

**HERDING BEHAVIOUR IN BANGLADESH
STOCK MARKET: A CASE OF DHAKA STOCK
EXCHANGE**

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ABSTRACT

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<p>Abstract</p> <p>The paper attempts to investigate the presence of herding behaviour in Dhaka stock exchange (DSE), the prime bourse of Bangladesh stock market. In this study, the models proposed by Christie and Huang (1995) and Chang et al. (2000) have been applied to detect market wide herding. Both daily and monthly data for the period of January 2005 to December 2018 are used. The results show that the investors of Dhaka stock Exchange are involved in herding activity. More specifically, this study finds evidence of herding for the whole study period (2005-2018), bullish and bearish market, first sub-period (2005 to 2011) and for the stock market crash period (2010-2011). Herding is detected only with the non-linear model of Chang et al. (2000) for daily data. However, the result fails to find evidence of herding for the second sub-period (2012 -2018). In this paper, the result of previous study conducted by Ahsan and Sarkar (2013) on herding behaviour in DSE has also been compared. The finding of this study is inconsistent with the finding of their study since they fail to detect herding by applying similar methodologies. The probable reason for finding different result in the previous study is using different market portfolio DSI (DSE all share price index) which includes both liquid and illiquid stocks. On the other hand, the index (DS30) used in this study includes only active and most liquid stocks. Moreover, in this study, a probable reason for detecting herding for the crash period is considering longer time frame for the crash period comparing to the previous study. The result is important for million of small investors of the market to avoid the psychological trap or irrational behaviour involved with investment decisions.</p>	
Key words Herding Behaviour, CSSD, CSAD, Linear, Non-Linear, DSE, Stock Market.	
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1 INTRODUCTION

The investment behaviour of stock market participants and impact of this behaviour on stock prices has always been a complex topic. Academic researchers and practitioners have made a great amount of effort to understand this behaviour (Chang et al. 2000). Generally, investment decisions are made for profitable payoff which requires detailed study about the market and different investment choices. It is a complex, time consuming and costly task. Many investors want to avoid this complexity and simply imitate other investors' decisions. Following other investors' decision without rational judgement is known as herding which is an irrational and biased decision.

For a long time, Efficient Market Hypothesis (EMH) theory has been used to explain the mechanism of equity market. Traditional finance is mainly based on this theory. According to EMH, all investors are rational, prices always fully reflect available information and new information is instantly added in the expected price (Fama, 1970). EMH theory also states that it is impossible to beat the market as stocks are always traded at their fair prices. However, the existence of excess volatility in expected returns challenges the validity of EMH theory. Many studies have been conducted to answer the reasons behind the excess volatility in stock returns. According to West (1988), it is not possible to resolve excess volatility of stock prices with rational bubbles or traditional return determination models (such as present value model) and perhaps non-traditional models (such as fads, sociological and psychological) would be required. Similar type of argument is made by Summers (1986) that financial markets are not rationally efficient and existence of large valuation errors in certain type of market inefficiency. Some researchers introduce alternative models like Behavioural finance models for stock valuations (Jiang and Lee, 2005). Herding behaviour is one of the important concepts of behavioural finance that has been studied heavily. Researchers find this behaviour as an influential cause for market volatility and financial crises. According to Lao and Singh (2011) herd behaviour challenges the validity of the EMH as it moves stock prices far away from their intrinsic value which eventually destabilizes the stock market.

Defining herding in exact form is difficult and not possible to understand through a single aspect (Rook, 2006). Devenow and Welch (1996) specify it as behaviour patterns as most general form that involve coordination mechanism among individuals. More accurately, the theory suggests that everyone doing what everyone else is doing though sometime their collected information suggests doing something else (Banerjee, 1992). Studies show that investors are influenced by different market conditions and factors to exhibit herding behaviour. For example, during the unusual market movements or market stress investors ignore their own information and exhibit herding, suggested by Christie and Huang (1995). According to Chang et al. (2000), investors are more influenced by

macroeconomic information than firm specific information to exhibit herding behaviour. The extent of herding is not identical for individuals as it depends on personal and environmental variables (Cote and Sanders, 1997). For example, Grinblatt et al. (1995) find presence of herding only among investors of the US mutual fund markets. Herding tendency among amateur investors is more prevalent than professionals and amateur investors cause more threat for market stability (Venezia et al., 2011).

After the several widespread financial crises, herd behaviour became a comparatively important topic in finance literature (Mobarek et al., 2014; Bikhchandani and Sharma 2001). Existence of herding among market participants proves price and information inefficiency (Yao et al. 2014) and examining herding behavior in the market helps participants to better understand price formation in stock market (Lao and Singh, 2011). The importance of herding behaviour in stock markets also attracted researchers heavily. As a result, researchers are continuously contributing to the herding behaviour theory. Voluminous studies are done by the researchers on both advanced (such as Clements et al., 2017; Mobarek et al., 2014; Galariotis et al., 2014) and emerging economies (such as Yao et al., 2014; Lao and Singh, 2011; Shah et al., 2017). More studies are found on the latter one. Bikhchandani and Sharma (2001) argue that there is a possibility to detect herding in emerging markets due to weak reporting requirements, poor accounting standards, inefficient regulations and information inefficiency. Findings of many studies are consistent with the prediction of Bikhchandani and Sharma (2001) that provide evidence of herding behaviour in the emerging economies (such as Lao and Singh, 2011; Chang et al., 2000; Demirer et al., 2010). Many studies have been conducted on important emerging markets of South Asian countries like, in India (Poshakwale and Mandal, 2014; Garg and Jindal, 2014) and Pakistan (Shah et al., 2017; Javaira and Hassan, 2015). However, to the author's best knowledge there is only one study on herding behaviour conducted on Dhaka stock Exchange (DSE) by Ahsan and Sarkar (2013).

Dhaka stock market, the biggest bourse of Bangladesh stock market has experienced huge developments by attracting millions of individual investors. The market has already experienced two major stock market crashes. The latest stock market crash of 2010-11 affected millions of investors who lost much of their capital (Choudhury, 2013). Previously done studies in Dhaka stock Exchange from different aspects provide evidences of high volatility (Roni et al., 2017) and market inefficiency (Alam et al. 2007; Shibli and Ahmed, 2015) which increase the probability of detecting herding among the investors of the market.

In this regard, the study investigates existence of herding behaviour in Dhaka stock Exchange. The scant empirical researches on herding behaviour in Bangladesh stock market also motivates to conduct this study. In this study, market-wide herding approach has been taken and methodologies proposed by Christie and Huang (1995) and Chang et al. (2000) are applied. The former is linear, and the latter is non-linear model. The reason for using non-linear in addition to linear model is to overcome the limitations of the linear model. One of the

limitations of the linear model is expressing the extent of dispersion as the assumption that relationship between the dispersion in stock returns and market portfolio return is a linear relation. There is evidence of studies (such as in Taiwanese market by Demirer et al., 2010) where herding has been detected with non-linear model, but linear model can not detect herding. There is a common shortcoming in both methodologies that the linear and non-linear models do not consider effect of changes in fundamental variables (Bikhchandani and Sharma, 2001). This study uses most recent and longer data from January 2005 to December 2018. Both daily and monthly data are used for the study.

The main contribution of this study is finding significant evidence of herding in Dhaka stock exchange and the result is inconsistent with the previous study done by Ahsan and Sarkar (2013). This study detects herding only with the non-linear model for the whole study period, first sub-period (2005-2011) and recent stock market crash period of Bangladesh 2010-11. Herding has also been detected in bullish and bearish market. The evidence of herding is found only in daily data. In contrast, the study could not detect herding for the second sub-period (2012 to 2018) and in monthly data for any period.

This study differs from the study of Ahsan and Sarkar (2013) in two ways. Firstly, the study period since it covers a longer period (from 2012 to 2018) after the latest stock market crash of Bangladesh 2010-11 which has not been covered by the previous study of Ahsan and Sarkar (2013). Secondly, the market portfolio used in this study includes all liquid firms and the active stocks in the sample. This is a possible reason for finding contradictory result with the previous study. Moreover, during the stock market crash period of 2010-11, herding has not been detected in the previous study. A probable reason for detecting herding in this study is considering longer time frame for the crash period comparing to the previous study. The findings of this study suggest that investors of Bangladesh stock market make their investment decisions by following others and make their investment decisions irrationally.

