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Article

Exploring herding behavior in an innovative-oriented stock market: Evidence from ChiNext

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Exploring herding behavior in an innovative-oriented stock market: evidence from ChiNext

Sin-Huei Ng D^a, Zhehan Zhuang^b, Moau-Yong Toh^a, Tze-San Ong^c and Boon-Heng Teh^d

^aSchool of Economics & Management, Xiamen University Malaysia, Sepang, Malaysia; ^bSchool of Business, Hong Kong Baptist University, Kowloon Tsai, Hong Kong; School of Business & Economics, Universiti Putra Malaysia, Selangor, Malaysia; dFaculty of Management, Multimedia University, Selangor, Malaysia

ABSTRACT

We adopt the cross-sectional absolute deviation model (CSAD) to test the herding behavior of ChiNext, a decade-old NASDAO-style stock market in China, based on its stocks from 2015-2019. Our findings show that the herding behavior is prevalent, implying that such behavior is widespread in a relatively new stock market themed with growth-oriented innovative enterprises and dominated by individual investors instead of institutional investors. Moreover, we find that herding tends to be more severe during the periods of falling market than rising market. We explain that several distinct attributes of the individual investors cause them to sell during the falling market, an act contrary to the standard account of the "disposition effect of holding the losers" in behavioral finance. We contribute to the herding behavior literature for a relatively new innovative-oriented stock market as well as our understanding of the investors' circumstances, which may disprove the often-quoted disposition effect.

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herding behavior; ChiNext; cross-sectional absolute deviation (CSAD); rising and falling markets

1. Introduction

Herding refers to a group of investors trading in the same direction over a period of time. Specifically, it is the tendency of investors to conform towards the market consensus. An explanation in Nofsinger and Sias (1999) that depicts individual investors as engaging in herding as a result of irrational, but systematic, responses to fads or sentiment is apt in describing the situation in China's stock market. Herding affects the stock price movement and the deviated stock prices may present profitable trading opportunities. The effects on the stock price movement may affect the asset pricing models. As put forward by Chiang and Zheng (2010) that market participants tend to herd around the market consensus, and this kind of herding behavior will cause asset prices to deviate from economic fundamentals, which means assets are not appropriately priced. The herding of aimless buy high and sell low increases the risk of the market and could even be a trigger for

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CONTACT Sin-Huei Ng 🖾 shng@xmu.edu.my 🖃 School of Economics & Management, Xiamen University Malaysia, Sepang, Malaysia

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a stock market crash. Such irrational behavior of individual investors chasing after lagged news, coupled with the lack of financial knowledge, may cause stock price bubbles and intensify the inefficiency of the stock market in China.

ChiNext is a NASDAQ-style subsidiary of the Shenzhen Stock Exchange (SZSE) that commenced operations in 2009. While the Main Board of SZSE is positioned to support the financing and development of relatively mature enterprises, the ChiNext board mainly serves the growing innovative and entrepreneurial enterprises. It provides a crucial platform for implementing the national strategy of independent innovation. It helps accelerate the transformation of economic development mode and stimulates growth in emerging industries of strategic importance. There were 868 companies listed on ChiNext until the 30th of August 2020; these companies are supposed to be innovative, entrepreneurial and creative with their involvement in either new technologies, new industries, new forms of business or new business models. The stocks of some of these companies which claim to be involved in artificial intelligence, big data or blockchain businesses, which sound futuristic and advanced, could be sensationalized and possibly overvalued. These companies may spend significant amount of time and investments to achieve innovation yet only a small portion of them succeeded. Over the long term, ChiNext may be an important step of China's economic transition. However, the expectation of high-growth might become bubbles as some of the enterprises in ChiNext may not have the actual ability to develop, and the high prices of their stock may be due to speculation on hightech theme stocks and the consequences of the herding effect. Whether herding behavior and its effects exist in ChiNext is a critical issue to examine because such behavior and effects could impact the long-term development of ChiNext in which the prices of stocks listed in ChiNext should reflect the growth ability of the companies.

The aim of this study is to explore the herding behavior in ChiNext. Empirical analysis is conducted to detect the presence and the degree of severity, if the herding effect exists. Specifically, we aim to test the recent year (from 2015 to 2020) herding effect in ChiNext, which is currently in the midst of undergoing structural and policy reformation involving the registration system, trading system and other reform policies. Whether such reformation may be effectively implemented depends on an important factor, which is the degree of market maturity (in terms of market information efficiency and stock pricing behavior). The degree of market maturity is closely associated with an important characteristics of market maturity: the extent of herding (Teng, 2018; Yao, Ma, & He, 2014; Zhao and Ng, 2021). A relatively immature market tends to exhibit substantial herding, which may in turn affect the effectiveness of the market reformation. Therefore, through the study on the existence and extent of herding in ChiNext, our paper aims to shed some lights on the prospects of ChiNext reformation over the time.

In summary, our findings show that herding effect is pronounced in ChiNext and the effect is especially prevailing during the falling market though it is also significant in the rising market. We discuss some possible causes of such herding and propose some suggestions to moderate the irrational and herding behavior of investors in ChiNext.

