Asymmetric information and herding behavior: an empirical analysis from Vietnam

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Abstract: This research examines the impact of information asymmetry on herding behavior among investors in the Vietnamese stock market. We investigate this relationship at three levels: aggregate market level, investor level, and firm level. First, at the aggregate market level, our evidence suggests that decrease of asymmetric information resulting from the issuance of a new regulation - Circular 155/2015/TT-BTC can reduce the intensity of herding due to a decrease in non-information-based intentional herding and the losing popularity of momentum trading. Second, at the investor level, the study finds evidence of asymmetric herding between arbitrageurs and noise traders. Herding among arbitrageurs and noise traders is also found to significantly decrease following the issuance of the new regulation. Finally, at the firm level, herding intensity is higher between stocks with higher levels of information asymmetry, such as those with lower market capitalization, heavier tails in their return distribution, and higher idiosyncratic risk variance ratios.

Key words: stock market, herding behavior, Circular 155/2015/TT-BTC, information environment, asymmetric information, regulation.

1. Introduction

Herding behavior is a phenomenon that occurs when many people act in the same way, possibly as the result of people imitating the conduct of others (Graham, 1999). It has been linked to adverse phenomena in financial markets such as asset price bubbles and financial crises (Hott, 2009; Rui, 2017). There are two possible causes of herding behavior: information externalities and payoff externalities. Regarding information externalities, or information asymmetry, uninformed investors are impacted by the disclosure of information made by informed investors' investment. Individual investors tend to ignore their own information and imitate others' investment decisions (Bikhchandani et al., 1992; Welch, 1992). In contrast, payoff externalities imply that the explicit preferences of investors, rather than the information others have, are what drive their investment decisions (Owens, 2010). Investors' preferences for stocks can occasionally overlap, which leads to an increase in purchases of a particular stock, thus raising its price. However, the impact of payoff externalities on herding behavior in financial markets is not clear (Devenow and Welch, 1996), thus they are outside the scope of this study.

There are two types of herding: intentional herding and unintentional herding (Bikhchandani and Sharma, 2000). While intentional herding occurs when investors follow others' behavior due to poor information and greed, unintentional herding occurs when investors trade securities based on available fundamental information until the securities' market value equals their fundamental value. Relatively, momentum trading strategy (buying stocks with recent high performance and selling those with recent low performance based on their historical returns) is considered a form of intentional herding because it relies on past information rather than fundamental analysis (Chen et al., 2003).

Additionally, there are two types of investors in the market: arbitrageurs and noise traders (Dang and Lin, 2016). Arbitrageurs are sophisticated and rational investors, enabling them to effectively identify outperforming stocks (positive alpha). Noise traders are less sophisticated investors who lack rationality and tend to make trading decisions based on sentiments, thus are more likely to hold and trade underperforming stocks (negative alpha). With distinct trading approaches, herding behavior of arbitrageurs and noise traders could be different and correlated to each other.

When some investors have more information than others, information asymmetry occurs, giving the informed part a competitive advantage. Due to information asymmetry, uninformed investors only observe the past actions of informed investors, but they are not able to observe signals about the fundamental value of the asset. This implies that uninformed investors can only invest by mimicking strategies of informed traders rather than their beliefs. Thus, asymmetric information is clearly the driving factor of herding in the equity markets (Alhaj-Yaseen and Rao, 2019; Wermers, 1999). The transparency of the stock market is crucial for reducing information asymmetry among investors, and information disclosure practice is an essential method for achieving transparency. Proper corporate disclosures can reduce information asymmetry, allowing investors to make better investment decisions (Alves et al., 2015). In general, an information disclosure regulation is used by the government to regulate the market, thus is expected to reduce information asymmetry. Such information asymmetry reduction could result in the decline of herding mentality. In Vietnam, corporate responsibility of disclosing information before 2016 is not good (Hoang et al., 2020). The criterion of disclosing financial statements was violated by more than 30% while criterion of disclosing managerial reports was violated by 23% of total surveyed companies. However, the situation has quickly improved due to the newly issued Circular 155/2015/TT-BTC guiding the information disclosures on the stock market. The Circular strengthens regulations on financial statement and annual report disclosure deadlines, leading to significant improvements in disclosure practices (Phong et al., 2018). Thus, we believe that information asymmetry declines following this Circular, leading to the decrease of herding intensity of the Vietnamese stock market.

Even though the degree of information asymmetry is not directly observable, researchers (Alhaj-Yaseen and Rao, 2019; McLaughlin et al., 1998) use firm characteristics as proxy variables to study its effect. Capitalization, fat-tailed kurtosis, and idiosyncratic risk are three firm measures of information asymmetry focused in this study. Information asymmetry tend be lower among bigger firms as a result of increase transparency and evaluation ease (Beatty and Ritter, 1986). Thus, firms that have higher capitalization are likely to have less asymmetric information. Higher asymmetry may be indicated by fat-tailed kurtosis, which is characterized by more extreme returns in the upper and lower tails of the return distribution. Finally, idiosyncratic risk variance can be standardized by a firm's total variance and used as a proxy for information asymmetry. The higher this ratio is, the greater information asymmetry becomes.

In this study, we develop existing literature on herding by analyzing the connection between the level of information asymmetry and herding intensity. Herding behavior at the aggregate market level and investor level is investigated in the context of a newly issued regulation on information disclosure in Vietnam - Circular 155/2015/TT-BTC. First, at the aggregate market level, our results confirm the existence of herding mentality during the research period. After the issuance of the Circular, the herding intensity reduces significantly due to the decrease of non-information-based herding. Momentum trading strategy is also found losing popularity after the issuance of the Circular. Secondly, at the investor level, we find that herding among arbitrageurs and noise traders significantly decrease following the issuance of the Circular. Lastly, at the firm level, herding tends to be more intense among stocks with higher levels of information asymmetry, such as those with smaller market capitalization, heavier tails in their return distribution, and higher idiosyncratic risk variance ratios.

The remainder of our paper proceeds as follows. In section 2, we provide a background of the Vietnamese stock market and develop the research hypotheses. Section 3 describes data and methodology. Section 4 shows the empirical results. The last section presents the conclusions of the research.

2. Literature review and hypothesis development

2.1. Herding behavior in Vietnam

Herding is defined as behavioral patterns that are similar across individuals. There are two views of herding, which are the non-rational and rational views (Welch, 1992). The non-rational view centers on investor psychology and assumes that individual investors follow one another blindly and forego rational analysis. The rational view centers on externalities, which supposes that decision-making is distorted by informational differences. According to Bikhchandani et al. (1992), the rational view arises from information asymmetry. Retail investors usually do not carry enough information for their investment decisions or even have no data about stocks so they imitate better-informed investors.

In Vietnam, herding behavior is an important issue where retail investors are prominent[1]. Tran (2010) claims that there were many trading sessions VN-Index fluctuated in a wide range without any large information. She believes one of the most influencing factors is herding mentality.

[1] Retail investors account for over 90% of trading volume in Vietnam stock market. See for example https://fortune.com/2021/06/11/vietnam-stock-market-boom-retail-investor/

First, Vietnamese investors are likely to utilize social networks to decide on their investment activities. Therefore, when a very fragile signal just appears, a large part of investors may act on the same side, which causes the price momentum of the market. It is a visible highlight of herding in the market. This social interaction can be an important means for market manipulation activities since these groups or platforms are not controlled by the authorities.

Second, as the equity market is sparkling as a new trendy investment channel, many individual investors have participated in the market aggressively. Individuals join the market without any knowledge and experience about the financial market. The issue becomes severe when most of them blindly follow the information, which is delivered to manipulate the crowd. They also ignore all the fundamental features of the market to struggle to achieve short-term profits (Ando and Scheela, 2005), which puts high pressure on the market by large price movements, triggers bubbles in the financial market, and deteriorates the sustainable development of the market.

Another common practice for domestic investors, especially retail investors, is following foreign investors and institutional investors (Nguyen et al., 2016). This can be explained by representative bias. Professional investors can identify opportunities in the market when it comes. As a result, it triggers herding behavior of the market.

From such evidence, we propose the following hypothesis:

Hypothesis 1 (H1): Herding behavior is present among market participants in Vietnam.

2.2. The issuance of the Circular 155/2015/TT-BTC

Due to information asymmetry, uninformed investors only observe the past actions of informed investors and follow them blindly while not conducting independent analysis of stocks, which leads to herding in the stock market. Thus, reducing information asymmetry can mitigate herding behavior as it removes the imbalance of information among investors. One way of diminishing information asymmetry is to enhance the information environment. Alhaj-Yaseen and Rao (2019) show empirical evidence that a more transparent environment alleviates herding behavior. Wang and Huang (2019) conclude that increasing market transparency prevents investors from engaging in herding behavior.

In Vietnam, the Vietnamese stock market has been experiencing more than 20 years of construction and development. Before 2016, practices of corporate disclosure in Vietnam are less extensive and less credible, which results in information asymmetry. For voluntary disclosures, regarding criterion of disclosing misstatement reporting policy, no listed company mentioned this policy in their annual reports during the two years 2015-2016. This reflects that the corporate responsibility of disclosing information of listed companies in Vietnam before 2016 is not good (Hoang et al., 2020).

Fortunately, the situation has quickly improved due to the Circular 155/2015/TT-BTC guiding the information disclosures on the stock market effective in 2016 in replace of Circular 52/2012/TT-BTC in 2012. Circular 155/2015/TT-BTC has more rigorous regulations on the deadline for disclosing financial statements and annual reports and serious sanctions on late filing by the SSC. Therefore, disclosure practices have been significantly improved (Phong et al., 2018). In addition, one of the prominent changes is the inclusion of provisions that encourage listed firms to disclose information in both Vietnamese and English to facilitate foreign investors' access to information. This new circular is expected to promote information disclosure in English and gradually raise domestic disclosure practices to meet international standards (Hoang et al., 2020).