The remainder of the paper is designed as follows. The second section provides relevant literature about herding in general terms, in financial market and how to measure it. Section three presents previous empirical results of advanced and emerging economies. The fourth section of the paper will represent the data, methodology and variable construction. In section 5, regression results and empirical findings will be discussed. Finally, section 6 will conclude the paper.

2 HERD BEHAVIOUR

2.1 What is herding?

The phrase `herd behaviour` was first introduced by the medic Trotter in 1908. The concepts behind herd mentality and herding behaviour have an extensive history that can be identified even in the early Iron Age (Wallace, 2003). In their study, Bikhchandani et al. (1998) mention that the tendency of imitating in our society is phenomenon for many generations which benefits to acquire hard-won information from others`.

Raafat et al. (2009) defines herding as a form of convergent social behaviour that organizes thoughts and behaviours of individuals in a group without centralized coordination but through local interaction. Devenow and Welch (1996) specify it as behaviour patterns as most general form that involve coordination mechanism among individuals.

Herding is an influential and well documented feature of human behaviour. An important component of herding is that it can incorporate beliefs of a group (Raafat et al., 2009). For that reason, we often notice that people behave accordance with the behaviours and beliefs of the group where they belong to. The necessity of studying herd behaviour arises from different perspectives including economics, ethology and social psychology. However, when analysing herding the economists have only focused on mathematical algorithms as the outcome of herding and disregarded different cognitive and emotional decision-making systems as they neglected sociological, and psychological forces (Baddeley, 2010). By neglecting sociological and psychological forces economists ignore the possibility that herding occurs due to interactions between different cognitive and emotional decision-making systems.

Similar information, similar action alternatives and similar payoffs are the basic causes for convergent behaviour and observing others` information would be inexpensive and time saving (Bikhchandani et al., 1998). During the unpredictable situations people use heuristics and rules of thumb to make their decisions. This could create cognitive bias, and group biases as beliefs repeat similarly as predecessors and generate herding (Baddeley, 2013). Baddeley (2013) also mention that propensity to follow others may be amplified by other social influences including reputation building and conformity preference. Following predecessors and not using private information would create a situation where no further information will be added for the followers which has been termed as informational cascade by Bikhchandani et al. (1998). The authors also mention that a cascade is fragile and vulnerable due to different small shocks. The rationale behind the prediction is that as the participants living in a cascade with little information, any shock for example, better informed investor or new public data would demolish a cascade.

2.2 Herding in financial markets

Preceding section discusses about most common form of herding behaviour in our society which has more important implication in financial market as well. The issue belongs to behavioural finance which includes sociology and psychology to describe investment behaviour of financial market participants. It is observable that after financial crises the importance of herd behaviour attracted many researchers and practitioners.

To define herding behaviour in financial markets Spyrou (2013) indicates as a situation where economic agents copy each other actions and their decisions are made on others' actions and decisions. Similarly, Avery and Zemsky (1998) assert herd behaviour as a trade of informed agent who follows trends of past trades although his initial information contradicts with the asset value of past trades. In the literature, herding behaviour has two different views, rational and irrational. Rational herding arises when agents or managers try to improve their performance or protect their reputation as decision makers by ignoring their private information and following others' analytical skills or better information (Devenow and Welch, 1996; Scharfstein and Stein, 1990). The authors also mention that sharing-the-blame of unpredictable investment components, informational learning, unattractive labour market and principle-agent problems or compensation as other influencing factors of rational herding. On the other hand, Devenow and Welch (1996) views irrational herding is driven by investors' psychology where they follow others blindly without any rational judgement.

Researchers have pointed different causes for herding behaviour of economic agents relating to rational and irrational herding. Bikhchandani and Sharma (2001) include investment related imperfect information, secure reputation and compensation as the most important reasons for herding by rational investors. Spyrou (2013) adds some more causes which are consequence of psychological and/or social conventions and being irrational as other reasons behind herding by market participants.

Several models of herding behaviour have been developed by academicians. Scharfstein and Stein (1990) develop a model on reputational concerns in which there are two types of managers, smart or dumb (biased). Smart managers obtain informative (true) signal and dumb managers obtain uninformative (noise) signal about an investment decision. The authors examine some of the factors that force investment decision of money managers. They identify reputational concerns and sharing-the-blame as the factors for herding behaviour. Similar type of discussion on reputational herding about analysts arises in the theoretical model of Trueman (1994). The model describes that analysts forecast earnings similar to those previously published by other analysts. The analysts tend to herd for higher compensation or proving higher ability.

Banerjee (1992) and Bikhchandani et al. (1998) develop another model which is based on informational cascades. In this type of model authors explain short-lived phenomenon for example, fads and fashions. The model of Banerjee

(1992) is a sequential decision model. In this sequential model, the author mentions that it is rational for the decision makers to follow the previous decision makers since they possibly have obtained related information.

The nature of herd behaviour among market participants is not similar. For example, Bikhchandani and Sharma (2001) differentiate spurious herding from intentional herding. The former takes place when investors have similar data set, similar decision problems and eventually make similar decisions. While intentional herding arises from the intention to copy others` behaviour. Nonetheless, spurious herding may lead to efficient result and intentional herding might not. Empirically it is difficult or impossible to differentiate spurious herding from intentional herding as investment decision involves many factors.

Most of the studies related to herding behaviour focus how to detect herding behaviour in financial markets and how this behaviour affects asset prices. There is still a gap in the literature that does not include, if herding or level of herding could be used as a profitable investment strategy. In a recent study, Chen and Demirer (2018) show that level of herding in an industry can be used as a profitable investment strategy. The authors also mention that if an industry experiences high level of herding would yield higher subsequent returns though conventional momentum strategy works poorly in the same market.

2.3 Measuring herding in financial markets

There are two types of empirical approaches that investigate herding behaviour in stock markets. One type of approach investigates at investor level or more specifically on institutional investors/fund managers and financial analysts (such as Lakonishok et al., 1992, Sias, 2004) by employing micro data. The other approach investigates at the market consensus by using aggregate market data (such as Christie and Huang, 1995; Chang et al., 2000).

Two widely used measures for detecting herding at investor level have been developed by Lakonishok et al. (1992) and Sias (2004). Lakonishok et al. (1992) propose a common metric to detect herding behaviour among institutional investors which is also known as LSV measure. The rationale behind their measure is testing cross-sectional temporal dependence in institutional demand. If institutional investors follow each other for a stock and buy/sell (similar investment decision of buying/selling) the same stock over a quarter, then herding exists among institutional investors for the quarter. Herding is computed as the proportion of net buyers relative to the total money managers. The value of the metric should vary significantly from period to period to detect herding and value of metric should not vary if there is no herding. To measure herding for a stock in a quarter, $H(i)$, is calculated with the following equation:

$$H(i) = |B(i)/(B(i) + S(i) - p(t))| - AF(i)$$

Where $B(i)$ is the number of money managers who increase their holdings in the stock, $S(i)$ is the number of money managers who decrease their holdings in the stock, $p(t)$ is the expected proportion of money managers buying in that quarter relative to the number active, and $AF(i)$ is the adjustment factor of expected value $|B/(B+S)-p|$ under null hypothesis of no herding. For any stock, AF declines as the number of money managers active in that stock rises.

In another study, Sias (2004) argues that the demand for a stock by institutional investor is positively correlated with demand for the same stock in the previous quarter if they follow others or their own trades done in the previous quarter. This is a direct measure to test herding behaviour among institutional investors during the next periods whereas Lakonishok et al. (1992) tests indirectly for cross-sectional temporal dependence within the period. Sias estimates asset holding portion of an institutional investor's in every asset for the beginning and end of each quarter. When an investor increases asset holding position in an asset the investor would be a buyer and if decreases, a seller. In the next step, the proportion of buyers of the asset is estimated which is defined as raw fraction of institutions buying. The estimation formula is following:

$$Raw\Delta_{k,t} = \frac{BI_{k,t}}{BI_{k,t} + SI_{k,t}}$$

Where, BI refers to the number of institutions buying asset k during quarter t , SI refers to the number of institutions selling asset k during quarter t . Sias standardized fraction of institutions buying asset k in quarter t in the following way:

$$\Delta_{k,t} = \frac{Raw\Delta_{k,t} - \overline{Raw\Delta_{k,t}}}{\sigma(Raw\Delta_{k,t})}$$

Where, $\overline{Raw\Delta_{k,t}}$ is the cross-sectional average raw fraction of institutions buying in quarter t and $\sigma(Raw\Delta_{k,t})$ is the cross-sectional standard deviation of the raw fraction of institutions buying in quarter t .