The existence of serious herding implies that such behavior tends to be widespread in a relatively new stock market themed with growth-oriented innovative and start-up enterprises and dominated by individual investors ("retail investors" - individual investors and retail investors are used interchangeably in this paper) instead of institutional investors. We further test the existence of herding under two different market conditions: the rising market in which the market experiences an overall positive daily return and the falling market in which the market experiences an overall negative daily return. Notwithstanding our findings on the existence of herding in both market conditions, our results show that herding tends to be more severe during the periods of falling market than rising market. We provide an explanation to such an observation that several distinct attributes of the investors, in particular the retail investors, have caused them to sell their stocks during the falling market, an act which is against the backdrop of behavioral finance's "disposition effect" which asserts that investors tend to hold on to the losing stocks instead of selling them during the stock declining state. Overall, our findings add to the investment behavior literature in relation to the existence and prevalence of herding bias in a relatively new and dynamic stock market themed with growth and innovative-oriented enterprises. We also shed lights on the understanding of circumstances, which may disprove the often-quoted disposition effect.

The rest of this paper is structured as follows: Section 2 reviews the literature related to herding. Section 3 explains the data and method used. Section 4 focuses on the analysis, findings and discussion. Section 5 concludes and makes recommendations.

2. Literature review

2.1. Informational cascades and the investors' sentiment

Informational cascades occur when individuals make decisions based purely on the decisions of others while disregarding their own personal knowledge or private information (Alevy, Haigh, & List, 2007; Bikhchandani, Hirshleifer, & Welch, 1992). However, when people base their decisions on the behavior of others, they are not adding to the public's knowledge base. There is very little new information added to the cascade, and people simply imitate others because they believe that such a big number of people cannot all be wrong. Thus, herd behavior occurs when market participants imitate the prior actions (such as buying or selling) of others. Individuals may be reacting merely to hearsay and public observation, making information cascades and herding exceedingly brittle. Any additional public information or more precise information source can alter the activities as well as the cascade's direction (Bikhchandani et al., 1992; Bikhchandani, Hirshleifer, & Welch, 1998). Consequently, herding behavior may cause the misalignment between prices and fundamental values of assets and increase price volatility.

On a different note, Avery and Zemsky (1998) show that in financial markets, the fact that prices efficiently adjust to the order flow, that is, to the sequence of trades, makes it impossible for herding to arise than in other setups, such as those studied in the social learning literature, where there is no price mechanism. Nevertheless, the authors also show that herding may arise once market participants are faced with different and multi-dimensional sources of uncertainty in the market, in particular, the "event uncertainty" as referred to by the authors. Specifically, these sources of uncertainty may "overwhelm" the price mechanism and interesting behavior such as herding becomes possible. In addition, Cipriani and Guarino (2008) show that the presence of transaction costs may also adversely affect the ability of the price to aggregate private information dispersed among market participants and thus cause informational cascades and herd behavior since valuable private information can be held back from being incorporated into prices due to the transaction costs.

According to Lee, Shleifer, and Thaler (1990), investors' sentiment refers to systematic deviation of the investor's expectations of the future. It is among the sources of irrational behavior of investors that subsequently causes the herding effect. The sentiment is difficult to measure, and each investor has a different sentiment because of different characters, wealth and other factors. In the stock investment activities, investors' sentiment is an uncertain variable, which affects the investors' subjective judgment of future returns and their investment behaviors. Investors' sentiment may amplify the positive news and negative news related to the companies and the stock market, in particular, the negative news which makes investors more anxious as the pain from potential losses is generally more evident than the pleasure from potential gains (Kahneman & Tversky, 1979). Due to asymmetric information, individual investors in particular have limited ability and ways to gather information for their investment decisions. Hence, in practice, these investors may feel unconfident about this information and hence may be more comfortable to imitate the investment decisions made by other investors. Information transmission and disclosure mechanism in China stock market are far from perfect. For instance, insider trading makes investors in a disadvantageous position in information acquisition. This leads to incomplete information received by investors from the authorities and the proliferation of grapevine in the market, which leads to the herding effect in the stock market.

2.2. The improvement of models

Various models used in the empirical research have proven the existence of herding behavior. Christie and Huang (1995) assert that investors are usually drawn to the consensus of the market, implying that individual returns would not stray far from the market return. The presence of herding behavior implies that investors are willing to suppress their own beliefs in favor of the market consensus, stock returns will follow with the market fluctuation. Asset pricing models predict that significant changes in the market return would translate into an increase in dispersion because individual assets are different in their sensitivity to the market return. Such relationship is predicted to be linear. On the contrary, herding behavior predicts that significant changes in the market return would translate into a decrease in dispersion. Hence, herding behavior and asset price models present conflicting predictions for the dispersions. Christie and Huang (1995) believe that individual participants trade based on personal information, and personal information is varied. However, during the period of extreme market volatility, individual investors' decisions are more prone to emulate the action of the entire market. The authors build a cross-sectional standard deviation (CSSD) model as a measure of dispersion to analyze the herding effect in the U.S.'s stock market.

Chang, Cheng, and Khorana (2000) propose a revised model to test the herding behavior known as cross-sectional absolute deviation of returns (CSAD) model. On the basis of the CSSD model proposed by Christie and Huang (1995), in CSAD, the market return and dispersion are used as variables to replace the dummy variables in CSAD and as such provides more abundant data to support the empirical analysis of herding. If market participants tend to follow aggregate market behavior and ignore their own beliefs during periods of large average price movements, then the linear and increasing relation between dispersion and market return will no longer hold. Instead, the relation can become non-linearly increasing or even decreasing. Thus, adding a quadratic term to the model and the resulted non-linear equation is more appropriate to describe the herding behavior. The finding from Chang et al. (2000) shows a significant non-linear relationship between stock return dispersions and the underlying market price movement in two emerging markets, South Korea and Taiwan. Dai and Lu (2016) add two new explanatory variables in Chang et al.'s CSAD model - amplitude and turnover rate. These two data are publicly available for investment decision-making. Amplitude measures the degree of stock market fluctuations, and turnover rate describes the liquidity of the stock market trades, both are of concern to the investors in China. Dai and Lu (2016) claim that their model becomes more fitted in China's stock market after adding these two variables. Based on the small firm effect theory by Banz (1981), He (2016) discovers that small firm effect exists in the A-share market in China after analyzing the correlation between the aggregate market value and the returns on the stocks. Dai and Lu (2016) use the weighted average market return to calculate the CSAD as a way to eliminate the small firm effect. In this paper, we adopt Dai and Lu's (2016) approach by using the weighted average market return to calculate the CSAD instead of equal-weight to eliminate the small firm effect in ChiNext caused by the differences in the market value of the companies.

