An Empirical Study of Herding Behaviour in China's A-Share and B-Share Markets: Evidence of Bidirectional Herding Activities

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Abstract: Research Question: This paper examines whether A-share markets predominated by unsophisticated local investors follow the trading of the B-share markets, dominated by sophisticated foreign institutional investors. **Motivation:** Our goal was to explore whether A-share investors follow the trading behaviour of the B-share investors or vice versa given the uniqueness of the Chinese markets. This paper drew on the findings of Chui and Kwok (1998) and Doukas and Wang (2013) who claimed that the Chinese foreign investors are more sophisticated and thus have an information advantage over unsophisticated local investors. **Idea:** The core idea of this paper was to empirically examine the herding behaviour in the four local Chinese markets and herding effect during the turbulent and calm period. The study was conducted using Cross-sectional Absolute Deviation (CSAD) as the dependent variable, the average of the cross-sectional returns of the market portfolio, the absolute value of market returns, and market returns squared as independent variables. **Data:** The analysis was conducted based on 1,782 days of observing the 188 individual firm's stock returns from January 2010 to October 2016 from Shanghai A-share, Shanghai B-share, Shenzhen A-share, and Shenzhen B-share. All relevant data was downloaded from DataStream. **Method/Tools:** We utilised the CSAD method to calculate the value of all the variables. Then we employed robust-regression to regress all these variables and *t-test* to determine the intensity of herding during the turbulent and calm period to reach the findings of this study. **Findings:** The results pointed out that the A-share markets were herding around the B-share markets and vice versa. Besides, there was cross-herding between the Shanghai Stock Exchange and Shenzhen Stock Exchange due to information transmission between the A-share and B-share holders in both markets. Finally, this study also discovered that there was a significant difference between the herding coefficients during the stock market turbulent period and the calm periods. **Contributions:** This study extends existing research on herding behaviour related to Chinese A-share and B-share markets which yet to be explored in detail and whether herding is more pronounced during the turbulent period compared to calm period.

Keywords: Herding behaviour, cross-market herding, bidirectional, CSAD method, Chinese stock market turbulence.
JEL classification: G01, G12, G14, G40, G41

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1. Introduction

Herding describes a group of investors who ignore their private information (Nofsinger and Sias, 1999) and follow the investing behaviour of other market participants or base their investments on a market consensus (Bikhchandani and Sharma, 2001). Herding can be unintentional or intentional behaviour (Bikhchandani and Sharma, 2001; Devenow and Welch, 1996; Hirshleifer and Teoh, 2003). According to Kremer and Nautz (2013), unintentional herding is driven by fundamentals; it is not due to blind copying of other investors' decisions. Instead, it occurs when an investor chooses to invest in a certain way but ends up trading like many others because of receiving the same kind of information and reaching the same conclusions regarding the underlying value of securities (Choi and Skiba, 2015; Hirshleifer *et al*., 1994). Kremer and Nautz (2013) believe that intentional herding is driven more by sentiment than unintentional herding because investors are consciously copying other investors' trade decisions and this causes them to herd in and herd out of the same stocks regardless of their personal information, judgments, and past beliefs (Caparrelli *et al*., 2004).

Herding can also be irrational or rational. Both types will cause an asset's price to deviate from their fundamental value (Banerjee, 1992; Hirshleifer, 2001; Hwang and Salmon, 2004; Shiller, 2005; Chiang and Zheng, 2010; Chiang *et al*., 2015) and will also affect the valuation of an asset (Bikhchandani *et al*., 1992; Nofsinger and Sias, 1999; Chiang and Zheng, 2010; Chiang *et al*., 2015). These effects may lead to market volatility and instability (Chang *et al*., 2000; Blasco *et al*., 2012), as happened during the Dutch tulip mania of 1634 to 1637, Asian financial crisis of 1997 and subprime crisis of 2008.

Most studies on herding behaviour in global financial markets have found that it occurs to a significant degree in emerging markets (Blasco and Ferreruela, 2008; Chang *et al*., 2000; Chiang and Zheng, 2010) and this is in line with the notion that developed markets have more efficient dissemination of information compared with emerging markets (Alhaj-Yaseen and Yau, 2018; please see Kim and Singal, 2000a, 2000b). China, as one of the fastest developing countries in the world, has attracted much research concerning this issue. This study aimed to test whether the A-share markets in Shanghai and Shenzhen, which are mainly local investors who are considered unsophisticated, less knowledgeable, less educated and less informed, have herded around the B-share markets in Shanghai and Shenzhen, which are dominated by foreign institutional investors. Chui and Kwok (1998) and Doukas and Wang (2013) claim that Chinese foreign institutional investors have more experience in terms of collecting, processing and analysing essential and relevant information, and thus have an information advantage over local investors. Many studies use foreign institutional investors as proxies for sophisticated investors (Ahn *et al*., 2008, 2010; Chui and Kwok, 1998; Kim and Ryu, 2012; Miao *et al*., 2016; Webb *et al*., 2016).

Our results show that local retailers in A-share markets are herding around foreign institutional investors in B-share markets, and vice versa. We were not surprised to find that local investors were herding around foreign investors because foreign investors are more sophisticated than local investors. We were surprised, however, to find that foreign institutional investors were also herding around investors in A-share markets. When individual investors dominate a market, most of the trading is not based on fundamental information but is based, to a slight degree, on rumours, as is the case in the Chinese market (Alhaj-Yaseen *et al*., 2017; Chan *et al*. 2008). It means that foreign institutional investors have no information advantage over domestic investors, and this may be due to the fact that foreign institutional investors need to overcome the barriers of language and culture, along with differences in accounting practices and standard disclosure requirements in China (Alhaj-Yaseen and Yau, 2018; Chan *et al*., 2008).

This paper also aimed to investigate the intensity of herding during the period of stock market turbulence in China in 2015. The Chinese stock market had risen more than 150% by

2014, but it started to fall on 12 June 2015, with a significant drop of more than 30%, which was equivalent to a total amount of 15 trillion Renminbi (USD2.4 trillion), in 3 weeks (Tian *et al.*, 2018). This scenario has been an interesting subject of research for financial analysts, investors and regulators from many countries because there is a firm reliance on China's economy around the world.

We anticipated that herding activities between foreign institutional investors and local investors would intensify during the turbulent period because of a loss of direction and feelings of panic on the part of local investors. Past studies have shown that turbulence can generate herding behaviour and also cause it to intensify; Christie and Huang (1995) argued that herding is common during times of market stress. Chiang and Zheng (2010) included the 1997 Asian financial crisis, 1994 Mexican crisis, 1999 Argentina crisis and 2008 subprime crisis in their research to observe the impact of a crisis on herding behaviour. Chiang and Zheng (2010) found that investors in Argentina and Mexico showed signs of herding behaviour as the economic crisis developed in their markets. Luo and Schinckus (2015b) included the subprime crisis in their herding behaviour studies to see whether the crisis affected the Chinese stock markets, and the results showed that there was no transmission effect due to herding between the United States and China's market.