Next, Sias proposed the following equation to detect herding:

$$\Delta_{k,t} = \beta_t \Delta_{k,t-1} + \varepsilon_{k,t}$$

Comparably more studies are done on the other approach for detecting herding toward market level. One possible reason is difficulty to have data on institutional investors, specially in emerging stock market. Most of the studies of this approach use methodologies proposed by Christie and Huang (1995) and Chang et al. (2000). This study is also based on market wide herding approach and employs these two methodologies. The methodologies of Christie and Huang (1995) and Chang et al. (2000) have also been modified in many studies.

Christie and Huang (1995) propose an empirical model to investigate herd behaviour toward market consensus. They aim to test existence of herd behavior during the market stress when large price movements occur, and investors tend to form herd by following the market consensus. They use cross-sectional standard deviation (CSSD) as measure of stock return dispersion to detect herd behaviour and its impact on prices. Dispersion of equity return is the way to measure average proximity of individual return to the mean. According to rational asset pricing models, during the market stress, dispersion of individual stock returns increases to the market return. To detect herding, dispersions during the market stress should be lower than normal periods as individual returns cluster around the market return. Thus, herd behaviour contradicts with rational asset pricing models.

In a later study, Chang et al. (2000) develop an alternative and simpler model to the one proposed by Christie and Huang to examine herd behaviour in the equity markets. They use cross-sectional absolute deviation (CSAD) of returns as measure of dispersion and added a non-linear regression parameter. The rationale behind their proposed model is that when investors herd during the market stress relation between dispersion and market return becomes non-linearly increasing or decreasing. Details about these two methodologies are thoroughly discussed in the methodology and estimation models section.

Hwang and Salmon (2004) propose another model namely state space model to measure herding toward the market. The model is based on beta dispersion. This is a more powerful and comprehensive model having several factors that define stock returns, size and value. For example, they define market portfolio as beta herding (Hwang and Salmon, 2006). The model applies cross-sectional dispersion of the sensitivities of stocks to these factors which enables to detect herding in relation to other factors and control to change the fundamentals. At first the model inspects herding to a balanced state of the CAPM (capital asset pricing model) with the following equation:

$$E_t(r_{it}) = \beta_{imt}E_t(r_{mt})$$

Where, r_{it} is the excess returns on asset i and r_{mt} is the market premium at time t . β_{imt} is the systematic risk measure and E_t is the expected value at time t . In the absence of herding share price of stock i should only be equated from using β_{imt} and E_t values. It shows presence of herding when share price of stock i is incorrect with the above equation. However, according to the author's assumption following relationship should hold to detect herding:

$$\frac{E_t^b(r_{it})}{E_t(r_{mt})} = \beta_{imt}^b = \beta_{imt} - h_{mt}(\beta_{imt} - 1)$$

Where $E_t^b(r_{it})$ stock i 's deviation from expected abnormal value at time t , β_{imt}^b is systematic risk at time t and h_{mt} is a latent herding parameter to determine herding which changes over time.

The value of the equation should be $h_{mt}=0$ and $\beta_{imt}^b = \beta_{imt}$ for no herding. On the other hand, for perfect herding it should be $h_{mt}=1$ and $\beta_{imt}^b = 1$. Existence of some degree of herding is determined by the magnitude of h_{mt} , when $0 < h_{mt} < 1$.

3 PREVIOUS EMPIRICAL RESULTS

This part of the paper provides result of previous empirical researches on herding behaviour. Empirical researches are done on both advanced and emerging markets and the findings are mixed. The results of different studies on advanced markets, emerging markets and Bangladesh stock market are discussed separately. Finally, summary of empirical findings is presented in table 1.

3.1 Advanced markets

Christie and Huang (1995) propose cross-sectional standard deviation of returns to test the hypothesis that Individual equity returns herd during the market stress. By using daily and monthly returns, they find significant increasing dispersion during the large average price movement periods for both market and industry level and could not detect herding in the US market. They use 1% and 5% deviations of equity returns from the market returns in the lower and upper tail of distribution to indicate large price movement days.

By employing their non-linear regression specification, Chang et al. (2000) investigate herding in the international markets including the US, Hong Kong, Japan, South Korea and Taiwan. Data of daily stock returns for all countries are used for the study. The study can not detect herding in developed countries of the sample namely the US and Hong Kong. However, they find limited evidence of herding in Japan for down market and significant evidence of herding in the emerging markets namely South Korea and Taiwan.

Gleason et al. (2004) examine herding in the US market by employing both methodologies proposed by Christie and Huang (1995) and Chang et al. (2000) for intraday US Exchange Traded Funds data. Their result suggests that investors do not herd during the large price movements.

Lakonishok et al. (1992) use 769 the US tax-exempt equity funds data and their proposed LSV measure to investigate herding and positive feedback trading among institutional investors. Their results show weak evidence of herding and strong evidence of positive-feedback trading for small stocks. For largest stocks, there is little evidence for both herding and positive feedback trading. Their evidence suggests that institutional investors do not destabilize prices of individual stocks.

In contrast, Hwang and Salmon (2004) find evidence of herding in the US market by introducing a different methodology in their study which is based on beta dispersion. The evidence of herding in the US market is also found in a recent study by Clements et al. (2017). The authors also propose a new empirical framework to investigate herding where traditional regression analysis has been

extended to vector autoregressive framework. By employing daily returns data for the period of 28 January 2003 to 16 September 2016, the study finds episodic herding for 30 Dow Jones Industrial Average stocks during subprime crisis, European debt crisis, the US debt-ceiling crisis and Chinese stock market crash. Sias (2004) also conducts a study among institutional investors and finds evidence of institutional herding. The author proposes a different methodology which is based on cross-sectional temporal dependence. The result of the study suggests that institutional demand is more strongly related to lag institutional demand than lag returns.

Chiang and Zheng (2010) investigate herding in 18 countries which includes advanced (Australia, France, Germany, Hong Kong, Japan, the UK, the US), Latin American (Argentina, Brazil, Chile, Mexico) and Asian (China, Indonesia, Malaysia, Singapore, South Korea, Taiwan, Thailand) stock markets. They find evidence of herding in advanced markets (except the US) which contradicts with Chang et al. (2000) and consistent with Zheng et al. (2017) that herding exist in Japan and Hong Kong. The result also shows that herding creates contagion from crisis country to neighbouring countries. The study period covers from May 1988 to April 2009 and employs daily industry and market data with CSAD as return dispersion. In the study, the proposed methodology of Chang et al. (2000) has been modified by adding a $R_{m,t}$ in the right-hand side of the original equation. It allows to take care of the asymmetric investor behaviour.

Herding at the industry level has been investigated in nine Asian markets (Japan, China, South Korea, Hong Kong, Taiwan, Singapore, Indonesia, Malaysia and Thailand) by Zheng et al. (2017). The findings of the study demonstrate that industry herding exists at all these nine markets and herding activities are stronger at technology and financial industries. In the study, the methodology of Chang et al. (2000) has been applied with daily data.

Henker et al. (2006) find contradictory result for Australian equities that shows herding does not exist in Australian market and not for industry sectors as well. The authors use both CSSD and CSAD and investigate intraday herding.

If major macroeconomic information announcements have impact on herd behaviour in the US and UK market is tested in the study conducted by Galariotis et al. (2014). The authors use CSAD as the measure of return dispersion for daily returns data. They divide the whole study period (October 1989 to April 2011) into different volatile sub-periods which are Peso Crisis, the Asian Crisis, the Russian Crisis, the Dotcom bubble burst and the Subprime Crisis, and investigate as previous studies mention about herding tendency during extreme market movements. Though, the study is consistent with the findings of Christie and Huang (1995) and Chang et al. (2000) that could not detect herding in the US market. However, important finding is that investors of the market tend to herd during the announcements of important macroeconomic data. According to the result, there have been herding spill-over effects from the US to the UK during earlier financial crises. Furthermore, UK investors herd only for fundamentals (return factors that captures significant information) data during the Dotcom

bubble and US investors herd because of both fundamentals and non-fundamentals (return factors that does not capture significant information) data in various crises.

