The COVID-19 Pandemic and Herding Behaviour: Evidence from India’s Stock Market

Rosy Dhall¹ and Bhanwar Singh¹

Abstract
This article examines the herding behaviour at the industry level from national stock exchange (NSE). The novel contribution of this article is to examine the herding behaviour during the whole, pre- and post-coronavirus disease 2019 (COVID-19) pandemic outbreak period. We deployed the popular model proposed by Chang et al. (2000) to examine herd formation. Using daily stock closing prices of 191 firms, which constitute the 12 industry indices for the period from 1 January 2015 to 1 June 2020, the results for the full sample period (1 January 2015 to 1 June 2020) and before COVID-19 outbreak period (1 January 2015 to 29 January 2020) indicate the non-existence of herding formation at the industry level, but they do suggest a strong evidence of anti-herding behaviour. In addition, during the bull and bear market conditions, we found evidence of herding behaviour during the post-COVID-19 outbreak period (1 January 2020 to 1 June 2020). Further, the findings suggest that COVID-19 pandemic caused the formation of herding behaviour at the industry level. The study facilitates investors to devise their trading strategies in the regime of the COVID-19 pandemic.

Keywords
COVID-19, herding behaviour, industry, investor behaviour

¹ Institute of Management Studies and Research, Maharshi Dayanand University, Rohtak, Haryana, India.

Corresponding author:
Bhanwar Singh, Institute of Management Studies and Research, Maharshi Dayanand University, Rohtak, Haryana 124001, India.
E-mail: write2bhanwar@gmail.com
1. Introduction

In the finance literature, behavioural aspect in investment decision has always been a debatable topic for investors, financial asset managers as well as academic researchers (BenSaïda et al., 2015; Chauhan et al., 2019). Behavioural finance suggests that investors mimic others’ action, especially during the turbulent period of fear, uncertainty and panic. The ongoing coronavirus disease 2019 (COVID-19) pandemic has wreaked havoc all over the world economies as well as weakened the stock markets’ performance and has caused panic among stock market participants.

Since December 2019, an unprecedented disease that originated from the Republic of China and was later named as COVID-19 has spread across the world to become a pandemic. After the mass spread of the COVID-19 pandemic within the Republic of China, specifically in the province state of Wuhan, the negative effect of COVID-19 outbreak has been felt all over the world. On 30 January 2020, the World Health Organization (WHO) announced the COVID-19 pandemic as a Public Health Emergency of International Concern (PHEIC) to warn the countries over the world about the spread of the deadly virus. On 11 March 2020, the WHO declared COVID-19 as a pandemic. However, on 24 June 2020, India reported 4,56,183 confirmed positive cases of COVID-19, including 14,476 deaths, 1,83,022 active cases and 2,58,685 recoveries (Indian Express, 2020). The COVID-19 pandemic destabilized the global financial markets, including India’s stock market.

In this article, we examine whether the COVID-19 outbreak causes herd formation in stock markets, specifically at the industry level. Researchers who focused on herd behaviour tend to agree that it is one of the common irrational investment behaviours that may cause abnormal losses and returns in a financial market (Bui et al., 2018). Banerjee (1992) defines herding as ‘everybody doing what everyone else is doing even when their private information suggests doing something else’. Herding behaviour refers to the investor’s tendency to mimic the behaviour of other investors. It is observed that during the turbulent period of uncertainty, investor follows the crowd decision with suppressing their private information (Chauhan et al., 2019). Herd formation causes asset prices to deviate from fundamental value, aggravate volatility of returns, destabilize financial markets, exacerbate the crises and eventually increase the fragility of the financial system (Javaira & Hassan, 2015).

A large number of studies have been conducted to detect investor herding behaviour in the past two decades. However, to the best of our knowledge, this study is the pioneering research work to examine the herding behaviour in the financial market under the present conditions of the COVID-19 pandemic. In normal circumstances, people would have sufficient time to collect adequate information, think rationally, analyse the market and make informed decisions (Mertzanis & Allam, 2018). However, in periods of market distress, for instance, the COVID-19 outbreak, investor is more inclined to follow the crowd decision with suppressing their private information. This article focuses on the Indian stock market and examines whether there is evidence of herding behaviour. Moreover,
we test for herding behaviour during both the pre- and post-COVID-19 outbreak phases as well as for the whole period.

We examine the herd behaviour from an industry perspective for two main reasons. First, this article follows the suggestions of Bikhchandani and Sharma (2001) and Bui et al. (2018), and they argue that investors generally face a similar investment decision problems and intend to observe the trades of others at the industry level. Additionally, asset managers’ suggestions, financial analyst’s analysis and investors’ decisions are based on information dispersed at the industry level (Demirer et al., 2010). Second, the industry index is composed of different stocks, and it is a good approach where herd behaviour in the Indian stock market occurs at the industry level.

We examine the herding behaviour using the cross-sectional absolute deviation (CSAD) measure proposed by Chang et al. (2000). Our findings indicate non-existence of herding behaviour at industry level for full sample and pre-COVID-19 pandemic period, but they do suggest the strong evidence of anti-herding behaviour. In contrast, we found strong evidence of herding behaviour in bull market conditions during the post-COVID-19 outbreak, and also found some evidence of herding formation in bear market conditions. Moreover, our findings contribute to identification of potential risks and guides in devising an appropriate strategy for investment in stock markets during the regime of the COVID-19 pandemic. The rest of the article is organized as follows. Section II discusses the relevant literature. Section III provides the rationale of the study. Section IV explains the data and methodology. Section V presents a relevant methodology to detect herding behaviour. Section VI discusses and presents the empirical results of the study. Section VII concludes the article and provides practical implications for the stock market’s participants.

II. Literature Review

Christie and Huang (1995) defined herding behaviour as an environment where group decisions are followed by investors. Previous studies documented that herding behaviour intensely affected the movement of the stock markets (Jaiyeoba et al., 2018; Ph & Uchil, 2019). Herding causes volatility in the stock markets that disturb the financial system, and therefore, it is an important factor for the policymakers who aim to stabilize the markets (Demirer & Kutan, 2006).

Scharfstein and Stein (1990) argue that portfolio managers are more proven to herding behaviour because they are worried about losing their reputation. In the context of institutional and individual herding, Nofsinger and Sias (2002) documented that institutional investors do excessive positive feedback trading compared to individual investors. Besides, they found that institutional investors’ herding influences asset returns to a great extent than individual investors’ herding. The most cited study of Bikhchandani et al. (1992) argued that informational cascades facilitate to explain the localized conformity of behaviour and the fragility of mass behaviours, which implies an informational cascade occurs when it is optimal for an individual, having observed the actions of those ahead of him.
Chang et al. (2000) found significant prevalence of herding behaviour in South Korean and Taiwanese stock markets and do suggest partial evidence of herding behaviour in Japanese stock markets. In addition, they documented that the US and Hong Kong stock markets are free from herding behaviour. In context, in China, Tan et al. (2008) found that herding behaviour is more severe under up-market conditions, high trading volume and high volatility in Chinese A share market, while they found the absence of herding behaviour in B share market. Further, findings of Chiang and Zheng (2010) suggested that herding behaviour causes deviation in asset prices. Using the data of frontier stock markets, Balcilar et al. (2014) found strong evidence of herding behaviour in Dubai, Kuwait, Qatar and Saudi Arabian stock markets, while they do suggest weak herding behaviour in the Abu Dhabi stock market. During the crisis period, Asian markets are driven by herding behaviour, but American markets are free from herding formation (Chiang & Zheng, 2010). Lakonishok et al. (1992) documented that herding behaviour can be seen in the stock market securities, having a short time horizon. In the context of Italian stock market, Caparrelli et al. (2004) stated that herding behaviour is more common in extreme market conditions. Philippas et al. (2020) documented that the sentiment of investors is attached with different external signals, as they are received from different sources.

Furthermore, Lao and Singh (2011) found a significant presence of herding behaviour in Indian and Chinese stock markets and stated that it was more severe in the Chinese share market. In contrast, recent studies of Kumar et al. (2016) and Dutta et al. (2016) did not find significant presence of market-wise herding in the context of Indian stock market. In addition, Ganesh et al. (2016) examined the presence of herding behaviour at the industry level and found no sign of herding behaviour in the Indian stock market. Moreover, it is interesting to note that findings of recent studies support efficient market hypothesis (Fama, 1970)—this implied that Indian stock markets are informationally efficient, and investors are rational in the selection of financial assets. However, the ongoing COVID-19 pandemic has created an environment of panic and fear in stock markets that has resulted in high volatility, high market concentration, low returns and relatively high inability to mobilize new investment. Therefore, we suppose that probability of herd formation in the Indian stock market during the present conditions of the COVID-19 pandemic is relatively higher than in normal market conditions.

