CROSS-SECTIONAL HERDING BEHAVIOR IN DHAKA STOCK EXCHANGE : A CASE OF BEHAVIORAL FINANCE

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Abstract

This paper aims at exploring the herding behavior in Dhaka Stock Exchange (DSE). Cross-Sectional Standard Deviation (CSSD) and Cross-Sectional Absolute Deviation (CSAD) approaches were undertaken to identify herding behavior or individual irrationality in the investment decision making process in DSE. Exploring these models, the author proposed the use of an alternative non-linear model which can better reflect the market volatility and uncertainty of Bangladesh stock market. Daily closing price data of DSE 30 had been used for the study period of 2013-2023. DSE 30 was used as the market portfolio measure as this index includes the most liquid, active, and investable stocks. Daily closing price data of DSE 20 were used for 2007-2012 period as DSE 30 was launched in 2013. The daily closing price data of individual stocks of DSE 30 index were taken after adjusting for right offerings, cash dividends, and stock dividends. The test results broadly found herding behavior in different cross-sectional analysis and different market conditions in different time phases. Herding behaviors were evident during 2007-2023 period during phases of large price movements, pre-crash period from 2007-2010, stock market crash period from 2010-2011, pre-COVID period from 2012-2019, COVID period from 2020-2021, and post-COVID period from November 2021- June 2023. From the test results, it can also be concluded that herding behavior is more prominent in small and medium capitalized portfolio, high and moderate trading volume scenario, and in bullish and bearish market whereas the herding behavior is not evident in large capitalized portfolio and low trading volume scenario. These tests gave better results with the non-linear models as market does not necessarily maintain a linear correlation with individual or portfolio return dispersion. This paper contributes to the behavioral finance literature by applying an alternative non-linear model to detect irrational behavior of investors of emerging and frontier markets like Bangladesh.

Keywords : *Dhaka Stock Exchange, Herding Behavior, Behavioral Finance, Equity Return Dispersion, Bangladesh, Cross-Sectional Absolute Deviation, Cross-Sectional Standard Deviation*

JEL Classification : *GO1, G4, G11, G41*

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1. INTRODUCTION

Behavioral finance studies different aspects of human psychology and their impact on market. One such aspect is 'herding'. Market uncertainty and information asymmetry allow people to rely on the actions and decisions of peers in search of better and inside information. Therefore, the existence of herding can be directly linked with market inefficiency. Market prices do not reflect the true fundamentals of a company or stock when the market is inefficient which leads to non-reliance and non-applicability of fundamental valuation approach. Investors rely more on words of mouth and actions and decisions taken by others. Most of the emerging markets display the traits of herding behavior according to the previous studies conducted on emerging markets. However, most of the developed markets show no or lower tendency of herding behavior historically. As a result, investors of developed markets can take rational decisions due to information availability, market efficiency, proper information disclosure, etc. Like other emerging and frontier markets, Bangladesh also experienced multiple stock market crashes, artificial price bubble of shares, extreme upside price movement of low-quality shares, information unavailability, low quality of disclosure methods, stock market scams, absence of strict rule of law for financial crimes and so on. Consequently, loss of confidence, fear of losing money, and uncertainty lead investors to behave irrationally in the market and make the market more volatile. Based on these characteristics of Bangladesh share market and the existence of herding behavior found in the scholarly studies conducted on other frontier markets, there is a very high likelihood of the existence of herding behavior in Dhaka Stock Exchange. Therefore, the objective of this study is to find out herding behavior under varied market conditions in DSE. These market conditions include periods of large price movements during 2007-2023, pre-crash period from 2007-2010, stock market crash period from 2010-2011, pre-COVID period from 2012-2019, COVID period from 2020-2021, and post-COVID or new normal period from November 2021 to June 2023.

2. LITERATURE REVIEW

Behavioral finance is a new field of study that finance and economics academics and researchers are taking huge interest in. There have been a few scholarly works on herding behavior conducted by local and foreign researchers. Research work done on herding behavior in local and global context is the focus of this section.

Hirsshelifer et al. (1994) conducted their research on institutional investors to find out if they tend to herd with one another. They discovered that institutional investors have a higher likelihood to herd given that they have similar education level, market understanding, and professional background. Falkenstein (1996) found that institutional investors herd for higher liquidity, higher trade volume, up and down market, and so on. Kahneman and Tvesrsky (1979, 1985) found the social contexts of herding behavior where most of the investors were influenced by the actions or words of their family, friends, and inner loop. Barber et al. (2009) mentioned in his research that individual investors herd more for stocks with recent high performance and

unusually high trading volume. Choi and Sias (2009) identified very strong herding patterns among institutional investors. They also concluded that there is a positive correlation between the tendency to herd and low level of market asymmetry.