Mobarek et al. (2014) consider most liquid constituent stock data of 11 developed European stock markets (i.e. Germany, France, Portugal, Italy, Ireland, Greece, Spain, Sweden, Norway, Denmark and Finland) for their study. The study investigates comparative herd behaviour in Europe. By using CSAD as a measure of dispersion developed by Chang et al. (2000), their investigation does not find herding in the normal periods of 2001-2012. However, it finds herding during the crisis and extreme market condition periods. An important finding of the study is that Nordic (Finland, Norway, Denmark and Sweden) countries are more affected by Eurozone crisis than global financial crisis because of capital injection and bailout policies in the PIIGS countries (Portugal, Ireland, Italy, Greece and Spain). On the other hand, continental (France and Germany) and PIIGS market are affected by global financial crisis. Furthermore, result indicates Germany having heavy influence on regional cross-country herding effect. The study result is consistent with the result of Caparrelli et al. (2004) that herding exist in Italian stock market during extreme market conditions. Presence of herding in France, Germany, Italy and the UK has also been detected in the study of Khan et al. (2011). They find that capital markets of these four European countries follow herding during crisis period. They use models of Hwang and Salmon to detect herding for the period of 2003 to 2008.

3.2 Emerging markets

The number of empirical researches conducted on herd behaviour in emerging markets demonstrate that researchers have paid more attention to emerging markets than advanced markets. In their paper, Bikhchandani and Sharma (2001) argue that there is a possibility to detect herding in emerging markets due to weak reporting requirements, poor accounting standards, inefficient regulations and information inefficiency. Dhaka stock exchange has similar types of characteristics (Choudhury, 2013).

China is one of the most important emerging economies in Asia and in the world. Some studies have been conducted in Chinese stock market to investigate existence of herding behaviour among the market's participants. First study on herding behaviour in the market is conducted by Demirer and Kutan (2006). They use sector level data and daily returns of 375 stocks listed in Shanghai and Shenzhen stock exchanges. They find return dispersions are significantly higher during periods of large price movements. More specifically, comparable lower dispersions are detected during downside movements than upside movements. Their findings support rational asset pricing models and could not detect herding

formation in individual and sector level data of any of the exchanges. Tan et al. (2008) conduct a study on Chinese A-share and B-share listed in Shanghai and Shenzhen stock exchanges. They find existence of herding for both type of shares within both Exchanges. They use daily, weekly and monthly data for 43 dual-listed stocks in Shenzhen and 44 dual-listed stocks in Shanghai exchange. According to their result, herding behaviour among A-share investors in Shanghai Exchange is more pronounced under conditions of rising markets, high trading volume and high volatility. Yao et al. (2014) also investigate herding behaviour on A and B-shares listed in both exchanges. The study detects herding for B-share market in both Shanghai and Shenzhen exchanges and not for A-share market in either exchanges. They also find herding is more pronounced at industry level, for largest, and smallest stocks and for growth stocks. All these three studies have mixed results of herding behaviour in Chinese stock market. Tan et al. (2008) and Yao et al. (2014) results are partially consistent with the finding prevalence of herding in B-share market. Moreover, Lao and Singh (2011) have studied both Chinese and Indian stock market to find level of herding behaviour in the markets. They find existence of herding in both markets, but the prevalence is greater in Chinese market. In Chinese market, the prevalence is stronger during the falling market and high trading volume. But, in Indian market herding takes place during increased market activity.

Few studies regarding herding behaviour have been conducted in Taiwanese market which is another important emerging market of Asia. In the study of Chang et al. (2000), prevalence of herding is found in the emerging markets namely, Taiwan and South Korea. They find macroeconomic information has more influence on investor's behaviour than microeconomic information to exhibit herding in these markets. Demirer et al. (2010) apply several methodologies in their study to investigate herding at sector level in Taiwanese market. By applying linear model, the study could not detect herding but, non-linear and state space-based models find strong evidence of herding in all sectors. In a different study, trading behaviours and performance of foreign investors in Taiwan's market has been studied by Lin and Swanson (2003). According to their study, foreign investors do not herd toward market consensus but use momentum strategies and favour high-tech, large-size and high book-to-price shares to take investment decisions.

Relatively more studies on herding behaviour are conducted on Indian and Pakistani stock exchanges which are neighbouring countries of Bangladesh. Both markets are important economies of South Asia. The empirical result of most studies on Indian stock market provide evidence against herding at the market level (such as Garg and Jindal, 2014; Kumar and Sharma, 2018) and even at the industry level (Ganesh, Naresh and Thiyagarajan, 2016). One more recent study conducted by Satish and Padmasree (2018) could not detect herding among the stocks of Indian market for the period of 2013 to 2017. They also examine the effect of global financial crises on herd behaviour and fail to find evidence of herding. However, the study of Poshakwale and Mandal (2014) find evidence of

significant herding behaviour which is consistent with the result of Lao and Singh (2011).

By employing Ordinary Least Square and Quantile Regression Analysis, Malik and Elahi (2014) find evidence of herding in Karachi stock exchange during normal, bullish and bearish markets for the period of 2003 to 2013. In contrast, Javaira and Hassan (2015) find no evidence of herding in Pakistani Stock Market during 2002 to 2007. They use both methodologies suggested by Christie and Huang (1995) and Chang et al. (2000) for daily and monthly stock returns. The study of Shah et al. (2017) find that individual firm herd when market experiences a negative return of 5%, large firms have herding tendency in extreme market movements and few firms herd toward industry portfolios. The study uses daily stock returns data, and trading volume and employs methodology of Christie and Huang (1995). The sample period of the study covers from 2004 to 2013.

3.3 Previous studies on Bangladesh stock market

There are some studies related to market efficiency and volatility in Bangladesh stock market. Results of these studies show that DSE is not efficient even in its weak form (Alam et al. 2007; Shibli and Ahmed, 2015). Security returns in Dhaka stock exchange do not follow the random walk model and market does not price new information instantaneously (Mobarek et al., 2008). By examining volatility in Bangladesh stock market (i.e. in DSE), Roni et al. (2017) show that risk premium in DSE is negative indicating high risk with low yield during the crisis period and leverage effects during all periods (crisis, pre and post crisis). Moreover, the authors mention that investors avoid risk of declining prices to be more sensitive to bad rumours than good.

There are millions of small investors active in Bangladesh stock market and most of them are unaware about potential risks and returns which make the market volatile (Rahman et al., 2017). In the study of Choudhury (2013), different types of irregularities (such as lack of monitoring, rumour, violation of banking act, using wrong method in face value determination) have been detected in Bangladesh stock market. The results of these studies suggest that DSE has similar characteristics of market inefficiencies as any other emerging stock markets. This arises necessity of investigating and possibility of detecting herding behaviour in DSE.

The only paper that studies herding behaviour in Bangladesh stock market (i.e. DSE) done by Ahsan and Sarkar (2013). In the study, both CSSD based linear and CSAD based non-linear models are applied for daily and monthly returns data of all stocks listed in the market. Their study period covers from January 2005 to December 2011. The study could not find presence of herding in the market.

3.4 Summary of empirical results

The empirical results of previous sections have mixed findings for both advanced and emerging markets. In some studies (e.g. for the US), herding has been detected by using different methodologies. The results of few studies demonstrate that herding is also present in advanced markets. Most of the studies in Chinese market find evidence of herding. For Indian and Pakistani markets, the results are mixed. Herding is not present even in the only study done in Dhaka stock exchange.

Table 1: A brief sampling of herding behaviour in different studies

Country/Market	Author(s)	Model(s)	Herding?
The US	Christie and Huang (1995)	CH	No
The US, Hong Kong, Japan, South Korea and Taiwan	Chang et al. (2000)	CCK	No herding in the US, Hong Kong and Japan (partial) Yes, herding in South Korea and Taiwan
The US	Clements et al. (2017)	VAR	Yes
The US	Hwang and Salmon (2004)	HS	Yes
The US	Gleason et al. (2004)	CH and CCK	No
The US	Lakonishok et al. (1992)	LSV	No herding, except in smaller stocks
The US and UK	Galarotis et al. (2014)	CCK	Yes, in both markets
NYSE, AMEX and NASDAQ	Sias (2004)	Sias	Yes
Australia	Henker et al. (2006)	CH and CCK	No
Italy	Caparrelli et al. (2004)	CH, CCK and HS	Yes
France, Germany, Italy and the UK	Khan et al. (2011)	HS	Yes, in all markets
Japan, China, South Korea, Hong Kong, Taiwan, Singapore, Indonesia, Malaysia and Thailand	Zheng et al. (2017)	CCK	Yes, in all nine markets