III. Rationale of the Study

Previous studies on pandemics, for instance, SARS, Ebola, Zika, and H1N1, or HIV/AIDS, provide empirical evidence of the impact of epidemics, associated risks and costs and mitigation strategies on the stock markets (Haacker, 2004; Hoffman & Silverberg, 2018; Liu et al., 2020; Loh, 2006; Pendell & Cho, 2013). The ongoing deadly COVID-19 outbreak has wreaked havoc on world economies as well as weakened the stock markets’ performance and hurt the sentiments of stock market participants. India has been greatly hit by the COVID-19 pandemic (Times of India, 2020); hence, the COVID-19 pandemic has proved to be an
unprecedented shock. Stock markets have not yet demonstrated their safe haven properties during any major economic crisis and recession, and early evidence suggests that stock markets failed to display hedging opportunities and flight to safety properties during the COVID-19 pandemic (Albulescu, 2020; Liu et al., 2020; Zhang et al., 2020). Given this finding, we assume that the COVID-19 pandemic can have a black swan effect on the stock market, resulting in behavioural anomalies such as conditional and unconditional herding. Herding behaviour among investors can explain some of the behavioural anomalies against the efficient market hypothesis. However, to the best of authors’ knowledge, it is the first attempt to uncover the herding behaviour in the regime of the COVID-19 pandemic. Furthermore, this study investigates the herding behaviour in different market conditions, for instance, bullish and bearish market conditions. This article attempts to present an integrated model to test the herding behaviour in the period of pandemic.

**IV. Data and Methodology**

**Data**

This study examines the herding behaviour using the daily closing prices of stocks that constitute the sectoral indices of NSE (see Table 1). The sectoral indices of NSE represent the whole industry-wise economy. Table 1 presents the details of the sample for the study, indicating industry index, industry name corresponding to industry index, the abbreviation of industry name used in the analysis and the number of companies that constitute the index corresponding to the industry. On 30 January 2020, the WHO announced the COVID-19 pandemic as a PHEIC to

| Indices                  | Industry/Sector               | Abbreviations | N  |
|--------------------------|-------------------------------|---------------|----|
| Nifty Auto Index         | Automobile                    | AUTO          | 15 |
| Nifty Bank               | Banking                       | BANK          | 12 |
| Nifty Financial Services Index | Financial services     | FIN           | 20 |
| Nifty FMCG Index         | Fast-moving consumer goods    | FMCG          | 15 |
| Nifty IT Index           | Information technology        | IT            | 10 |
| Nifty Media Index        | Media and entertainment       | MEDIA         | 14 |
| Nifty Metal Index        | Metal                         | METAL         | 15 |
| Nifty Pharma Index       | Pharmaceutical                | PHARMA        | 10 |
| Nifty Realty Index       | Real estate                   | REALTY        | 10 |
| Nifty Energy Index       | Energy                        | ENERGY        | 10 |
| Nifty Services Index     | Services                      | SERVICES      | 30 |
| Nifty Infra Index        | Infrastructure                | INFRA         | 30 |

Source: Compile from NSE website.

Notes: N represents the number of companies constitutes an index.
warn the countries about its spread over the world. Later, the WHO declared COVID-19 as a pandemic on 11 March 2020. To detect the herding behaviour among stock market participants pre and post the COVID-19 outbreak, we subdivided the full sample data according to the WHO timeline. Therefore, we decided the cut-off date to subdivide the full sample data into pre and post the COVID-19 outbreak for the study as 30 January 2020, when WHO declared COVID-19 as a PHEIC. Hence, the full sample data have been divided from 01 January 2015 to 01 June 2020 into three subsamples as follows:

1. Whole period: from 01 January 2015 to 01 June 2020
2. Pre-COVID-19 outbreak: from 01 January 2015 to 29 January 2020
3. Post-COVID-19 outbreak: from 30 January 2020 to 01 June 2020

In normal circumstances, people would have sufficient time to collect adequate information, think rationally, analyse the market and make informed decisions (Mertzanis & Allam, 2018). Therefore, we took more than 5 years of data before the COVID-19 pandemic to detect the herding behaviour, and we assumed that the market was in normal trading phase before the COVID-19 outbreak. We obtained all data sets from the ProwessIQ, powered by Centre for Monitoring of Indian Economy (CMIE) database. Further, the entire data set was analysed using Microsoft Excel and Stata.

**Methodology**

First, we drive the daily return of stock $i$ on day $t$ using the following equation:

$$ R_{it} = \ln \left( \frac{P_{i,t}}{P_{i,t-1}} \right) \times 100 $$

where, $R_{it}$ is the stock return $i$ on day $t$, $\ln$ is the natural logarithm, $P_{i,t}$ denotes the closing price for stock $i$ on day $t$ and $P_{i,t-1}$ is the closing price of stock $i$ in the previous trading day, whereas the cross-sectional average stock of $N$ returns ($R_{m,t}$) is calculated by taking an average of all individual stock returns on day $t$ as per the following equation:

$$ R_{m,t} = \frac{\Sigma R_{i,t}}{N} $$

where $R_{i,t}$ is the observed stock return of firm $i$ at time $t$, and $N$ is the number of firms included in the industry index.

**V. Empirical Methods for Herding Detection**

Literature has classified the school of thoughts to test the herding behaviour into broadly two categories—the first school of thought uses the trading data, including buy and sell orders executed by the participants in a given time period (Lakonishok et al., 1992), and the second school of thought uses the financial assets returns
organized into groups of similar characteristics like a country or industry classifications (Chang et al., 2000; Christie & Haung, 1995). Moreover, in this study, we follow the second school of thought to detect the herding behaviour at the industry level by examining the CSAD of stock returns in three phases, respectively—the whole period, pre-COVID-19 outbreak and post-COVID-19 outbreak. We test for herding behaviour at the industry level.

**Chang et al.’s Method with Cross-sectional Absolute Deviation Measure**

Previous studies suggest two widely used measures to detect herding behaviour. One model is proposed by Christie and Haung (1995) and the second by Chang et al. (2000). Literature suggests that issues with cross-sectional dispersion (CSSD) model of Christie and Haung (1995) are threefold. First, Economou et al. (2011) provided evidence that calculated CSSD can be easily biased by an outlier in the data series. Second, Hwang and Salmon (2004) noted that the deployment of dummies to capture extreme market conditions is rather crude, as it limits the sample upon which herding behaviour is tested, for instance, herding behaviour may exist in the stock markets during periods of mild market returns, and this is something the aforementioned model cannot identify (Erdenetsogt & Kallinterakis, 2016). Third, the aforementioned model proposes a linear relationship between CSSD of returns and absolute return of market during the prevalence of herding behaviour; however, there is little certainty of proposed relationship during the presence of herding behaviour. Findings of Lux (1995) and Lux and Marchesi (1999) provide evidence that herding behaviour is capable of introducing non-linear dynamics in the market. Therefore, to account for the aforementioned issues, we use the popular model proposed by Chang et al. (2000) to detect the herding behaviour. As a modification of the Christie and Huang (1995) method, Chang et al. (2000) propose another CSAD, an empirical method for the detection of herding towards average, which is statistically defined as follows:

\[
\text{CSAD}_t = \frac{1}{N} \sum_{i=1}^{N} |R_{i,t} - R_{m,t}|
\]  

where \(CSAD_t\) is a proxy that indicates the distance from the market average return, how much of the stock returns are dispersed around the average return, \(N\) is the total number of stocks in industry index, \(R_{i,t}\) is the return of stock \(i\) on day \(t\) and the variable \(R_{m,t}\) is the cross-sectional average market return at day \(t\). Since herding would increase the correlation of stock returns, the presence of herding in the market would transform the linear relationship between individual stock return and market return based on the capital asset pricing model into a non-linear relation (Mertzanis & Allam, 2018). Following the Lee et al. (2013) study, we examine the herding behaviour using the modified regression model as per the following equation:

\[
\text{CSAD}_t = \alpha + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \varepsilon_t
\]
where, $R_{m,t}$ is the cross-section average return of sample on day $t$ and is used to account for asymmetric behaviour under different market conditions; $|R_{m}|$ is the absolute market return at day $t$, used to account for the magnitude and not the direction of the market; $R^2_{m,t}$ is the squared value of the equally weighted portfolio; $R_{m,t}$, captures the non-linear relationship that would arise because of the herding behaviour in the market. According to Chang et al. (2000), the presence of significantly negative non-linear coefficient $\gamma_3$ confirms the existence of herding behaviour; otherwise, a statistically positive $\gamma_3$ indicates no evidence of herding.

Previous studies documented that the rate of increase in dispersion with respect to aggregate market returns is higher in increasing trends compared to decreasing trends. We estimated regression coefficient separately for positive and negative market returns to investigate the asymmetry in bullish and bearish market conditions, specifically, using the following models:

$$
\text{CSAD}_{Up}^t = \alpha + \gamma_{1}^{Up} |R_{m,t}^Up| + \gamma_{2}^{Up} (R_{m,t}^Up)^2 + \varepsilon_{t,Up} \text{ if } R_{m,t} > 0
$$

$$
\text{CSAD}_{Down}^t = \alpha + \gamma_{1}^{Down} |R_{m,t}^Down| + \gamma_{2}^{Down} (R_{m,t}^Down)^2 + \varepsilon_{t,Down} \text{ if } R_{m,t} < 0
$$

where, $\text{CSAD}^t_{Up}$ ($\text{CSAD}^t_{Down}$) is the CSAD at day $t$ corresponding to rising (declining) market returns, $R_{m,t}^Up$ ($R_{m,t}^Down$) represents equal-weighted portfolio returns during the bull (bear) market condition on day $t$ and $(R_{m,t}^Up)^2$ $(R_{m,t}^Down)^2$ is the squared value of the equal-weighted portfolio to investigate the non-linearity in market returns when the market is rising (declining).