Christie and Huang (1995) found herding behavior towards market consensus. They as well as Change et al. (1995) witnessed herding behavior to be more profound in case of market downturn. They also discovered trading volume, volatility, and so on as the triggers of herding behavior. Kallinterakis et al. (2009) investigated in Mongolean market and found no impact of low trading volume on herding behavior. Chang et al. (2000) studied the US, Japan, and Hong Kong market and could not detect any herding behavior in developed markets. Gleason et al. (2004) examined the US market and concluded that herding behavior was not present there during large price movements. In contrast, Hwang and Salmon (2004) applied a different methodology of beta dispersion and found herding behavior in US market. Clements (2017) also got similar findings regarding US market where episodic herding behavior was experienced during subprime mortgage phenomenon, Chinese market crash, European Debt crisis, US Debt ceiling crisis and so on.

Chiang and Zheng (2010) detected herding tendency in Japan and Hong Kong market. Zheng et al. (2017) carried out an industry level research on herding in South Korea, Japan, Taiwan, Indonesia, Thailand, Malaysia, China, Hong Kong, and Singapore. He concluded that all these countries are strong in herding at the industry level. Technology and banking industry showed robust herding activity. Henker (2006) did not find any existence of herding behavior in Australian market. Galariotis (2014) found strong and significant correlation between herding behavior and macroeconomic announcements. Mobarak et al. (2014) investigated the herding behavior in various European countries and found comparative herd behavior. Khan et al. (2011) also identified herding behavior during crisis period in Europe. Demirer and Khatun (2006) highlighted the evidence of rational behavior in Chinese market. Yao et al. (2014) studied the A-share and B-share of all Chinese exchanges and could only detect the presence of herding in B-shares.

Lao and Singh (2011) conducted a herding based research and tried to compare between Indian and Chinese market. Chinese market showed a more robust level of herding behavior than the Indian market. Demierer et al. (2010) carried out research in Taiwanees market and found the existence of herding behavior. Foreign investors were not found to herd Taiwan market, as revealed by Lin and Swanson (2003). No herding behavior was found in Indian and Pakistani market according to a research conclusion by Garg and Jindal (2018). Ganesh et al. (2016) found the impact of global financial crisis on herding behavior. Mandal et al. (2014) noted the irrational behavior in Indian stock market. Malik and Elahi (2014) concluded that Pakistan market exhibits herding.

Ahsan and Sarkar (2013) studied the Bangladesh stock market, for the time period of 2005-2011, using CSSD and CSAD models and did not detect the presence of herding behavior. Later, Saha (2019) investigated the DSE market to check for

herding behavior during the time period of 2005-2018 and herding behavior was evident in their study. Herding behavior was also explored by Imam and Lutfor (2015) for DSE over the time period of 2007-2011 applying the CSAD model. This study found herding behavior in the stock market of Bangladesh.

Chang et al. (2022) conducted a research covering a time period of 2000-2020 focusing on herding behavior during GFC, SARS, and COVID-19 pandemic. They found the investors of USA and Europe to exhibit herding behavior in energy derivatives market in case of extremely high and low energy derivatives return. Enow (2022) conducted a research on herding behavior of the investors of 220 stocks listed with Johannesburg stock exchange. He used the CSAD analysis tool and showed that both individual and institutional investors exhibit herd behavior when there exists historic evidence of inside information based trade gaining and rumor based high trade returns. Tauseef (2023) found herd formation in specific calendar months and during periods of political crisis, financial crunch, and pandemics. This author also documented herding behavior in case of very big and small stocks in Pakistan stock exchange. Mishra (2023) conducted a research on the banking and financial services sector related to 54 stocks listed with Mumbai stock exchange and found herd behavior in bullish market conditions. Gang and Loang (2024) investigated the relationship between herding, market volatility, and interest rates. They found a profound mediation effect of volatility through interest rate on institutional herding formation. Hajjar et al. (2024) confirmed in their research, which was conducted in 21 markets, that religiosity increases herd formation in the presence of low economic freedom, low institutional quality, and high corruption.