Country/Market	Author(s)	Model(s)	Herding?
18 countries (7 Advanced, 4 Latin American and 7 Asian countries)	Chiang and Zheng (2010)	Modified CCK model	No herding in the US and Latin American countries. Yes , herding in other advanced and Asian countries.
European (2 Continental, 5 PIIGS, and 4 Nordic) countries	Mobarek et al. (2014)	CCK and modified CCK model	Yes , herding in crisis and extreme periods. No , herding in normal periods.
China	Demirer and Kutan (2006)	CH, CCK and Gleason et al.	No
China	Tan et al. (2008)	Modified CCK model	Yes
China	Yao et al. (2014)	CH	Yes
China and India	Lao and Singh (2011)	CCK	Yes , in both markets
India	Garg and Jindal (2014)	CH and CCK	No
India	Poshakwale and Mandal (2014)	HS	Yes
India	Ganesh et al. (2016)	CH and CCK	No
India	Kumar and Sharma (2018)	CCK	No
India	Satish and Padmasree (2018)	CCK	No
Pakistan	Malik and Elahi (2014)	OLS and QRA	Yes
Pakistan	Javaira and Hassan (2015)	CH and CCK	No
Pakistan	Shah et al. (2017)	CH	Yes
Bangladesh	Ahsan and Sarkar (2013)	CH and CCK	No
Taiwan	Lin and Swanson (2003)		No
Taiwan	Demirer et al. (2010)	CH, CCK and HS	No , herding (with linear model) Yes , (with non-linear and state space-based models)

Note: CH, CCK, VAR, HS, OLS, QRA refers to Christie and Huang model, Chang et al. model, Vector Autoregressive framework, Hwang and Salmon model, Ordinary Least Square and Quantile Regression Analysis respectively.

4 EMPIRICAL METHODOLOGY AND DATA

4.1 Methodology and estimation models

It is not possible to examine herding behaviour in a financial market directly from the financial data. However, financial literature has developed different proxies to detect the phenomenon. This study adopts both CSSD and CSAD methods as measures of return dispersion to detect herding in Dhaka stock exchange.

Christie and Huang (1995) propose CSSD as measure of equity return dispersion with the following equation:

$$CSSD_t = \sqrt{\frac{\sum_{i=1}^N (R_{i,t} - R_{m,t})^2}{N-1}} \quad (1)$$

Where, N is the number of firms in the aggregate market portfolio, $R_{i,t}$ is the observed stock return of firm i at time t and $R_{m,t}$ is the cross-sectional average of the N returns in the portfolio at time t .

Calculating CSSD quantifies the degree to which individual return disperse from the average market return and that is the main element to detect herding behaviour. According to Christie and Huang (1995), herd formation most likely to appear during the periods of large price movements when investors follow the market consensus. To examine whether the return dispersions are significantly lower than the average, they used following linear regression model:

$$CSSD_t = \alpha + \beta^U D_t^U + \beta^L D_t^L + \varepsilon_t \quad (2)$$

Where, α = Average dispersion of the sample excluding the regions covered by the dummy variables.

$D_t^L = 1$ if the market return on day t lies in the extreme lower tail of the return distribution, and 0 otherwise.

$D_t^U = 1$ if the market return on day t lies in the extreme upper tail of the return distribution, and 0 otherwise.

The average level of dispersion of the sample is captured by the α coefficient, excluding the regions covered by the two dummy variables. The dummy variables in the equation (2) are designed to indicate differences of investor behaviour between abnormal price movement periods (ups and downs) and normal periods. In this study ± 2 times standard deviation is used to define extreme upward and downward movements of the market. Statistically significant negative coefficients β^U (for up markets) and β^L (for down markets) would capture the existence of herd behaviour.

An alternative measure of return dispersion which is cross-sectional absolute deviation (CSAD) developed by Chang et al. (2000) to detect herding under all market conditions. The CSAD model which is derived from the Capital Asset Pricing Model (CAPM) is more generalized model. Their proposed CSAD model is following:

$$CSAD_t = \frac{1}{N_t} \sum_{i=1}^N |R_{i,t} - R_{m,t}| \quad (3)$$

Where, N is the number of firms in the aggregate market portfolio, $R_{i,t}$ is the observed stock return of firm i at time t and $R_{m,t}$ is the cross-sectional average of the N returns in the market portfolio at time t . For a comprehensive analysis following equation of CSAD analogues to equation (2) also tested:

$$CSAD_t = \alpha + \beta^U D_t^U + \beta^L D_t^L + \varepsilon_t \quad (4)$$

The alternative model proposed by Chang et al. (2000) based on quadratic relationship between $CSAD_t$ and $R_{m,t}$ where non-linear relationship is modelled in the following equation:

$$CSAD_t = \alpha + \gamma_1 |R_{m,t}| + \gamma_2 R_{m,t}^2 + \varepsilon_t \quad (5)$$

Where, $R_{m,t}$ is the cross-sectional average of the N returns in the market portfolio at time t , the squared market return $R_{m,t}$ is used to capture the non-linearity in the relationship and the α is the constant.

A significant negative non-linear coefficient γ_2 implies the existence of herd behaviour and positive γ_2 indicates no herding. The relationship between $CSAD_t$ and $R_{m,t}$ is designed to detect herding which has similar purpose as the one proposed by Christie and Huang (1995). However, it is possible to generate contradictory result with this equation. For example, Demirer et al. (2010) could not detect herding by using linear equation but detected herding by using this non-linear equation.

Chang et al. (2000) argue that in the presence of herding, the relationship between $CSAD_t$ and the average market return is non-linear. This is likely to increase the correlation among individual asset returns and the dispersion among asset returns will either decrease or increase at a decreasing rate. If investors herd during the large price movements, then there should be a less than proportional increase (or decrease) in the CSAD measure. In contrast, in the absence of herding the relationship is linear and increasing that is, the dispersion increases proportionately with the increasing returns of the market.

The authors also argue that the relationship between CSAD and market returns may be asymmetric and test the hypothesis with the two following models for bull and bear phases.

$$CSAD_t^{UP} = \alpha + \gamma_1^{UP} |R_{m,t}^{UP}| + \gamma_2^{UP} (R_{m,t}^{UP})^2 + \varepsilon_t, \text{ if } R_{m,t} > 0 \quad (6)$$

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

Where, $CSAD_t$ is the average absolute value of the deviation of each stock relative to the return of the equally weighted market portfolio in period t . $|R_{m,t}^{UP}|$ and $|R_{m,t}^{DOWN}|$ are the absolute value of an equally weighted realized return of all available securities on period t when the market is up (down). A significantly negative γ_2 captures herding in the market and positive γ_2 would demonstrate no herding.

The rationale behind applying the CSAD based non-linear model in addition to the CSSD based linear model is to overcome limitations of the linear model. One of the limitations of the linear model is expressing the extent of dispersion as the assumption that relationship between the dispersion in stock returns and market portfolio return is a linear relation. According to Hwang and Salmon (2004), considering value of market return as extreme is entirely subjective. In addition, herding is also possible to observe in calm periods, not only during the market stress. There is a common shortcoming in both methodologies that the linear and non-linear tests do not consider effect of changes in fundamental variables (Bikhchandani and Sharma, 2001).

4.2 Data

The Bangladesh stock market consists of two different exchanges namely Dhaka stock exchange (DSE) and Chittagong stock exchange (CSE). Dhaka stock exchange which is the largest and oldest stock exchange of the country, incorporated in 1954 and continued its operation until the liberation war of 1971. After the independence trading resumed in 1976 with 9 listed companies having issued capital of TK. 137.52 million. The regulator of the Bangladesh stock market called Securities and Exchange Commission (SEC), established in 1993. Both exchanges are operated through automated trading system since 1998. Bangladesh stock market has already experienced two major stock market crashes in 1996 and 2010. DSE general index (DGEN) dropped to 700 point in November 1997 from highest 3600 point in November 1996 and in February 2012 declined to 3616 points from 8918 in December 2010.

Dhaka stock exchange has experienced significant growth in last few years. Now the exchange has around 2.5 million investors, 578 listed securities and total market capitalization is USD 48 billion. Figure 1 illustrates development of DSE with the growing number of listed companies and total market capitalization for the years 2005 to 2018. DSE excluded DGEN Index and DSE20 index and launched new indices namely DSEX (DSE Broad Index) and DS30 from January 2013. DSEX is the benchmark index of the exchange which reflects around 97%

of the total equity market capitalization. DS30 index reflects around 51% of the total equity market capitalization which is comprised of 30 leading companies. DS30 index is called as investable index which has most liquid stocks. The other exchange of the country namely Chittagong stock exchange was established in 1995. It has five indices; CSI, CASPI, CSCX, CSE30 and CSE50. Currently CSE has 312 listed securities.