**VI. Results**

**Descriptive Statistics**

Table 2 provides descriptive statistics of CSAD, of each industry for the whole sample data. To investigate the presence of herding behaviour in the stock market, we divided the whole data into three panels, that is, panel A presents the whole period, panel B presents before the COVID-19 outbreak period and panel C presents after the COVID-19 outbreak period. Panel A finds that the maximum value of CASD is found in media and realty industry, respectively, 1.641 and 1.611. Panel B reveals that values of CSAD corresponding to all industry are lower than in panel A. Results of panel C show that values of CSAD corresponding to all industry are marginally higher than in panels A and B.

Tables 3 and 4 provide descriptive statistics of CSAD, of each industry in extreme market conditions, respectively, in bull and bear market conditions. More specifically, to investigate the presence of herding behaviour in upward trends and downward trends, further, we divided the whole data into three panels, that is, panel A presents the whole period, panel B presents before the COVID-19 outbreak period and panel C presents after the COVID-19 outbreak period. The normality test shows that all series of market return and CSAD are not normal since their skewness terms are different from 0, and their kurtosis coefficients
Table 2. Descriptive Statistics for Daily CSAD

| Indices | Panel A: Whole Period | Panel B: Pre COVID-19 | Panel C: Post COVID-19 |
|---------|-----------------------|-----------------------|-----------------------|
|         | Mean | St. Dev | Ske | Kurt | Obs. | Mean | St. Dev | Ske | Kurt | Obs. | Mean | St. Dev | Ske | Kurt | Obs. |
| AUTO    | 1.174 | 0.481 | 2.278 | 12.064 | 1336 | 1.119 | 0.381 | 0.976 | 1.580 | 1254 | 2.008 | 0.903 | 1.495 | 3.990 | 82  |
| BANK    | 1.187 | 0.742 | 5.440 | 60.698 | 1336 | 1.115 | 0.603 | 6.861 | 117.177 | 1254 | 2.291 | 1.466 | 2.007 | 5.110 | 82  |
| FIN     | 1.335 | 0.596 | 3.147 | 18.486 | 1336 | 1.270 | 0.454 | 2.061 | 10.990 | 1254 | 2.338 | 1.251 | 1.494 | 3.012 | 82  |
| FMCG    | 1.120 | 0.409 | 1.346 | 3.067 | 1336 | 1.083 | 0.361 | 1.032 | 1.928 | 1254 | 1.678 | 0.637 | 0.525 | 0.217 | 82  |
| IT      | 1.247 | 0.597 | 1.788 | 5.297 | 1336 | 1.200 | 0.533 | 1.521 | 3.841 | 1254 | 1.972 | 0.953 | 1.140 | 1.397 | 82  |
| MEDIA   | 1.641 | 0.725 | 2.142 | 9.929 | 1336 | 1.582 | 0.653 | 2.216 | 13.212 | 1254 | 2.542 | 1.094 | 0.873 | 0.581 | 82  |
| METAL   | 1.409 | 0.527 | 1.708 | 5.897 | 1336 | 1.365 | 0.465 | 1.204 | 2.991 | 1254 | 2.073 | 0.872 | 1.356 | 1.966 | 82  |
| PHARMA  | 1.187 | 0.573 | 2.449 | 10.511 | 1336 | 1.138 | 0.487 | 1.983 | 8.442 | 1254 | 1.936 | 1.061 | 1.384 | 1.664 | 82  |
| REALTY  | 1.611 | 0.712 | 2.132 | 9.520 | 1336 | 1.560 | 0.638 | 1.971 | 10.058 | 1254 | 2.405 | 1.177 | 1.225 | 2.090 | 82  |
| ENERGY  | 1.224 | 0.602 | 3.122 | 19.949 | 1336 | 1.180 | 0.524 | 2.896 | 23.221 | 1254 | 1.903 | 1.112 | 1.881 | 3.750 | 82  |
| SERVICES| 1.258 | 0.556 | 3.697 | 23.342 | 1336 | 1.185 | 0.383 | 2.182 | 11.073 | 1254 | 2.375 | 1.217 | 1.526 | 2.981 | 82  |
| INFRA   | 1.241 | 0.421 | 2.616 | 13.225 | 1336 | 1.197 | 0.342 | 1.970 | 11.446 | 1254 | 1.918 | 0.788 | 1.402 | 1.944 | 82  |

Source: The author.

Notes: This table reports the mean, standard deviation, skewness, kurtosis and observations of the cross-sectional absolute deviation (CSAD) over the sample period for all industries.
Table 3. Descriptive Statistics for Daily CSAD in Bull Market Conditions

| Indices  | Panel A: Whole Period | Panel B: Pre-COVID-19 | Panel C: Post COVID-19 |
|----------|----------------------|-----------------------|-----------------------|
|          | Mean | St. Dev | Ske. | Kurt. | Obs. | Mean | St. Dev | Ske. | Kurt. | Obs. | Mean | St. Dev | Ske. | Kurt. | Obs. |
| AUTO     | 1.191 | 0.476   | 2.021 | 9.203 | 694  | 1.141 | 0.386   | 0.952 | 1.636 | 655  | 2.037 | 0.890   | 1.180 | 2.652 | 39   |
| BANK     | 1.202 | 0.811   | 6.564 | 76.719 | 678  | 1.134 | 0.685   | 8.459 | 135.533 | 640  | 2.346 | 1.584   | 2.281 | 7.126 | 38   |
| FIN      | 1.344 | 0.560   | 2.404 | 10.519 | 707  | 1.289 | 0.468   | 2.224 | 12.780 | 667  | 2.264 | 1.012   | 0.759 | 0.326 | 40   |
| FMCG     | 1.140 | 0.426   | 1.320 | 3.011 | 718  | 1.104 | 0.376   | 0.981 | 1.588 | 679  | 1.774 | 0.674   | 0.465 | 0.016 | 39   |
| IT       | 1.243 | 0.582   | 1.465 | 3.135 | 701  | 1.201 | 0.528   | 1.354 | 3.131 | 658  | 1.890 | 0.901   | 0.536 | 0.625 | 43   |
| MEDIA    | 1.693 | 0.726   | 1.502 | 3.384 | 703  | 1.636 | 0.659   | 1.362 | 2.988 | 666  | 2.715 | 1.060   | 0.734 | 0.089 | 37   |
| METAL    | 1.445 | 0.526   | 1.690 | 6.373 | 695  | 1.407 | 0.475   | 1.154 | 2.625 | 653  | 2.045 | 0.839   | 1.997 | 4.882 | 42   |
| PHARMA   | 1.196 | 0.564   | 2.402 | 9.950 | 692  | 1.129 | 0.436   | 1.274 | 2.617 | 644  | 2.090 | 1.098   | 1.136 | 0.786 | 48   |
| REALTY   | 1.658 | 0.709   | 1.656 | 5.443 | 707  | 1.610 | 0.660   | 1.625 | 6.223 | 669  | 2.506 | 0.977   | 1.039 | 0.464 | 38   |
| ENERGY   | 1.217 | 0.555   | 1.797 | 5.173 | 713  | 1.183 | 0.512   | 1.653 | 4.699 | 674  | 1.799 | 0.875   | 1.190 | 1.142 | 39   |
| SERVICES | 1.243 | 0.536   | 3.112 | 14.405 | 725  | 1.176 | 0.390   | 2.483 | 13.680 | 686  | 2.425 | 1.102   | 0.797 | 0.136 | 39   |
| INFRA    | 1.228 | 0.405   | 2.110 | 9.174 | 729  | 1.185 | 0.335   | 1.316 | 3.971 | 690  | 2.000 | 0.679   | 1.730 | 3.307 | 39   |