2. China's Economy

According to Morrison (2018), since the implementation of economic reforms in China, from 1978 to 2017, the average real annual growth gross domestic product (GDP) of the country has been almost 9.5%; while the real GDP growth rate in 2017 was 6.9% and is expected to be 5.8% in 2022, according to the International Monetary Fund. The per capita GDP has increased 55 times, from USD155 (1978) to USD8,583 (2017), lifting 800 million Chinese people from poverty and hardship, the highest rate in the world. It shows that China has been able to redouble its economic size every eight years. Measured in US dollars with the nominal exchange rate, the Chinese GDP in 2017 was approximately USD11.9 trillion, which is about 62% of the size of the US economy.

In 2002, China's stock market became a primary one in Asia, ranked third after Japan and Hong Kong. According to the Chinese Securities Regulatory Commission, as of May 2010, the total market value of the Shanghai and Shenzhen markets had reached USD3.07 trillion. Based on statistics from the World Federation of Exchanges, as of October 2016, the total market capitalisation of the SHSE and SZSE reached USD4.1 trillion and USD3.35 trillion, respectively, so that these stock markets were the second and third largest in Asia after the Japanese market. Currently, the combined market capitalisation for these two Chinese stock exchanges is ranked third globally after the New York Stock Exchange (NYSE) and NASDAQ in the United States. With this growth, many researchers have begun to pay more attention to the Chinese markets. China plays an essential role in economic and financial matters, and its financial system has gradually improved along with its economic reforms, yet it is still considered to be underdeveloped compared with other countries in the implementation of central planning for market-based operations (Zhang *et al.*, 2012).

2.1 China's Stock Market Structure, Share Structure and Segmentation

China currently has two stock exchanges, the Shanghai Stock Exchange (SHSE) in northern China and the Shenzhen Stock Exchange (SZSE) in southern China. Both were established in late 1990. Large, established firms, including state-owned enterprises (SOEs), are listed on the SHSE, and relatively small and medium-sized companies, most of which are joint-venture and export companies (not SOEs), are listed on the SZSE (Xu, 2000; Yao, 2014).

When the SHSE and SZSE were formally established in 1990, there were only ten local Chinese companies listed on them. In 2007, the number had jumped to 1,550, an increase of

approximately 15,400%. Of these companies, 1,527 were A-shares, and 109 were B-shares; 86 were listed as both A-share and B-share markets simultaneously (dual listing). In 2015, the number of companies listed was 2,827, an increase of approximately 82.4% (from 2007 to 2015). Of these, 2,808 were A-shares, and 101 were B-shares; only 82 were dual-listed companies. In a nutshell, it can be concluded that the B-shares do not even add up to 10% of the A-shares. Companies may choose to list both A-shares and B-shares to attract both local and foreign investors. However, they are not allowed to cross-list on the SHSE and SZSE at the same time. Table 1 shows a trading summary for stocks in China for the year ended 2015, where A-share market capitalisation is much higher than B-share market capitalisation by 239.4 times. The total turnover of A-shares is approximately 687.6 times higher than of B-shares. Additionally, the A-share trading volume is about 342.1 times higher than the B-share trading volume.

Table 1: Trading summary for stocks in China for the year ended 2015

Item	2015
No. of listed companies (unit)	2827
No. of listed stocks (unit)	2909
A-shares	2808
B-shares	101
Total issued capital (100 million shares)	43,024.14
A-shares	42,753.16
B-shares	270.98
Total market capitalization (100 million yuan)	531,463
A-shares	529,252
B-shares	2,211
Total turnover (100 million Yuan)	2,550,541
A-shares	2,546,838
B-shares	3,704
Trading volumes (100 million share)	171,039.48
A-shares	170,541.00
B-shares	498.48

Source: China Statistic Yearbook 2016

Since the 1990s, the government of China has stepped up its attempts to appeal to foreign capital for listed companies by forming proper channels with particular conditions. In 1992, it established the B-share market by allowing foreign investors, particularly foreign institutional investors, to buy Chinese stocks (Chen *et al*., 2013). The establishment of the B-share market has provided an additional fund-raising channel for the listed companies, which are in the infancy stage of growth and are hungry for capital. Because of the dominance of retail investors, the Chinese stock market operates in a completely different way from the European and US markets (Reuters, 2015; CNBC, 2015; 2016; Pension & Investment, 2017; U.S. Securities and Exchange Commission, 2013; OECD, 2018; Fabozzi and Jones, 2019). The rapid growth of the economy in China has resulted in the growth of wealth and disposable household income, as well. The Chinese are known to have high savings rates. In 2014, China's savings rate accounted for almost 50% of its GDP. However, the Chinese have limited opportunities to invest in such entities as real estate, stocks and bank deposits (below the market rate) (Hilliard and Zhang, 2015). Currently, there are more than 200 million trading accounts in China, of which retail investors have 80% to 90% (CNBC, 2015, 2016; Kishan and Alfan, 2017; Li *et al.*, 2017; Reuters, 2015).

The emerging Chinese stock market is unique. First, most Chinese listed companies are large and medium-sized SOEs set up by the government. Second, upon meeting specific requirements, listed companies can issue two different types of stocks traded on the two

exchanges. A-shares (which are for companies based in mainland China) are limited to domestic investors who trade exclusively in the Renminbi (RMB), which is the Chinese currency and is not freely convertible to any foreign currencies. Since 2003, however, select foreign institutions have been allowed to buy A-shares through a programme known as Qualified Foreign Institutional Investor (QFII).[1] Nonetheless, foreign shares (B-shares) are reserved for foreign investors. B-shares denominated in US dollars are traded on the SHSE, and those denominated in Hong Kong dollars are traded on the SZSE.

According to Su (2003), only established companies with proven track records are allowed to obtain capital from abroad. At first, B-shares were, by law, to be traded exclusively by foreign investors or foreign institutional investors. After 19 February 2001, the B-share markets were open to local Chinese investors with foreign currency deposit accounts. It is evident that the Chinese stock market is entirely segmented. The primary purpose of this segmentation is to generate more rapid reforms of SOEs, as well as to woo foreign capital. Firms that choose to offer A-shares and B-shares at the same time, to appeal to both local retail and foreign institutional investors, are needed to provide two types of financial statements. One is based on the International Accounting Standard for B-shareholders, and the other is based on the domestic accounting standards (Chinese Generally Accepted Accounting Principles) for A-shareholders. Both sets of financial statements are released on the same day.

B-share holders also get half-yearly earnings, together with a dividend report and an annual report. A company provides its reports for A-shareholders, via newspapers or other media (Yao, 2014). The A-share market is primarily dominated by less sophisticated local investors who are lacking in knowledge and experience in investments, in contrast, foreign institutional investors who mainly dominated the B-share markets, are generally more sophisticated and have more knowledge and experience in investments. Both the A-share and B-share holders have the same ownership and voting rights.