Tan, Chiang, Mason, and Nelling (2008) discover herding behavior in the duallisted A-share and B-share markets. They find that herding behavior exists in both the rising and falling markets and the herding effect in Shanghai A-share market is more severe under the condition of the rising market with large trading amount and high volatility, whereas herding in the B-share market is symmetrical. Though both boards belong to China's stock market, they show different characteristics and sensitivity of herding. Therefore, we believe that if herding exists in ChiNext, it is valuable to analyze it in the rising and falling markets separately. Analysis of the rising and falling markets could shed lights on whether positive news or negative news has a larger effect on the market. Wermers (1999) discovers that herding effect is more serious in small-cap stocks. He also shows that the herding effect of buyers is stronger in high return stocks, and the herding effect of sellers is stronger in low return stocks. Zhou and Lai (2008) believe that herding behavior is more common in small-cap stocks and during the period of sluggish economy. They also find that investors "act more like herds" in selling than buying activities. Their discoveries may have an implication on ChiNext, since investors' behaviors and sentiment may differ from those that trade on the 528 😔 S.-H. NG ET AL.

mainboard of China's stock market. Both Christie & Huang (1995) and Chang et al. (2000) find that herding behaviors change with the change in the stock market and that herding behavior may be more pronounced during the period of market stress. In contrary, Hwang and Salmon (2004) notice that herding behavior is prevalent when the market is peace and investors are confident of the direction in which markets are heading, but such behavior begins to disappear when the market is in crisis. In short, from the above discussion, it is clear that herding effect varies depending on various factors, such as different markets, boards and times.

Yao et al. (2014) examine the herding effect in China A-share and B-share stock market and study the difference in herding across the two markets in detail. They discover that the herding effect of growth stocks is stronger compared to value stocks, and the herding effect is more pronounced under the condition of declining markets. Such findings motivate us to examine the herding effect in ChiNext since it contains a substantial number of "high-growth" stocks. Even though Deng Yuan (2014) discovers that herding behavior exists in ChiNext, he does not make a more in-depth analysis on the causes and intensity of the herding. Chai, Wang, and Song (2018) also discover that ChiNext has a severe herding effect during the drastically fluctuating market based on the GARCH model, using the data from 2014 to 2016. Zheng, Li, and Zhu (2015) adopt the institutions' holding data in order to study how the herding affects the present and future stock returns in China both in the short and longer terms. They find that both short-term and long-term future excess stock returns are positively correlated, and they notice that the more institutional investors herd on the buy side, the higher the future excess stock returns. Conversely, the more institutional investors herd on the sell side, the more negative the future excess stock returns. They indicate that smaller institutional investors and amateur investors may therefore follow the larger institutional investors.

3. Data and method

3.1. Data selection

Data are collected from the China Stock Market Accounting Research (CSMAR) database and verified by the annual Shenzhen Stock Exchange Fact Book. Specifically, daily stock price, total number of daily shares traded and year-end market capitalization (market value) for each firm, and total number of shares outstanding data; over the time-span of 5 years, from the beginning of January 2015 to the end of December 2019, with a total of 1219 trading days are obtained for all ChiNext firms (the annual trading days for 2015 to 2019 were 244 days except for 2018 where the trading days were 243 days). The number of firms listed on ChiNext increased steadily from 406 in January 2015, to 493 by January 2016, 570 by January 2017, 711 by January 2018, 739 by 2019 and 793 by January 2020.

3.2. Methods

We adopt the cross-sectional absolute deviation (CSAD) model as explained in the earlier section as the measure of dispersion in order to examine herding behavior,

$$CSAD_t = \frac{1}{N} \sum_{i=1}^{N} |R_{it} - R_{mt}|$$
 (1)

where

N = number of firms

 R_{it} = stock return of firm *i* at time *t*

 R_{mt} = weight-average stock return of N firms at time t

The model uses the method of absolute deviation to measure the dispersion of stock return. We use the method of weighted-average market return to eliminate the small firm effect. There is a huge difference between individual stock's market value in ChiNext. For instance, the largest stock in ChiNext 100 Index is Wens Group, which has a circulation market value of 163.6 billion RMB, whereas the smallest stock, Tongguang Cable has the value of only 1.6 billion RMB. As stated in the earlier section, weight-average is the preferred method to deal with the issue of varied market value among the stocks. The proportion of each stock's market value in ChiNext to the aggregate market value of all the stocks in ChiNext is used as the weight. The formula of weight-average market return is as follows,

$$R_{wmt} = \sum_{i=1}^{N} a_i R_{it}$$
$$a_i = \frac{MV_i}{\sum_{i=1}^{N} MV_i}$$

where

 a_i = proportion of each stock's market value in ChiNext to the whole market value of stocks in ChiNext

 MV_i = market value of firm *i*

Christie and Huang (1995) estimate the cross-sectional standard deviation (CSSD) model,