We assume a better information environment for the Vietnamese stock market following the improvement of domestic disclosure practices. Therefore, the asymmetric information is expected to reduce leading to the decline of herding intensity of the market after the Circular is issued. We propose the following hypothesis.

Hypothesis 2 (H2): The issuance of Circular 155/2015/TT-BTC reduces the extent of herding among Vietnamese market participants.

2.3. Momentum trading strategy in Vietnam

The momentum trading strategy involves buying stocks that have recently performed well and selling stocks that have recently performed poorly based on their historical returns. This strategy is considered a form of herding behavior because it relies on past information rather than fundamental analysis, and it can worsen return volatilities (Chen et al., 2003). Given the difficulties of short selling, individual investors are more likely to adopt momentum strategies in an upward-trending market (Jagadeesh and Titman, 1993).

In Vietnam, Vo and Truong (2018) argue that momentum effects are present in the Vietnamese stock market between June 2007 and November 2015. Duong and Bertrand (2023) find that returns on these strategies remain robust even after adjusting for momentum, while returns on momentum portfolios become insignificant after adjusting for overreaction. By double-sorting, they discover that the average returns of portfolios increased with their measure of overreaction, holding past returns constant. This finding shows that the momentum profit in Vietnam can be attributed to investors' overreaction.

We suppose that information disclosure can reduce overreactions to stock prices. When companies disclose relevant information to the public, investors will have a better understanding of the company's financial situation and potential. Thus, irrational trading of the company's stock will be prevented, as investors have a clearer understanding of the company's actual value. However, when companies do not provide enough information, investors have to speculate on the firms' situation. This may lead to overreaction in the stock market as investors may overvalue or undervalue the company. We construct the third hypothesis as:

Hypothesis 3 (H3): The momentum trading strategy, if being adopted by investors in Vietnam before the Circular 155/2015/TT-BTC came into force, loses its popularity following the issuance of Circular 155.

2.4. Intentional and unintentional herding

Bikhchandani and Sharma (2000) identify two types of herding behavior in financial markets: intentional herding and unintentional herding. Intentional herding occurs when investors follow the behavior of other investors due to greed and poor information environment, leading to risky investments and irrational analysis (Ullah and Ather, 2014). Intentional or irrational herding is not based on information and is expected to increase volatility and drive prices away from fundamental values (Dang and Lin, 2016). Fads herding (Shiller et al., 1984), reputational herding (Keynes, 1937) and characteristic herding (Falkenstein, 1996) are the three main causes of irrational herding behavior. On the other hand, unintentional herding happens when fundamental information is abundant and easy to obtain, leading investors to buy or sell securities until their market value equals their fundamental value. This type of herding is considered rational and may occur unintentionally, following the efficient market model (Bikhchandani and Sharma, 2000). Two common explanations of information-based herding are information cascades and investigative herding. Information cascades occur when investors disregard their private information and instead make investment decisions based on other’s trades (Bikhchandani et al., 1992), while investigative herding occurs when investors analyze and interpret available information in the same way and therefore reach similar conclusions (Banerjee, 1992). Consequently, the quality of information plays an important role in determining the type of herding existing in the market.

Galariotis et al. (2015) indicate that the releasing of new information tends to decrease the extent of intentional (non-fundamental) herding and motivate the extent of “spurious" (rational) herding. In addition, Alhaj-Yaseen and Rao (2019)’s research also shows that while herding due to fundamental information remains relatively the same, herding due to non-fundamental information declined significantly following the improvement of the information environment. In the Vietnamese stock market, most of the researchers investigate the fundamental and non-fundamental herding in the aggregate market but there is no research studying the change in two types of herding based on the improvement of the information environment.

With the discussion above, assuming better information environment for the Vietnamese stock market following the Circular 155/2015/TT-BTC, we come to construct the fourth hypothesis:

Hypothesis 4 (H4): While the extent of herding due to non-fundamental information is alleviated, the extent of herding due to fundamental information remains unchanged following the issuance of the Circular 155/2015/TT-BTC.

2.5. Herding among and between arbitrageurs and noise traders

Shleifer and Summers (1990) argue that both arbitrageurs and noise traders exist in the stock market. According to Dang and Lin (2016), arbitrageurs are sophisticated and rational investors, enabling them to effectively identify stocks that are expected to outperform the market. These investors attempt to arbitrage, but face limitations due to potential risks namely fundamental risk and risk due to unpredictability of the future resale price (De Long et al., 1990). On the other hand, noise traders are less sophisticated investors who lack full rationality and tend to make trading decisions based on sentiments, which makes their trading patterns subject to systematic biases. They frequently use trading strategies that are based on pseudo-signals and are correlated to each other, resulting in the same judgment biases and persistent mistakes (Shleifer and Summers, 1990). As a result, noise traders are more likely to hold and trade stocks that underperform the market.

Dang and Lin (2016) suggest that herding behavior could happen not only within groups of investors, but also between groups. Within-group herding among arbitrageurs because fund managers would like to preserve their reputation and compensation (Admati and Pfleiderer, 1997), or due to information-based cascades (Bikhchandani et al., 1998). However, within-group herding among noise traders is more likely due to their intrinsic preference for conformity and sentimental imitation (Bikhchandani and Sharma, 2001; Shleifer and Summers, 1990). Between-group herding or interaction may occur when arbitrageurs attempt to take advantage of noise traders' actions. As arbitrage is limited by risk, arbitrageurs may create more positive signals if noise traders are already optimistic about specific stocks, in order to benefit from such herding behavior (Shleifer and Summers, 1990).

Alhaj-Yaseen and Rao (2019) reveal several notable facts of how changes in the information environment impact the herding among and between arbitrageurs and noise traders in the Chinese stock market. Alhaj-Yaseen and Rao (2019) argue that in a poor information environment, arbitrageurs' ability to outperform the market is limited by the available data and they may tend to herd. In their research results, herding is present among both groups before and after the market liberalization in the Chinese stock market. Before market liberalization, arbitrageurs exhibited a strong tendency to herd with noise traders. However, after the market liberalization, arbitrageurs appear to have adopted a strategy that takes advantage of noise traders' trend-chasing or price-chasing behavior.

With the discussion above, assuming better information environment for the Vietnamese stock market following the Circular 155/2015/TT-BTC, we come to construct the fifth hypothesis:

Hypothesis 5 (H5): The issuance of the Circular 155/2015/TT-BTC reduces herding intensity among noise traders and arbitrageurs.

2.6. Herding with asymmetric information

Leland and Pyle (1977), Grossman and Hart (1981), and Myers and Majluf (1984) show theoretically that information asymmetry can have a profound impact on a firm's financing and investment decisions, which are firm's characteristics. Although the degree of information asymmetry is not directly observable, researchers can use firm characteristics as proxy variables.

Previous empirical studies have argued that the asymmetric information problem is most severe for firms with significant growth opportunities, and consequently, have used proxies for a firm's investment opportunity set as measures of information asymmetry. McLaughlin et al. (1998) use a firm's market-to-book ratio as a measure of information asymmetry and find that firms with greater information asymmetry have more negative abnormal performance. Alhaj-Yaseen and Rao (2019) present six firm characteristics as measures for information asymmetry including market capitalization, market-to-book ratio, bid-ask spreads, distribution of returns, firm's total variance, and SOE ratio. They assume that information varies with firm characteristics, which lead to information asymmetry. Therefore, these measures are used to examine herding behavior. However, given the limited data available, we can only implement three characteristics into our study.

2.6.1. Market capitalization

Firm size has been employed in earlier research as a proxy for the level of information asymmetry. Lo and MacKinlay (1990) found that firm size is negatively correlated with the degree of information asymmetry. Due to their stronger institutional ownership and analyst following, larger enterprises are likely to have less asymmetric information (Atiase, 1985; Brent and Addo, 2012). As a firm grows, the intensity of information asymmetry should decrease as the company becomes more transparent and simpler to evaluate (Beatty and Ritter, 1986). Wermers (1999) examines herding behavior in small- and large-capitalization stocks and concludes that herding intensity is greater among small-capitalization stocks.

Thus, we believe that, in the context of the Vietnamese stock market, firm size is negatively associated with information asymmetry. That leads to the sixth hypothesis as below:

Hypothesis 6 (H6): Firm size has a negative impact on herding behavior.

2.6.2. Fat-tailed kurtosis

In the theory of efficient markets, Fama (1969) argues that a market is efficient if the market prices of securities reflect all the available information and the announcement of new information can drive the stock price. And unless the firm faces a shock event, the change in price of securities will occur gradually and slowly. If a stock's return has the leptokurtosis distribution, it means that the more frequency shock event occurs in expected return or it implicitly shows the irrational evaluation process due to the lack of necessary information. Alhaj-Yaseen & Rao (2019) states that the fat-kurtosis return distribution is the sign of asymmetric information. On the other hand, Stoyan et al. (2011) recommend investors should exclude the stock having fat-tail return distribution from their portfolios. It inspires the idea that the "smart" investors will choose the low risk security while other investors (noise traders) will choose the fat-tail shares (riskier instruments) and expect higher returns. As discussed above, the blind action of noise traders will create more herding behavior among the group of fat-tail shares.

Consequently, we expect that the fat-tail return distribution is the indicator of asymmetric information and the extent of herding behavior will be greater among these shares. Then, we construct the following hypothesis:

Hypothesis 7 (H7): The extent of herding behavior among shares having fat-kurtosis return distributions is larger, compared with them between shares having thin tail return distributions.