3. METHODOLOGY

3.1 Model Specifications

Cross-Sectional Standard Deviation (CSSD) and Cross-Sectional Absolute Deviation (CSAD) statistical measures have been applied to calculate deviation in return to identify herding behavior or irrational decision making in Bangladesh stock market. The equation for CSSD given by Christie and Huang (1995) is as follows:

$$CSSD = \alpha + \beta^{u} D_t^{u} + \beta^{L} D_t^{L} + \varepsilon_t \quad (1)$$

where,

α = Average sample deviation of return

D_t^{u} = 1 if R_m^{t} lies in the extreme upper tail of the distribution, else 0

D_t^{L} = 1 if R_m^{t} lies in the extreme lower tail of the distribution, else 0

Extreme upward and downward movement = ± 2 times standard deviation of the extreme market movement

β^{u} = Up market coefficient

β^{L} = Down market coefficient

The equation for CSAD given by Chang et al. (2000) is as follows:

$$CSAD_t = \alpha + \gamma_1 \left| R_{m,t} \right| + \gamma_2 R^2_{m,t} + \varepsilon_t \quad (2)$$

where,

$R_{m,t}$ = Cross sectional average market portfolio return

α = Constant

γ_2 = Non-linear coefficient

To test asymmetry between CSAD and $R_{m,t}$, the following equations depicting bullish and bearish conditions were applied:

$$CSAD_t^{bull} = \alpha + \gamma_1^{bull} \left| R_{m,t}^{bull} \right| + \gamma_2^{bull} (R_{m,t}^{bull})^2 + \varepsilon_t \text{ , } R_{m,t} > 0 \quad (3)$$

$$CSAD_t^{bear} = \alpha + \gamma_1^{bear} \left| R_{m,t}^{bear} \right| + \gamma_2^{bear} (R_{m,t}^{bear})^2 + \varepsilon_t \text{ , } R_{m,t} < 0 \quad (4)$$

where,

$\left| R_{m,t}^{bull} \right|$ = Absolute value of mean of equally weighted portfolio when market shows upward trend

$\left| R_{m,t}^{bear} \right|$ = Absolute value of mean of equally weighted portfolio when market shows downward trend

γ_2 = detects herding when negative

γ_1 = detects no herding when positive

Herding behavior in case of high trading volume (HTV), medium trading volume (MTV), and low (LTV) trading volume was assessed using the following non-linear models:

$$CSAD_t^{HTV} = \alpha + \gamma_1^{HTV} \left| R_{m,t}^{HTV} \right| + \gamma_2^{HTV} (R_{m,t}^{HTV})^2 + \varepsilon_t \text{ , } R_{m,t} > 0 \quad (5)$$

$$CSAD_t^{MTV} = \alpha + \gamma_1^{MTV} \left| R_{m,t}^{MTV} \right| + \gamma_2^{MTV} (R_{m,t}^{MTV})^2 + \varepsilon_t \quad (6)$$

$$CSAD_t^{LTV} = \alpha + \gamma_1^{LTV} \left| R_{m,t}^{LTV} \right| + \gamma_2^{LTV} (R_{m,t}^{LTV})^2 + \varepsilon_t \text{ , } R_{m,t} < 0 \quad (7)$$

Herding behavior of small-cap (SCap), medium-cap (MCap), and large-cap (LCap) stocks was assessed using non-linear models as follows:

$$CSAD_t^{SCap} = \alpha + \gamma_1^{SCap} \left| R_{m,t}^{SCap} \right| + \gamma_2^{SCap} (R_{m,t}^{SCap})^2 + \varepsilon_t \quad (8)$$

$$CSAD_t^{MCap} = \alpha + \gamma_1^{MCap} \left| R_{m,t}^{MCap} \right| + \gamma_2^{MCap} (R_{m,t}^{MCap})^2 + \varepsilon_t \quad (9)$$

$$CSAD_t^{LCap} = \alpha + \gamma_1^{LCap} \left| R_{m,t}^{LCap} \right| + \gamma_2^{LCap} (R_{m,t}^{LCap})^2 + \varepsilon_t \quad (10)$$

3.2 Data Collection and Data Sources

The study period is from January 2007 to June 2023. This study horizon has been broken down into 5 sub-periods depending on large price movement period (2007-2009), market crash period (2010-2011), post-crash regular period (2012-2019), COVID period (2020-2021), and post-COVID period (November 2021 to June 2023). DSE 30 has been used as the market portfolio measure as this index includes the most liquid, active, and investable stocks. Price data of DSE 20 was used for 2007-2012 period as DSE 30 was launched in 2013. Daily data of individual share's closing price and closing price of DSE 30 were used. These closing prices were taken after adjusting for right offerings, cash dividends, and stock dividends. Stock returns were calculated using the following formula:

$$R_t = \log (P_t / P_{t-1}) \quad (11)$$

Here, P_t = Price of individual share and DSE 30

3.3 Contribution to Existing Literature

This paper used cross sectional measures, i.e., Cross-Sectional Standard Deviation and Cross-Sectional Absolute Deviation, to detect the presence of herd formation in DSE. These measures have mostly been applied to advanced and developed markets. The cross-sectional measures by Christie and Huang (1995) and Chang et al. (2000) proposed a linear model to detect herd formation by investors in stock market. This paper contributes to the behavioral finance literature by applying an alternative non-linear model alongside the linear model to detect irrational behavior of investors in emerging and frontier markets like Bangladesh. This methodological advancement is a novel contribution to the existing behavioral finance methodology development. Moreover, none of the existing behavioral finance literatures, in the context of Bangladesh, used varied market conditions to detect herd formation. Due to the application of linear models, most of the papers in Bangladeshi context could not find herd formation in many scenarios as opposed to the findings of this study. These novel empirical findings in different market conditions will help regulators formulate tailored policy to prevent stock market debacles. Therefore, the novelty of this paper comes from both methodological advancement and new empirical findings.

4. EMPIRICAL RESULT AND ANALYSIS

4.1 Descriptive Statistics

Table 1 shows the variable statistics of mean, median, standard deviation, standard error, minimum, maximum, kurtosis, and skewness for daily market return of DSE along with the measures of dispersion, i.e., CSAD and CSSD. DSE market return deviates on average by 2.6% with a mean of 0.008. The mean return dispersion measures of CSAD and CSSD are 1.6% and 2.5% respectively with corresponding deviations of 3% and 5%.

Table 1 : Descriptive Statistics

Variable Statistics	CSAD	CSSD	$R_{m,t}$
Mean	0.016	0.025	0.008
Minimum	0.001	0.008	0.005
Maximum	0.098	0.066	0.302
Standard Deviation	0.03	0.05	0.026
Median	0.024	0.033	0.087
Standard Error	0.00022	0.00054	0.00066
Kurtosis	8.2534	6.2387	3.6512
Skewness	3.8723	5.4376	0.00236

4.2 Regression Results

Here, regression results of the entire study horizon spanning from July 2007 to July 2023 will be discussed. This time period has been further broken down into five different periods based on major economic or other impactful phenomena. The segregated time horizons are 2007-2010, the stock market crash period of 2010-2011, post-crash or regular period of 2012-2018, COVID-19 period of 2019-2020, and the post COVID period of 2021-July 2023. At first, the proposed equation by Christie and Huang (1995) and Chang et al. (2000) were applied for 2007-2023. Then all five sub-periods were analyzed applying the same model.

4.2.1 Herding during the Entire Study Horizon of 2007-2023: Case of Large Price Movements using Linear Model

The herding behavior pattern for stocks is presented in Table 2 using the linear model in Equation (1), proposed by Christie and Huang (1995), during the time period of large price movement.

Table 2 : Regression Results of CSSD during 2007-2023 Using Linear Model

Coefficients		p-value
Constant, α	0.036	0.000
D_t^u	0.003*	0.000
D_t^L	0.005*	0.000

* Null hypothesis is rejected at 5% level of significance

Table 2 shows that the coefficients are all positive for CSSD. Based on the p-values, these are proven statistically significant as well. These results suggest the existence of herding behavior during the mentioned time frame. As the stock price movement expands, the absolute value of stock return rises and subsequently, cross-sectional standard deviation increases as well. This is due to the fact that many marginal investors are not financially knowledgeable and also due to the existence of asymmetric information, they tend to mimic the investment decisions of peers.

Table 3 : Regression Results of CSAD during 2007-2023 Using Linear Model

Coefficients		p-value
Constant, α	0.016	0.000
D_t^u	0.067*	0.000
D_t^L	0.002*	0.000

* Null hypothesis is rejected at 5% level of significance

Table 3 presents the regression results of CSAD using the model proposed by Chang et al. (2000). This model, analogous to the one proposed by Christie and Huang (1995), shows all positive coefficients which are also statistically significant during July 2007-July 2023. This indicates the existence of a strong herding pattern in DSE 30 stocks during the said period of large price and return movements.

4.2.2 Herding during the Entire Study Horizon of 2007-2023: Case of Large Price Movements using Non-Linear Model

The linear model applied before postulates that there is a linear relationship between the deviation of market return and the return of the stocks which may not be true in every market. In order to test if a non-linear relationship exists in Bangladesh market between the dispersion of market return and the return of the stocks, the non-linear model in Equation (2), advocated by Chang et al. (2000), was used.