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

where

 $D_T^L = 1$, if the market return on day *t* lies in the extreme lower tail of the distribution; and equal to zero otherwise

 $D_T^U = 1$, if the market return on day *t* lies in the extreme upper tail of the distribution; and equal to zero otherwise

Chang et al. (2000) suggest the original CSAD model, which uses the R_{mt} instead of dummy variables and adopt the linear relation in regression equation as follows,

$$CSAD_t = \beta_0 + \beta_1 R_{mt} + \varepsilon_t \tag{2}$$

The demonstration processes can be expressed as follows. At first, the relationship between CSAD and the market return is shown, where Jensen et. al. (1972) CAPM model formula is shown as follows,

$$E(R_t) = R_f + \beta_i E(R_{mt} - R_f)$$

where

 R_f = return on the zero-beta portfolio

= security's systematic risk

 R_{mt} = return on market portfolio

Given β_m is the systematic risk of the equally weighted market portfolio

$$\beta_m = \frac{1}{N} \sum_{i=1}^N \beta_i$$

Taking the derivation of the market return,

$$\frac{\partial E(CSAD_t)}{\partial R_m} = \frac{1}{N} \sum_{i=1}^N \left| \beta_i - \beta_m \right| > 0$$

$$\frac{\partial^2 E(CSAD_t)}{\partial R_m^2} = 0$$

Hence, there is an increasing and linear relationship between dispersion and the market return. Under the CAPM theory, in the CSAD model, the dispersion is positively correlated to the market return, and has a linear relationship. Thus, the herding effect is conflicting with the CAPM model (detail discussion is available in Chang et al., 2000). Therefore, if herding effect exists in the market, we may reject the hypothesis of rational market of the CAPM model. Since non-linear regression model is able to explain the herding better than the linear model as explained earlier, the regression is extended to the polynomial regression as follows,

$$CSAD_t = \beta_0 + \beta_1 |R_{mt}| + \beta_2 R_{mt}^2 + \varepsilon_t$$
(3)

If herding behavior exists in the stock market, investors' decision will be close to the majority of actions in the stock market, leading to the returns of investing in the entire stock market to converge to the market return, i.e., stock returns is close to the market return. In the CSAD model, if herding among the market participants exists, a non-linear relation between CSAD and the market return would result. Such non-linearity will be reflected by a negative and statistically significant β_2 coefficient. A positive β_1 and a negative β_2 coefficients in Equation 3 would suggest the presence of herding behavior in which dispersion increases at a decreasing rate or even a decrease in dispersion if herding is severe. The quadratic relation in Equation 3 indicates that $CSAD_t$ reaches its maximum value when $R_{mt}^* = -(\beta_1/2\beta_2)$ before it declines.

As explained in the earlier section, according to the traits of China's stock market and the ChiNext board, both the amplitude and turnover rate of the stock market are two important indicators of focus for the Chinese investors as they capture the breadth and depth of market responses to news (Dai & Lu, 2016). The turnover rate, measuring the degree of stock market trading activity, is obtained by dividing the total number of daily shares traded by the total number of shares outstanding of the constituent stocks in our sample. The higher the turnover rate, the greater the liquidity of the stock market trades. Amplitude measures the volatility in the stock market, proxied by the standard deviation of ChiNext 100 Index daily movement. Based on the above elaboration, in examining the herding effect in ChiNext, we adopt Dai and Lu's (2016) model by adding the amplitude and turnover rate as the control variables to the CSAD model as follows,

$$CSAD_t = \beta_0 + \beta_1 |R_{mt}| + \beta_2 R_{mt}^2 + \alpha_0 ampli_i + \gamma_0 turnover_i + \varepsilon_t$$
(4)

4. Analysis and findings

4.1. Descriptive statistics

In the herding behavior analysis, the dispersion between individual stock's daily return and the ChiNext's market daily return is an important measurement.

From the scatter graph of CSAD and market return in Figure 1, there is no apparent linear relationship between CSAD and the market return as suggested by the CAPM theory. The dots of CSAD are mostly concentrated in the area where the market return is zero. Moreover, there is no clustering in the areas where the market return increases or decreases beyond 0.4. We perform empirical analysis to further investigate the relationship.



Figure 1. The scatter of the relation between CSAD and market return.

Variables	Mean (%)	Std. Dev. (%)	Maximum (%)	Minimum (%)
CSAD	1.5178	0.4438	4.2507	0.6778
R _{mt}	0.0459	1.7377	6.1301	-8.1273
AMPLI	3.6845	2.0752	22.1541	0.0001
TURNOVER	2.1134	2.3087	35.2159	0.0649

Table 1. Descriptive statistics.

Note: CSAD is the cross-sectional absolute deviation of returns, R_{mt} is the daily market return, AMPLI is the amplitude measuring the volatility in the stock market, and TURNOVER is the turnover rate measuring the degree of stock market trading activity.

532 😉 S.-H. NG ET AL.

In Table 1, we report descriptive statistics for the variables in the model over the period. As stated, the average daily CSAD for our sample is 1.52% with the maximum and minimum values of 4.25% and 0.68%, respectively. The average daily market return is close to zero with the maximum and minimum values of 6.13% and -8.1273%. The means of amplitude and turnover rate are 3.68% and 2.11%, respectively.