China is not the only country that has two classes of stocks in its market. Chan and Kwok (2005) and Darrat *et al*., (2010) cited several advanced and emerging markets, such as Finland, Switzerland, Mexico and the Philippines that have two-class stocks owing to ownership controls imposed by the government or the issuing firms. According to Alexander *et al*. (1988), these restrictions are the result of capital controls and sovereignty. In China, B-shares are sold at a discounted rate compared with domestic A-shares. Su (2003) found that A-shares commonly were traded at a higher price compared with B-shares. Despite the B-share market mainly led by foreign institutional investors, its performance cannot be matched with A-shares. Many previous studies have offered some explanation for the discounting of B-shares.

For example, Fenald and Roger (2002) noted that because of limited investment options in China, local investors tended to accept a lower rate of returns while also being prepared to pay higher prices compared with foreign investors. Darrat *et al*. (2010) contended that a lower B-share price would continue to attract foreign investors who wanted to pursue diversification. Several other related studies documented empirical evidence showing that discounts are associated with asymmetric information, market liquidity, the size effect, different demands, corporate governance and beta risk (Chen *et al*., 2001; Gao and Kling, 2006; Li, 2013; Tong and Yu, 2012). After the B-share market was partially opened to local retailers on 19 February 2001, B-share discounts gradually decreased (Chan *et al*., 2007). This study will focus on shares traded in mainland China, namely A-shares and B-shares. The different characteristics

[1] Qualified Foreign Institutional Investor (QFII) - A programme which permits certain licensed international investors to take part in China stock exchanges. The Chinese launched QFII in 2002 to allow foreign investors to access SHSE and SZSE. Access to these shares for foreign investors are restricted to specified quotas that specify the amount of money which the license foreign investors are allowed to invest in the China's capital markets.

of the A-share and B-share markets may result in different levels of herding in their respective markets.

3. Review of Herding in The Global Market

Recently, herding has become the main subject of study for researchers when classical financial theory could not explain changes in securities prices; researchers can easily find answers in behavioural finance (Babalos *et al.*, 2015). According to psychological definitions, herding behaviour occurs when individuals base their actions on group decisions even though they believe that the group is wrong (Christie and Huang, 1995; Rook, 2006). An investor, for example, may sustain interest in what others do and may sometimes follow others' actions and ignore their own ability to analyse information and make decisions. Therefore, herding is considered to be impulsive behaviour and always involves the process of decision making. Herding can be irrational behaviour, especially in an atmosphere of little information; it may intensify (Fu and Lin, 2010). Avery and Zemksy (1998) argue that if an investor's information is inadequate, the investor may observe others' trading decisions and follow in their footsteps. Alhaj-Yaseen and Yau (2018) suggest that herding behaviour occurs when the investors' decision-making process is depending on a market consensus rather than personal reasoning.

Bikhchandani *et al*. (1992) argue that besides uneven information, there may be other reasons for herding behaviour among market participants. Empirical findings have suggested that herding is mostly linked to the preserving of an investor's reputation (Bickhchandani and Sharma, 2001; Devenow and Welch, 1996; Kremer and Nautz, 2013; Scharfstein and Stein, 1990), a principal–agency problem (Lakonishok *et al*., 1992; Maug and Naik, 2011; Scharfstein and Stein, 1990) or stock characteristics (Kim and Nofsinger, 2005; Kremer and Nautz, 2013; Nofsinger and Sias, 1999; Sias, 2004) and may be driven by essential information or investigative herding (Chen, 2017; Choi and Skiba, 2015).

Because herding behaviour is a non-quantifiable behaviour in a human being, it cannot be directly measured. It must be described by studying relevant, measurable parameters. Empirical research has focused on detecting herding behaviour among investors by two main methods. The first method requires detailed, accurate information about changes in investor trading activities and their portfolios. Examples of this type of measurement include the LSV method pioneered by Lakonishok *et al.* (1992), the Sias method (2004) and the portfolio change measure (PCM) of Wermers (1999). All these methods are suitable for examining the herding behaviour of a small group of people, usually a homogeneous group such as pension fund managers, mutual fund managers or institutional investors. Despite its popularity, the LSV method suffers from several drawbacks; the results cannot be used to make generalisations about whole-market herding activity even though they are using primary data. This method involves a great deal of data processing and can only produce a narrow survey range if such data are available. Despite the drawbacks, Friend *et al*. (1970), Kraus and Stoll (1972), Nofsinger and Sias (1999), Choi and Sias (2009) and Andreu *et al*. (2009) used the LSV method in their studies on institutional investors, pension funds and pension managers.

Another branch of the literature has identified herding across the market by employing the cross-sectional dispersion of stock returns, a methodology developed by Christie and Huang (1995) and Chang *et al.* (2000). Christie and Huang (1995) proposed the cross-sectional standard deviation (CSSD) and Chang *et al.* (2000) proposed the cross-sectional absolute deviation (CSAD) to measure herding activities in the financial market with aggregate market data (cross-sectional deviation of returns or stock dispersion), and this is unlike the localized herding pioneered by Lakonishok *et al*. (1992). Even though the methods of Christie and Huang (1995) and Chang *et al.* (2000) both use secondary data, they offer a broader view of herding activities in general. The data can capture the sentiments of investors through the examination of the dispersion of the returns, allowing for generalisations to be made. The

CSSD method only estimates herding behaviour during a period with large price fluctuations and ignores calm periods in which herding may also occur (Luo and Schinckus, 2015b). It is also not suitable for a stock market with a short history, such as the Chinese market. Hence, more researchers have been turning to the CSAD method, which has proved to be a better method for capturing signs of herding behaviour in the stock market in various phases.

The CSAD developed by Chang *et al.* (2000) is a modified method built on the method of CSSD; it assumes that both individual asset return dispersion and the value of absolute market returns increase in a linear fashion. During market volatility, participants may exhibit more consistent behaviours associated with herding behaviour, and such behaviour is going to increase the correlation between returns on assets and the dispersion of corresponding returns, which will be reduced or increased relative to the market returns. Thus, it concludes that the relationship between asset return dispersion and market return dispersion may be nonlinear when herding occurs. With this improved method of aggregate data, Chang *et al.* (2000) found significant herding in developing markets like South Korea and Taiwan. There were no signs of herding being found in advanced markets, like Hong Kong and the United States, and only limited evidence of herding in Japan. Other prominent researchers who applied the CSAD method were Blasco *et al*. (2017), Chiang and Zheng (2010), Demirer and Kutan (2006), and Tan *et al.* (2008).

Recently, several studies have focused on herding activities in the international market; some of them, such as the one by Chiang and Zheng (2010), has followed in the footsteps of Chang *et al.* (2000) in attempting to study herding behaviour in a total of 18 countries on a global scale. They divided markets by region and level of development. Other than the United States and Latin America, they found substantial evidence of herding behaviour throughout the markets in all sample countries. In analysing the impact of the US market on these countries, they found much evidence that mainly these countries are herding around the US market. Although Latin America does not show herding behaviour at the national level, its stock market is herding around the US market. Other researchers who attempted to study cross-country herding using the CSAD method are Economou *et al*. (2011), Gebka and Wohar (2013), Chen (2013), Mobarek *et al.* (2014) and Ahmad Fawwaz *et al*. (2017). This study applies the CSAD method of Chiang and Zheng (2010) to examine herding behaviour among China's A-share and B-share markets and during the turbulent and calm periods that occurred from 1 January 2010 to 31 October 2016.