2.6.3. Idiosyncratic risk

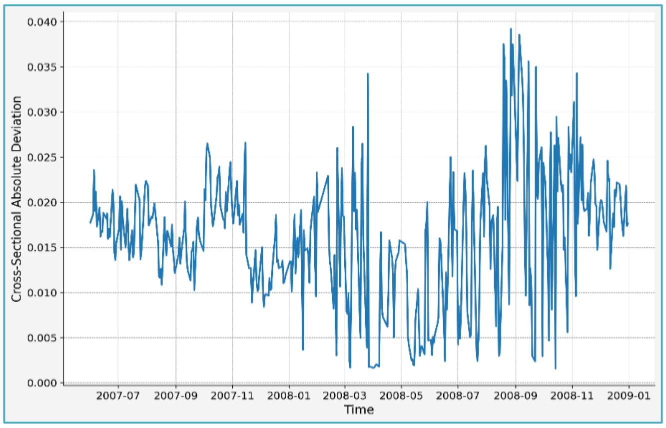
O'Hara (2003) explains how information asymmetry affects the risk and behavior of investors. He says that when investors have more information than others, they can change the amount and type of risk that investors face. Traditional asset pricing models also say that investors can get rid of the risk that is specific to each stock by diversifying their portfolios. However, some investors may not diversify enough and may follow what other investors do (Melton, 1989). This creates a situation where informed investors can profit from buying or selling stocks that are not priced correctly, while uninformed investors hold the opposite positions. It suggests that one way to measure information asymmetry is to look at the ratio of the specific risk to the total risk of a stock. The higher this ratio, the more information asymmetry there is (Alhaj-Yaseen and Rao, 2019). Huang et al. (2014) support this idea and show that information asymmetry leads to more herding behavior among investors.

Obviously, based on the empirical results of previous researchers, we construct the hypothesis as:

Hypothesis 8 (H8): The herding behavior between high idiosyncratic risk shares is worse than the extent of herding phenomenon among the low ones.

3. Data and methodology

3.1. Data



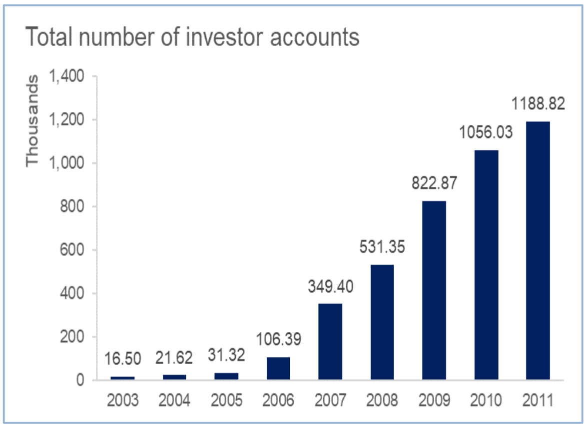


Chart 1. CSAD movements from 06/2007 to 01/2009

(Source: Self-collect Python)

Chart 2. Total number of investor accounts in the Vietnamese stock market (2003-2011)

(Source: cafef.vn)

Based on the total number of investor accounts (Chart 2) and history of daily trading limits of the market illustrated in Table 3.1, we consider picking August 18, 2008 as our starting date due to several reasons. First, as the herding behavior exists when investors in the market imitate the observed decisions of others, we suppose that the number of investors in the market has an impact on the objectivity of measuring herding. Regarding the number of investor accounts, the size of the market for the period before 2006 is relatively small to measure herding behavior. However, within two years (2006-2007), the number of investor stock trading accounts skyrocketed from 31,316 accounts to 349,402 accounts, which is sufficient to objectively measure herding. Second, in 2008, due to the global financial crisis, SSC implemented a market-wide circuit breaker to prevent panic among investors and reduce market volatility. There were four times that the daily trading limit was changed during this year, including one sharp decrease from ±5% to ±1%, and three increases to bring it back to the initial level (Table 3.1).

Table 3.1. Daily price limits for HoSE from 2000 to 2013

Date	Daily price limit	Date	Daily price limit
28/07/2000	± 2%	27/03/2008	± 1%
13/06/2001	± 7%	07/04/2008	± 2%
15/10/2001	± 2%	16/06/2008	± 3%
01/08/2002	± 3%	18/08/2008	± 5%
23/12/2002	± 5%	15/01/2013	± 7%

(Source: vietstock.vn)

Too narrow fluctuation limit could prevent individual stock prices from moving further away from each other, thereby lowering cross-section dispersion ($CSAD_t$) and causing the estimated coefficient of R_m^2 (γ_2) to be negative and significant when they should not be, which affects the overall evidence in favor of herding (Chang et al., 2000). Therefore, we pick 18/08/2008 which the date SSC adjusted fluctuation limit back to 5% as a good starting point. Chart 1 shows the recovery of $CSAD$ after this day, which further supports the argument of choosing this date.

The Circular 155/2015/TT-BTC guiding the information disclosures on the stock market is used as a proxy for the improvement of the information environment. Thus, December 29, 2017 is chosen to end our research period due to the fact that it is possible that the effectiveness of the circular on market transparency has reduced two years after the issuance of the Circular. After a period, firms can figure out loopholes of the circular, which allows them to manipulate their published information, which is one of the reasons why SSC has to continuously issue new circulars on guidelines for information disclosure and replace the old ones as discussed above. After nearly two years of enforcing the Circular, the disclosure of information on the Vietnamese stock market has improved, but it also reveals some weaknesses. The specific deadline for explaining the opinions and notes of auditors on financial reports is not defined in Circular 155/2015/TT-BTC, which enables firms to publish their financial reports before the deadline and then later publish explanations for the auditors' opinions and notes, causing difficulties for investors to collect information (Tran, 2017). It can be further proved that as of December 18, 2018, nine individuals have been administratively fined for their involvement in stock price manipulation, with fines totaling up to VND 5.1 billion (approximately USD 219,000), with these results, 2018 is considered a record year in terms of penalties for stock price manipulation (Linh, 2018). This implies that the Circular effectiveness has decayed in 2018 and the years following, which explains why we choose to end our research period at the end of 2017.

This paper uses aggregate market data of daily trading prices, free-risk rate, capitalization, P/B ratio for listed stocks on the HoSE, ranging from 18/08/2008 up to 29/12/2017. VN-Index is used to calculate the market return. Website cafef.vn by VCCorp Corporation, the most well-known stock-market public data distributor in Vietnam provides the data built on direct trading data from the exchange. In the paper, return calculation approach is:

$$R_i = \frac{P_{t+1} - P_t}{P_t}$$

We also use logarithmic return in lieu of simple return as Doan and Hoang (2017) for the research. This approach yields relatively the same results as the return calculation approach used in this paper. The results will be provided upon request.

In our research, all observations that have absolute values of daily return exceed 5% before 15/01/2013 and 7% after that are excluded. The dataset then includes 501,375 firm-day observations for 326 stocks. As we calculate market-wide $CSAD$ for each day and exclude all days with zero or missing $CSAD$, our sample collides into 2,341 observations of daily trading on HoSE. Next, we use free-risk rate, capitalization, P/B ratio and market return to calculate four factors of Carhart four-factor model. $CSAD_{FUND}$, $CSAD_{NONFUND}$ and yearly alphas (abnormal returns) and its p-value of stocks are then based on Carhart four-factor model to calculate.

3.2. Methodology

3.2.1. Herding at the aggregate market level

3.2.1.1. Herding of overall market

To examine the herding mentality over the period from 18/08/2008 to 29/12/2017 in the Vietnam stock market, we employ the model of Chang et al. (2000):

$$CSAD_t = \alpha + \beta_1 |R_{m,t}| + \beta_2 R^2_{m,t} + \varepsilon_t \quad (1)$$

where $CSAD_t$ is the average cross-sectional absolute deviation of the N stock stocks in the researching portfolio at day t. $R_{m,t}$ is market returns at the time t.

When β_2 is negatively significant, herding behavior is statistically confirmed in the entire market. However, when β_2 is positive significant, herding behavior is statistically rejected.

3.2.1.2. Herding affected by changing market information environment

The approach of Dang and Lin (2016) is utilized to measure herding behavior:

$$\begin{aligned} CSAD_t &= \gamma_0 + \gamma_1 D_u R_{m,t} + \gamma_2 (1-D_u) R_{m,t} + \gamma_3 D_u (1-D_a) R^2_{m,t} \\ &+ \gamma_4 (1-D_u)(1-D_a) R^2_{m,t} + \gamma_5 D_u D_a R^2_{m,t} + \gamma_6 (1-D_u) D_a R^2_{m,t} + \gamma_7 CSAD_{t-1} + \varepsilon_t \end{aligned} \quad (2)$$

where D_u is a dummy that takes the value of 1 if the market return is positive and 0 otherwise. Similarly, D_a is a dummy that takes the value of 1 for all observations after the issuance of Circular.

Coefficients of interest in this table are γ_3 and γ_4, which represent the degree of herding behavior in up and down markets prior to the issuance of Circular, respectively. γ_5 and γ_6 are also coefficients of interest, which reflect the degree of herding behavior in up and down markets after the issuance of the Circular, respectively. To enhance the precision of our regression, we follow the approach proposed by Yao et al. (2014) to include a 1-day lag of our dependent variable ($CSAD_t$).

By utilizing Equation (2), we can examine any changes in herding behavior subsequent to the issuance of Circular. Potential asymmetry of herding behavior between up and down markets is also analyzed to investigate momentum trading strategy in HoSE before and after the issuance of the Circular.

