Moreover, some noteworthy differences in the herding intensity among Nordic markets are observed. Herding intensity is not compared on the Baltic stock markets, as herding is detected only on the Lithuanian stock market. The confidence intervals within the OLS model for the Finish stock market (ranging from -5.64106 to -2.9477) indicate higher variation in herding compared to the Swedish and Danish stock markets.

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Table 2 | Herding during COVID-19 in research sample

Country	α	λ_1	λ_2
Lithuania	0.008***	0.661***	**-2.526*** **
Latvia	0.014***	0.536***	0.988
Estonia	0.009***	0.391***	-0.405
Sweden	0.015***	0.366***	**-1.211** **
Iceland	0.013***	0.638***	-3.584
Denmark	0.126***	0.531***	**-1.931*** **
Finland	1.012***	0.985***	**-4.018*** **

Note: *** p < 0.001, ** p < 0.01, * p < 0.05.
Source: Authors

The next step of our analysis involves the evaluation of herding behaviour separately for the periods of upward and downward market movements (see Table 3 for the results). The focus is on comparing how herding manifests in these two directions. To assess the outcomes of OLS models for each Nasdaq Nordic and Nasdaq Baltic stock market, we examine λ_2 values, which indicate herding during upward market movements, and δ_2 values, which show the difference in herding between upward and downward movements. For further interpretation of our findings, we also calculate $\lambda_2 + \delta_2$, allowing us to estimate herding within individual markets during downward market movements. The OLS outcomes reveal no evidence of herding on any of the Nasdaq Nordic and Nasdaq Baltic stock markets during the periods of upward market movements due to the failure to meet the required criteria ($\lambda_2 < 0$ and $p < 0.05$). On the contrary, during the downward market movements, herding is identified on four Nasdaq Baltic stock markets: Lithuania ($\lambda_2 + \delta_2 = -2.032$), Sweden ($\lambda_2 + \delta_2 = -1.099$), Denmark ($\lambda_2 + \delta_2 = -2.263$) and Finland ($\lambda_2 + \delta_2 = -4.061$). Notably, herding behaviour during market downturns is observed on the same four stock markets (Sweden, Denmark, Finland and Lithuania) as during the entire COVID-19 pandemic.

Additionally, on three stock markets (Lithuania, Sweden and Finland) herding intensity is stronger during the entire COVID-19 period compared to the periods of downturn markets, while only the Danish stock market has more intense herding during the falling markets. However, these differences in herding intensities are not significant. On the contrary, when comparing the differences in intensity between upward and downward market movements (δ_2), the same four stock markets exhibit statistically significant and substantial differences in herding behaviour.

Table 3 | Herding during a global disruptive event in research sample under upward and downward market movements

Country	α	λ_1	δ_1	λ_2	δ_2	$\lambda_2 + \delta_2$
Lithuania	0.008***	0.483***	0.107	5.123*	**-7.155*** **	**-2.032** **
Latvia	0.014***	0.573**	-0.125	1.631	0.233	1.864
Estonia	0.009***	0.581***	-0.307***	-4.823	5.734**	0.911*
Sweden	0.015***	0.383***	-0.012	2.165	**-3.264** **	**-1.099***
Iceland	0.013***	0.493**	0.103	3.429	-7.201	-3.772
Denmark	0.013***	0.423***	0.101**	2.561	**-4.824*** **	**-2.263** **
Finland	0.012***	0.932***	0.034	-1.378	**-2.683***	**-4.061***