Source: The author.
Notes: This table reports the mean, standard deviation, skewness, kurtosis and observations of the cross-sectional absolute deviation (CSAD) over the sample period for all industries.
Table 4. Descriptive Statistics for Daily CSAD in Bear Market Conditions

| Indices  | Mean | St. Dev | Ske | Kurt | Obs. | Mean | St. Dev | Ske | Kurt | Obs. | Mean | St. Dev | Ske | Kurt | Obs. |
|----------|------|---------|-----|------|------|------|---------|-----|------|------|------|---------|-----|------|------|
| AUTO     | 1.155| 0.485   | 2.560| 15.205| 642  | 1.095| 0.374   | 1.006| 1.537| 599  | 1.981| 0.925   | 1.808| 5.703| 43   |
| BANK     | 1.172| 0.664   | 3.100| 16.284| 658  | 1.095| 0.503   | 1.802| 6.090| 614  | 2.243| 1.372   | 1.675| 2.494| 44   |
| FIN      | 1.325| 0.633   | 3.713| 23.708| 629  | 1.248| 0.438   | 1.829| 8.271| 587  | 2.408| 1.452   | 1.613| 2.835| 42   |
| FMCG     | 1.096| 0.388   | 1.356| 3.022 | 618  | 1.059| 0.341   | 1.076| 2.401| 575  | 1.590| 0.596   | 0.530| -0.631| 43   |
| IT       | 1.252| 0.613   | 2.090| 7.206 | 635  | 1.199| 0.538   | 1.700| 4.610| 596  | 2.063| 1.010   | 1.615| 2.580| 39   |
| MEDIA    | 1.583| 0.721   | 2.911| 18.218| 633  | 1.520| 0.641   | 3.313| 27.444| 588  | 2.400| 1.112   | 1.083| 1.378| 45   |
| METAL    | 1.370| 0.526   | 1.758| 5.582 | 641  | 1.321| 0.450   | 1.270| 3.569| 601  | 2.102| 0.915   | 0.863| 0.185| 40   |
| PHARMA   | 1.178| 0.582   | 2.503| 11.134| 644  | 1.148| 0.537   | 2.320| 10.361| 610  | 1.717| 0.980   | 1.964| 4.831| 34   |
| REALTY   | 1.559| 0.712   | 2.702| 14.644| 629  | 1.502| 0.606   | 2.475| 16.621| 585  | 2.317| 1.331   | 1.376| 2.504| 44   |
| ENERGY   | 1.233| 0.652   | 4.002| 27.890| 623  | 1.176| 0.537   | 4.146| 41.077| 580  | 1.997| 1.293   | 1.903| 3.158| 43   |
| SERVICES | 1.275| 0.579   | 4.238| 30.908| 611  | 1.195| 0.373   | 1.781| 7.510| 568  | 2.331| 1.325   | 1.956| 4.632| 43   |
| INFRA    | 1.257| 0.439   | 3.080| 16.524| 607  | 1.213| 0.350   | 2.679| 19.084| 564  | 1.844| 0.875   | 1.392| 1.632| 43   |

Source: The author.

Notes: This table reports the mean, standard deviation, skewness, kurtosis and observations of the cross-sectional absolute deviation (CSAD) over the sample period for all industries.
largely exceed 3 (BenSaïda et al., 2015). Moreover, the CSAD\textsubscript{t} series are stationary but non-normal and asymmetrical, since their kurtosis largely exceeds the threshold. Further, the Jarque–Bera test statistics were found significant for both CSAD\textsubscript{t} and \(R_{m,t}\) in different markets phases. Further, we employed the Jarque–Bera test, and its results suggest the rejection of the null hypothesis of a normal distribution of CSAD\textsubscript{t} and \(R_{m,t}\) time series.

**Herding Behaviour in the Indian Stock Market**

Table 5 provides the regression results for all industries as per Equation (4). Panel A of Table 5 provides the results for the full sample period corresponding to all industries. Except for AUTO, FMCG and IT, the estimated coefficient \(\gamma_3\) in other industries is statistically significantly positive, indicating that investors intend to anti-herd behaviour in these industries. However, \(\gamma_3\) is positive and statistically significant, indicating no evidence of herding behaviour because industry

**Table 5.** Estimating Regression Coefficients of the Daily CSAD\textsubscript{t} on Equation (4)

| Indices | \(\alpha\) | \(\gamma_1\) | \(\gamma_2\) | \(\gamma_3\) | F-stat | Adj. \(R^2\) |
|---------|---------|---------|---------|---------|-------|-----------|
| AUTO | 0.923 | 0.029 | 0.263 | -0.003 | 178.25*** | 0.285 |
|         | (51.946)*** | (3.685)*** | (14.660)*** | (-1.275) |       |           |
| BANK | 0.802 | 0.073 | 0.327 | 0.005 | 262.297*** | 0.370 |
|         | (31.469)*** | (7.276)*** | (15.372)*** | (2.200)* |       |           |
| FIN | 1.042 | 0.023 | 0.286 | 0.004 | 263.764*** | 0.371 |
|         | (53.617)*** | (2.491)* | (16.184)*** | (2.079)* |       |           |
| FMCG | 0.904 | 0.053 | 0.307 | -0.007 | 155.823*** | 0.258 |
|         | (57.045)*** | (5.488)*** | (14.213)*** | (-1.927) |       |           |
| IT | 0.973 | 0.008 | 0.318 | -0.006 | 123.838*** | 0.216 |
|         | (41.230)*** | (0.666) | (11.975)*** | (-1.576) |       |           |
| MEDIA | 1.249 | 0.080 | 0.357 | 0.007 | 166.915*** | 0.272 |
|         | (41.810)*** | (6.369)*** | (10.856)*** | (1.195) |       |           |
| METAL | 1.108 | 0.040 | 0.226 | 0.009 | 246.272*** | 0.355 |
|         | (54.821)*** | (5.608)*** | (12.141)*** | (3.014)** |       |           |
| PHARMA | 0.920 | 0.013 | 0.255 | 0.011 | 155.720*** | 0.258 |
|         | (39.722)*** | (1.311) | (9.974)*** | (2.550)* |       |           |
| REALTY | 1.316 | 0.070 | 0.202 | 0.030 | 218.544*** | 0.328 |
|         | (49.312)*** | (6.453)*** | (7.505)*** | (6.923)*** |       |           |
| ENERGY | 0.977 | 0.017 | 0.206 | 0.025 | 225.562*** | 0.335 |
|         | (42.695)*** | (1.679) | (8.240)*** | (6.606)*** |       |           |
| SERVICES | 0.971 | 0.041 | 0.344 | 0.006 | 335.807*** | 0.429 |
|         | (55.645)*** | (4.040)*** | (17.237)*** | (2.414)** |       |           |
| INFRA | 1.109 | -0.033 | 0.119 | 0.012 | 76.308*** | 0.145 |
|         | (59.061)*** | (-3.726) | (5.225)*** | (2.744)** |       |           |

(Table 5 continued)
(Table 5 continued)

| Indices | $\alpha$ | $\gamma_1$ | $\gamma_2$ | $\gamma_3$ | F-stat | Adj. $R^2$ |
|---------|---------|---------|---------|---------|--------|-----------|
| **Panel B: Pre COVID-19 from 01/01/2015 to 29/01/2020** | | | | | | |
| AUTO | 0.957*** | 0.023 | 0.181 | 0.001 | 81.967*** | 0.162 |
| (56.183)*** | (2.848)*** | (8.439)*** | (0.248) |
| BANK | 0.902*** | 0.039 | 0.119 | 0.048 | 163.681*** | 0.280 |
| (34.293)*** | (3.642)*** | (3.839)*** | (7.418)*** |
| FIN | 1.077*** | 0.015 | 0.198 | 0.014 | 98.532*** | 0.189 |
| (51.442)*** | (1.541) | (6.658)*** | (1.860) |
| FMCG | 0.934*** | 0.054 | 0.188 | 0.028 | 101.568*** | 0.194 |
| (57.043)*** | (5.093)*** | (6.658)*** | (3.236)*** |
| IT | 0.995*** | 0.014 | 0.228 | 0.016 | 73.196*** | 0.147 |
| (40.601)*** | (1.061) | (6.494)*** | (1.731) |
| MEDIA | 1.267*** | 0.081 | 0.268 | 0.025 | 148.230*** | 0.261 |
| (44.904)*** | (6.615)*** | (8.101)*** | (3.543)*** |
| METAL | 1.130*** | 0.036 | 0.163 | 0.022 | 166.263*** | 0.284 |
| (53.565)*** | (4.847)*** | (6.625)*** | (4.021)*** |
| PHARMA | 0.942*** | −0.008 | 0.180 | 0.022 | 87.479*** | 0.172 |
| (39.706)*** | (−0.756) | (5.368)*** | (2.495)* |
| REALTY | 1.327*** | 0.074 | 0.126 | 0.050 | 180.848*** | 0.301 |
| (49.597)*** | (6.853)*** | (3.917)*** | (7.408)*** |
| ENERGY | 0.984*** | 0.034 | 0.159 | 0.037 | 157.606*** | 0.273 |
| (45.087)*** | (3.046)*** | (6.226)*** | (7.823)*** |
| SERVICES | 1.015*** | 0.008 | 0.226 | 0.015 | 96.306*** | 0.186 |
| (58.134)*** | (0.758) | (7.568)*** | (1.580) |
| INFRA | 1.089*** | −0.016 | 0.116 | 0.003 | 42.592*** | 0.091 |
| (67.481)*** | (−1.738) | (5.850)*** | (0.617) |
| **Panel C: Post COVID-19 from 30/01/2020 to 01/06/2020** | | | | | | |
| AUTO | 1.279*** | 0.035 | 0.388 | −0.016 | 16.480*** | 0.364 |
| (9.103)*** | (1.280) | (5.111)*** | (−2.289)* |
| BANK | 1.334*** | 0.123 | 0.330 | 0.003 | 20.842*** | 0.424 |
| (6.126)*** | (3.366)*** | (3.607)*** | (0.476) |
| FIN | 1.533*** | 0.036 | 0.274 | 0.003 | 22.656*** | 0.445 |
| (8.879)*** | (1.135) | (3.828)*** | (0.497) |
| FMCG | 1.251*** | 0.056 | 0.334 | −0.017 | 14.349*** | 0.331 |
| (12.266)*** | (2.086)* | (3.999)*** | (−1.729) |
| IT | 1.412*** | −0.010 | 0.315 | −0.013 | 9.663*** | 0.243 |
| (8.486)*** | (−0.322) | (2.860)** | (−1.131) |
| MEDIA | 1.749*** | 0.067 | 0.562 | −0.038 | 7.196*** | 0.187 |
| (8.000)*** | (1.242) | (3.430)*** | (−1.659) |
| METAL | 1.456*** | 0.045 | 0.243 | 0.002 | 20.969*** | 0.425 |
| (10.669)*** | (1.766) | (3.102)*** | (0.241) |
| PHARMA | 1.286*** | 0.047 | 0.345 | −0.003 | 15.911*** | 0.356 |
| (7.706)*** | (1.307) | (2.928)*** | (−0.233) |
Panel B shows the regression result of the pre-COVID-19 period for all industries. Results of panel B provided the positive coefficient $\gamma_3$ for all sectors that suggest the anti-herd behaviour in Indian stock markets. Moreover, results of panel B reveal that market participants traded the trading away from the market consensus before the COVID-19 outbreak. The value of adjusted $R^2$-square is in the range of 9–30 per cent, implying appropriateness of the model for all sectors. Similarly, results of panel B is in line with findings of Ganesh et al. (2016). Furthermore, findings of Kumar et al. (2016) and Dutta et al. (2016) also fail to provide significant evidence of herding behaviour in the Indian equity market.