4. Empirical Studies of Herding Behaviour in China

Previous research on the behaviour of herds in the Chinese stock markets had mixed and inconclusive findings. Demirer and Kutan (2006) obtained data on 375 stocks from the SHSE and SZSE during the period from 1999 to 2002 to review the existence of herding behaviour in the Chinese market. They concluded that Chinese investors were rational and had not exhibited significant herding in the Chinese market at either the sectoral or individual level. Contrary to Demirer and Kutan (2006), Zhou (2007) reviewed the A-share and B-share markets and found strong evidence of herding. Tan *et al.* (2008) investigated herding behaviour for 87 dual-listed Chinese A-share and B-share stocks from 1994 to 2003. They reported significant herding in both rising-market and falling-market conditions for A-shares and B-shares in both the SHSE and SZSE. Chiang *et al*. (2010) examined the Chinese stock market from 1996 to 2007; they reported the presence of herding behaviour in A-share markets of the SHSE and SZSE but failed to find evidence of herding in the B-share markets of the SHSE and SZSE. Fu and Lin (2010) looked for market-wide herding in the Chinese market from 2004 to 2009 but did not find any significant evidence of it.

Lao and Singh (2011) studied the Chinese and Indian stock markets. In the Chinese market, herding was more pronounced during falling market conditions and high volumes of trading.

They theorised that Chinese domestic investors might be tempted to follow other investors' trading strategies because Chinese culture encourages mutual bonding and may, therefore, encourage people to imitate others. Yao *et al*. (2013) investigated the Chinese stock market under various market conditions from 1999 to 2008 and found no signs of herding in the A-share market but robust signs of herding in the B-share market. Hilliard and Zhang (2015) found that herding behaviour was significant and strong for both the SHSE and SZSE from 2002 to 2012. Herding declined after 2006, and this suggested that the Chinese market had become more mature and efficient. These findings aligned with those of Yao *et al*. (2013), which showed that herding behaviour declined over the same period.

Luo and Schinckus (2015a) examined 602 mostly capitalised companies listed on both the SHSE and SZSE from 2006 to 2012 and found that herding existed during rising market conditions for B-shares and falling market conditions for A-shares. Their findings were in line with the outcomes of Chiang *et al*. (2010) and Lao and Singh (2011); all of them found more pronounced evidence of herding behaviour during falling market conditions.

Gong and Dai (2017) examined herding tendencies in the Chinese stock market from 2005 to 2016. Their results showed that interest rate increases and Renminbi devaluation led to herding behaviour in the Chinese stock market. It was more prevalent in bearish markets, which showed that investors responded more intensely to lousy news than great news. Li *et al*. (2018) studied herding activities in the Chinese market and found that herding behaviour occurred during the volatile periods but not during the calm periods. Their findings were in line with those of Economou *et al*. (2016), who saw that herding in the Greek stock market was more pronounced during turbulent periods, as well.

Herding behaviour seemed to occur in turbulent periods or during uncertain phases because most investors traded in the same stocks as the rest of the market. Such trading can push up or push down asset prices rapidly and cause them to further deviate from their fundamental values. Sophisticated and rational investors will exit the market when asset prices near a peak to collect their profits. Consequently, panic among irrational investors leads them to follow other investors' trading decisions, and this can lead to a collapse in asset prices (Li *et al.*, 2018; Spyrou, 2013). These findings are in line with the argument of Fu and Lin (2010), who feel that during a financial distress period, investors may not have sufficient time to collect and analyse information from many sources. Consequently, investors may herd during such a period.

One can conclude that signs of herding behaviour in Chinese markets are mixed and inconclusive and that most studies focus on dual-listed companies or different market conditions without truly exploring whether investors in B-shares may cause investors in A-shares to herd around their market, or vice versa. Also, past studies have rarely explored whether herding is more significant during a turbulent period in the stock market.

5. Research Methodology

5.1 Data Collection

This research collected all of the daily individual prices of stocks still actively listed on the SZSE and SHSE from 1 January 2010 to 31 October 2016. On the two exchanges, there are 1,391 Shanghai A-share firms (SHA), 50 Shanghai B-share firms (SHB), 850 Shenzhen A-share firms (SZA) and 44 Shenzhen B-share firms (SZB). This study collected 50 prices for individual A-share firms that were randomly listed on the SHSE and 44 prices for individual A-share firms that were randomly listed on the SZSE. Because not many B-share firms are listed on both exchanges, this study included all of the B-share firms listed on both exchanges as samples. This is the reason for tracking 50 prices of B-share firms on the SHSE and 44 prices of B-share firms on the SZSE. The final data were gathered over 1,782 days of observing the 188 stock returns of companies from all four local markets. All of the firms'

stock prices are dividend unadjusted in local currency and based on daily closing prices acquired from the Thomson Reuters Datastream. When data were not available due to the stock exchanges being closed for a national holiday, the stock price was considered to stay the same as on the earlier trading day.

Unlike Tan *et al*. (2008), Luo and Schinckus (2015b) and Alhaj-Yaseen and Yau (2018), this study tried to avoid using any individual firms in the A-share markets that were at the same time listed in the B-share markets for both the SHSE and SZSE in order to reduce sampling bias. Other than that, this study used only daily prices rather than weekly or monthly prices because Christie and Huang (1995) has proven that "herd behaviour is a very short-lived phenomenon"; employing daily data enabled us to capture this phenomenon efficiently. The formula used to calculate the stock return prices is shown below:

$$R_t = 100 * (\log(P_t) - \log(P_{t-1})) \tag{1}$$

5.2 Methodology

This study intended to estimate the herding behaviour of a market-wide and to investigate signs of herding behaviour in the A-share and B-share markets to see whether A-share market investors followed the trading trends of B-share market investors, and the other way round.

Christie and Huang (1995) contends that herding occurs when the dispersion in a market is low; *dispersion*, in this case, refers to the difference between individual returns and aggregate market returns. As retail investors trade based on their personal information and judgments, individual returns should push away from the aggregate market returns in the usual market periods. Conversely, in extreme conditions, market participants are likely to ignore their personal information and judgments, and their trade decisions are likely to be based on collective actions in the market. The proposed CSSD method is expressed as:

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

where *CSSD* is the cross-sectional standard deviation for i^{th} firms in the t^{th} period and expresses the dispersion. $R_{i,t}$ is the returns of i^{th} firms in the t^{th} period, and $R_{m,t}$ is the average of the cross-sectional returns of the market portfolio consisting of N shares over the t^{th} period.