Note: *** p < 0.001, ** p < 0.01, * p < 0.05.
Source: Authors

4 Discussion

The results of this study support the presence of herding behaviour on Northern European stock markets during the COVID-19 period but only on the Swedish, Danish, Finnish and Lithuanian stock markets, and indicate irrationality within these stock markets during times of global disruption. It adds to the overall body of COVID-19 pandemic-related research on the presence of herding behaviour on stock markets (Ampofo et al., 2023; Bogdan et al., 2022; Jiang et al., 2022; Maquieira & Mendez, 2022; Rubesam & Raimundo, 2022; Vidya et al., 2023). Also, it offers additional insights that herding is not restricted to highly liquid markets such as China and the US (Ampofo et al., 2023; Jiang et al., 2022) but also extends to smaller and less explored regions such as Northern Europe. Regarding individual stock markets, our findings suggest that the impact of the COVID-19 pandemic was more prominent on the Nordic stock markets, as three out of the four Nordic countries (Sweden, Denmark and Finland) experienced herding effects during the COVID-19 period. In the Baltic region, the only affected country was Lithuania. These results provide interesting insights into the fact that although the Nordic countries experienced fewer number of COVID-19 caused cases and deaths than the Baltic countries and imposed more complex support measures, the Nordic population may have been more affected psychologically, which may have contributed to the higher prevalence of herding. The psychological COVID-19 issues have been explored by McCracken et al. (2020), who found that almost half of the analysed Swedish residents reported psychological disorders such as depression or anxiety. Gémes et al. (2022) also provided evidence that Swedish respondents had the highest symptoms of anxiety compared to the sample from France, Germany, Italy, the Netherlands and Spain. These results support our initial assumption that besides economic realities, global disruptive events affect the investors' psychology, which is then reflected in the rationality of financial markets.

We also investigated herding behaviour on Nordic and Baltic stock markets separately for downward and upward market movements during COVID-19, aiming to understand how investors respond to different market dynamics and negative environments during times of disruption. In line with the findings of Ferreruela and Mallor (2021) on Spanish and Portuguese markets, we observed that falling and rising markets had caused variations in investor behaviour in Nordic and Baltic countries. While herding behaviour was absent on all

the sample stock markets during the upward market movements, during the market downturns, it was observed on the Swedish, Danish, Finnish and Lithuanian stock markets. Interestingly, our estimations revealed that the intensity of herding during the market downturn was approximately twice as high as during upward movements. Moreover, the presence and intensity of herding during the market downturns followed the same patterns as throughout the entire COVID-19 period, indicating that herding during market declines affected the market irrationality of the entire COVID-19 period. Our results are consistent with the research findings of Jiang et al. (2022), who showed that herding behaviour is more pronounced on stock markets with large idiosyncratic volatilities during the COVID-19 pandemic. Investors were not only affected by the COVID-19 pandemic but also by market pressure due to price volatility. These findings uncover investors' psychological responses to negative news, constraints caused by the COVID-19 pandemic and conditional volatility of returns. During downward market movements caused by disruptive events, investors tend to experience fear and panic, driving them to follow the general market trend of selling shares and trying to avoid losses (Ampofo et al., 2023). Negative reactions and investor sentiments to market declines during disruptive events are considered among the primary reasons for the formation of spurious herding (Guo et al., 2020). Also, during a downward market movement, investors might exhibit a more pronounced loss aversion bias, making them particularly sensitive to risks on a declining market and increasing the likelihood of displaying herding tendencies (Ferreruela & Mallor, 2021). More research is needed to determine whether all types of disruptive events and their potential negative consequences cause investors to react negatively and herd.

The findings of this study have significant practical implications for investors in Northern and Eastern Europe, particularly in the context of stock market behaviour during periods of global disruption such as the COVID-19 pandemic. Firstly, it builds awareness of the presence of herding on the investigated markets. Individual investors in Nordic and Baltic countries, especially those on the developed stock markets of Sweden, Denmark and Finland, should be aware of the existence of herding behaviour, especially during turbulent times. Such investors can benefit from herding by adjusting their investment strategies in terms of effective risk diversification and taking advantage of mispriced assets (Bogdan et al., 2022). Moreover, understanding the herding driven by cognitive biases should enable individual and, to an extent, institutional investors to resist panic selling and encourage them to review their risk tolerance and ability to withstand market volatility, leading to more rational decision-making. Meanwhile, policymakers can implement measures to promote market rationality, such as investor education programmes aimed at building investors' cognitive resilience and portfolio management strategies during turbulent times. These education programmes should encourage investors to take a long-term perspective and focus on market fundamentals rather than reacting to short-term market fluctuations. Similarly to Bogdan et al. (2022), we also suggest that our results provide additional insights for policymakers on adjusting market rules in times of market turbulence.