We are more interested in investigating the industry-wide herd behaviour after the COVID-19 outbreak. Panel C provided the regression results of all industries post-COVID-19 outbreak in India. Estimated coefficient $\gamma_3$ is found negative and significant for AUTO industry, indicating that investors intend to herd behaviour in the auto industry. The Indian government has changed its focus from fuel-run automobile sector to electronic vehicle industry to protect and sustain the environment for the coming generations. As a result, the Indian automobile industry experienced low demand for vehicles. Further, outbreak of the COVID-19 pandemic, high interest rates, high fuel price and high inflation have resulted in contraction of demand for vehicles. Therefore, it seems the outbreak of COVID-19 causes sell-side herding behaviour in the automobile sector. Besides, the estimated coefficient of $\gamma_3$, for FMCG, IT, media and pharma industry, was found

| Indices | $\alpha$ | $\gamma_1$ | $\gamma_2$ | $\gamma_3$ | F-stat | Adj. $R^2$ |
|---------|---------|-----------|-----------|-----------|--------|------------|
| REALTY  | 2.021   | 0.054     | 0.069     | 0.030     | 13.665*** | 0.319      |
|         | (10.479)*** | (1.068) | (0.574) | (2.337)* |        |            |
| ENERGY  | 1.351   | -0.016    | 0.198     | 0.015     | 17.099*** | 0.374      |
|         | (7.244)*** | (-0.450) | (1.574) | (1.064) |        |            |
| SERVICES| 1.505   | 0.081     | 0.332     | 0.005     | 27.379*** | 0.494      |
|         | (8.930)*** | (2.353)* | (3.895)*** | (0.651) |        |            |
| INFRA   | 1.624   | -0.045    | 0.147     | 0.012     | 6.989***  | 0.182      |
|         | (10.203)*** | (-1.626) | (0.888) | (0.445) |        |            |

Source: The authors.
Notes: t-Statistics are given in parentheses. ***, ** and * Indicate significance at 0.001, 0.01 and 0.05, respectively.

dispersion increases as the rate increases, thus showing efficiency in market rather than herding. Furthermore, our findings suggest that investor’s trade away from the market consensus. As a result, there is no evidence of herding employing the benchmark model for the entire sample period for all sectors. Therefore, our results are consistent with findings of Ganesh et al. (2016) who found that Indian equity market is free from industry-wise herding. As many previous studies provide convincing theoretical arguments that emerging markets are known for weak access to accurate and timely information, investors can earn high returns if they compromise with the market and invest accordingly. Therefore, markets are more driven by herding behaviour. Hence, our results do not support these theoretical arguments.
to be negative but insignificant—this implied that there was no evidence of herding behaviour in respective industries. The results of panel C provided some significant evidence of herd behaviour in the Indian stock markets after the COVID-19 pandemic. For robustness of predictive models, the value of adjusted $R^2$-square is in the range of 18–49 per cent, implying appropriateness of the model for all sectors.

**Industry Herding Behaviour Under Bull Market Conditions**

This and the immediate succeeding sections provide the empirical results of whether industry herding shows different behaviours under different market trends. We divided the full sample into two subsamples using the industry index returns, respectively, positive and negative industry index returns. Previous studies provided that herding behaviour is asymmetric based on stock market returns. Investors were prone to herding behaviour during the bull market conditions (Lee et al., 2013; Tan et al., 2008).

Table 6 reports the results of herding behaviour during the bull market conditions (positive returns) as per Equation (5). Panel A of Table 6 provided regression results of herding behaviour for all industries for the full sample period during positive returns. $F$-test statistic gives significant results, indicating that all models corresponding to all sectors have an overall good fit. The explanatory

| Indices | $\alpha$ | $\gamma_{1}^{Up}$ | $\gamma_{2}^{Up}$ | $F$-stat | Adj. $R^2$ |
|---------|---------|-----------------|-----------------|----------|-----------|
| AUTO    | 0.944   | 0.260           | 0.003           | 147.548*** | 0.297     |
|         | (36.379)***, (8.332)*** | (0.582) |                  |           |           |
| BANK    | 0.949   | 0.071           | 0.076           | 290.395*** | 0.461     |
|         | (22.793)***, (1.550) | (9.791)*** |                  |           |           |
| FIN     | 1.083   | 0.236           | 0.021           | 149.104*** | 0.296     |
|         | (33.993)***, (5.854)*** | (2.514)* |                  |           |           |
| FMCG    | 0.891   | 0.354           | 0.000           | 150.371*** | 0.294     |
|         | (37.153)***, (9.609)*** | (−0.052) |                  |           |           |
| IT      | 0.929   | 0.391           | −0.019          | 86.840***  | 0.197     |
|         | (26.488)***, (8.791)*** | (−2.222) |                  |           |           |
| MEDIA   | 1.324   | 0.311           | 0.042           | 123.002*** | 0.258     |
|         | (27.507)***, (4.273)*** | (2.045)* |                  |           |           |
| METAL   | 1.213   | 0.107           | 0.045           | 195.170*** | 0.359     |
|         | (39.614)***, (2.978)*** | (5.855)*** |                  |           |           |
| PHARMA  | 0.909   | 0.295           | 0.004           | 105.867*** | 0.233     |
|         | (27.159)***, (7.269)*** | (0.441) |                  |           |           |
| REALTY  | 1.326   | 0.257           | 0.034           | 127.989*** | 0.265     |
|         | (29.576)***, (4.214)*** | (2.285)* |                  |           |           |

(Table 6 continued)
| Indices  | $\alpha$  | $\gamma_{1}^{Up}$ | $\gamma_{2}^{Up}$ | $F$-stat | Adj. $R^2$ |
|---------|-----------|-----------------|-----------------|---------|------------|
| ENERGY  | 0.963     | 0.238           | 0.023           | 113.934*** | 0.241      |
|         | (28.400)*** | (5.361)***      | (2.334)*        |         |            |
| SERVICES| 1.036     | 0.168           | 0.073           | 260.085*** | 0.417      |
|         | (38.483)*** | (3.983)***      | (7.269)***      |         |            |
| INFRA   | 1.075     | 0.154           | 0.003           | 66.011***  | 0.152      |
|         | (43.940)*** | (5.404)***      | (0.639)         |         |            |

Panel B: Pre COVID-19 from 01/01/2015 to 29/01/2020

| Indices  | $\alpha$  | $\gamma_{1}^{Up}$ | $\gamma_{2}^{Up}$ | $F$-stat | Adj. $R^2$ |
|---------|-----------|-----------------|-----------------|---------|------------|
| AUTO    | 0.973     | 0.195           | 0.001           | 66.639***  | 0.167      |
|         | (41.200)*** | (6.564)***      | (0.158)         |         |            |
| BANK    | 0.934     | 0.065           | 0.072           | 182.161*** | 0.362      |
|         | (23.733)*** | (1.429)***      | (8.588)***      |         |            |
| FIN     | 1.087     | 0.217           | 0.010           | 66.328***  | 0.164      |
|         | (34.951)*** | (4.897)***      | (0.850)         |         |            |
| FMCG    | 0.916     | 0.249           | 0.035           | 90.403***  | 0.209      |
|         | (36.056)*** | (4.919)***      | (1.736)         |         |            |
| IT      | 1.003     | 0.190           | 0.040           | 56.220***  | 0.144      |
|         | (25.730)*** | (2.770)***      | (1.727)         |         |            |
| MEDIA   | 1.301     | 0.300           | 0.037           | 109.715*** | 0.246      |
|         | (28.576)*** | (4.180)***      | (1.754)         |         |            |
| METAL   | 1.161     | 0.176           | 0.025           | 127.430*** | 0.279      |
|         | (37.802)*** | (4.648)***      | (2.732)**       |         |            |
| PHARMA  | 0.958     | 0.155           | 0.026           | 57.274***  | 0.149      |
|         | (29.362)*** | (2.904)***      | (1.526)         |         |            |
| REALTY  | 1.285     | 0.247           | 0.040           | 150.650*** | 0.309      |
|         | (31.072)*** | (4.356)***      | (2.907)**       |         |            |
| ENERGY  | 0.939     | 0.248           | 0.025           | 75.647***  | 0.182      |
|         | (25.477)*** | (3.986)***      | (1.182)         |         |            |
| SERVICES| 1.051     | 0.105           | 0.071           | 86.186***  | 0.199      |
|         | (41.771)*** | (2.225)**       | (4.387)***      |         |            |
| INFRA   | 1.075     | 0.121           | 0.000           | 32.599***  | 0.084      |
|         | (50.185)*** | (4.799)***      | (−0.064)        |         |            |