4.2. Empirical regression

We adopt Equation 4 as our CSAD regression model. Due to autocorrelation problem in the model (our regression results before correcting for autocorrelation show the Durbin– Watson statistic of 1.282074 and our graphical plot of the residuals and the lagged residuals also reveals the existence of positive autocorrelation), we perform the auto regression in which we introduce the lagged of the dependent variables into the model to address the autocorrelation issue. The number of lags to be included in the model is determined based on (minimization of) the Akaike Information Criterion (AIC).

Studies based on time series data assume that the underlying time series are stationary. However, time series in finance may exhibit nonstationary or, in other terms, they contain a unit root. Some researchers argue that using nonstationary data may result in highly autocorrelated residuals with low Durbin–Watson statistics and a non-constant mean over time (Kutty, 2010). Thus, all the variables, CSAD, R_{mt} , AMPLI and TURNOVER, are tested for unit roots using the Augmented Dickey and Fuller (ADF) test for the individual intercept equation. The results, as presented in Table 2, indicate that these variables are free of unit roots. It indicates that the probability values of the results of all tests have a statistical significance of 1%. Thus, no unit roots are present in the variables used in this study.

4.2.1. The examination of herding effect in the whole ChiNext

Based on the information criterion AIC, four lags, AR(1), AR(2), AR(3) and AR(4), are being added in our revised model. With the regression results presented in Table 3, the estimated model is given as follows,

 $CSAD_{t} = 0.012954 + 0.104241R_{mt} - 1.446791R_{mt}^{2} + 0.016218ampli_{i}$ $+ 0.024508turnover_{i} + 0.269716CSAD_{t-1} + 0.176417CSAD_{t-2}$ $+ 0.153048CSAD_{t-3} + 0.038555CSAD_{t-4}$ (5)

Table 2. I	ests of	stationary
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	Augmented Dickey-Fuller test Statistic		
	Statistic	Prob.	
CSAD	-27.235641	0.000*	
R _{mt}	-41.589277	0.000*	
AMPLI	-25.900868	0.000*	
TURNOVER	-7.755812	0.000*	

Note: CSAD is the cross-sectional absolute deviation of returns, R_{mt} is the daily market return, AMPLI is the amplitude measuring the volatility in the stock market, and TURNOVER is the turnover rate measuring the degree of stock market trading activity. * denotes significance at the 1% level.

Table 3. Regression results of the C	SAD model.		
Variable	Coefficient	t-Statistic	Prob.
С	0.012954	72.2295	0.000*
ABS(MARKET_RETURN)	0.104241	14.19722	0.000*
MARKET_RETURN*MARKET_RETURN	-1.446791	-5.327171	0.000*
AMPLI	0.016218	4.98763	0.000*
TURNOVER	0.024508	4.21042	0.000*
AR(1)	0.269716	48.17760	0.000*
AR(2)	0.176417	30.87076	0.000*
AR(3)	0.153048	16.70208	0.000*
AR(4)	0.038555	4.841492	0.000*
Durbin-Watson statistic	2.004010		
Adjusted R Squared	0.351528		

Note: C is the intercept, ABS(MARKET_RETURN) is the absolute value of the daily market return, MARKET_RETURN*MARKET_RETURN is the squared value of the daily market return, AMPLI is the amplitude measuring the volatility in the stock market, TURNOVER is the turnover rate measuring the degree of stock market trading activity. AR(1), AR(2), AR(3) and AR(4) are the four lag terms of CSAD. * denotes significance at the 1% level.

73.189*

Variable	Coefficient	t-Statistic	Prob.
С	0.012548	60.9520	0.000*
ABS(MARKET_RETURN)	0.086490	13.15268	0.000*
MARKET_RETURN*MARKET_RETURN	-1.292544	-7.694973	0.000*
AMPLI	0.018107	5.42535	0.000*
TURNOVER	0.028330	4.59538	0.000*
AR(1)	0.396506	6.09512	0.000*
Durbin-Watson statistic	2.143743		
Adjusted R Squared	0.242209		
F-test	61.331*		

Table 4. Regression results of the rising market.

F-test

Note: C is the intercept, ABS(MARKET_RETURN) is the absolute value of the daily market return, MARKET_RETURN*MARKET_RETURN is the squared value of the daily market return, AMPLI is the amplitude measuring the volatility in the stock market, TURNOVER is the turnover rate measuring the degree of stock market trading activity and AR(1) is the lag term of CSAD. * denotes significance at the 1% level.

Table 3 shows that the Durbin–Watson value is 2.004, indicating that the autocorrelation detected earlier has been resolved. The coefficients for all the above variables, including the AR(p), are significant at 1%. In the model, the coefficient of the linear term, R_{mt} , is significantly positive at 0.1042. The result confirms the prediction that CSAD_t increases with R_{mt} . However, without examining the coefficient of R_{mt}^2 , the result alone does not prove nor disprove the presence of herding. Notably, the R_{mt}^2 coefficient is negative and statistically significant. This suggests that as the average market return becomes large in absolute terms, the CSAD_t increases at a decreasing rate. Thus, the linear relation between CSAD_t and R_{mt} , suggested by the CAPM does not hold. Moreover, the R_{mt}^2 coefficient of -1.4468 suggests that CSAD_t may drop as R_{mt} becomes large beyond a certain threshold level. Specifically, based on the $R_{mt}^* = -(\beta_1/2\beta_2)$, CSAD_t reaches its peak (before it declines) when R_{mt} , = -[0.1042/2(-1.4468)] = 0.0360 or 3.60%. We may interpret that large swings in the market return exceeding 3.60% leads to the narrowing of CSAD as investors deliberately put aside their own assessments in favor of the market consensus during the large market movements. Besides, the significance of both the

amplitude and turnover rate coefficients show that they are important in explaining the CSAD. Thus, a higher trading activity (turnover rate) as well as a higher market volatility (amplitude) in general lead to an increase in the average stock return dispersion in ChiNext. The significant findings of amplitude and turnover rate are consistent with the finding in recent studies such as Dai and Lu (2016).