This study also presents new evidence that herding behaviour is more pronounced on developed stock markets (Sweden, Denmark and Finland) than on frontier stock markets (Lithuania) within the Northern European region. Our results diverge from the previous research findings (Bogdan et al., 2022; Fang et al., 2021; Jiang et al., 2022; Maquieira &

Mendez, 2022; Vidya et al., 2023), which have reported more prevalent herding on emerging and frontier stock markets than on developed ones. This brings new considerations about the risk tolerance and rationality of individual investors. One argument could be made that investors from Nordic countries characterized by high living standards and advanced economies were less resilient to COVID-19-related pressures and had lower investment risk resilience. Consequently, they followed the market and withdrew their investments. Despite the perception that investors in developed countries have access to better information and high-quality analytical tools, their risk-bearing behaviour and, therefore, rationality might be bounded. In the presence of a large amount of negative information, such investors could become disoriented and vulnerable to the reaction of others, leading to herding behaviour on a stock market. On the other hand, our results also raise interesting considerations regarding smaller, less liquid and transparent Northern European markets such as the stock markets of Latvia and Estonia. Such markets might act more rationally during global disruptive events. However, individuals considering investments in smaller, less liquid and transparent Baltic stock markets should approach their investments with caution. While these markets may seem to exhibit more rational behaviour during global disruptive events, they may also be exposed to limited liquidity, making them riskier and less attractive in the long term. Further research in this respect is needed. Based on our findings, we propose that educational interventions are needed to train investors to assess their investment risk tolerance more efficiently. Also, it may call for interventions from market operators and regulators to develop policies and technological solutions aiming to intervene and, in a timely manner, prevent the formation of herding and other behavioural biases. Similarly to Bouri et al. (2021), we also suggest that market regulators could implement measures to enhance market transparency, reduce information asymmetry and strengthen investor protection. The use of more advanced, innovative and targeted solutions and analytical techniques could enable investors to gain insights into market dynamics and anticipate potential herding behaviour, allowing them to adjust their behaviour accordingly.

Conclusion

The paper contributes to the herding literature by providing evidence of the existence of herding behaviour in times of global disruptive events, not only on highly liquid markets such as China and the US but also on economically developed yet less liquid Northern European stock markets. During the COVID-19, herding was observed on three out of the four Nasdaq Nordic stock markets (Sweden, Denmark and Finland) and one out of the three Nasdaq Baltic stock markets (Lithuania), building awareness of the occurrence of such investor behaviour on these markets. Further investigation of upward and downward market movements revealed diverging results. No herding behaviour was detected on any of the sample stock markets during the upward market movements. However, during the downward market movements, herding behaviour was estimated on the Swedish, Danish, Finnish and Lithuanian stock markets, suggesting that investors were affected not only by the COVID-19 pandemic but also by individual psychological pressures and market volatility. Our results also provide interesting insights that more economically prosperous, more financially educated and less pandemic-affected Nordic investors may have been more psychologically affected and, therefore, were more inclined to herd and act irrationally. Such results support our initial assumption that besides economic realities, global disruptive events affect investors' psychology, which is then reflected in their rationality and in financial market

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efficiency. This calls for further research into the rationality of individual investors during global disruptive events, especially on less liquid yet economically developed markets.

This study had some limitations related to the sample size, which is determined by the stock market size and liquidity. Also, the study assessed herding during the period of COVID-19 and not in the periods before or after it. Consequently, no conclusions can be drawn about whether herding behaviour intensified during COVID-19. All this could be addressed in future research. In addition, although Northern European stock markets belong to the same global marketplace of Nasdaq and are often seen as homogeneous regions, the results of our study show varying degrees of investor rationality and market efficiency across these markets. During the COVID-19 period, herding behaviour was more pronounced on the stock markets of developed countries. This suggests that investors accustomed to high living standards might be less resilient to negative news and risks, and in times of global disruptive events, smaller and less liquid stock markets might prove to be more rational. In future research, it would be relevant to control for the socioeconomic, stock market and investor-specific factors to further explore the determinants of herding behaviour.

Our results bear relevance for policymakers and institutional and individual investors. Policymakers could use our findings to formulate and implement appropriate market efficiency-enhancing policies tailored to the level of market development and efficiency, investor profile and other market-specific factors, including educational interventions. This could involve actions towards more efficient market monitoring and enhanced quality of information transmission aiming to reduce herding behaviour, as well as investor education programmes aiming to build investors' cognitive resilience and effective portfolio construction and management strategies in times of market turbulence. Institutional as well as individual investors should be more aware and knowledgeable about market movements during global disruptive events and build more robust investment strategies to withstand them and resist panic and fear. Herding behaviour promoted by the urge to follow market reactions makes it more difficult to manage and diversify investment portfolios in the hope of lowering investment losses and risks.

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