Panel C: Post COVID-19 from 30/01/2020 to 01/06/2020

| Indices  | $\alpha$  | $\gamma_{1}^{Up}$ | $\gamma_{2}^{Up}$ | $F$-stat | Adj. $R^2$ |
|---------|-----------|-----------------|-----------------|---------|------------|
| AUTO    | 1.034     | 0.641           | −0.046          | 20.490***  | 0.506      |
|         | (4.872)*** | (3.946)***      | (−2.059)*       |         |            |
| BANK    | 1.813     | −0.202          | 0.102           | 25.184***  | 0.567      |
|         | (4.643)*** | (−0.704)        | (2.716)*        |         |            |
| FIN     | 1.467     | 0.350           | −0.002          | 12.591***  | 0.373      |
|         | (5.680)*** | (1.872)         | (−0.079)        |         |            |
| FMCG    | 1.221     | 0.439           | −0.025          | 14.486***  | 0.415      |
|         | (7.495)*** | (2.796)**       | (−1.063)        |         |            |
| IT      | 0.978     | 0.741           | −0.070          | 10.418***  | 0.310      |
|         | (4.138)*** | (3.928)***      | (−2.938)***     |         |            |
power is more than 15 per cent for all models, implying appropriateness of the model for all industries. Panel A reports that $\gamma_{1}^{Up}$ coefficients for the up-market returns are significant and positive for all industries, whereas $\gamma_{2}^{Up}$ coefficients are significant and positive, except AUTO, PHARMA, INFRA, FMCG and Information Technology (IT) industry, hence implying the presence of anti-herding behaviour for the whole period data in respective industries. Furthermore, $\gamma_{2}^{Up}$ coefficient for IT industry regression model was found to be negative and significant, indicating the presence of herding behaviour in the IT sector. Moreover, the results of the full sample period suggest that investors do not mimic the herding behaviour during bull market conditions. Therefore, our results are consistent with findings of Ganesh et al. (2016), Kumar et al. (2016) and Dutta et al. (2016) who deny the evidence of herding behaviour during bull market conditions in the Indian stock market.

Panel B of Table 6 reports the regression results of herding behaviour at the industry level before the COVID-19 outbreak period in positive returns. The results of panel B showed that $\gamma_{1}^{Up}$ coefficients for the up-market returns are significantly positive for 11 of the 12 industries, whereas $\gamma_{2}^{Up}$ coefficients are positive and insignificant for the 4 of the 12 sectors, except for BANK, METAL, REALTY and SERVICES industry. Estimated coefficients $\gamma_{2}^{Up}$ of BANK, METAL, REALTY and SERVICES sectors are positive and significant, indicating the anti-herding behaviour in respective industries before the COVID-19 outbreak. $F$-test statistic gives significant results, indicating all models corresponding to all sectors have an overall good fit. The explanatory power of the OLS model corresponding to all sectors decrease in panel B as compared to the OLS model corresponding to all sectors in panel A. Our findings of panel B are consistent with findings of panel A, which denies the presence of herding behaviour during
bull market conditions and in line with results of Ganesh et al. (2016), Kumar et al. (2016) and Dutta et al. (2016). Furthermore, the results reveal that herding behaviour was not prevalent in the Indian stock market before the spread of COVID-19 virus across the world.

Panel C of Table 6 reports regression results of herding behaviour for all industries during the COVID-19 outbreak period in bull market conditions. Estimated coefficients $\gamma_{2}^{up}$ of AUTO, IT and PHARMA sectors are negative and significant, indicating that the investors intended to herding behaviour in these industries. The rationale of herding behaviour in the PHARMA industry is that the pharmaceutical industry is at the forefront battling against the COVID-19 pandemic. Indian pharmaceutical companies ensure the adequate supplies of medicines to its customers across the world despite the supply chain disruptions and the lockdown restrictions in various countries (The Economic Times, 2020).

Businesses, in the post-coronavirus world, will undergo a transition, and the biggest gainer could be the IT industry. Businesses, mainly those in the services sector such as banking and other financial services, education, retail, healthcare, food and grocery delivery will further embrace technology and automation to better leverage growth. Therefore, the COVID-19 pandemic ignites investment appeals to investors in the pharmaceutical and IT companies. Furthermore, estimated coefficients $\gamma_{2}^{up}$ of FIN, FMCG and INFRA sectors are negative but not significant. Additionally, estimated coefficients $\gamma_{2}^{up}$ of BANK, METAL and ENERGY industries are positive and significant, indicating that the investors intended to anti-herding behaviour in these industries. The results of panel C suggest that the COVID-19 outbreak leads to the herding behaviour in bull market conditions, specifically in automobile, IT and pharmaceutical industries.

**Industry Herding Behaviour Under Bear Market Conditions**

Table 7 presents the results of herding behaviour during the bear market conditions (negative returns) as per Equation (6). Panel A of Table 7 reports the regression results of herding behaviour for all industries, using the full sample period in negative returns. The estimated coefficient $\gamma_{2}^{down}$ of the regression model for AUTO, FMCG, IT, MEDIA and SERVICES was found to be negative and insignificant, suggesting that herding behaviour is not found in these sectors during the whole period sample. On the other side, findings of panel A reveal that estimated coefficient $\gamma_{2}^{down}$ is significantly positive for the REALTY, ENERGY and INFRA sectors’ herding behaviour regression model, indicating the anti-herd behaviour in these sectors.

Panel B of Table 7 presents the results of the regression model industry-wise before the COVID-19 outbreak in India in bull market conditions. The estimated coefficient $\gamma_{2}^{down}$ of the regression model is positive and significant for FMCG, MEDIA, METAL, REALTY and ENERGY industry, implying anti-herding behaviour in these industries before the COVID-19 pandemic. Additionally, the estimated coefficient $\gamma_{2}^{down}$ of the regression model for BANK and SERVICES industries was found to be negative but statistically insignificant, indicating
Table 7. Estimating Regression, Coefficient in Bear Market Conditions on Equation (6)

| Indices | $\alpha$ | $\gamma_1^{\text{Down}}$ | $\gamma_2^{\text{Down}}$ | F-stat | Adj. $R^2$ |
|---------|---------|----------------|----------------|--------|-----------|
| Panel A: Whole period from 01/01/2015 to 01/06/2020 |
| AUTO | 0.911 | 0.247 | -0.005 | 119.856*** | 0.271 |
| (35.327)*** | (10.183)*** | (-1.677) | |
| BANK | 0.847 | 0.268 | 0.001 | 180.949*** | 0.354 |
| (26.195)*** | (10.546)*** | (0.297) | |
| FIN | 1.035 | 0.273 | 0.003 | 248.282*** | 0.441 |
| (37.939)*** | (11.677)*** | (1.460) | |
| FMCG | 0.926 | 0.243 | -0.007 | 80.958*** | 0.206 |
| (42.292)*** | (8.537)*** | (-1.754) | |
| IT | 1.000 | 0.279 | -0.002 | 100.163*** | 0.238 |
| (30.059)*** | (7.794)*** | (-0.520) | |
| MEDIA | 1.209 | 0.316 | 0.002 | 125.077*** | 0.282 |
| (28.747)*** | (7.497)*** | (0.285) | |
| METAL | 1.057 | 0.237 | 0.002 | 190.406*** | 0.372 |
| (37.201)*** | (9.758)*** | (0.554) | |
| PHARMA | 0.923 | 0.230 | 0.013 | 127.986*** | 0.283 |
| (28.096)*** | (6.668)*** | (2.642)** | |
| REALTY | 1.311 | 0.136 | 0.029 | 203.306*** | 0.392 |
| (36.531)*** | (4.069)*** | (6.583)*** | |
| ENERGY | 0.991 | 0.178 | 0.026 | 219.770*** | 0.413 |
| (29.824)*** | (5.224)*** | (6.010)*** | |
| SERVICES | 1.001 | 0.304 | 0.004 | 287.056*** | 0.484 |
| (40.201)*** | (11.554)*** | (1.443) | |
| INFRA | 1.177 | 0.007 | 0.048 | 51.384*** | 0.143 |
| (39.340)*** | (0.159) | (4.690)*** | |
| Panel B: Pre COVID-19 from 01/01/2015 to 29/01/2020 |
| AUTO | 0.940 | 0.166 | 0.002 | 54.183*** | 0.151 |
| (38.100)*** | (5.257)*** | (0.274) | |
| BANK | 0.833 | 0.270 | -0.009 | 69.013*** | 0.182 |
| (24.524)*** | (6.302)*** | (-0.917) | |
| FIN | 1.065 | 0.179 | 0.018 | 83.051*** | 0.219 |
| (38.197)*** | (4.524)*** | (1.829) | |
| FMCG | 0.957 | 0.114 | 0.029 | 58.967*** | 0.168 |
| (43.548)*** | (3.170)** | (3.088)** | |
| IT | 1.007 | 0.215 | 0.013 | 54.486*** | 0.152 |
| (29.713)*** | (4.724)*** | (1.261) | |
| MEDIA | 1.243 | 0.208 | 0.022 | 106.749*** | 0.265 |
| (31.489)*** | (4.980)*** | (2.924)** | |
| METAL | 1.097 | 0.150 | 0.020 | 115.843*** | 0.277 |
| (37.653)*** | (4.630)*** | (2.862)** | |
| PHARMA | 0.928 | 0.202 | 0.020 | 70.557*** | 0.186 |
| (25.767)*** | (4.242)*** | (1.804) | |