According to the CSMAR database, until January 2020, individual investors (retail investors) account for about 65% of the total trading value of equity in ChiNext with the remaining from institutional investors (such as mutual funds, insurance companies, security firms and pension funds). This percentage is significantly higher compared to other emerging markets such as Malaysia where retail investors account for only about 35% of the total trading value [According to Zheng, Li, and Chiang (2017), in terms of trading turnover, in Japan and Malaysia, around 75% come from institutional investors with the rest from retail investors; in Hong Kong and Korea, the percentage is 65% and 50%, respectively, whereas, in China, the percentage is the lowest at only 12%]. Moreover, institutional investors are reported as holding equity securities for a more extended period than the retail investors in ChiNext. On average, 14.3% and 32.8% of the retail investors have holding period of less than a month and within 1 to 6 months, respectively. These percentages are significantly higher compared to 6% and 30% for the institutional investors, implying that there are more short-term traders and speculators among the retail investors than institutional investors. The dominance of retail investors in total trading value together with their relatively shorter holding period and the lack of institutional investors contribute to the presence of both significant speculation and herding, which exist hand-in-hand in ChiNext. Retail investors tend to rely more on public and anecdotal information for their trades as they are influenced by market sentiment and attention-grabbing events (Li, Rhee, & Wang, 2017). Unlike the institution investors, the greater asymmetric information faced by retail investors means lack of access to abundant and accurate information and data including big data for analysis; pushing them to herd-like tendency to follow the majority and conform to group decisions. The speculative atmosphere and herding impact in ChiNext may be demonstrated, for instance, by the loss of more than 90% of the market value of numerous number of thematic stocks in technology compared with their peak value in 2019 (Chen, 2019). As an illustration, the market value of Geeya (stock code: 300,028) declined to less than 0.3 billion yuan in 2019 from its peak market value of 18.2 billion yuan more than 1 year ago.

4.2.2. The examination of herding effect in the rising and falling markets

As explained earlier, the degree of herding may be asymmetric in the up versus the down markets. The study by Zhang and Chen (2010) shows that positive information is strengthened, whereas negative information is weakened during the rising market when investor sentiment is high. Investors are generally optimistic about macro economy and the profit prospects of listed companies. The "feel good" sentiment about the future in the market infects investors who are not investing in the market; thus, actively attracting new investors and new funds into the market. Conversely, negative news is strengthened, whereas positive news is weakened during the declining market with low investor sentiment. Generally, investors are wary and worried about the macro economy and might even exhibit panicky behavior, which is contagious during the period. In

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Coefficient	t-Statistic	Prob.
0.012383	34.6848	0.000*
0.200434	18.10607	0.000*
-1.814129	-5.51898	0.000*
0.024864	3.80924	0.000*
0.024086	4.70917	0.000*
0.356965	4.97435	0.000*
2.099671		
0.331947		
55.726*		
	Coefficient 0.012383 0.200434 -1.814129 0.024864 0.024086 0.356965 2.099671 0.331947 55.726*	Coefficient t-Statistic 0.012383 34.6848 0.200434 18.10607 -1.814129 -5.51898 0.024864 3.80924 0.024086 4.70917 0.356965 4.97435 2.099671 0.331947 55.726* 5.726*

Table 5. Regression results of the falling market.

Note: C is the intercept, ABS(MARKET_RETURN) is the absolute value of the daily market return, MARKET_RETURN*MARKET_RETURN is the squared value of the daily market return, AMPLI is the amplitude measuring the volatility in the stock market, TURNOVER is the turnover rate measuring the degree of stock market trading activity and AR(1) is the lag term of CSAD. * denotes significance at the 1% level.

essence, the psychological state and the ways of logical thinking are in great difference under the two contrasting market situations. Below we present and compare the results of the herding effects in the rising and falling markets, respectively.

After separating the average daily market return data into the positive and negative returns, we are left with 669 rising days (rising market) and 550 falling days (falling market). With reference to the AIC criteria again, we present the regression results of the $CSAD^{up}$ and $CSAD^{down}$ models with AR(1) in Tables 4 and 5.

The estimated CSAD^{up} model is thus given as follows,

$$CSAD_{t}^{up} = 0.012548 + 0.086490 |R_{mt}| - 1.292544 R_{mt}^{2} + 0.018107 ampli_{i} + 0.028330 turnover_{i} + 0.396506 CSAD_{t-1}^{up}$$
(6)

We use the absolute value of R_{mt} to facilitate a comparison of the coefficients of the linear term in the up and down markets. The Durbin–Watson value of 2.1437 is apparent that autocorrelation is a non-issue. All the coefficients in the model are significant at 99% confidence level. The coefficient of the variables of interest, $|R_{mt}|$ and are 0.0865 and -1.2925, respectively; indicating that as the average market return increases, the CSAD_t increases at a decreasing rate before reaches its peak and then declines.