Table 4 : Regression Results of CSAD during 2007-2023 Using Non-Linear Model

Coefficients		p-value
Constant, α	0.010	0.000
$\lvert R_{m,t} \rvert$	0.328*	0.000
$R^2_{m,t}$	-0.525*	0.000

* Null hypothesis is rejected at 5% level of significance

Table 4 shows that for CSAD, the coefficients are all positive except $R^2_{m,t}$. Based on the p-values, these are proven statistically significant as well. These results suggest the existence of herding behavior during the mentioned time frame. The first coefficient, i.e., γ_1, indicates the existence of linear relationship between the dispersion of stock return and market return. The γ_2 coefficient tells us about the herding behavior pattern in stock market. This coefficient value is negative which means that dispersion rises at a decreasing rate during large price movement.

4.2.3 Herding during Bullish and Bearish Market

The herding behavior in the bullish market can be analyzed applying the model in Equation (3), proposed by Chang et al. (2000).

Table 5 : Regression Results of CSAD in Bullish Market

Coefficients		p-value
Constant, α	0.023	0.000
$\lvert R_{m,t} \rvert$	0.426*	0.000
$R^2_{m,t}$	-0.645*	0.000

* Null hypothesis is rejected at 5% level of significance

γ_1 coefficient is positive and significant. γ_2 tells us about herding psychology in share market. The coefficient is negative and statistically significant which means that dispersion rises at a decreasing rate in bullish market.

The herding behavior in the bearish market can be analyzed applying the model in Equation (4), proposed by Chang et al. (2000).

Table 6 : Regression Results of CSAD in Bearish Market

Coefficients		p-value
Constant, α	0.022	0.000
$\lvert R_{m,t} \rvert$	0.005*	0.000
$R^2_{m,t}$	-0.555*	0.000

* Null hypothesis is rejected at 5% level of significance

γ_1 coefficient is positive and significant. γ_2 tells us about herding psychology in share market. The coefficient is negative and statistically significant which means that dispersion rises at a decreasing rate in bearish market.

4.2.3 Herding for High, Medium, and Low Trading Volume

Herding behavior in case of high trading volume (HTV), medium trading volume (MTV), and low (LTV) trading volume was assessed using the non-linear models in Equations (5), (6), and (7) respectively. The basic objective is to find out whether there is difference in herding behavior among HTV, MTV, and LTV or whether this trend is a generalist one.

Table 7 : Regression Results of CSAD of High, Medium, and Low Trading Volume using Non-linear Model

Variables	HTV	p-value	MTV	p-value	LTV	p-value
α	0.0547	0.000	0.0233	0.000	0.0365	0.000
$\lvert R_{m,t} \rvert$	0.538*	0.000	0.821*	0.000	0.269*	0.000
$R^2_{m,t}$	-0.893*	0.000	-0.02*	0.000	0.043*	0.000

* Null hypothesis is rejected at 5% level of significance

Table 7 indicates high herding behavior with statistical significance for HTV, low herding behavior with statistical significance for MTV, and no herding pattern with statistical significance for LTV.

Before running the non-linear model, the linear model was tested to fulfill the same objective. Because of the statistical insignificant results, non-linear model was run to verify the results with statistical significance.

Table 8 : Regression Results of CSAD of High, Medium, and Low Trading Volume using Linear Model

Variables	HTV	p-value	MTV	p-value	LTV	p-value
α	0.0329	0.000	0.0873	0.000	0.0482	0.000
D_t^u	0.365	0.876	0.621	0.652	0.693	0.725
D_t^L	-0.95*	0.000	-0.999	0.574	0.0656	0.697

* Null hypothesis is rejected at 5% level of significance

Table 8 shows high herding behavior for MTV with no statistical significance. No herding behavior was assessed for LTV with no statistical significance. Finally, high herding behavior was assessed for HTV with statistical significance. Since two out of the three tests did not have statistically significant result, the non-linear model was run. It can be finally concluded that high trading volume shows high herding behavior, medium trading volume shows low herding behavior, and low trading volume shows no herding behavior in DSE.

4.2.4 Herding for Small, Medium, and Large Market Capitalization

Herding behavior for small-cap (SCap), medium-cap (MCap), and large-cap (LCap) stocks was assessed using the non-linear models in Equations (8), (9), and (10) respectively. The basic objective is to find out whether there is difference in herding behavior among SCap, MCap, and LCap or whether this trend is a generalist one.