(Table 7 continued)
(Table 7 continued)

| Indices  | $\alpha$ | $\gamma_1^{\text{Down}}$ | $\gamma_2^{\text{Down}}$ | F-stat | Adj. $R^2$ |
|----------|----------|------------------|------------------|--------|-----------|
| REALTY   | 1.362    | 0.020            | 0.054            | 114.095*** | 0.279     |
|          | (37.603)*** | (0.505)          | (7.163)***       |        |           |
| ENERGY   | 1.023    | 0.092            | 0.040            | 171.954*** | 0.371     |
|          | (34.358)*** | (2.813)***       | (8.280)***       |        |           |
| SERVICES | 1.001    | 0.286            | −0.013           | 69.702***  | 0.195     |
|          | (41.151)*** | (7.366)***      | (−1.167)         |        |           |
| INFRA    | 1.116    | 0.082            | 0.016            | 31.204***  | 0.097     |
|          | (43.790)*** | (2.250)*         | (1.666)          |        |           |

Panel C: Post COVID-19 from 30/01/2020 to 01/06/2020

| AUTO     | 1.365    | 0.308            | −0.013           | 8.175**   | 0.255     |
|          | (6.481)*** | (2.883)**        | (−1.506)         |        |           |
| BANK     | 1.536    | 0.175            | 0.003            | 13.448*** | 0.367     |
|          | (5.227)*** | (1.542)          | (0.507)          |        |           |
| FIN      | 1.571    | 0.227            | 0.003            | 18.873*** | 0.466     |
|          | (5.858)*** | (2.229)*         | (0.492)          |        |           |
| FMCG     | 1.256    | 0.267            | −0.015           | 5.761**   | 0.185     |
|          | (8.823)*** | (2.364)*         | (−1.358)         |        |           |
| IT       | 1.601    | 0.175            | 0.001            | 7.792**   | 0.263     |
|          | (6.532)*** | (1.174)          | (0.082)          |        |           |
| MEDIA    | 1.417    | 0.693            | −0.058           | 9.797***  | 0.286     |
|          | (5.236)*** | (3.613)**        | (−2.476)*        |        |           |
| METAL    | 1.311    | 0.311            | −0.009           | 16.196*** | 0.438     |
|          | (5.856)*** | (2.685)*         | (−0.881)         |        |           |
| PHARMA   | 1.179    | 0.195            | 0.014            | 26.872*** | 0.611     |
|          | (5.998)*** | (1.502)          | (1.109)          |        |           |
| REALTY   | 1.457    | 0.246            | 0.014            | 29.001*** | 0.566     |
|          | (5.724)*** | (1.776)          | (1.059)          |        |           |
| ENERGY   | 1.208    | 0.324            | 0.004            | 13.973*** | 0.382     |
|          | (3.950)*** | (1.716)          | (0.216)          |        |           |
| SERVICES | 1.502    | 0.266            | 0.003            | 25.102*** | 0.534     |
|          | (6.602)*** | (2.443)*         | (0.408)          |        |           |
| INFRA    | 1.826    | −0.272           | 0.117            | 8.584**   | 0.265     |
|          | (8.613)*** | (−1.056)         | (2.435)*         |        |           |

**Source:** The authors.  
**Notes:** t-Statistics are given in parentheses. ***, ** and * Indicate significance at 0.001, 0.01 and 0.05, respectively.

non-presence of herding behaviour in respective sectors. The value of adjusted $R$-square is in the range of 9–37 per cent, implying appropriateness of the model for all sectors. F-test statistic gives significant results, indicating all models corresponding to sectors have an overall good fit.

Panel C of Table 7 presents the results of the regression model industry-wise during the COVID-19 outbreak in India. The estimated coefficient $\gamma_2^{\text{Down}}$ of the regression model for MEDIA industry indicates that investors are intended to
herding behaviour in this industry. According to PHD Chamber of Commerce and Industry report, media has been one of the most badly affected sectors due to the COVID-19 pandemic. The Electronic media experienced a heavy loss in advertisement revenues; the outdoor media got all orders cancelled, owing to no traffic on roads due to lockdown; and the events business drew a blank as there were no events permitted in prevailing conditions of COVID-19. These falling advertising revenue trends are expected to pose a significant threat to the industry as advertisement is a prime source of revenue for the media. Therefore, it seems the outbreak of COVID-19 causes sell-side herding behaviour in media and entertainment industry. Moreover, the results of panel C provided weak evidence of herding behaviour during the coronavirus outbreak.

VII. Conclusion and Implications

The ongoing deadly COVID-19 outbreak has wreaked havoc on all world economies as well as weakened the stock markets’ performance and hurt the sentiments of stock market participants. This article examined the herding behaviour in the Indian stock market in the prevalence of the COVID-19 pandemic. We argued that pandemic turmoil causes extreme market conditions and fuels panic among the market participants. Using daily data from the national stock exchange (NSE), we deployed different models to investigate the industry herding behaviour among investors under different market conditions and time horizons. Using the different models proposed by Chang et al. (2000), we examined the herding behaviour in general, in the pre- and post-COVID-19 outbreak, and during both bull and bear market conditions.

Our results of this article for the whole sample and before the COVID-19 outbreak period failed to provide the general evidence of herding behaviour for all industries, but they did suggest strong evidence of anti-herding behaviour for Banking, Financial Services, Metal, Pharmaceutical, Realty, Energy, Services and Infrastructure industry that also showed non-linearity. Therefore, our findings are consistent with Kumar et al. (2016), Dutta et al. (2016) and Ganesh et al. (2016), who recently tested the herding behaviour in the Indian stock market and suggested that Indian equity market is generally free of industrial herding and even when they showed some level of herding. But our findings contradict with Lao and Singh (2011), who suggest the presence of herding behaviour in the Indian stock market. The rationale of our findings being inconsistent with Lao and Singh (2011) is threefold. First, we detect the herding behaviour at the industry level, whereas Lao and Singh (2011) observe the herding behaviour at the market level. Second, Lao and Singh (2011) used the data of top 300 firms from the Bombay Stock Exchange index (BSE) over the period from 1 July 1999 to 30 June 2009 to observe the herding behaviour, and during the study period, Indian stock market could be inefficient. On the other hand, we used the latest data of 12 industries from the NSE over the period from 1 January 2015 to 1 June 2020 to investigate the herding behaviour. Third, in recent years, market regulator, that is Securities
and Exchange Board of India (SEBI) has attempted to maintain information symmetry that has resulted in informed decision-making by the shareholders.

Furthermore, during the bull market conditions, we found weak evidence of herding for the whole sample and pre-coronavirus pandemic period. But, the post-COVID-19 pandemic period provided strong evidence of herding behaviour for the automobiles, IT and pharmaceutical industry in bullish market conditions. Further, in the bearish market conditions, our results suggest the presence of herding behaviour during the post-COVID-19 outbreak period for the media and entertainment industry. Therefore, it seems the outbreak of COVID-19 causes herding behaviour in the automobile industry, IT, pharmaceutical and media and entertainment industry.

This article has certain relevant implications for investors, policymakers and market regulators in market turbulence phase like the COVID-19 pandemic. For a fair valuation of financial assets, market participants should consider the role of herding in the selection of assets. Knowledge of herding behaviour at the industry level helps individual investors in the pursuit of making sensible and effective financial decisions in the regime of the COVID-19 pandemic. Herding behaviour encourages market participants to invest in risky assets that may fuel market volatility. Easily accessible and quality information helps investors in the selection of risky assets. During the turbulence period, market regulators should issue guidelines to listed entities for full disclosure of qualitative and quantitative information regarding associated risk that listed entities are exposed to. Similarly, the Indian stock market regulator, Securities and Exchange Board of India (SEBI), has recently advised listed companies to make suitable disclosures regarding the economic impact of COVID-19 on its operations as part of its disclosure obligations to shareholders and investors.