From Table 5, the estimated CSAD^{down} model is thus given as follows,

$$CSAD_{t}^{down} = 0.012383 + 0.200434 |R_{mt}| - 1.814129 R_{mt}^{2} + 0.024864 ampli_{i} + 0.024086 turnover_{i} + CSAD_{t-1}^{down}$$
(7)

In comparison with the Main Board and the Small and Medium Enterprise (SME) Board of SZSE, ChiNext is home for technology and innovation-oriented companies. As such, stocks listed on the ChiNext board are considered growth-oriented and more volatile. Apparently, our finding of the more serious herding effect during the falling market (where investors are inclined to sell than hold the losers) is contrary to the standard account of the "disposition effect" of behavioral bias, which states that investors tend to "hold to losers too long" (Goldberg and von Nitzsch, 2001; Shefrin, 2005; Shefrin & Statman, 1985). Thus, our finding serves as an evidence to Dacey and Zielonka's (2013) proposition that when a market experiences greater volatility, investors will be more prone to sell instead of holding the losers. The irrational reaction of investors during the 536 👄 S.-H. NG ET AL.

down market can be so strong that they put more weight on bad news than on good news; causing them to succumb to panic selling of stocks during the falling market (while hoping to avoid greater losses). In relation to the above, in terms of the types of market participants, the presence of greater percentage of retail investors in ChiNext who are more short term and speculative compared to the institutional investors may also contribute to the more pronounced herding effect during the falling market. This is because as opposed to intermediate and long-term investors, short-term investors and speculators in general believe in "cutting losses" short and quickly during the falling market. Unlike the intermediate and long-term investors, they also in general have lack of interest in long-term fundamental values of the stocks. Moreover, herding effect may be worsened during the down market in ChiNext due to the common practice of the eager short-term retail investors to borrow and buy equities when stock prices increase (jump on the bandwagon). Once the prices fall even slightly, because of margin calls, many of these investors find themselves needing to sell, leading to a sharp market correction.

Last but not least, an interesting point to note from the regression outputs is related to the adjusted R-squared values reported in both the rising and falling market regressions. The higher adjusted R-squared of 33.19% in the falling market regression compared to the much lower 24.22% in the rising market regression suggests that the combination of the three broad market independent variables in the regression, namely, the systematic risks as indicated by the market return variable (example of systematic risks is news pertaining to the macro economy), the market turnover rate and the market volatility; are market information that have relatively greater impact on investors' behavior during the down market than the up market. In other words, we postulate that there might exist a tendency for investors to react more to these three types of broad market information instead of firm-specific information in their decision-making behavior during the falling market than during the rising market.

4.3. Robustness test

Seen as a common practice in many stock markets across the globe, daily price limit rules have also been imposed on SZSE, including its ChiNext board. Based on the rules, the daily price of individual stock can only increase or decrease by a maximum of 10% relative to the closing price on the previous trading day (this daily price limit has been revised to 20% from 24 August 2020). Once a specific stock price touches the limit, trading is still allowed as long as the transaction prices are within the upper and lower limits. We perform the robustness test to examine whether the daily price limit affects our

	Table 6.	Robustness	tests on	the impa	ct of dail	y price	limit on	herding.
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	Whole Market	Rising Market	Falling Market
ABS(MARKET_RETURN)	0.092749 (0.000*)	0.083977 (0.000*)	0.188636 (0.000*)
MARKET_RETURN*MARKET_RETURN	-1.423884 (0.000*)	-1.288364 (0.000*)	-1.811932 (0.000*)
Durbin-Watson statistic	2.012137	2.149732	2.110633
Adjusted R Squared	0.350126	0.236989	0.330125
F-test	70.230*	58.129*	54.811*

Note: ABS(MARKET_RETURN) is the absolute value of the daily market return, MARKET_RETURN*MARKET_RETURN is the squared value of the daily market return. The numbers in parentheses are p-values. * denotes significance at the 1% level.

overall finding in support of herding in ChiNext. Table 6 reports our findings on whether the observed herding effects from our full sample in the earlier analysis are affected by the daily price limit in the whole ChiNext market, during the rising market and during the falling market. We are particularly interested to find out whether the upper daily price limit rule has any impact on our finding in favor of herding during the rising market. This is because it is believed by some that whenever there is a large price increase induced by a fundamental or industry news, it may serve as a convenient device for unrelated individual investors, especially the larger individual investors who have greater financial ability, to act as speculators, to coordinate to push up the stock price together to the upper price limit and then taking profits by selling on the next day (such behavior is termed as destructive market behavior by Chen, Gao, He, Jiang, & Xiong, 2019). In conjunction with such behavior, it is asserted that stock prices that hit the upper daily price limit often attract the attention of the rest of investors (Barber & Odean, 2008; Seasholes & Wu, 2007) and may therefore exacerbate the herding among the investors during the rising markets. However, the similar cannot be expected during the down market (by pushing down prices to the lower daily price limit) due to the difficulty and high cost of short-selling in ChiNext.

Out of our 758,711 firm-day observations, 20,030 observations exhibit closing price at the upper price limit and 5083 observations exhibit closing price at the lower price limit. We re-estimate Equations 5, 6 and 7 after removing these firm-day observations from our full sample. It can be seen from Table 6 that the elimination of these extreme observations does not alter the statistical significance of our prior findings for the whole market, the rising market as well as the falling market. The signs of both the $|R_{mt}|$ and R_{mt}^2 coefficients remain unchanged and the coefficients remain significant at 1% (with p-value of 0.000) under the three different market conditions. Meanwhile, we may also infer from the robustness tests that the "destructive market behavior" of the individual investors as reported in Chen et al.'s (2019) study makes the overall herding effect in ChiNext neither stronger nor weaker.