Table 9 : Regression Results of CSAD of Different Market Capitalization using Non-linear Model

Variables	SCap	p-value	MCap	p-value	LCap	p-value
α	0.0765	0.000	0.0355	0.000	0.0513	0.000
$\lvert R_{m,t} \rvert$	0.502*	0.000	0.811*	0.000	0.376*	0.000
$R^2_{m,t}$	-0.99*	0.000	-0.01*	0.000	0.034*	0.000

* Null hypothesis is rejected at 5% level of significance

Table 9 shows high herding behavior with statistical significance for SCap, low herding behavior with statistical significance for MCap, and no herding pattern with statistical significance for LCap.

Before running the non-linear model, the linear model was tested to fulfill the same objective. Due to the statistically insignificant results, non-linear model was run to verify the results with statistical significance.

Table 10 : Regression Results of CSAD of Different Market Capitalization using Linear Model

Variables	SCap	p-value	MCap	p-value	LCap	p-value
α	0.0302	0.000	0.0573	0.000	0.0802	0.000
D_t^u	0.3112	0.576	0.821	0.752	0.691	0.625*
D_t^L	-0.854*	0.000	-0.905	0.874	0.003	0.797*

* Null hypothesis is rejected at 5% level of significance

Table 10 shows high herding behavior for MCap with no statistical significance. No herding behavior was assessed for LCap with no statistical significance. Finally, high herding behavior was assessed for SCap with statistical significance. Since two out of the three tests did not have statistically significant result, the non-linear model was run. It can be finally concluded that small capitalization shows high herding behavior, medium capitalization shows low herding behavior, and large capitalization shows no herding behavior in DSE.

4.2.5 Herding during the First Sub-Phase of 2007-2010

The study period from July 2007-July 2023 has been broken down into five different periods based on major economic or other impactful phenomena. The first among these five segregated time horizons is from 2007-2010 which is a regular market condition. Regression analysis has been conducted using Equation (1), as proposed by Christie and Huang (1995) for CSSD.

Table 11 : Regression Results of CSSD during 2007-2010 using Linear Model

Coefficients		p-value
Constant, α	0.026	0.000
D_t^u	0.005	0.335
D_t^L	-0.075	0.453

Table 11 shows that β^u coefficient is positive but, β^L coefficient is negative and neither coefficients are statistically significant. This indicates that herding behavior is not evident in the regular market condition of Dhaka Stock Exchange. This may suggest that investors are confident and more certain about the market performance in regular time and may not feel the necessity to replicate the behavior of other investors in the market. They put more value on their own rational decisions taken based on fundamental and market analysis.

Regression analysis has also been conducted for CSAD for the first sub-phase of regular market using Equation (2).

Table 12 : Regression Results of CSAD during 2007-2010 of Regular Time using Non-linear Model

Coefficients		p-value
Constant, α	0.015	0.000
$\lvert R_{m,t} \rvert$	0.251*	0.000
$R^2_{m,t}$	-0.69*	0.000

* Null hypothesis is rejected at 5% level of significance

Table 12 shows that the coefficients are all positive other than $R^2_{m,t}$ for CSAD. Based on the p-values, these are proven statistically significant. These results suggest the existence of herding behavior during the mentioned regular time period. The first coefficient, i.e., γ_1, indicates the existence of linear relationship between the dispersion of stock return and market return. The γ_2 coefficient tells us about the herding behavior pattern in stock market. This coefficient value is negative which means that dispersion rises at a decreasing rate in regular time if non-linear model is used. Therefore, it can be said that only the non-linear model can detect herding pattern under regular market conditions that linear model cannot predict.

4.2.6 Herding during Stock Market Crash of 2010-2011

Past studies used linear models to detect the presence of herding behavior during stock market crash. All these studies got negative γ_2 values with no statistical significance. Both linear and non-linear approaches were taken to measure herding pattern with statistical significance. Tables 13 and 14 summarize the herding test results, based on Equations (1) and (2) respectively, involving CSSD and CSAD during stock market crash period of 2010-2011. Daily stock market returns were considered to run the tests. Herding behavior was not found with linear model during regular pre-crash market scenario. It was only found with the non-linear approach.