Over time, researchers have discovered some significant drawbacks of the CSSD, such as that it is only able to capture herding behaviour during extreme conditions and is not suitable for a stock market that has such a relatively short history as the SHSE and SZSE. For example, Demirer and Kutan (2006) applied the CSSD method but were not able to find any signs of herding behaviour in the Chinese market. Chiang and Zheng (2010) pointed out that the $CSSD_t$ is calculated by squared return dispersion that are likely to be sensitive to outliers. Based on these drawbacks, Chang *et al.* (2000) introduced the cross-sectional absolute deviation (CSAD) method, as expressed below:

$$CSAD_t = \frac{1}{N}\sum_{i=1}^{N} |R_{i,t} - R_{m,t}| \tag{3}$$

To examine trading activities and detect herding activity, the formula has been expanded as shown:

$$CSAD_t = \alpha + \gamma_1 |R_{m,t}| + \gamma_2 R_{m,t}^2 + \varepsilon_t \tag{4}$$

where γ_1 is the coefficient of $|R_{m,t}|$, $R_{m,t}^2$ is the square of $|R_{m,t}|$ and γ_2 is the coefficient of $R_{m,t}^2$. In terms of herding activity, the relation between return dispersion and the market average will not be linear and increase further; instead, it will be nonlinear with increasing or decreasing rates (Caparrelli *et al*., 2004). It is important to make it clear that the CSAD will not detect the presence of herding. Indeed, it is the relation between the CSAD and the $R_{m,t}^2$ that is captured by a negative, statistically significant coefficient γ_2, and it is evidence of the presence of herding activities in the Chang *et al.* (2000) model, as shown in Equation (4). To detect herding, we applied the Chiang and Zheng (2010) method with a modification of CCK's specifications, as shown below:

$$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \varepsilon_t \quad (5)$$

Equation (5) is different from Equation (4) by Chang *et al.* (2000) in that $R_{m,t}$ is inserted on the right-hand side of Equation (5). Chiang and Zheng (2010) includes this specification to take care of asymmetric or random factors in market participants' behaviour in time of different market conditions and to reduce the error of misspecification.

The CSAD method assumes that the individual asset's return dispersion and the absolute value market returns increase in a linear manner. During volatile phases, market participants may exhibit more consistent behaviour related to herding; such behaviour is expected to enhance the correlation between asset returns, and the corresponding dispersion between returns will be reduced or increased as the less-than-proportional rate of market returns changes (Khan *et al*., 2011). Thus, one can conclude that the relationship between asset return dispersion and market return dispersion can be nonlinear when herding occurs. Therefore, a nonlinear term, $R_{m,t}^2$, is included in the equation. A significantly negative coefficient of the $R_{m,t}^2$ the term in the empirical test shows the signs of herding behaviour.

Table 2: Descriptive statistic of CSAD

Statistics	SHA	SHB	SZA	SZB
Mean	1.4146	1.0831	1.5022	1.0755
Median	1.2565	1.0208	1.3702	0.9842
Std. Dev	0.5983	0.4329	0.6206	0.4562
Minimum	0.5170	0.2784	0.4947	0.3292
Maximum	6.2758	4.6488	6.0594	4.2157
Kurtosis	8.9386	8.4657	8.5008	11.5906
N	50	50	44	44

Notes: Descriptive statistics of daily, cross-sectional absolute deviation ($CSAD_t$) of Shanghai A-share (SHA) and Shanghai B-share (SHB), Shenzhen A-share (SZA) and Shenzhen B-share (SZB). The starting period is from 4 January 2010 to 31 October 2016. Missing information for a holiday is carefully inspected and has been taken out for this descriptive statistics test. Calculation of CSAD is as follows:

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

Table 2 provides descriptive statistics for the CSAD on a total market level based on Equation (3). The number of individual companies in the SHSE and SZSE for A-shares and B-shares ranged from 44 to 50. We noticed that both the SHAs and SZAs had a higher mean, as well as a higher standard deviation, compared with the SHBs and SZBs. As stated by Chiang and Zheng (2010), a higher mean could suggest that a higher market variation is present for both of the A-share markets and a higher standard deviation can indicate that both the SHAs and SZAs had different cross-sectional variations owing to unexpected news or events. Such observations were expected because individual local investors predominated in

owning the A-shares in both stock exchanges. Past studies have shown that unsophisticated individual investors tend to overreact to news (Barberis *et al.*, 1998; Mahani and Poteshman, 2007; Chung and Liu, 2017).

Table 3: Pairwise cross-market correlation of CSAD measure

Market	SHA	SHB	SZA	SZB
SHA	1.0000			
SHB	0.7550	1.0000		
SZA	0.8756	0.7487	1.0000	
SZB	0.7568	0.8087	0.7461	1.0000

Notes: Pairwise correlation coefficients of the cross-sectional absolute deviation (CSAD) measures (equally-weighted returns) for China's Shanghai A-share (SHA) and Shanghai B-share (SHB) and Shenzhen A-share (SZA) and Shenzhen B-share (SZB). The starting period is from 4 January 2010 to 31 October 2016. For all the calculation, in this case, our observation includes all the opening and closing for the trading days.

Table 3 summarises the pair-wise cross-market correlations. In conclusion, the markets had a strong relationship with one another, with a correlation ranging from 75% to 88%. This may have been due to the fact that all four markets had the same opening hours and were located in mainland China.

6. Empirical Results

This section presents the results of empirical tests of herding in China's four local markets and of herding during a turbulent period for China's stock markets.

6.1 Overall Market-Wide Herding[2]

We examined market-wide herding for all four local markets by estimating the regression specified in Equation (5) for the entire sample period from 1 January 2010 to 31 October 2016. As was mentioned earlier, a significantly negative value for the coefficient γ_3 indicated the presence of herding behaviour in the markets. As shown in Table 4, both the SHA and SHB markets and the SZA market showed signs of herding, but the SZB market did not.

Table 4: Examine herding within SHA, SHB, SZA and SZB

Market	*Constant*	$R_{m,t}$	$\lvert R_{m,t}\rvert$	$R_{m,t}^2$	R^2
SHA	0.9053 ***	-0.0538***	0.4130***	-0.0228***	0.3500
	(37.07)	(-4.76)	(13.31)	(-3.64)	
SHB	0.6513***	-0.0186**	0.4444***	-0.0329***	0.5013
	(47.38)	(-2.19)	(25.52)	(-10.85)	
SZA	0.9405***	-0.0567***	0.4714***	-0.0335***	0.3453
	(36.41)	(-5.09)	(16.23)	(-6.83)	
SZB	0.6902***	-0.0146	0.3550***	-0.0076	0.4882
	(43.27)	(-1.36)	(15.17)	(-1.33)	

Notes: The result of the regression for equation (5):

$$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 \left|R_{m,t}\right| + \gamma_3 R_{m,t}^2 + \varepsilon_t \quad (5)$$

where $CSAD_t$ the Cross-Sectional Absolute Deviation for i^{th} firms in t^{th} period and indicates the dispersion. While $R_{m,t}$ is the average of the cross-sectional returns of the market portfolio consisting of N stocks during the t^{th} period. The presence of herd behaviour occurs when the coefficient of $R_{m,t}^2$ is negative and statistically significant. All the above data range is from 1/1/2010 to 31/10/2016 and is downloaded from Thomson DataStream. The number in the parentheses are t-statistics. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

The results contradict the findings of Demirer and Kutan (2006) and Fu and Lin (2010), who did not find any signs of herding behaviour in the Chinese market. Our results are partly

in line with the findings of Zhou (2007), Tan *et al*. (2008), and Alhaj-Yaseen and Yau (2018), who found the presence of herding in both the A-share and B-share markets. Our results were also partially consistent with those of Chiang *et al*. (2010), who reported an indication of herding in the A-share markets of the SHSE and SZSE but no indication of herding in the B-share markets of the SHSE and SZSE. Our results also contradicted the findings of Yao *et al*. (2013), who failed to find signs of herding in the A-share markets, but they found significant evidence of herding effects in the B-share markets.