3.2.1.3. Herding due to fundamental and non-fundamental information

As previously mentioned, herding behavior can be categorized into two types: information-based (unintentional) herding and non-information-based (intentional) herding. Following Galariotis et al. (2015), as unintentional herding is based on fundamental information, we also call it fundamental herding. Similarly, unintentional herding is not based on fundamental information so we also call it non-fundamental herding. In this paper, we distinguish between these two types of herding by employing the method developed by Dang and Lin (2016), which is a modified version of the approach introduced by Galariotis et al. (2015). Galariotis et al. (2015) hypothesized that return factors, such as those proposed by Fama and French (1995, 1996) and Carhart (1997), effectively capture significant fundamental information that may influence investor decisions at the market level. To decompose the $CSAD_t$ measure into deviations resulting from common fundamental and non-fundamental factors, they estimated the following regression model:

$$CSAD_t = \beta_0 + \beta_1 \left(R_{m,t} - R_F \right) + \beta_2 HML_t + \beta_3 SMB_t + \beta_4 MOM_t + \epsilon_t \tag{3}$$

where HML_t is the high minus low return factor, SML_t is the small minus big return factor, MOM_t is the momentum factor.

However, when applying this method on the Vietnam stock market (HoSE in particular), Dang and Lin (2016) realize that their equations have low explanatory powers and factors that are not significant even at the level 10%. They argue that $CSAD_t$, by construction, responds to the absolute value of factors and thus, they suggest the “absolute value approach” for $CSAD_t$ decomposition:

$$CSAD_t = \delta_0 + \delta_1 \left| R_{m,t} - R_F \right| + \delta_2 \left| HML_t \right| + \delta_3 \left| SMB_t \right| + \delta_4 \left| MOM_t \right| + \varepsilon_t \tag{4}$$

The error term in this equation ε_t can be interpreted as the cross-sectional absolute deviations without the effect of the fundamental information ($CSAD_{NONFUND,t}$). This implies that return dispersion due to fundamental information can be calculated as follows:

$$CSAD_{FUND,t} = CSAD_t - CSAD_{NONFUND,t} \tag{5}$$

where $CSAD_{FUND,t}$ and $CSAD_{NONFUND,t}$ are cross-sectional absolute deviations due to fundamental and non-fundamental information, respectively. By utilizing this approach, we are able to isolate deviations attributable to non-fundamental information ($CSAD_{NONFUND,t}$), which can be employed as a proxy for non-information-based intentional herding. Similarly, we can identify deviations attributable to fundamental information ($CSAD_{NONFUND,t}$), which can serve as a proxy for information-based unintentional herding.

Subsequently, following Alhaj-Yaseen and Rao’s (2019) approach, we estimate the following two equations:

$$\begin{aligned} CSAD_{FUND,t} &= \gamma_0 + \gamma_1 D_u R_{m,t} + \gamma_2 \left(1 - D_u\right) R_{m,t} + \gamma_3 D_u \left(1 - D_a\right) R_{m,t}^2 \\ &+ \gamma_4 \left(1 - D_u\right)\left(1 - D_a\right) R_{m,t}^2 + \gamma_5 D_u D_a R_{m,t}^2 + \gamma_6 \left(1 - D_u\right) D_a R_{m,t}^2 + \gamma_7 CSAD_{FUND,t-1} + \varepsilon_t \end{aligned} \tag{6}$$

$$CSAD_{NONFUND,t} = \gamma_0 + \gamma_1 D_u R_{m,t} + \gamma_2 (1-D_u) R_{m,t} + \gamma_3 D_u (1-D_a) R_{m,t}^2 + \gamma_4 (1-D_u)(1-D_a) R_{m,t}^2 + \gamma_5 D_u D_a R_{m,t}^2 + \gamma_6 (1-D_u) D_a R_{m,t}^2 + \gamma_7 CSAD_{NONFUND,t-1} + \varepsilon_t \tag{7}$$

Equation (6), similar to Equation (2), includes coefficients γ_3 and γ_4 that correspond to intensity of herding based on fundamental information, respectively, prior to the Circular's issuance. Likewise, Equation (7) features coefficients γ_5 and γ_6 that respectively reflect the degree of herding based on non-fundamental information following the Circular's issuance.

By utilizing Equation (6) and (7), we can examine any changes in intentional and unintentional herding after the issuance of the Circular 155/2015/TT-BTC, while also considering the potential asymmetry between up and down markets.

3.2.2. Herding at the investor level

As discussed above, to investigate the phenomenon of herding among investors with different expectations, we study two distinct groups of traders: informed arbitrageurs and uninformed noise traders. The former group is characterized by their high level of sophistication and expertise, which allows them to effectively identify stocks that are expected to outperform the market. Conversely, noise traders are regarded as less sophisticated and lacking rationality, and thus, are more prone to relying on sentiment and other non-fundamental factors when trading stocks. This behavioral tendency may result in the selection of stocks that underperform the market.

To investigate herding tendency among and between those two groups of traders, we employ the approach of Dang and Lin (2016). The Carhart (1997) four-factor model is used to obtain yearly alpha values for each stock by the following formula:

$$R_t = \alpha_0 + \alpha_1 (R_{m,t} - R_F) + \alpha_2 HML_t + \alpha_3 SMB_t + \alpha_4 MOM_t + \epsilon_t \tag{8}$$

According to Carhart (1997), if a stock has a positive and significant alpha, it can be inferred that the stock outperforms the market. Conversely, a negative alpha indicates that the stock underperforms the market. It is hypothesized that positive alpha stocks will be frequently traded by arbitrageurs, and thus the behavior of these stocks reflects the behavior of the arbitrageurs. In contrast, negative alpha stocks are likely to be traded by noise traders, who are often not fully rational and trade stocks sentimentally, and as a result, the behavior of these stocks reflects the behavior of the noise traders.

We split stocks in our sample into 2 groups according to the sign of their alphas (α_0) in Equation (8) and only select alphas that are statistically significant at the 10% level. Yearly values for alpha are calculated and then the return dispersion measure ($CSAD_t$) is calculated for stocks with positive ($CSAD_{+,t}$) and negative ($CSAD_{-,t}$) alphas. Finally, these measures are used to estimate the following regressions:

$$CSAD_{+,t} = \gamma_0 + \gamma_1 R_{+m,t} + \gamma_2 \left| R_{+m,t} \right| + \gamma_3 R^2_{+m,t} + \gamma_4 R^2_{-m,t} + \gamma_5 CSAD_{-,t} + \varepsilon_t \tag{9}$$

$$CSAD_{-,t} = \gamma_6 + \gamma_7 R_{-m,t} + \gamma_8 \left| R_{-m,t} \right| + \gamma_9 R^2_{-m,t} + \gamma_{10} R^2_{+m,t} + \gamma_{11} CSAD_{+,t} + \varepsilon_t \tag{10}$$

where $R^2_{+m,t}$ and $R^2_{-m,t}$ represent the returns of the (sub)market equally weighted portfolio for stocks with positive and negative alphas respectively. The existence of herding behavior within each group can be inferred by negative and significant estimates for γ_3 and γ_9, while the existence of herding behavior between the two groups can be inferred by negative and significant estimates for γ_4 and γ_{10}. Additionally, the presence of interactions between the two groups can be detected by significant estimates for γ_5 and γ_{11}.

By testing two equations (9) and (10) on two periods - before and after the issuance of Circular - we are able to examine the changes in herding behavior within- and between- arbitrageurs and noise traders subsequent to the issuance of the Circular.

However, Dang and Lin (2016) do not support us to test whether the changes in herding behavior among two investor groups after the Circular issuance are significant or not. Thus, following Wu et al. (2020), we use the following model to examine the changes herding behavior within a group after the Circular issuance:

$$CSAD_t = \beta_0 + \beta_1 R_{m.t} + \beta_2 \left| R_{m,t} \right| + \beta_3 R^2_{m,t} + \beta_4 R^2_{m,t} D_a + \varepsilon_t \tag{11}$$

where D_a is a dummy that takes the value of 1 for all observations after the issuance of Circular.

According to Wu et al. (2020), the significantly negative coefficients β_3 implies that herding behavior exists during the research period. However, the interaction term's coefficient β_4 to be significantly positive implies that herding behavior is significantly lower after the issuance of the Circular.

3.2.3. Herding at the firm level

We examine the relationship between herding intensity and information asymmetry by categorizing our stocks into equal-sized portfolios based on their levels of information asymmetry. The study aims to investigate the difference in herding tendency between the highest and lowest portfolios. Three firm-specific measures of information asymmetry are utilized to reflect firm levels of information asymmetry: capitalization, kurtosis of returns and idiosyncratic risk. Note that when firms have higher capitalization, lower fat-tail kurtosis of returns, and lower idiosyncratic risk, there is less asymmetric information, and vice versa. We implement following models:

$$CSAD_{high,t} = \beta_0^{high} + \beta_1^{high} \left| R_{m,t}^{high} \right| + \beta_2^{high} \left(R_{m,t}^{high} \right)^2 + \varepsilon_t^{high} \tag{12}$$

$$CSAD_{low,t} = \beta_0^{low} + \beta_1^{low} \left| R_{m,t}^{low} \right| + \beta_2^{low} \left(R_{m,t}^{low} \right)^2 + \varepsilon_t^{low} \tag{13}$$

where $CSAD_{high,t}$, $CSAD_{low,t}$ are the cross-sectional absolute deviation of returns at day t of high and low level of asymmetric information portfolio, respectively. $R_{m,t}^{high}$, $R_{m,t}^{low}$ are the market return at day t of high and low level of asymmetric information portfolio, respectively.

When β_2^{high} or β_2^{low} is negatively significant, herding behavior is statistically confirmed in this specific portfolio. However, when β_2^{high} or β_2^{low} is positive significant, herding behavior is statistically rejected and the rational asset pricing model is more likely to give valuable results in this portfolio.