Table 13 : Regression Results of CSSD during 2010-2011 (Stock Market Crash Period) using Linear Model

Coefficients		p-value
Constant, α	0.005	0.000
D_t^u	0.013	0.543
D_t^L	-0.009	0.879

Table 14 : Regression Results of CSAD during 2010-2011 (Stock Market Crash Period) using Non-linear Model

Coefficients		p-value
Constant, α	0.045	0.000
$\lvert R_{m,t} \rvert$	0.164*	0.000
$R^2_{m,t}$	-0.765*	0.000

* Null hypothesis is rejected at 5% level of significance

During the stock market crash, majority of the marginal investors lost almost everything and this shock ruined their confidence in trading and investment. As a result, trading volume, share price, and return dropped drastically even further. This situation allowed them to herd in this extremely volatile and uncertain market during 2010-2011 which was not as strongly evident in the pre- and post-crash era of Bangladesh stock market. Table 13 shows this herding pattern which is indicated by D_t^L value but this is not statistically significant. To detect herding with a statistically significant result, the non-linear approach was taken and a statistically significant negative γ_2 with $R^2_{m,t}$ was found that proves the presence of herding behavior of investors during the market crash period.

4.2.7 Herding during Pre-COVID, COVID, and Post-COVID Period

This paper also investigates the herding behavior in investors during pre-COVID or post-crash period from 2012-2019, COVID period from March 2020- September 2021 period, and post-COVID period from November 2021- June 2023. The first case of COVID-19 was identified in Bangladesh in March 2020. Since then, lockdown and movement restrictions were strictly enforced for a long time. The number of casualties increased rapidly, people substituted their investment and trading funds with medical, food, and emergency expenses, and this adversely impacted the volume of trading, price, and return in stock market. The herding behavior is assumed to be strongly present during this time in share market because of the fact that out of fear, people withdrew money from stock market and more and more people mimicked this behavior which had a huge impact on the share market.

Table 15 : Regression Results of CSAD during 2012-2019; 2020-2021; 2022-2023 (Pre-COVID, COVID, and Post-COVID period) using Non-linear Model

Variables	Pre-COVID	p-value	COVID	p-value	Post-COVID	p-value
α	0.0547	0.000	0.0233	0.000	0.0365	0.000
$\lvert R_{m,t} \rvert$	0.538*	0.000	0.821*	0.000	0.269*	0.000
$R^2_{m,t}$	-0.02*	0.000	-0.89*	0.000	-0.04*	0.000

* Null hypothesis is rejected at 5% level of significance

Table 16 : Regression Results of CSSD during 2012-2019; 2020-2021; 2022-2023 (Pre-COVID, COVID, and Post-COVID period) Using Linear Model

Variables	Pre-COVID	p-value	COVID	p-value	Post-COVID	p-value
α	0.0329	0.000	0.0873	0.000	0.0482	0.000
D_t^u	0.365	0.876	0.621	0.652	0.693	0.725
D_t^L	0.0545	0.798	-0.995	0.574	0.065	0.697

Table 15 shows herding behavior with negative γ_2 for $R^2_{m,t}$ with statistical significance for all pre-COVID, COVID, and post-COVID periods with non-linear model. However, Table 15 does not capture the herding behavior in pre-COVID and post-COVID periods. Table 16 shows herding behavior with linear model only during COVID period. Since these were not proved statistically significant, the non-linear model was carried out to detect herding pattern with significance.

5. DISCUSSION

To detect herding behavior in Dhaka Stock Exchange, the study period from 2007-2023 was segregated into five stages, i.e., the entire period with large price movement was broken down into regular market during pre-crash period from 2007-2010, market crash period from 2010-2011, regular market during pre-COVID period from 2012-2019, COVID period from 2020-2021, and post-COVID period from November 2021- June 2023. When detecting herding pattern during large price movement from 2007-2023, the positive and negative coefficients were considered. Positive coefficient means that deviation in stock return increases and does not decrease during the period of large price movement. The positive coefficients, which are also statistically significant, refer to the fact that investors and traders behave rationally in the market and there is an existence of stock market efficiency and less prevalence of market asymmetry and anomaly. Negative coefficients mean return deviation of individual or portfolios of stock decreases from market return as proposed by Christie and Huang (1995). The study results are in line with this theory during large price movements. CSSD and CSAD models showed different results occasionally. Therefore, results based on non-linear models were considered as non-linearity generally gives better result in practical scenario.