The possible reasons why our study may have shown more pronounced herding evidence in all of the markets was because of the data set employed. Unlike previous studies, our study employed daily data. According to Christie and Huang (1995), herding behaviour occurs in minimal circumstances, and, hence, using data from a shorter time interval, such as a daily interval, would detect herding more efficiently.

6.2 Investigating Whether A-share Investors Followed the Trading Practices of B-share Investors, and Vice Versa[2]

In this regard, this study applied the method of Chiang and Zheng (2010) to examine whether A-share trading, which is led by local investors, herded around B-share trading, which is led by foreign institutional investors. To begin with, we investigated the herding behaviour of both A-shares and B-shares in the SHSE and SZSE. We used the estimation model, as shown below:

$$CSAD_{SHA,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4\ CSAD_{SHB,m,t}} + \gamma_5 R_{SHB,m,t}^2 + \varepsilon_t \quad (6)$$

$$CSAD_{SZA,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4 CSAD_{SZB,m,t}} + \gamma_5 R_{SZB,m,t}^2 + \varepsilon_t \quad (7)$$

We also examined cross-market herding as to whether the Shanghai A-share investors followed the Shenzhen B-share investors and whether the Shenzhen A-share investors followed the Shanghai B-share investors, using the estimations as shown below:

$$CSAD_{SHA,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4\ CSAD_{SZB,m,t}} + \gamma_5 R_{SZB,m,t}^2 + \varepsilon_t \quad (8)$$

$$CSAD_{SZA,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4 CSAD_{SHB,m,t}} + \gamma_5 R_{SHB,m,t}^2 + \varepsilon_t \quad (9)$$

where $CSAD_{SHA,t}$ and $CSAD_{SZA,t}$ are measures for the return dispersion of the respective stock markets. The subscript of SHA represents Shanghai A-share market; the subscript of SHB represents Shanghai B-share market. While the subscript of SZA represents Shenzhen A-share market and the subscript of SZB represents of Shenzhen B-share market. The difference in Equation (8) and Equation (9) is that the $CSAD_{SHB,m,t}$, $CSAD_{SZB,m,t}$ and $R_{SHB,m,t}^2$, $R_{SZB,m,t}^2$ are included. For example, in Equation (6), a negative and statistically significant γ_3 shows the presence of herding behaviour in the SHA. A negative and statistically significant γ_5 suggests that the SHA herds around the SHB. A positive and highly statistically significant γ_4 will indicate that the return dispersion of the SHB has a dominant influence on the SHA.

This study also tested whether both of the B-share markets were herding around the A-share markets, using the regression model, as shown below:

[2] We have also tried to increase the sample size of the SHA to 420 which is equivalent to 30% of 1,391 Shanghai's A-share, and also increase the sample size of SZA to 244 which is equivalent to 30% of 850 Shenzhen's A-share in the empirical tests in section 6.1 and 6.2. The results we got still the same; only with enhanced R^2.

$$CSAD_{SHB,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_4 \, CSAD_{SHA,m,t} + \gamma_5 \, R_{SHA,m,t}^2 + \varepsilon_t \quad (10)$$

$$CSAD_{SZB,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_4 \, CSAD_{SZA,m,t} + \gamma_5 \, R_{SZA,m,t}^2 + \varepsilon_t \quad (11)$$

Alternatively, we examined the cross-market test as to whether the SHB followed the SZA and whether the SZB followed the SHA, with the estimation, as shown below:

$$CSAD_{SHB,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_4 \, CSAD_{SZA,m,t} + \gamma_5 \, R_{SZA,m,t}^2 + \varepsilon_t \quad (12)$$

$$CSAD_{SZB,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_4 \, CSAD_{SHA,m,t} + \gamma_5 \, R_{SHA,m,t}^2 + \varepsilon_t \quad (13)$$

All of the explanations from Equation (10) to Equation (13) are exactly like the explanation given for the example of Equation (6).

After adding the variable of the SHB in Equation (6), we did not find the signs of herding in the SHA, because of the coefficient γ_3 was not statistically significant at all, yet it showed the dominant influence of the SHB on the SHA because of the coefficient γ_4 is positive and significant. The SHA did not herd around the SHB as was expected because of the coefficient γ_5 did not show signs of negative activity, and it was not significant at all. As for the SZA in Equation (7), the results indicated that the SZA indeed showed signs of herding in its market and was also influenced by the SZB's market conditions and caused it to herd around the SZB. As for the results of Equation (8), it reveals that the SHA showed signs of herding in its market, as well as being influenced by the SZB and causing it to herd around the SZB. Equation (9) results were similar to those of Equation (8), which shows that the SZA showed signs of herding behaviour in its market, as well as signs of being influenced by the SHB and herding around the SHB.

As Table 3 shows, there was a high pair-wise correlation between the markets; this finding prompted us to test whether B-share markets' investors followed A-share market investors in both the SHSE and SZSE. Equation (10) examined whether the SHB followed the SHA, and the results indicated the signs of herding activity in the SHB, and it was influenced by the SHA and caused it to herd around the SHA. As for Equation (11), presenting the test results for the SZB following the SZA, it shows that in the SZB, there were no signs of herding. It shows that the SZB also was influenced by the market conditions of the SZA and caused it to herd around the SZA. In Equation (12), we tried to establish whether the SHB followed the SZA. The results also showed that in the SHB, there were signs of herding, and it was influenced by the SZA and caused it to herd around the SZA. Finally, in Equation (13), we tested whether the SZB followed the SHA, and the results show that the SZB did not show signs of herding behaviour in its market. Nonetheless, the SZB was still significantly influenced by the market conditions of the SHA and caused it to herd around the SHA.

To discuss the results in Section 6.2 on Equations (6) to (13), some research found that the B-share market was the cause of leading information and, hence, played a role in leading the returns of the A-shares (Chui and Kwok, 1998; Doukas and Wang, 2013). Chui and Kwok also proved that the correlation between the B-share and A-share markets depended largely on the information transmission mechanism; Doukas and Wang (2013) showed that foreign investors were better informed because they processed more relevant information and firm-specific information in emerging countries where investor protection rights were quite fragile, as in China. Other studies showed that the A-shares were playing the leading role in stock returns between both the A-share and B-share markets (Chakravarty *et al*., 1998; Chan *et al*., 2008; Guo *et al*., 2008). However, as Alhaj-Yaseen and Yau (2018) concluded, all of these studies recognised the two-way exchange of information between the A-share and B-share markets, which explains our results in Table 5.