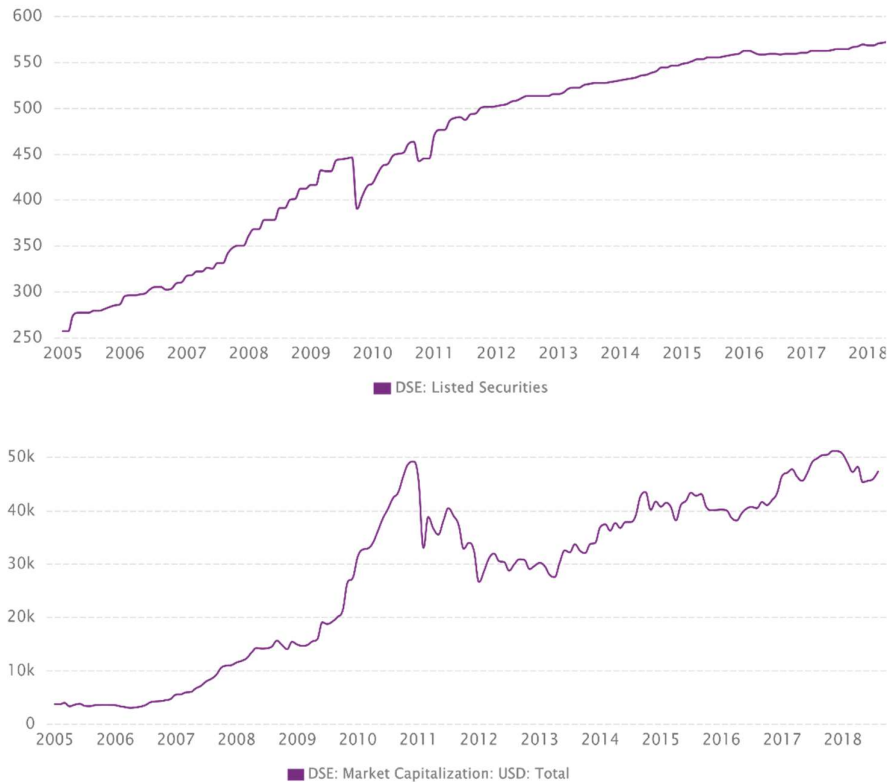


Figure 1: Development of DSE from 2005-2018, data retrieved from <https://ceicdata.com>

The data used for this study is obtained from Thomson DataStream Database. It contains daily and monthly stock price data for DS30 index, and all stocks included in the index. In this study DS30 index is used as the market portfolio which has been introduced in DSE on 28th January 2013. However, the data of this study covers from 1st January 2005 to 31st December 2018. That is why the price data of DS20 index is used and linked with DS30 index. The price data of one share has been omitted as it was unavailable.

Herding is a very short-lived phenomenon (tan et al., 2008). However, if herding requires a longer time period to affect market prices during large price

movements period, using only the daily data fails to detect herding in dispersions (Christie and Huang, 1995). That is why monthly data has also been used for this study. In the sample, there are 3652 observations at daily level and 164 observations at monthly level for each stock and market portfolio. The price data used in the study is in local currency (Bangladeshi Taka).

All stock returns are calculated as Log returns by using the following formula:

$$R_t = \log(p_t/p_{t-1})$$

Where, (P_t) refers to price of individual stock or stock market index price.

4.3 Descriptive statistics

In table 2, the descriptive statistics of the sample contains daily and monthly mean, minimum, maximum and standard deviation of market portfolio (DS30 index). The descriptive statistics of the dispersion measures (CSSD and CSAD) are also reported in table 2.

For the whole sample period (2005-2018), daily and monthly mean return of the market portfolio is 0.002% and 0.04% respectively and returns fluctuate between -20.9% and 24.3% for daily and -29.1 to 25.4% for monthly data. The average monthly market return is higher than the daily return. The market returns of Dhaka stock exchange also show standard deviation of 1.4% for daily returns and 6.7% for monthly returns.

The return dispersion measures of CSSD and CSAD are higher for the monthly data (9.2% and 0.4%) than daily data (1.9% and 1.4%). In addition, mean and standard deviation is lower for CSAD (1.4% and 0.06%) than CSSD (1.9% and 1%) in daily data.

Table 2: Descriptive statistics

Variables	Daily			Monthly		
	CSSD	CSAD	$R_{m,t}$	CSSD	CSAD	$R_{m,t}$
No. of Observations	3651	3651	3651	164	164	164
Mean	0.019	0.014	0.0002	0.092	0.090	0.004
Minimum	0.004	0.003	-0.209	0.032	0.031	-0.291
Maximum	0.209	0.079	0.243	0.230	0.224	0.254
Standard Deviation	0.010	0.006	0.014	0.036	0.036	0.067

The graphs of CSSD, CSAD, DS30 index and DS30 daily and monthly returns are also presented for an overview of the Dhaka stock market during the study period. The data of linked indices (DSE20 and DS30) are used to generate the following graphs. In general terms, the CSSD and CSAD measures (Figure 2) are relatively stable over-time without one notable exception in 2015 for both CSSD and CSAD in daily data and one exception in 2008 for monthly data. In these two periods deviations from the market consensus are significantly increasing.

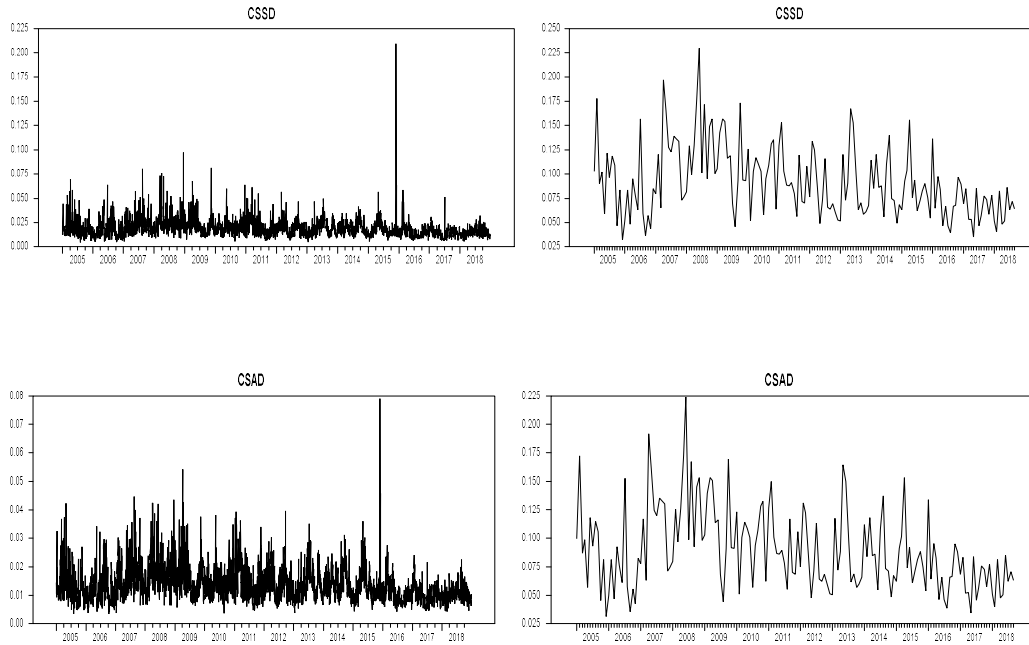


Figure 2: CSSD and CSAD of daily and monthly data (2005-2018)

In Figure 3, the graphs of DS30 index (both daily and monthly) reveals that during the subprime crisis of 2008 the market declined more than 20%, however, the market recovered and continuously developed till the stock market crash of Bangladesh 2010-11. There is a significant growth during the years of 2016 and 2017.