3.3. Research technique

3.3.1. Unit root test

Since our data sets are time series data, the spurious regression can happen if the time-series variables are non-stationary and independent. Thus, we conduct unit root tests to check whether the variables are stationary before estimating the models based on the OLS method.

3.3.2. Newey-West estimator

In time series regression, when the product of the error term and the regressor is serially correlated and generalized least squares is not possible, one must use heteroskedasticity and autocorrelation robust (HAR) standard errors (SEs). In econometrics, the dominant method for computing HAR SEs entails computing the Newey-West estimator of the Long Run Variance (LRV) matrix (Newey and West, 1987). Newey and West (1987) develop a variance–covariance estimator that is consistent in the presence of both heteroscedasticity and autocorrelation. The Newey–West procedure requires the specification of a truncation lag length to determine the number of lagged residuals used to evaluate the autocorrelation.

4. Empirical research

4.1. Summary statistics

We begin our research with descriptive statistics to reveal the characteristics of the two main variables in our report. Because our work concerns with the herding behavior in Ho Chi Minh Stock Exchange (HoSE), cross-sectional absolute deviation ($CSAD$) and market return during the period from 18/08/2008 to 29/12/2017 are the two most important investigative variables. Firstly, we use the return of VN-Index as market return in our analysis and for calculating $CSAD$. In addition, to strengthen the results, we use an equally weighted average as another market return for our test. We separate descriptive statistics into two parts (the measurement of central tendency and dispersion and the interaction between market return and $CSAD$).

4.1.1. The measurement of central tendency and dispersion

Table 4.1. Descriptive statistics

Variable	Observation	Mean	Maximum	Minimum	Std. Dev	Skewness	Kurtosis	1st quartile	3rd quartile
Panel A: VN-Index for $R_{m,t}$									
CSAD	2,341	0.0190	0.0395	0.0016	0.0038	0.4846	3.8703	0.0168	0.0210
$R_{m,t}$	2,341	0.0004	0.0476	-0.0587	0.0136	-0.1758	1.8275	-0.0061	0.0075
Panel B: Equally Weighted Portfolio for $R_{m,t}$									
CSAD	2,341	0.0184	0.0383	0.0016	0.0035	0.5187	4.4878	0.0164	0.0201
$R_{m,t}$	2,341	0.0006	0.0473	-0.0477	0.0125	-0.1623	2.2911	-0.0050	0.0065

Table 4.1 presents descriptive statistics for Ho Chi Minh Stock Exchange (HoSE) of daily return and cross-sectional absolute deviations (CSAD) using index return (Panel A) and equally weighted average return (Panel B). The data range is from 18/08/2008 to 29/12/2017.

(Source: Self-collect Python)

In Table 4.1, our sample contains 2,341 observations and it corresponds to 2,341 trading days in the studying period. In panel A, the average return of the market is 0.0004 and skewness index (-0.1758) illustrates that the distribution of market return according to VN-Index is approximately symmetric. The difference between market return calculated by VN-Index and market return calculated by equally weighted average (in panel B) seems to be tiny in mean, skewness, standard deviation.

$CSAD$ in both panels measures the dispersion between individual stock returns and the whole market return. As illustrated in Table 4.1, the average $CSAD$ is around 0.0190 and 50% of the observed $CSAD$ lies from 0.0168 to 0.0210. As a result, the kurtosis coefficient is higher than 3 and indicates that the distribution around its mean is high. For more specific, when we see the scatter plot of $CSAD$ over time (Chart 4.3), it is clear that from the mid-year 2008 to the beginning of 2010, the range of $CSAD$ is larger than that of eight years later.

4.1.2. The interaction between market return and CSAD

As illustrated in the Chart 4.2, during the up market, the distribution of $CSAD$ has a tendency to follow the quadratic function of market return, which is downward sloping. That is the initial evidence for the presence of herding behavior, when the increase in absolute return of the market would be followed by the higher level of dispersion ($CSAD$) to some certain level. However, if the market returns continuously go up, $CSAD$ will begin to go down and it means that many stocks in the financial market tend to move in the same way. In order to support that idea, we also observe that when the return of the market is over 2%, 75% of all individual stocks achieve positive returns, too (Table 4.2). The same picture is likely to happen in the down market. In Chart 4.1 we see that the fitted curve is a quadratic function of market return and over 75% of stock's prices in the market go down when the market return is lower than -2% (Table 4.2).

Table 4.2. Summary statistics for listed companies' returns in extreme market return

$R_{m,t}$	Observation	Mean	Maximum	Minimum	Std. Dev	Skewness	Kurtosis	1st quartile	3rd quartile
$> 2\%$	21,282	0.0237	0.0700	-0.0700	0.0263	-0.8665	0.3537	0.0043	0.0464
$< -2\%$	24,870	-0.0251	0.0700	-0.0700	0.0274	0.9635	0.5214	-0.0470	-0.0066

Table 4.2 presents descriptive statistics of listed companies' daily returns when the return of the market is higher than 2% or lower than -2%. The data is collected from trading data in HoSE in the period from 18/08/2008 to 29/12/2017.

(Source: Self-collect Python)

Overall, in Chart 4.3, it is clear that the observations of $CSAD$ lie mostly in the area of market return from -2% to 2% and it is suitable with the discussion in the previous part about the central tendency of market return. While the range of market return gets smaller (Chart 4.5), the level of central tendency of $CSAD$ is higher (Chart 4.3) and the distribution of $CSAD$ tends to be symmetric about the coordinate axis at the market return equal to zero (Chart 4.6). In the situation of the normal market (market return kept at a normal level), the stock's returns are diversified to be allocated while in the extreme market (market gets a large profit or a huge loss), most of individual stock's returns have the same direction (Table 4.2) and it reduces the extent of dispersion (Chart 4.6). On the other hand, one of our main purposes is to evaluate the impact of Circular 155/2015/TT-BTC on the herding behavior in Ho Chi Minh Stock Exchange so it is necessary to see the behavior of $CSAD$ after the event. After the issuance of Circular, the range of market return is lower, compared with the previous period from the late of 2008 to 2015. It is the reason why when we look at the Chart 4.4 $CSAD$ is scattered in the market return range from -2% to 2%. Despite the lower range of market return, at any given market return, $CSAD$ seems to jointly distribute as the previous one.

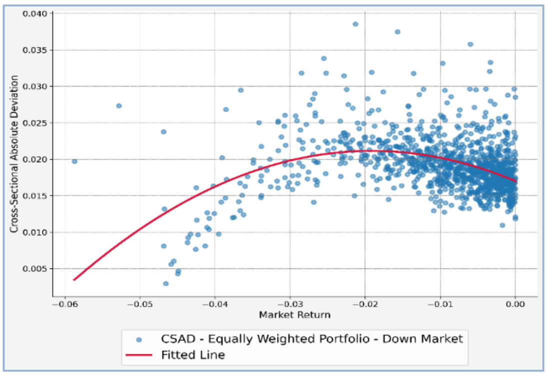


Chart 4.1. Relationship between CSAD and market return when the return is negative

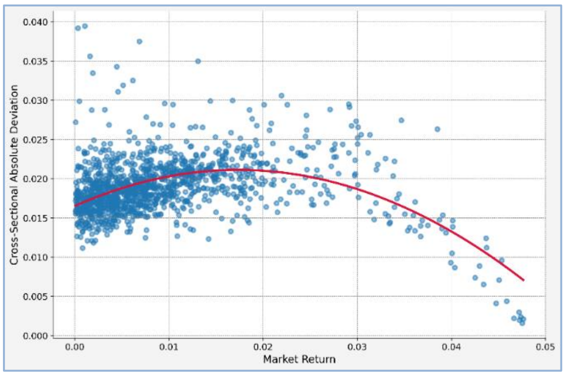
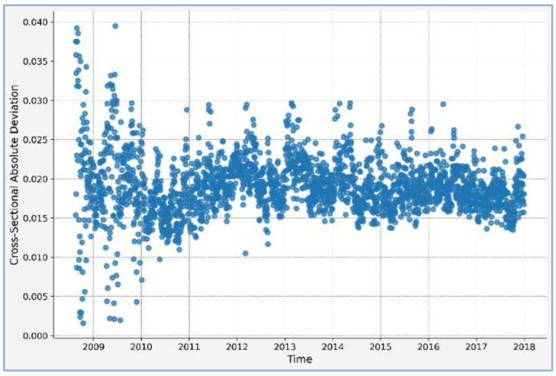


Chart 4.2. Relationship between CSAD and market return when the return is positive



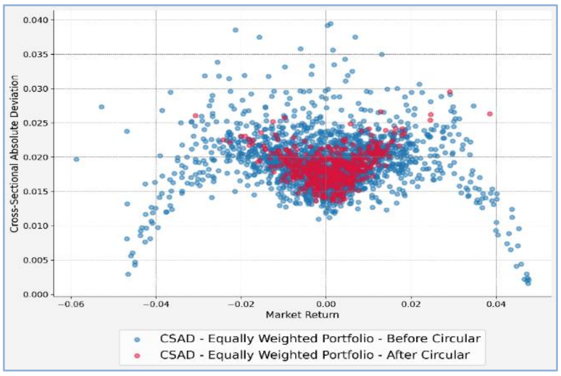
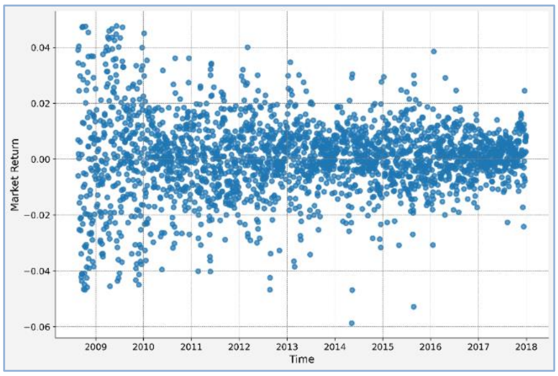