Table 5: Examining herding A-share investors make their investment decision based on B-share investors decision

Markets	Υ_0	Υ_1	Υ_2	Υ_3	Υ_4	Υ_5	R^2
SHA follows SHB	0.2984***	-0.0478***	0.1343***	-0.0024	0.8777***	-0.0052	0.6162
	(10.54)	(-5.76)	(4.87)	(-0.36)	(23.85)	(-1.45)	
SZA follows SZB	0.2400***	-0.0520***	0.2547***	-0.0197***	0.9698***	-0.0257***	0.6307
	(8.03)	(-6.62)	(10.23)	(-3.69)	(24.91)	(-4.63)	
SHA follows SZB	0.2261***	-0.0494***	0.2048***	-0.0094*	0.9350***	-0.0258***	0.6389
	(7.90)	(-6.85)	(9.00)	(-1.68)	(26.03)	(7.90)	
SZA follows SHB	0.3165***	-0.0455***	0.1774***	-0.0093*	0.9104***	-0.0066*	0.6073
	(11.64)	(-5.51)	(6.92)	(-1.78)	(25.81)	(-1.87)	
SHB follows SHA	0.2562***	0.0062	0.2889***	-0.0178***	0.4084***	-0.0096***	0.7029
	(12.04)	(0.86)	(17.79)	(-7.58)	(21.17)	(-4.03)	
SZB follows SZA	0.2625***	0.0081	0.1868***	0.0087	0.4043***	-0.0055**	0.7086
	(11.66)	(0.97)	(8.29)	(1.48)	(20.47)	(-2.13)	
SHB follows SZA	0.2545***	-0.0005	0.2936***	-0.0175***	0.3825***	-0.0092***	0.7043
	(11.37)	(-0.09)	(18.11)	(-6.72)	(19.86)	(-4.88)	
SZB follows SHA	0.2551***	0.0160**	0.1888***	0.0088*	0.4369***	-0.0076***	0.7153
	(12.33)	(1.97)	(9.49)	(1.72)	(22.13)	(-2.96)	

*Note*s: The results of the regression for equation (6) to (13):

$$CSAD_{SHA,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4 CSAD_{SHB,m,t}} + \gamma_5 R_{SHB,m,t}^2 + \varepsilon_t \quad (6)$$

$$CSAD_{SZA,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4 CSAD_{SZB,m,t}} + \gamma_5 R_{SZB,m,t}^2 + \varepsilon_t \quad (7)$$

$$CSAD_{SHA,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4\ CSAD_{SZB,m,t}} + \gamma_5 R_{SZB,m,t}^2 + \varepsilon_t \quad (8)$$

$$CSAD_{SZA,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4 CSAD_{SHB,m,t}} + \gamma_5 R_{SHB,m,t}^2 + \varepsilon_t \quad (9)$$

$$CSAD_{SHB,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4\ CSAD_{SHA,m,t}} + \gamma_5 R_{SHA,m,t}^2 + \varepsilon_t \quad (10)$$

$$CSAD_{SZB,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4\ CSAD_{SZA,m,t}} + \gamma_5 R_{SZA,m,t}^2 + \varepsilon_t \quad (11)$$

$$CSAD_{SHB,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4\ CSAD_{SZA,m,t}} + \gamma_5 R_{SZA,m,t}^2 + \varepsilon_t \quad (12)$$

$$CSAD_{SZB,t} = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_{4\ CSAD_{SHA,m,t}} + \gamma_5 R_{SHA,m,t}^2 + \varepsilon_t \quad (13)$$

where $CSAD_{SHA,t}$, $CSAD_{SHB,t}$, $CSAD_{SZA,t}$, and $CSAD_{SZB,t}$ are measures for return dispersion. The subscript of SHA represents Shanghai A-share market; the subscript of SHB represents Shanghai B-share market. While the subscript of SZA represents Shenzhen A-share market and SZB represents of Shenzhen B-share market. All the above data range is from 1/1/2010 to 31/10/2016 and is downloaded from DataStream International. The number in the parentheses are t-statistics. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

As in Table 5, we were not surprised to find that A-share markets herded around B-share markets because the B-share markets are mostly led by foreign investors who are perceived to be more intelligent and able to process more information compared with local retailers. However, we found that B-share markets also herded around A-share markets. This may have been due to the fact that local retailers had been allowed to trade in the B-share markets since 2001 and this led to the exchange of information between A-share and B-share markets (Alhaj-Yaseen and Yau, 2018).

In China, opportunities for investing in the stock market had been limited; as time passed, however, and reforms were made, the government relaxed regulations on local retailers. When the government became more open, local retailers rushed to invest in the stock market but did not have experience with accurate analysis and also lacked knowledge. These deficiencies caused them to speculate and herd together; they listened mostly to rumours rather than relying on fundamental information (Chan *et al*., 2008; Alhaj-Yaseen and Yau, 2018).

As the results show in Equations (10) to (13), foreign institutional investors dominating the B-share markets in China had no comparative advantages over local investors because they needed to collect, process and analyse information while, at the same time, face language and cultural barriers (Chan *et al*., 2008). A different standard of accounting and disclosure requirement also was a reason why foreign institutional investors may not have had an information advantage compared with local retailers (Chan *et al*., 2008; Alhaj-Yaseen and Yau, 2018). Cultural and language barriers may have become detrimental factors because foreign institutional investors did not understand, speak, or write Chinese. Both factors caused

them to be afraid to hold and invest in foreign shares, whereas local retailers had certain cultural and language advantages (Hau, 2001; Choe *et al*., 2001; Chan *et al.*, 2008).

Chakravarty *et al*. (1998) and Chan *et al*. (2008) pointed out that information asymmetry was quite severe in China because insider trading and share manipulating were rampant and investors' rights were not well protected. Hence, they concluded that foreign institutional investors were the least informed groups in China, and this may have been the reason why the B-share markets followed the trading practices of the A-share markets.