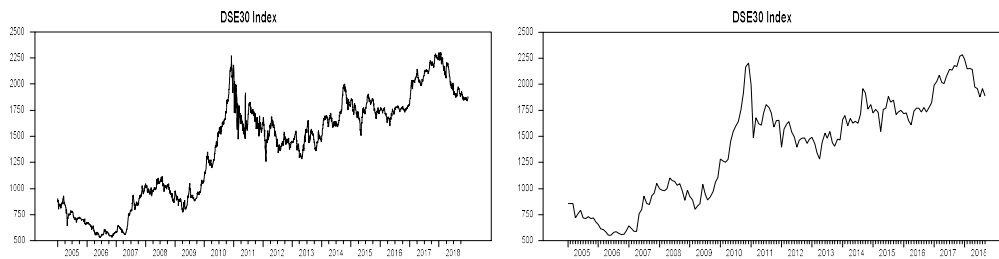
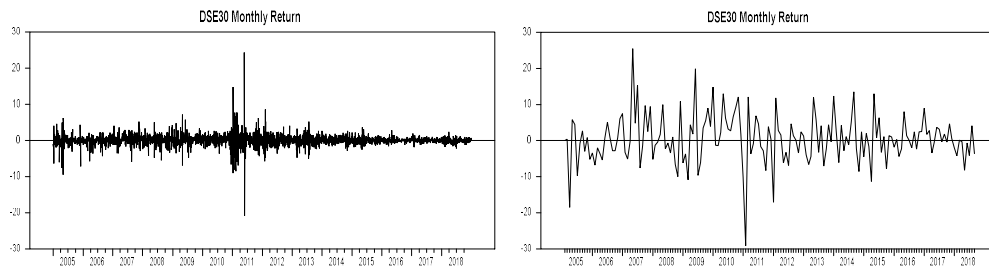


Figure 3: historical development of DSE during 2005-2018 (daily and monthly)

Figure 4 also demonstrates that daily and monthly returns of DS30 index is not stable and has notable decrease during the stock market crash of 2010-11.

**Figure 4: DS30 index return (daily and monthly)**

5 REGRESSION RESULTS AND ANALYSIS

In this section, regression results of whole study period, two sub-periods and the stock market crash period of 2010-11 would be presented separately. Firstly, regression results of equations proposed by Christie and Huang (1995) and Chang et al. (2000) for whole study period (from 2005 to 2018) would be presented. Secondly, whole study period has been divided into two sub-periods and similar methodologies have been applied separately. Thirdly, the stock market crash period of 2010-11 would be tested with the similar methodologies. Finally, all regression results would be discussed and compared with findings of Ahsan and Sarkar (2013).

5.1 Herding during extreme market movements using linear and non-linear model

Table 3 represents the tendency of herding behaviour in Dhaka stock exchange during large price movements by using dummy variables (in equation 2 and 4) suggested by Christie and Huang (1995).

Left-hand side of the table 3 represents tendency of herding behaviour during extreme market movements by using original equation (equation 3). Based on daily and monthly data, table shows that all coefficients are positive and statistically significant excluding the dummy variable β^L for monthly data which is statistically insignificant. Thus, the result indicates equity return dispersion increase rather than decrease during the large price movements. The result is consistent with the findings of Christie and Huang (1995).

Right-hand side of the table 3 represents tendency of herd behaviour by using analogue equation of Chang et al. (2000) to the proposed equation of Christie and Huang (1995). In this analogue equation, all positive coefficients for daily and monthly data indicate no evidence of herding in DSE during the extreme movements for the period of January 2005 to December 2018.

Table 3: Regression results of CSSD and CSAD by using dummy variables

Daily					
$CSSD_t = \alpha + \beta^U D_t^U + \beta^L D_t^L + \varepsilon_t$			$CSAD_t = \alpha + \beta^U D_t^U + \beta^L D_t^L + \varepsilon_t$		
Coefficients		p-value	Coefficients		p-value
Constant	0.019	0.000	Constant	0.013	0.000
α			α		
D_t^U	0.009	0.000	D_t^U	0.008	0.000
D_t^L	0.007	0.000	D_t^L	0.005	0.000

Monthly					
$CSSD_t = \alpha + \beta^U D_t^U + \beta^L D_t^L + \varepsilon_t$			$CSAD_t = \alpha + \beta^U D_t^U + \beta^L D_t^L + \varepsilon_t$		
Coefficients		p-value	Coefficients		p-value
Constant	0.090	0.000	Constant	0.088	0.000
α			α		
D_t^U	0.035	0.001	D_t^U	0.033	0.001
D_t^L	0.009	0.585	D_t^L	0.009	0.600

5.2 Herding using non-linear model

The rationale behind applying the non-linear model proposed by Chang et al. (2000) in addition to the CSSD based linear model of Christie and Huang (1995) is to overcome limitations of the linear model. One of the limitations of the linear model is expressing the extent of dispersion as the assumption that relationship between the dispersion in stock returns and market portfolio return is a linear relation.

Therefore, the equation 5 is tested accordance with the proposed model of Chang et al. (2000) and results are presented on Table 4. For daily data, a significant coefficient γ_1 (absolute market return) implies a linear relationship between market return and stock dispersion. On the other hand, the negative and significant coefficient γ_2 shows evidence of herding. The coefficients γ_1 and γ_2 for monthly data are positive and statistically insignificant.

Thus, by applying non-linear equation of Chang et al. (2000), this study finds evidence of herding only in daily data and absence of herding in monthly data.

Table 4: Total market regression result by using CSAD

$CSAD_t = \alpha + \gamma_1 R_{m,t} + \gamma_2 R^2_{m,t} + \varepsilon_t$					
Daily			Monthly		
Coefficients		p-value	Coefficients		p-value
Constant α	0.012	0.000	Constant α	0.079	0.000
$ R_{m,t} $	0.224	0.000	$ R_{m,t} $	0.196	0.137
$R^2_{m,t}$	-0.818	0.000	$R^2_{m,t}$	0.222	0.655

5.3 Herding during up and down market

Now, two more equations restricting the data to up and down movements of market portfolio will also investigate herding which are also accordance with proposed model of Chang et al. (2000). The equation 6 and 7 would investigate herding under up (bullish) and down (bearish) market price movements respectively. First, the result of herding in rising market is reported in the table 5 obtained by using equation (6).

The coefficient γ_2 is negative for both daily and monthly data. However, for daily data, it is statistically significant which indicates evidence of herding and for monthly data it shows absence of herding as the result indicates insignificant γ_2 .

Table 5: Up market regression

$$CSAD_t^{UP} = \alpha + \gamma_1^{UP} |R_{m,t}^{UP}| + \gamma_2^{UP} (R_{m,t}^{UP})^2 + \varepsilon_t, R_{m,t} > 0$$

Daily			Monthly		
Coefficients		p-value	Coefficients		p-value
Constant α	0.013	0.000	Constant α	0.073	0.000
$ R_{m,t} $	0.261	0.000	$ R_{m,t} $	0.374	0.008
$R^2_{m,t}$	-1.064	0.000	$R^2_{m,t}$	-0.360	0.592

Similarly, to detect herding in the down-market equation (7) is used and the result is presented in the table 6. The presence of herding is also noticeable in down market for daily data as it has negative and significant γ_2 . For monthly data γ_2 is positive and insignificant providing evidence of no herding.

Table 6: Down market regression

$$CSAD_t^{DOWN} = \alpha + \gamma_1^{DOWN} |R_{m,t}^{DOWN}| + \gamma_2^{DOWN} (R_{m,t}^{DOWN})^2 + \varepsilon_t, R_{m,t} < 0$$

Daily			Monthly		
Coefficients		p-value	Coefficients		p-value
Constant α	0.011	0.000	Constant α	0.086	0.000
$ R_{m,t} $	0.002	0.000	$ R_{m,t} $	-0.030	0.905
$R^2_{m,t}$	-0.550	0.000	$R^2_{m,t}$	0.867	0.280

5.4 Herding during the first sub-period (2005-11)

The study period of this study has been divided into two sub-periods to compare the results of this study with the results of previous study. Ahsan and Sarkar (2013) covers a sample period from 2005 to 2011 which is similar to the first sub-period of this study. Following tables (7 and 8) show results for the first sub-period. Similar methodologies (equation 2 and 5) are applied to compare the results.

Table 7 demonstrates that all coefficients are positive without the dummy variable β^L of monthly data which is not statistically significant. The finding of the first sub-period for daily and monthly data is consistent with Ahsan and Sarkar (2013) that can not detect herding with CSSD based linear model.

On the other hand, in table 8, all daily and monthly data coefficients are positive without the coefficient γ_2 of daily data which is negative and statistically significant. Thus, this study detects herding for daily data by using non-linear methodology of Chang et al. (2000) for the similar period investigated by Ahsan and Sarkar (2013).