Chart 4.3. CSAD movements in the research period (18/08/2008-29/12/2017)

Chart 4.4. Relationship between CSAD and market return before and after the issuance of the Circular



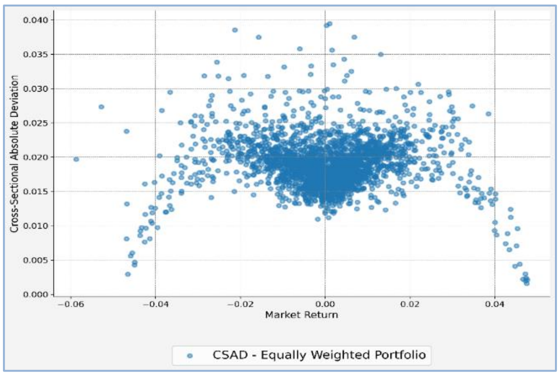


Chart 4.5. Market return in the research period (18/08/2008-29/12/2017)

Chart 4.6. Relationship between CSAD and market return

(Source: Self-collect Python)

4.2. Regression analysis

4.2.1. Herding at the aggregate market level

4.2.1.1. Herding of overall market

After conducting the regression on the Equation (1), Table 4.3 illustrates the results of estimating the herding behavior over the whole research period.

As stated above, a significant negative β_2 coefficient confirms the presence of the herding behavior in the market. Our study's findings show that herding behavior is present in the Ho Chi Minh Stock Exchange during the research period. With a t-statistic of -10.493 and a negative β_2, the detection of herding behavior is at a significance level of 1%. The findings support our first hypothesis (H1) that herding behavior is present in the Ho Chi Minh Stock Exchange during the research period.

Table 4.3. Herding of overall market

Constant (α)	$\lvert R_{m,t} \rvert$ (β_1)	$R_{m,t}^2$ (β_2)
0.0168***	0.4748***	-13.0403***
(92.121)	(12.592)	(-10.493)

$$CSAD_t = \alpha + \beta_1 \lvert R_{m,t} \rvert + \beta_2 R_{m,t}^2 + \varepsilon_t \tag{1}$$

*Table 4.3 presents regression results of Equation (1) for Ho Chi Minh Stock Exchange. Numbers in parentheses are t-statistics of Newey-West (1987) with lag-time as 1 day consistent standard errors. ***, **, and * imply statistical significance at the 1%, 5%, and 10% respectively.*

(Source: Self-collect Python)

4.2.1.2. Herding at aggregate market level with changing market information environment (before and after the Circular)

Table 4.4 summarizes the panel regression estimates of Equation (2). We estimate this equation over the pre- and post-circular periods, which allows us to measure the net impact of the improvement of the information environment on herding behavior. Our four variables of interest are γ_3, γ_4 and γ_5, γ_6, which measure herding behavior during up and down markets pre-Circular periods and post-Circular respectively, are all negative and statistically significant. This means that herding behavior is present in up and down markets before and after the Circular issued.

Table 4.4. Herding at aggregate market level with changing market information environment (before and after the circular)

Panel A: Regression results

Constant (γ_0)	$D_u R_{m,t}$ (γ_1)	$(1-D_u)R_{m,t}$ (γ_2)	$D_u(1-D_a)R_{m,t}^2$ (γ_3)	$(1-D_u)(1-D_a)R_{m,t}^2$ (γ_4)	$D_u D_a R_{m,t}^2$ (γ_5)	$(1-D_u)D_a R_{m,t}^2$ (γ_6)
0.011***	0.444***	-0.416***	-13.633***	-11.197***	-6.872***	-7.985***
(16.21)	(15.616)	(-9.174)	(-16.264)	(-6.955)	(-4.889)	(-3.370)

Panel B: Test statistics

χ^2_{up}	$pvalue_{up}$	χ^2_{down}	$pvalue_{down}$	χ^2_{before}	$pvalue_{before}$	χ^2_{after}	$pvalue_{after}$
42.58***	0.0000	6.37**	0.0117	2.89*	0.0888	0.20	0.6553

$$\begin{aligned} CSAD_t = {} & \gamma_0 + \gamma_1 D_u R_{m,t} + \gamma_2 (1-D_u) R_{m,t} + \gamma_3 D_u (1-D_a) R_{m,t}^2 + \gamma_4 (1-D_u)(1-D_a) R_{m,t}^2 \\ & + \gamma_5 D_u D_a R_{m,t}^2 + \gamma_6 (1-D_u) D_a R_{m,t}^2 + \gamma_7 CSAD_{t-1} + \varepsilon_t \end{aligned} \tag{2}$$

*In Panel A, we present the estimated coefficients and their t-statistics in parenthesis. All estimations are conducted using Newey and West's (1987) heteroscedasticity and autocorrelation consistent standard errors. In Panel B, we report test statistics for asymmetry in herding behavior. χ^2_{up} and $pvalue_{up}$ are the chi-square statistic for the Wald test for the null hypothesis $H_0: \gamma_3 = \gamma_5$, while χ^2_{down} and $pvalue_{down}$ are the chi-square statistic for the Wald test for the null hypothesis $H_0: \gamma_4 = \gamma_6$, χ^2_{before} and $pvalue_{before}$ are the chi-square statistic for the Wald test for the null hypothesis $H_0: \gamma_3 = \gamma_4$; while χ^2_{after} and $pvalue_{after}$ are the chi-square statistic for the Wald test for the null hypothesis $H_0: \gamma_5 = \gamma_6$. ***, **, and * imply statistical significance at the 1%, 5%, and 10% respectively.*

(Source: Self-collect Python)

Even though herding is present before and after the issuance of Circular in both up and down markets, it drops significantly in both up and down markets following the issuance of the Circular. Wald tests of the null hypotheses $H_0: \gamma_3 = \gamma_5$ and $H_0: \gamma_4 = \gamma_6$, reported in Panel B of the same table, suggest the rejection of both hypotheses at the 1% and 5% level respectively.

Moreover, it is worth noting from Table 4.4 is that the extent of herding behavior in up markets is larger than down markets pre-circular, while the opposite tendency probably happens following the issuance of the Circular. This suggests that HoSE market participants, in general, were momentum traders before 155/2015/TT-BTC was issued; however, after that, this trading strategy is no longer followed by investors. Results from Wald tests in Panel B of the null hypotheses $H_0: \gamma_3 = \gamma_4$ yield χ^2_{before} statistics of 2.89, implying a rejection hypothesis at the 10% level, which confirms the higher intensity of herding of up markets compared to down markets during pre-event period. This result is fairly consistent with the study of Vo and Truong (2018), which claims that momentum effects are present in the Vietnamese stock market during this period. The Wald tests of the null hypotheses $H_0: \gamma_5 = \gamma_6$ despite yielding positive and statistically insignificant χ^2_{after}, still shows the disappearance of momentum trading strategies in the market and sign of the opposite trend of herding the period after the Circular issuance.

To sum up, in Table 4.4, the assumption that the extent of herding among Vietnamese market participants reduces following the issuance of the Circular is confirmed. Moreover, momentum trading is also confirmed losing its popularity after the Circular. These results support our hypothesis H2 and H3.

4.2.1.3. Herding due to fundamental and non-fundamental information

Table 4.5. Decomposing total $CSAD_t$ to $CSAD_{FUND,t}$, and $CSAD_{NONFUND,t}$

Panel A: VN-Index for $R_{m,t}$				
Constant (δ_0)	$\lvert R_{m,t} - R_F \rvert$ (δ_1)	$\lvert HML_t \rvert$ (δ_2)	$\lvert SMB_t \rvert$ (δ_3)	$\lvert MOM_t \rvert$ (δ_4)
0.0156***	-0.0410***	0.1625***	0.2897***	0.0911***
(96.644)	(-2.939)	(11.775)	(13.356)	(10.655)
Panel B: Equally Weighted Portfolio for $R_{m,t}$				
Constant (δ_0)	$\lvert R_{m,t} - R_F \rvert$ (δ_1)	$\lvert HML_t \rvert$ (δ_2)	$\lvert SMB_t \rvert$ (δ_3)	$\lvert MOM_t \rvert$ (δ_4)
0.0157***	-0.0451***	0.1421***	0.2558***	0.0675***
(94.765)	(-3.547)	(10.575)	(12.408)	(7.680)

$$CSAD_t = \delta_0 + \delta_1 \left| R_{m,t} - R_F \right| + \delta_2 \left| HML_t \right| + \delta_3 \left| SMB_t \right| + \delta_4 \left| MOM_t \right| + \varepsilon_t \quad (4)$$

Panel A of this table reports estimated coefficients of the Equation (4) using VN-Index return as a proxy for $R_{m,t}$ while in Panel B, we present results using Equally Weighted Portfolio return for $R_{m,t}$. From this equation, the total $CSAD_t$ is *decomposed into a non-fundamental component ($CSAD_{NONFUND,t}$) captured by $\hat{\varepsilon}_t$. The fundamental component ($CSAD_{FUND,t}$) is defined as the estimated $CSAD_t$. All estimations are conducted using Newey and West's (1987) heteroscedasticity and autocorrelation consistent standard errors. ***, **, and * imply statistical significance at the 1%, 5%, and 10% respectively.*

(Source: Self-collect Python)

Table 4.5 shows the results of the decomposition step, where we follow Dang and Lin's approach ("Absolute value approach") described in Equation (4) to decompose the total $CSAD_t$ into absolute values of Carhart 4 factors. Note that the results have all factors that are significant at the 1% level. $CSAD_{FUND,t}$ and $CSAD_{NONFUND,t}$ respectively for fundamental and non-fundamental components are then calculated based on Equation (5) as previously mentioned.