6.3 Investigating Herding During Chinese Stock Market Turbulence

The Chinese market suffered a stock market plunge on 12 June 2015, and it continued until early February 2016. We felt it was important to investigate herding activities during this period. Because the period for this study was 1 January 2010 to 31 October 2016, it included the turbulent and calm periods. Tian *et al*. (2018) have pointed out that within the first three weeks of the turbulent period, the Chinese market plummeted more than 30% and the total losses were 15 trillion Renminbi (USD2.4 trillion). The turbulence affected mainly the SHSE A-share market and caused almost half of the 1,400 SHSE A-share firms to file for a trading halt to prevent further losses. This study not only investigated herding in the SHA but also herding in the SHB, SZA and SZB because they are closely correlated with each other (Table 2). Similar estimation techniques were used to test herding during the turbulent phase:

$$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 \left|R_{m,t}\right| + \gamma_3 R_{m,t}^2 + \varepsilon_t \quad (5)$$

Table 6 shows the presence of herding activities in all four markets during the turbulent period. Table 7 shows the presence of herding activities during the calm periods except in the SZB. The herding activities found during the turbulent period reinforce Christie and Huang (1995), who argued that herding was more rampant during that time. Chiang and Zheng (2010) showed that herding activities appeared to be more prevalent during turbulent periods, as well, including the 1997 financial crises. Our results are also in line with the findings of Economou *et al*. (2016), who found that herding in the Greek stock market was stronger during a turbulent period.

Table 6: Examine herding within SHA, SHB, SZA and SZB during Chinese stock market turbulence from 12 June 2015 – 12 February 2016

Market	*Constant*	$R_{m,t}$	$\left\|R_{m,t}\right\|$	$R_{m,t}^2$	R^2
SHA	0.9132***	-0.0577***	0.3935***	-0.0384***	0.2444
	(36.62)	(-7.10)	(12.09)	(-4.60)	
SHB	0.6329***	-0.0175**	0.4769***	-0.0445***	0.4606
	(43.31)	(-2.19)	(21.86)	(-9.81)	
SZA	0.9600***	-0.0550***	0.4109***	-0.0326***	0.2674
	(35.92)	(-6.28)	(12.43)	(-3.79)	
SZB	0.6828***	-0.0196**	0.3700***	-0.0239***	0.3699
	(43.81)	(-2.52)	(17.59)	(-5.88)	

Notes: The results of the regression for equation (5):

$$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 \left|R_{m,t}\right| + \gamma_3 R_{m,t}^2 + \varepsilon_t \quad (5)$$

where $CSAD_t$ the Cross-Sectional Absolute Deviation for i^{th} firms in t^{th} period and indicates the dispersion. While $R_{m,t}$ is the average of the cross-sectional returns of the market portfolio consisting of N stocks during the t^{th} period. The presence of herd behaviour occurs when the coefficient of $R_{m,t}^2$ is negative and statistically significant. All the above data range is from 12/6/2015 to 12/2/2016 and is downloaded from DataStream International. The number in the parentheses are t-statistics. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 7: Examine herding within SHA, SHB, SZA and SZB during the calm periods

Market	*Constant*	$R_{m,t}$	$\lvert R_{m,t}\rvert$	$R^2_{m,t}$	R^2
SHA	0.8981***	-0.0850***	0.8220***	-0.0769***	0.4933
	(7.68)	(-3.27)	(8.10)	(-5.50)	
SHB	0.7827***	-0.0176	0.3958***	-0.0256***	0.4991
	(10.38)	(-0.89)	(7.19)	(-3.47)	
SZA	1.0281***	-0.1054***	0.8088***	-0.0818***	0.4186
	(7.44)	(-3.83)	(7.45)	(-6.10)	
SZB	0.7565***	0.0053	0.4279***	-0.0100	0.6677
	(8.85)	(0.24)	(5.53)	(-0.76)	

Notes: The results of the regression for equation (5):

$$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 \lvert R_{m,t}\rvert + \gamma_3 R^2_{m,t} + \varepsilon_t \quad (5)$$

where $CSAD_t$ the Cross-Sectional Absolute Deviation for i^{th} firms in t^{th} period and indicates the dispersion. While $R_{m,t}$ is the average of the cross-sectional returns of the market portfolio consisting of N stocks during the t^{th} period. The presence of herd behaviour occurs when the coefficient of $R^2_{m,t}$ is negative and statistically significant. All the above data range is from 1/1/2010 to 11/6/2015 and 13/2/2016 to 31/10/2016 and is downloaded from DataStream International. The number in the parentheses are t-statistics. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

The study also found signs of herding activities in the Chinese stock markets even during calm periods. However, our results are different from those of Li *et al*. (2018), who found that herding behaviour occurred during a volatile period but not during a calm period. This may have been because Chinese markets were still emerging and herding was rampant due to information that was more often asymmetric than in developed countries (Chang *et al*., 2000; Blasco and Ferreruela, 2008; Chiang and Zheng, 2010; Alhaj-Yaseen and Yau, 2018). If investors are more knowledgeable and well informed, herding behaviour is reduced (Alhaj-Yaseen and Yau, 2018). Lao and Singh (2011) argued that local Chinese retailers might be tempted to follow other investors' trading decisions because Chinese culture emphasises a more collective approach in human relationships and encourages people to copy trade decisions of others who are perceived to be correct.

Before we conclude this section, there is a need for us to examine whether the herding coefficients ($R^2_{m,t}$) during the turbulent period for the SHA, SHB, SZA and SZB were significantly different than in their calm periods. Hence, we performed the *t-test* for the herding coefficients to determine the differences between these two periods. Following the Chiang and Zheng (2010) method in order to provide a less biased sample for the comparison, we used a sample size of calm period data equivalent to that of the Chinese stock market turbulence data either before or after the turbulent period, depending on the suitability of the sample period for this test.

Table 8: T-test to compare the herding coefficient ($R^2_{m,t}$) during turbulent and the tranquil period

Markets	Herding coefficients during the Chinese stock market turbulence	Herding coefficients during the tranquil period	Degree of freedom	T-test	P-value
SHA	-0.0384***	-0.0769***	175	6.0255	0.0000
SHB	-0.0445***	-0.0256***	175	6.1344	0.0000
SZA	-0.0326***	-0.0818***	175	6.4527	0.0000
SZB	-0.0239***	-0.0100	175	5.1286	0.0000

Notes: Herding coefficients ($R^2_{m,t}$) during Chinese stock market turbulence and during the calm period as shown in Table 6 and 7, and ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

As shown in Table 8, we rejected the null hypothesis of no difference in herding coefficients between the stock market turbulent period and the calm periods. Our results are aligned with the findings of Chiang and Zheng (2010) and Economou *et al*. (2016), in which herding was found to be stronger during the turbulent period. Although the turbulence mainly occurred in the SHA market, we can conclude that based on the results shown in Table 8, it spread to other markets, as well. The data also showed that during the turbulent period, investors might not have had sufficient time to collect and analyse information from many sources, and, hence, investors may have opted for herding during this period.

7. Summary and Conclusions

This study investigated herding activities on SHA, SHB, SZA and SZB by employing daily data from 1 January 2010 to 31 October 2016. First, we found that the SHA, SHB and SZA showed herding in their markets, but the SZB did not. Second, we discovered that A-share markets herded around B-share markets, and vice versa. We also found that there was cross-herding between the SHSE and SZSE due to information transmission and the correlation among all of the SHA, SHB, SZA and SZB markets. Finally, there was a significant difference between the herding coefficients during the stock market turbulent period and the calm periods based on the *t-test*. It seems that herding in China was indeed more intense during the turbulent period compared with the calm periods, although we also found herding activities during the calm periods.

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