5. Conclusion

5.1. Concluding remarks

In this paper, we examine the herding behavior among investors in ChiNext Board based on the relation between the cross-sectional absolute deviation of stock returns (CSAD) and the overall market return over the span of 5 years from 2015 to 2019. Our findings indicate the presence of herding in the whole ChiNext market as well as during the states of up and down markets, respectively. Thus, the finding is consistent with many other past empirical studies involving either the overall markets in China such as Yao et al. (2014), and Wang, Li, and Ma (2021) or specifically the start-up and technological-based industry in China such as Lee, Chen, and Hsieh (2013) and Zhang et al. (2017) who found that herding activities are generally stronger in the technology and innovation-oriented industry than other industries. Since trading in ChiNext is dominated by retail investors, our finding is also in line with the theoretical explanation that herding is more likely to be present among the retail investors as opposed to the more sophisticated institutional investors (Venezia, Nashikkar, & Shapira, 2011). In general, retail investors portray shorter term investment behavior and know less about the fundamental value of firms and therefore display more herding behavior (Ng & Zhu, 2016). Retail investors also have less access to the industry and market-wide information, less professional experience and investment-related educational background compared to the institutional investors. Therefore, market such as ChiNext tends to exhibit greater information asymmetry and pervasive herding. Moreover, stocks in ChiNext, which are predominantly start-up and technology oriented, are generally growth stocks that tend to pay out low dividends and face greater uncertainty in their future earnings capability (from the uncertainty related to their product release and technology trends). Such characteristics also contribute to a higher possibility of herding.

Notably, we find that the degree of severity of herding during the down markets is greater than during the up markets. We believe that the worsened herding effect during the down markets is caused by several simultaneous contributing factors, which subsequently overcome the "disposition effect" as reported in seminal studies of Odean (1998) and Lee, Park, Lee, and Wyer (2008). Investors act contrary to the disposition effect by selling instead of holding or buying during the down market. Such contradictory result may be explained by the distinct attributes of the retail investors in ChiNext who make up the majority of the trading activity and value. A shorter term and speculative trading style with the lack of belief in long-term fundamental value of stocks in ChiNext among the retail investors together with their inclination to trade on margin cause them to become more sensitive to bad news and react abruptly by following the crowd to sell in mass volume during the down markets.

Chinese regulators such as the China Securities Regulatory Commission (CSRC) should be concerned about the adverse impacts brought about by the rife herding behavior in a young and exuberant market such as ChiNext. The herding behavior, which is exacerbated under the environment of asymmetric information, results in serious price inefficiency and market instability over the time because it causes increased volatility and over-adjustment in stock prices, either up or down, and the deviation of the stock prices from their intrinsic value. Due to herding, some listed companies may be more interested in using fake news or hypes to manipulate the stock prices instead of focusing on improving their financial statements as retail investors who form the major part of the participants in ChiNext are more inclined to making short-term profits out of their speculations. Thus, investor education is vital especially for the retail investors in order to create awareness and to learn the skills of the right way of investing vis-à-vis gambling and speculation. Investor education may also help to strengthen the psychological aspect of investment and lessen the cognitive biases in investing. Meanwhile, ChiNext and the authority should roll out more policies that encourage more quality investors, in particular, the professional institutional investors to take part, lead and invest in ChiNext market. Policies should be formed to encourage more high-quality companies to list on ChiNext in order to attract these institutional investors. In longer term, these efforts could shift participants' attention in ChiNext from the often overhyped theme stocks to the stable growing stocks. As a relative new market, there are still a number of challenges faced by ChiNext in improving its operations and system. This includes the needs to enhance its delisting provisions in order to effectively crack down the unscrupulous companies. A well-functioning delisting mechanism will make the investors to keep away from the stocks with delisting risk and make listed companies to realize that their ultimate corporate aim is to maximize shareholders' wealth. Structural and policy reformation in ChiNext is an on-going effort of the Chinese authority and efforts to improve the behavioral bias of herding should be seen as an integral part of the reformation of ChiNext as it moves forward into maturity.

5.2. Suggestion for further study

Though our study is in line with vast majority of empirical works on herding which focus on a single market [e.g., Tan et al. (2008) and Demirer and Kutan (2006) for China; Zhou and Lai (2009) for Hong Kong; Vo and Phan (2017) for Vietnam; Indars et al. (2019) for Russia; and Rubbaniy, Ali, Siriopoulos, and Samitas (2021) for the US ESG stocks], it is noted that there are studies that focus on cross-market or cross-country herding behavior associated with the dynamics of the behavior over the time. According to Chiang, Li, Tan, and Nelling (2013), when the market undergoes extreme stress, structural changes are likely to result, and therefore a time-varying approach is needed to capture the dynamics or changing nature of the herding behavior. It is suggested that future study may focus on examining the dynamic behavior of herding in ChiNext using the time-varying approach by including the time period of COVID-19 pandemic as such period aptly fulfils the conditions described by Chiang et al. (2013), added with the fact that firms listed on ChiNext are typically small- and medium-sized innovative firms with new business models and fragile operations, which make them more vulnerable to the negative impact of the pandemic. Such study may enrich our understanding of the possibility of various reactions of stock return dispersions to extreme market conditions and subsequently shed light on the more complex behavior of investors.

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Notes on contributors

Sin-Huei Ng is an associate professor at Xiamen University Malaysia.
Zhehan Zhuang is a postgraduate student at Hong Kong Baptist University.
Moau-Yong Toh is an assistant professor at Xiamen University Malaysia.
Tze-San Ong is an associate professor at Universiti Putra Malaysia.
Boon-Heng Teh is a senior lecturer at Multimedia University.

ORCID

Sin-Huei Ng D http://orcid.org/0000-0002-1225-7466

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542 👄 S.-H. NG ET AL.

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