Further, this study facilitates regulators who aim to bring back efficiency in the stock market and control volatility. To control volatility in the market during an environment of panic and fear like COVID-19 pandemic, the market regulator can issue various measures such as ensuring orderly trading and settlement, restrictions of positions and increased margins, enhanced margins for volatile stocks and reduced market-wide position limits for volatile scripts. We have investigated the presence of herding behaviour using the measure proposed by Chang et al. (2000) and provided $F$-test and adjusted $R$-square values as diagnostics. Therefore, future researchers could use other diagnostics of OLS estimation with outcomes for the robustness of results. Future researchers could use trading volume as a proxy variable to observe the herding behaviour.

**Acknowledgements**

The authors are grateful to the editor of Millennial Asia and the anonymous referees for their extremely useful suggestions to improve the quality of the article. All usual disclaimers apply.

**Declaration of Conflicting Interests**

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.
Funding
The authors received no financial support for the research, authorship and/or publication of this article.

References
Albulescu, C. (2020). Coronavirus and financial volatility: 40 days of fasting and fear. *Computational Finance*. https://arxiv.org/ftp/arxiv/papers/2003/2003.04005.pdf
Banerjee, A. V. (1992). A simple model of herd behavior. *The Quarterly Journal of Economics, 107*(3), 797–817.
Balcilar, M., Demirer, R., & Hammoudeh, S. (2014). What drives herding in oil-rich, developing stock markets? Relative roles of own volatility and global factors. *The North American Journal of Economics and Finance, 29*, 418–440.
BenSaïda, A., Jlassi, M., & Litimi, H. (2015). Volume–herding interaction in the American market. *American Journal Finance and Accounting, 4*(1), 50–69.
Bikhchandani, S., & Sharma, S. (2001). Herding behavior in financial markets. *IMF Staff Papers, 47*(3), 279–310.
Bikhchandani, S., Hirshleifer, D., & Welch, I. (1992). A theory of fads, fashion, custom, and cultural change as informational cascades. *Journal of Political Economy, 100*(5), 992–1026.
Bui, N., Nguyen, L., Nguyen, N., & Titman, G. (2018). Herding in frontier stock markets: Evidence from the Vietnamese stock market. *Account Finance, 58(S1)*, 59–81.
Caparrelli, F., D’Arcangelis, A. M., & Cassuto, A. (2004). Herding in the Italian stock market: A case of behavioral finance. *Journal of Behavioral Finance, 5*(4), 222–230.
Chang, E. C., Cheng, J. W., & Khorana, A. (2000). An examination of herd behavior in equity markets: An international perspective. *Journal of Banking & Finance, 24*(10), 1651–1679.
Chauhan, Y., Ahmad, N., Aggarwal, V., & Chandrad, A. (2019). Herd behavior and asset pricing in the Indian Stock Market. *IIMB Management Review*, 0–25. https://doi.org/10.1016/j.iimb.2019.10.008
Chiang, T. C., & Zheng, D. (2010). An empirical analysis of herd behavior in global stock markets. *Journal of Banking & Finance, 34*(8), 1911–1921.
Christie, W., & Huang, R. (1995). Following the pied piper: Do individual returns herd around the market? *Financial Analysts Journal, 51*(4), 31–37.
Demirer, R., & Kutan, A. M. (2006). Does herding behavior exist in Chinese stock markets? *Journal of International Financial Markets, Institutions and Money, 16*(2), 123–142.
Demirer, R., Kutan, A., & Chen, C. (2010). Do investors herd in emerging stock markets? Evidence from the Taiwanese market. *Journal of Economic Behavior & Organization, 76*(2), 283–295.
Dutta, A., Gahan, P., Panda, S. K. (2016). Evidences of herding behaviour in the Indian Stock Market. *Vilakshan: The XIMB Journal of Management, 13*(2), 23–40.
Economoua, F., Kostakisb, A., Philippasa, N. (2011). Cross-country effects in herding behaviour: Evidence from four south European markets. *Journal of International Financial Markets, Institutions and Money, 21*(3), 443–460.
Erdenetsogt, A., & Kallinterakis, V. (2016). Investors’ herding in frontier markets: Evidence from Mongolia. In P. Andrikopoulos, G. Gregoriou, & V. Kallinterakis (Eds.), *Handbook of Frontier Markets* (pp. 233–249). Academic Press.
Fama, E. (1970). Efficient capital markets: A review of theory and empirical work. *The Journal of Finance, 25*(2), 383–417. https://doi.org/10.2307/2325486
Ganesh, R., Naresh, G., & Thiyagarajan, S. (2016). Industry herding behaviour in Indian stock market. *American Journal of Finance and Accounting, 4*(3/4), 284–307.

Haacker, M. (2004). Front matter. In *The macroeconomics of HIV/AIDS*. International Monetary Fund. https://doi.org/10.5089/9781589063600.071

Hoffman, S. J., & Silverberg, S. L. (2018). Delays in global disease outbreak responses: Lessons from H1N1, Ebola, and Zika. *American Journal of Public Health, 108*(3), 329–333. https://doi.org/10.2105/AJPH.2017.304245

Hwang, S., & Salmon, M. (2004). Market stress and herding. *Journal of Empirical Finance, 11*(4), 585–616.

*Indian Express*. (2020). *India Coronavirus Updates, 24 June: Delhi overtakes Mumbai to become city with highest Covid-19 caseload in country*. https://indianexpress.com/article/india/india-coronavirus-updates-24-june-6473716/

Jaiyeoba, H., Adewale, A. A., Haron, R., & Ismail, C. M. (2018). Investment decision behaviour of the Malaysian retail investors and fund managers: A qualitative inquiry. *Qualitative Research in Financial Markets, 10*(9), 134–151.

Javaira, Z., & Hassan, A. (2015). An examination of herding behavior in Pakistani stock market. *International Journal of Emerging Markets, 10*(3), 474–490.

Kumar, A., Bharti, & Bansal, S. (2016). An examination of herding behavior in an emerging economy – A study of Indian stock market. *Global Journal of Management and Business Research: B Economics and Commerce, 16*(5), 57–64.

Lakonishok, J., Shleifer, A., & Vishny, R. W. (1992). The impact of institutional trading on stock prices. *Journal of Financial Economics, 32*(1), 23–43.

Liao, P., & Singh, H. (2011). Herding behaviour in the Chinese and Indian stock markets. *Journal of Asian Economics, 22*(6), 495–506.

Lee, C.-C., Chen, M.-P., & Hsieh, K.-M. (2013). Industry herding and market states: Evidence from Chinese stock markets. *Quantitative Finance, 13*(7), 1091–1113.

Liu, H., Manzoor, A., Wang, C., Zhang, L., & Manzoor, Z. (2020). The COVID-19 outbreak and affected countries stock markets response. *International Journal of Environmental Research and Public Health, 17*(8), 1–19.

Loh, E. (2006). The impact of SARS on the performance and risk profile of airline stocks. *International Journal of Transport Economics, 33*(3), 401–422.

Lux, T. (1995). Herd behavior, bubbles and crashes. *Economic Journal, 105*(431), 881–896.

Lux, T., & Marchesi, M. (1999). Scaling and criticality in a stochastic multi-agent model of a financial market. *Nature, 397*, 498–500.

Mertzanis, C., & Allam, N. (2018). Political instability and herding behaviour: Evidence from Egypt’s stock market. *Journal of Emerging Market Finance, 17*(1), 1–31.

Nofsinger, J. R., & Sias, R. W. (2002). Herding and feedback trading by institutional and individual investors. *The Journal of Finance, 54*(6), 2263–2295.

Pendell, D. L., & Cho, C. (2013). Stock market reactions to contagious animal disease outbreaks: An event study in korean foot-and-mouth disease outbreak. *Agribusiness, 29*(4), 455–468.

Ph, H., & Uchil, R. (2019). Impact of investor sentiment on decision-making in Indian stock market: An empirical analysis. *Journal of Advances in Management Research, 17*(1), 66–83.

Philippas, D., Philippas, N., Tziogkidis, P., & Rjiba, H. (2020). Signal-herding in cryptocurrencies. *Journal of International Financial Markets, Institutions & Money, 65*, 1–16.

Scharfstein, D. S., & Stein, J. C. (1990). Herd behavior and investment. *The American Economic Review, 80*(3), 465–479.
Tan, L., Chiang, T. C., Mason, J., & Nelling, E. (2008). Herding behavior in Chinese stock markets: An examination of A and B shares. *Pacific-Basin Finance Journal, 16*(2), 61–77.

*Times of India*. (2020). *India on track to become the most affected nation by the COVID pandemic: Experts*. https://timesofindia.indiatimes.com/life-style/health-fitness/health-news/coronavirus-latest-update-india-on-track-to-become-the-most-affected-nation-by-the-covid-pandemic-experts/photostory/77478198.cms

*The Economic Times*. (2020). *Pharmaceutical industry at forefront of battle against COVID-19: Sun Pharma chairman*. https://economictimes.indiatimes.com/industry/healthcare/biotech/pharmaceuticals/pharmaceutical-industry-at-forefront-of-battle-against-covid-19-sun-pharma-chairman/articleshow/77791019.cms

Zhang, D., Hu, M., & Ji, Q. (2020). Financial markets under the global pandemic of COVID-19. *Finance Research Letters, 36*. https://doi.org/10.1016/j.frl.2020.101528