Results from Equations (6) and (7) are reported in Table 4.6. We are interested in the coefficients γ_3 and γ_4; which reflect the extent of herding behavior before the circular issuance in up and down markets, respectively, and γ_5 and γ_6; which reflect the extent of herding behavior after the circular issuance in up and down markets, respectively. Note that the results present in Panel A uses the capitalization-weighted market index as proxy for the market return while Panel B uses the return on an equally weighted portfolio. It is clear that herding due to fundamental and non-fundamental information present in up and down markets before the issuance of the Circular. However, after the Circular's release, while herding due to non-fundamental information drops significantly, the intensity of herding due to fundamental information slightly increases.

The coefficients γ_3 and γ_4 for herding due to fundamental information before issuance of Circular are –3.119 and –2.345, and after Circular they are –3.676 and –3.134, respectively. Meanwhile, the same coefficients for herding due to non-fundamental information before Circular issuance are –10.747 and –9.059, but after Circular issuance they decline, in absolute values, to –3.616 and –5.367, respectively. The significant value of $\chi^2_{NONFUND,up}$ and $\chi^2_{NONFUND,down}$ further confirm our statement. In addition, note that considering 2 periods, γ_3 and γ_4 for herding due to non-fundamental information are higher than those for herding due to fundamental information.

Our results indicate that following the introduction of the Circular, there is a reduction of herding driven by non-informational factors. However, the level of herding driven by fundamental information has remained relatively unchanged compared to before the issuance of the Circular. These results suggest that the decrease in unconditional herding after the Circular was introduced is likely due to a reduction in intentional herding caused by non-informational factors.

Results from the approach of using return on an equally weighted portfolio as proxy for the market return are reported in Panel B of Table 4.6. These results confirm our earlier findings regarding the minor increase of informational herding and the decay of informational herding following the issuance of Circular 155/2015/TT-BTC.

Table 4.6. Herding due to fundamental and non-fundamental information

Panel A: VN-Index for $R_{m,t}$							
	Constant (γ_0)	$D_u R_{m,t}$ (γ_1)	$(1-D_u)R_{m,t}$ (γ_2)	$D_u(1-D_a)R_{m,t}^2$ (γ_3)	$(1-D_u)$ $(1-D_a)R_{m,t}^2$ (γ_4)	$D_u D_a R_{m,t}^2$ (γ_5)	$(1-D_u)D_a R_{m,t}^2$ (γ_6)
Fundamental	0.016***	0.116***	-0.094***	-3.119***	-2.345***	-3.676**	-3.134**
	(32.33)	(7.52)	(-5.03)	(-7.10)	(-3.79)	(-2.50)	(-1.98)
Non-fundamental	-0.002***	0.343***	-0.336***	-10.747***	-9.059***	-3.616***	-5.367***
	(-12.34)	(15.53)	(-9.95)	(-17.69)	(-7.83)	(-3.15)	(-3.03)

Panel B: Equally Weighted Portfolio for $R_{m,t}$							
	Constant (γ_0)	$D_u R_{m,t}$ (γ_1)	$(1-D_u)R_{m,t}$ (γ_2)	$D_u(1-D_a)R_{m,t}^2$ (γ_3)	$(1-D_u)$ $(1-D_a)R_{m,t}^2$ (γ_4)	$D_u D_a R_{m,t}^2$ (γ_5)	$(1-D_u)D_a R_{m,t}^2$ (γ_6)
Fundamental	0.016***	0.128***	-0.125***	-3.852***	-3.733***	-6.235**	-6.462**
	(33.00)	(10.35)	(-7.94)	(-11.00)	(-7.17)	(-2.27)	(-2.51)
Non-fundamental	-0.002***	0.370***	-0.413***	-12.043***	-11.801***	-4.278***	-6.126**
	(-16.37)	(17.42)	(-14.86)	(-19.96)	(-12.21)	(-2.82)	(-2.24)

Panel C: Test statistics		
	VN-Index for $R_{m,t}$	Equally Weighted Portfolio for $R_{m,t}$
$\chi^2_{NONFUND,up}$	62.857***	37.226***
$pvalue_{NONFUND,up}$	0.000	0.000
$\chi^2_{NONFUND,down}$	12.612***	6.288**
$pvalue_{NONFUND,down}$	0.0004	0.0122

$$\begin{aligned} CSAD_{FUND,t} &= \gamma_0 + \gamma_1 D_u R_{m,t} + \gamma_2 (1-D_u) R_{m,t} + \gamma_3 D_u (1-D_a) R_{m,t}^2 \\ &+ \gamma_4 (1-D_u)(1-D_a) R_{m,t}^2 + \gamma_5 D_u D_a R_{m,t}^2 + \gamma_6 (1-D_u) D_a R_{m,t}^2 + \gamma_7 CSAD_{FUND,t-1} + \varepsilon_t \end{aligned} \quad (6)$$

$$\begin{aligned} CSAD_{NONFUND,t} &= \gamma_0 + \gamma_1 D_u R_{m,t} + \gamma_2 (1-D_u) R_{m,t} + \gamma_3 D_u (1-D_a) R_{m,t}^2 \\ &+ \gamma_4 (1-D_u)(1-D_a) R_{m,t}^2 + \gamma_5 D_u D_a R_{m,t}^2 + \gamma_6 (1-D_u) D_a R_{m,t}^2 + \gamma_7 CSAD_{NONFUND,t-1} + \varepsilon_t \end{aligned} . \quad (7)$$

*In Panel A, we present results using VN-Index return as a proxy for $R_{m,t}$ while in Panel B, we present results using Equally Weighted Portfolio return for $R_{m,t}$. The model using Dang and Lin's (2016) approach to decompose $CSAD_t$ into fundamental ($CSAD_{FUND,t}$) and non-fundamental ($CSAD_{NONFUND,t}$) components as follows: $CSAD_t = \delta_0 + \delta_1|R_{m,t} - R_F| + \delta_2|HML_t| + \delta_3|SMB_t| + \delta_4|MOM_t| + \varepsilon_t$. All estimations are conducted using Newey and West's (1987) heteroscedasticity and autocorrelation consistent standard errors. In Panel C, we report test statistics for asymmetry in non-fundamental herding. $\chi^2_{NONFUND,up}$ and $pvalue_{NONFUND,up}$ are the chi-square statistic for the Wald test for the null hypothesis H_0: $\gamma_3 = \gamma_5$, while $\chi^2_{NONFUND,down}$ and $pvalue_{NONFUND,down}$ are the chi-square statistic for the Wald test for the null hypothesis H_0: $\gamma_4 = \gamma_6$. ***, **, and * imply statistical significance at the 1%, 5%, and 10% respectively.*

(Source: Self-collect Python)

To sum up, according to our results, the issuance of Circular 155/2015/TT-BTC has led to a reduction in the extent of herding attributed to non-fundamental information. However, the extent of herding associated with fundamental information remains unchanged. Thus, we conclude that the reduction in unconditional herding observed in our study is most likely attributable to a decrease in intentional herding caused by non-informational information. The results support our hypothesis H4.

4.2.2. Herding at the investor level

Estimated coefficients of Equations (9) and (10) are presented in Table 4.7. In Panel A, we report results from our analysis of positive alpha stocks, while in Panel B we report results from our analysis of negative alpha stocks. Additionally, while splitting our full sample into 2 groups according to the sign of the alphas, we create more restricted portfolios that exclude stocks with alphas that are statistically significant at the 10% level to achieve more precise results of identifying the positive and negative alpha stocks, following the work of Dang and Lin (2016).

Table 4.7. Within- and between- group herding of arbitrageurs and noise traders

Panel A: Positive alpha stocks regression											
Before						After					
Constant (γ_0)	$R_{+m,t}$ (γ_1)	$\lvert R_{+m,t}\rvert$ (γ_2)	$R^2_{+m,t}$ (γ_3)	$R^2_{-m,t}$ (γ_4)	$CSAD_{-,t}$ (γ_5)	Constant (γ_0)	$R_{+m,t}$ (γ_1)	$\lvert R_{+m,t}\rvert$ (γ_2)	$R^2_{+m,t}$ (γ_3)	$R^2_{-m,t}$ (γ_4)	$CSAD_{-,t}$ (γ_5)
0.014***	0.001	0.596***	-17.951***	1.648***	-0.028	0.014***	0.067***	0.423***	-8.987**	2.296**	0.069*
(37.61)	(0.12)	(18.29)	(-21.87)	(4.85)	(-1.46)	(17.93)	(2.39)	(4.55)	(-2.07)	(1.87)	(1.92)

Panel B: Negative alpha stocks regression											
Before						After					
Constant (γ_6)	$R_{-m,t}$ (γ_7)	$\lvert R_{-m,t}\rvert$ (γ_8)	$R^2_{-m,t}$ (γ_9)	$R^2_{+m,t}$ (γ_{10})	$CSAD_{+,t}$ (γ_{11})	Constant (γ_6)	$R_{-m,t}$ (γ_7)	$\lvert R_{-m,t}\rvert$ (γ_8)	$R^2_{-m,t}$ (γ_9)	$R^2_{+m,t}$ (γ_{10})	$CSAD_{+,t}$ (γ_{11})
0.015***	0.002	0.313***	-9.577***	-0.567	-0.056	0.013***	0.041	0.268***	-0.655	1.735	0.142**
(17.54)	(0.15)	(6.54)	(-8.96)	(-0.63)	(-1.27)	(10.56)	(1.66)	(2.64)	(-0.21)	(0.75)	(2.09)

$$CSAD_{+,t} = \gamma_0 + \gamma_1 R_{+m,t} + \gamma_2 \left|R_{+m,t}\right| + \gamma_3 R^2_{+m,t} + \gamma_4 R^2_{-m,t} + \gamma_5 CSAD_{-,t} + \varepsilon_t \tag{9}$$

$$CSAD_{-,t} = \gamma_6 + \gamma_7 R_{-m,t} + \gamma_8 \left|R_{-m,t}\right| + \gamma_9 R^2_{-m,t} + \gamma_{10} R^2_{+m,t} + \gamma_{11} CSAD_{+,t} + \varepsilon_t \tag{10}$$

*Panel A reports estimated coefficients for Equation (9), while Panel B reports estimated coefficients for Equation (10). The –/+ signs refer to the measures of $CSAD_t$ and $R_{m,t}$ computed using portfolio of stocks with negative/positive alphas. For compassion purposes, both equations are estimated before and after the issuance of the Circular 155/2015/TT-BTC. ***, **, and * imply statistical significance at the 1%, 5%, and 10% respectively.*

(Source: Self-collect Python)

Our coefficients of interest in this table are γ_3 and γ_9, which measure herding within-group; γ_4 and γ_{10}, which measure herding between-group; and γ_5 and γ_{11}, which capture interactions between the two groups.