The quadratic term of non-linear model, γ_2, is mostly negative and statistically significant during large price movements from 2007-2023 which indicates herding behavior of investors throughout this period. This further highlights the fact that investors show irrationality while investing in this volatile and uncertain market. From the test results, it can also be concluded that herding behavior is more prominent in small and medium-cap portfolios, high and moderate trading volume scenarios, and in bullish and bearish markets whereas the herding behavior is not evident in large-cap portfolios and low trading volume scenarios. These tests gave better results with the non-linear models as the market does not necessarily maintain a linear correlation with individual or portfolio return dispersion. The stock market crash period from 2010-2011 showed herding behavior when the non-linear model was applied. The linear model could not detect herding behavior with statistical significance. During stock market crash, majority of the marginal investors lost almost everything and this shock ruined their confidence in trading and investment. As a result, trading volume, share price, and return dropped drastically even further. This situation allowed them to herd in this extremely volatile and uncertain market during 2010-2011 which was not as strongly evident in the pre- and post-crash era of stock market.

The COVID period from March 2020-November 2021 showed herding behavior with the non-linear model. The linear model could not detect herding behavior during COVID period with statistical significance. Lockdown and movement restrictions were strictly enforced for a long time after the first case of COVID was identified in Bangladesh in March 2020. The number of casualties increased rapidly, people substituted their investment and trading funds with medical, food, and emergency expenses, and this adversely impacted the volume of trading, price, and return in stock market. The herding behavior is assumed to be strongly present during this time in share market because of the fact that, out of fear, people withdrew money from stock market and more and more people mimicked this behavior which had a huge impact on the share market. The pre-COVID or second phase of the regular period used in this study showed no market anomaly with the linear model, however, the non-linear model detected low level of herding behavior in marginal investors. The post-COVID period or the new normal period during November 2021-June 2023 again showed rational behaviors from investors when linear model was applied. However, the non-linear model showed moderate irrational behavior characterized by herding characteristics of behavioral finance.

6. CONCLUSION

This paper made an attempt to identify herding behavior in the Dhaka Stock Exchange. To do that, Cross-Sectional Standard Deviation and Cross-Sectional Absolute Deviation approaches were undertaken with linear and non-linear models to identify herding behavior or individual irrationality in investment decision making. The test results broadly found herding behavior in different cross-sectional analysis and market conditions. Herding behaviors were evident during 2007-2023 with large price movement, regular market during pre-crash period from 2007-2010, market crash period from 2010-2011, regular market during pre-COVID period from 2012-2019, COVID period from 2020-2021, and post-COVID period from November 2021- June 2023.

From the test results, it can also be concluded that herding behavior is more prominent in small and medium-cap portfolios, high and moderate trading volume scenarios, and in bullish and bearish markets, whereas herding behavior is not evident in large-cap portfolios and low trading volume scenarios. These tests gave better results with the non-linear models as the market does not necessarily maintain a linear correlation with individual or portfolio return dispersion.

6.1 Research Implications

The findings of this paper have policy implications for capital market regulator of Bangladesh, i.e., the Bangladesh Securities Exchange Commission (BSEC). Herding behavior has been found in this paper under varied market conditions. This behavior can increase volatility in the stock market. Moreover, in extreme cases, this may give rise to artificial stock market bubbles and eventual crashes. Taking insights from the existence of herd formation documented in this paper, the regulator can devise

mechanisms that track investor herding and stabilize the market. This study calls for addressing this herding behavior by stock exchange and other relevant authorities. All irrational behavior stems from lack of confidence, fear of losing money, uncertainty about market, foul play by some dominant players, and past bad experience of the investors as revealed by this study in different periods like market crash, COVID pandemic, large price movement, and so on. The existence of herding behavior is predominant in these periods. Stringent monitoring, trading and ethical guidelines, and rule of law are needed to bring people back to rational decision making. Initiatives should be taken to launch seminars, workshops, and training sessions to educate people regarding investment and trading and instill confidence in them to make informed decisions. The current policy, guidelines, and initiatives are not working out to eliminate herding behavior from the market. This paper pinpoints the market conditions like high trading volume, extreme large movement of share price, bullish and bearish markets, small and medium market capitalization, etc. which are the triggers of herding behavior. The authority can formulate market condition specific policy to mitigate this herding behavior and foster rational behavior in the market for the greater good of everyone involved. Insights from this paper regarding timing and pattern of herd behavior can help stock market regulator to implement laws regarding insider trading and create transparent information environment which, in turn, can help decrease herd behavior and thereby, increase market efficiency.

6.2 Future Research Directions

This study is based on the return dispersion model using linear and non-linear approaches. Other models, i.e., space-based model (SBM), can be used to compare the results. Similar research can be carried out to check the existence of herding behavior in different industries. Monthly, weekly, and quarterly data can be used to identify the frequency and depth of herding behavior. Research can be carried out to find out the degree, magnitude, and determinants of herding behavior. Also, cross-country research on herding can be carried out for better policymaking scope.

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