Table 7: Regression result by using CSSD (2005-2011)

$$CSSD_t = \alpha + \beta^U D_t^U + \beta^L D_t^L + \varepsilon_t$$

Daily			Monthly		
Coefficients		p-value	Coefficients		p-value
Constant α	0.021	0.000	Constant α	0.104	0.000
D_t^U	0.008	0.000	D_t^U	0.024	0.447
D_t^L	0.008	0.000	D_t^L	-0.023	0.331

Table 8: Regression result by using CSAD (2005-2011)

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

Daily			Monthly		
Coefficients		p-value	Coefficients		p-value
Constant α	0.014	0.000	Constant α	0.073	0.000
$ R_{m,t} $	0.169	0.000	$ R_{m,t} $	0.035	0.810
$R^2_{m,t}$	-0.579	0.000	$R^2_{m,t}$	0.527	0.393

5.5 Herding during the second sub-period (2012-2018)

Same methodologies are used to check herding behaviour for the second sub-period (from 2012 to 2018) that extends from the period investigated by Ahsan and Sarkar (2013.) The results are presented in the following tables 9 and 10.

According to the result of table 9, with the linear equation all coefficients are found positive for both daily and monthly data which indicates absence of herding. In table 10, both coefficients γ_2 for daily and monthly data are negative but less significant which indicates absence of herding. Thus, this study does not detect herding for the second sub-period.

Table 9: Regression result by using CSSD (2012-2018)

$$CSSD_t = \alpha + \beta^U D_t^U + \beta^L D_t^L + \varepsilon_t$$

Daily			Monthly		
Coefficients		p-value	Coefficients		p-value
Constant α	0.017	0.000	Constant α	0.076	0.000
D_t^U	0.007	0.000	D_t^U	0.028	0.074
D_t^L	0.005	0.002	D_t^L	0.016	0.009

Table 10: Regression result by using CSAD (2012-2018)

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

Daily			Monthly		
Coefficients		p-value	Coefficients		p-value
Constant α	0.011	0.000	Constant α	0.047	0.000
$ R_{m,t} $	0.296	0.000	$ R_{m,t} $	0.313	0.270
$R^2_{m,t}$	-1.558	0.106	$R^2_{m,t}$	-0.163	0.951

5.6 Herding during stock market crash period (2010-11)

Previous study investigated herding activity during the stock market crash period of Bangladesh 2010 -11. Their study result could not detect herding for the period with non-linear equation. In this study both linear and non-linear models are used to investigate herding for the stock market crash period of 2010-11. Only daily data is employed since monthly data contains less than 12 observations for the crash period which would be unable to produce significant result.

Left-hand side of table 11 shows that both coefficients are positive with linear model, proving no evidence of herding. However, according to the Right-hand side of the table, with non-linear model γ_2 is negative and statistically significant. Thus, this study detects herding with the non-linear model for daily data. The result is inconsistent with the study result of Ahsan and Sarkar (2013).

Table 11: Regression result by using CSSD and CSAD (2010-11)

Daily					
$CSSD_t = \alpha + \beta^U D_t^U + \beta^L D_t^L + \varepsilon_t$			$CSAD_t = \alpha + \gamma_1 R_{m,t} + \gamma_2 R_{m,t}^2 + \varepsilon_t$		
Coefficients		p-value	Coefficients		p-value
Constant α	0.019	0.000	Constant α	0.011	0.000
D_t^U	0.009	0.006	$ R_{m,t} $	0.241	0.000
D_t^L	0.020	0.000	$R_{m,t}^2$	-0.882	0.000

5.7 Result Analysis

When investigating herding activity during extreme market movements (for the whole study period), positive coefficients demonstrate that equity return dispersion tend to increase rather than decrease. Alternatively, the positive significant coefficients support rational asset pricing model and efficiency of market in extreme market movements. To identify herding, individual return dispersion from the market return should decrease (Christie and Huang). The result is similar for both CSSD and CSAD used for the whole study period. No evidence of herding is also found by applying this methodology for the sub-periods (from 2005 to 2011 and from 2012 to 2018) and for the stock market crash period 2010-11. In all cases the coefficients are positive for daily and monthly data indicating absence of herding.

The non-linear methodology investigates the possibility of non-linearity to change in dispersion. Regression result for the whole study period reports that the non-linear quadratic term (γ_2) is negative and statistically significant for daily data and insignificant for monthly data. The regression result of non-linear model confirms existence of herding in daily data. Thus, during the extreme market movements investors follow the market consensus. Similar result is found for daily data in the first sub-period and in the stock market crash period. First sub-period also contains stock market crash period 2010-11 which is tested separately to investigate impact of abnormal nature of financial market on investor's behaviour. Presence of herding activity in both first sub-period and crash period is logical. This finding is consistent with the idea of Christie and Huang (1995) that herding occurs during extreme market movements. Here the evidence is found in daily data with non-linear model. In Contrast, result for the second sub-period with negative insignificant γ_2 provides evidence of no herding. The result for the second sub-period (from 2012 to 2018) supports assumption of rational asset pricing model. Second sub-period is less volatile than first sub-period since first sub-period contains stock market crash period. The contradictory result of first sub-period has an interesting implication for financial market that herding is possible to detect during stock market crisis. The study has also detected herding for bullish and bearish market in DSE. The finding depicts that there is asymmetric herding behaviour in DSE during rising and declining market.

The first sub-period is the same period that has been studied by Ahsan and Sarkar (2013) by employing similar methodologies. The finding of this study contradicts with the finding of their study since they could not detect herding. The probable reason for finding different result in their study is using the market portfolio (DSE all share price index) that includes all types of stocks (liquid and illiquid stocks). They also studied stock market crash period 2010-11 separately and could not detect herding for the crash period as well. Previous study has probably considered smaller time period as the crash period which fails to detect herding during the crash period and contradicts with the finding of this study.

The finding of this study is consistent with the finding of Demirer et al. (2010) that linear model can not detect herding, but non-linear model detects. One important possible reason for failing to detect herding in this study with the linear model could be failing to take into consideration of the co-movement between individual asset returns and the aggregate market return (Demirer et al., 2010).

6 CONCLUSIONS AND SUGGESTION FOR FURTHER RESEARCH

6.1 Conclusion

In this paper, the investment behaviour of market participants in Dhaka stock exchange has been studied to understand their tendency to exhibit herding behaviour. The paper investigates market-wide herding which occurs due to neglecting investment related information and making investment decision by following the market trend. If individual investors make investment decision irrationally (rationally) then dispersion between a stock return and market return would be low (high), providing evidence of (no) herding.

The study employs methodologies proposed by Christie and Huang (1995) which is CSSD based linear model and Chang et al. (2000) which is CSAD based non-linear model. Both daily and monthly data have been used in the study for the period of 1st January 2005 to 31st December 2018. The whole study period is also divided into two sub-periods. Herding during bullish and bearish market and stock market crash period 2010-11 are also investigated separately. The results of whole study period, two sub-periods and stock market crash period have been compared with the results of previous study done by Ahsan and Sarkar (2013).

The main finding of the study is that investors of Dhaka stock exchange are involved in herding activity during the sample period (2005-2018). Herding has also been detected for bullish and bearish market. More specifically, evidence of herding is found for the first sub-period (2005 to 2012) and for the stock market crash period (2010-11). The evidence of herding for all these periods are found only in daily data. However, herding has not been detected in the second sub-period (2012-2018) with any of the models by employing both daily and monthly data.

The results indicate that during the large price movements equity return dispersion increase rather than decrease and the finding is consistent with Christie and Huang (1995). The possibility of non-linearity of relationship is investigated with Chang et al. (2000) methodology for all periods. This non-linear model detects herding for the daily data. The main possibility for finding different result in this study comparing to the study of Ahsan and Sarkar (2013) is the use of different market portfolio. Ahsan and Sarkar use DSE all share price index that includes both liquid and illiquid stocks. However, this study uses DS30 index which includes all active and most liquid stocks. Another probable reason for detecting herding during the stock market crash period is considering longer crash period in this study than previous study.

The overall result is consistent with the prediction of Bikhchandani and Sharma (2001) that herding is possible to detect in emerging markets and this

study is one of the evidences. It is also consistent with the finding of Chang et al. (2000) that herding is evident in emerging economies.

The study has important implications for market participants of Bangladesh stock market. Investors need to achieve a large number of stocks to get the same level of portfolio diversification in this market where investor herd around the market consensus. Moreover, imitating investment strategies has important consequence in the stock market efficiency which would deviate asset prices from its fundamental value and will eventually create asset bubbles.

6.2 Suggestion for further research

The results of both methodologies of this study are based on return dispersions. Further researches can be done by applying other models (for example, state space-based models of Hwang and Salmon, 2004) to compare the results. In addition to stock price data, trading volume could be used to check if trading volume has impact on herding activity. Furthermore, weekly data can also be used and other study periods as well.

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