As shown in the table, we find that herding is present among noise traders during the pre-Circular period, with γ_9 is -9.577 and statistically significant. However, after the issuance of the Circular, γ_9 is negative but not statistically significant which implies that there is no longer herding among noise traders during this period. Besides, the coefficient reflects herding among arbitrageurs, γ_3, is negative and statistically significant before and after the Circular respectively, which indicates that herding is present among them before and after the issuance of Circular. Note that the issuance of Circular causes a decrease in the intensity of herding among both noise traders and arbitrageurs. It is observed that γ_3 drops from -17.951 to -8.987 for herding among arbitrageurs.

In order to confirm the decline in herding intensity of arbitrageurs following the Circular, Equation (11) is used for positive alpha stocks and the results are presented in Table 4.8.

As stated before, the significantly negative coefficients β_3 confirm that herding behavior among arbitrageurs exists during the whole research period, which further confirms our finding that herding is present among them before and after the issuance of Circular. Moreover, the interaction term's coefficient is significantly positive, which confirms that herding behavior is significantly lower after the Circular is issued.

Table 4.8. Herding behavior among arbitrageurs

Constant (β_0)	$R_{+m,t}$ (β_1)	$\lvert R_{+m,t}\rvert$ (β_2)	$R^2_{+m,t}$ (β_3)	$R^2_{+m,t}D_a$ (β_4)
0.0144***	-0.0182**	0.5989***	-16.7120***	0.0776***
(72.301)	(-2.209)	(20.066)	(-22.218)	(3.268)

$$CSAD_{+,t} = \beta_0 + \beta_1 R_{+m,t} + \beta_2 \lvert R_{+m,t}\rvert + \beta_3 R^2_{+m,t} + \beta_4 R^2_{+m,t} D_a + \varepsilon_t \quad (11)$$

*Table 4.8 presents regression results of Equation (11) for positive alpha stocks in Ho Chi Minh Stock Exchange to investigate the change in herding intensity of arbitrageurs following the Circular. Numbers in parentheses are t-statistics of Newey-West (1987) with lag-time as 1 day consistent standard errors. ***, **, and * imply statistical significance at the 1%, 5%, and 10% respectively.*

(Source: Self-collect Python)

The findings of the between-group analysis indicate that γ_4 is positive and statistically significant both before and after the Circular was issued. This positive estimate of γ_4 could suggest that arbitrageurs possess the ability to identify when noise traders engage in herding behavior. Consequently, they take advantage of this situation by adjusting their holdings arbitrarily, instead of acting as contrarians to correct prices towards their fundamental values. This action causes the $CSAD_{+,t}$ to rise instead of fall, as described by Dang and Lin (2016). Additionally, the coefficient γ_{10} is statistically insignificant before and after the Circular was issued. This suggests that noise traders are unsophisticated and unable to recognize when arbitrageurs engage in herding behavior.

Our investigation of herding among arbitrageurs and noise traders reveals that herding is present among both groups before the Circular is issued. However, herding intensity among arbitrageurs has decreased significantly while herding behavior among noise traders disappears after the issuance of the Circular. Another interesting note is that during the research period, instead of acting as contrarians to bring stock prices to their fundamental values, arbitrageurs seem to follow a strategy that takes advantage of noise traders' price- or trend-chasing strategies. The results support our hypothesis H5.

4.2.3. Herding at the firm level

Table 4.9 presents the results from Equation (12) and (13), with β_2^{high} and β_2^{low} representing herding behavior in portfolios with high and low levels of asymmetric information, respectively.

The findings indicate that herding intensity increases with all the measures of information asymmetry used in this study. Results from the Wald test, which compares the coefficients between portfolios with high and low information asymmetry ($H0: \beta_2^{high} = \beta_2^{low}$), suggest that these coefficients are significantly different from each other. This implies that herding behavior is more pronounced among stocks with higher levels of information asymmetry, specifically those with smaller capitalization, heavier returns' tails, and higher idiosyncratic risk variance ratios. These results support our hypotheses H6, H7, and H8.

Table 4.9. Herding with asymmetric information

Information asymmetry measures		Panel A	Panel B	Panel C
Firm size	β_2^{high}	-14.67***	-15.48***	-15.37***
		(-15.28)	(-21.69)	(-20.03)
	β_2^{low}	-14.07***	-13.28***	-12.49***
		(-21.15)	(-14.09)	(-13.27)
	χ^2	0.236	3.380*	5.529**
Fat-tailed kurtosis	β_2^{high}	-19.62***	-18.09***	-17.82***
		(-17.17)	(-12.85)	(-11.93)
	β_2^{low}	-6.01***	-6.11***	-8.54***
		(-3.02)	(-2.68)	(-3.90)
	χ^2	34.780***	20.043***	16.042***
Idiosyncratic risk	β_2^{high}	-15.77***	-15.39***	-16.19***
		(-12.41)	(-11.45)	(-12.28)
	β_2^{low}	-10.15***	-10.10***	-10.11***
		(-13.15)	(-13.00)	(-12.91)
	χ^2	14.666***	11.966***	15.37***

$$CSAD_{high,t} = \beta_0^{high} + \beta_1^{high}\left|R_{m,t}^{high}\right| + \beta_2^{high}\left(R_{m,t}^{high}\right)^2 + \varepsilon_t^{high} \quad (12)$$

$$CSAD_{low,t} = \beta_0^{low} + \beta_1^{low}\left|R_{m,t}^{low}\right| + \beta_2^{low}\left(R_{m,t}^{low}\right)^2 + \varepsilon_t^{low} \quad (13)$$

*Table 4.9 presents regression results of Equation 12 and 13 for the herding behavior for different measures of information asymmetry. Three different measures of information asymmetry are used for this purpose: firm size (market capitalization), fat-tailed kurtosis, and variance of the idiosyncratic risk standardized by firm's total variance. The t-statistics are reported in parentheses. We split our sample into four, five and six equal-sized portfolios and choose the highest and lowest portfolios to study. The results are presented in Panel A, Panel B, and Panel C, respectively. Chi-square statistics (χ^2) of the Wald test comparing coefficients from portfolios with low and high information asymmetry ($H0: \beta_2^{high} = \beta_2^{low}$) are reported below our coefficients of interest. ***, **, and * imply statistical significance at the 1%, 5%, and 10% respectively.*

(Source: Self-collect Python)

5. Conclusion

This study focuses on the impact of betterment of the information environment on herding behavior. Using daily data between 2008 and 2018, unconditional herding at the market level was examined in Vietnam before and after the issuance of the Circular 155/2015/TT-BTC (Guidelines for information disclosure on securities market). During the research period, herding behavior is confirmed existing in the HoSE. However, obtained results reveal a significant decline in herding intensity among investors post-Circular. Through the superiority in herding of up markets compared to down markets, we also find evidence that investors in the Vietnamese market are momentum traders before the Circular is issued (the period from 2008 to 2016). Nevertheless, the issuance of the Circular reverses the trend, and makes investors in Vietnam no longer follow momentum trading strategy.

We then further investigate the driving factors of herding behavior in the Vietnamese market (HoSE to be specific), with the impact of the issuance of the Circular 155/2015/TT-BTC. While herding due to fundamental information remains relatively the same after the issuance of the Circular and shows signs of increasing, herding due to non-fundamental information declined significantly. We therefore conclude that the observed disappearance of unconditional herding intensity in the market is a result of receding in the non–information-based intentional herding.

Moreover, our investigation of herding among arbitrageurs and noise traders reveals that herding is present among both groups before the Circular is issued. The results also show that herding intensity among arbitrageurs has decreased significantly while herding behavior among noise traders disappears after the Circular is released. Another interesting note is that during the research period, instead of acting as contrarians to bring stock prices to their fundamental values, arbitrageurs seem to follow a strategy that takes advantage of noise trader’s price- or trend-chasing strategies.

To sum up, we would like to recommend several actions to reduce herding behavior in the Vietnamese market. For the government, we suggest creating and updating a legislative framework to increase market transparency and combat market manipulation. Besides, the SSC and exchanges should also educate investors on the stock market's operation. For fund and portfolio managers, they should be cautious when recommending investments. In addition, funds and portfolios can employ herding to choose portfolios that suit their clients' financial needs. Lastly, individual investors should improve their knowledge about the stock market, recognize fake signals, and determine their goals and strategies before investing.

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