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Does herding behavior in Chinese markets react to global markets?

Thomas C. Chiang[a], Jiandong Li[b], Lin Tan[c]

a. Drexel University, Philadelphia, PA.
b. Chinese Academy of Finance and Development (CAFD)
Central University of Finance and Economics (CUFE), Beijing, P. R. China
c. California State Polytechnic University, Pomona

Abstract: This study examines the possibility of herding behavior among investors in stocks listed on Chinese exchanges. Results based on daily data indicate that Chinese markets display herding behavior. This holds true whether we measure stock dispersions using firm data or industry data. Using a rolling regression method to estimate the herding equation, we find that the herding coefficient is sensitive to new information, displaying a time-varying property. This study finds significant evidence that herding behavior in the A-share markets is negatively correlated with that in global markets, while herding behavior in the B-share markets is positively related to that in global markets.

JEL: G15, G14

Key Words: Herding, Chinese stock markets, Cross-sectional dispersion

1. Introduction

In the finance literature the term herding is often used to describe the correlation of investor behavior resulting from copying and/or imitating trading activity. This correlation in trades may stem from informational cascades, in that the observation of prior investors' trades can be so informative that investors are willing to ignore their own private information in trading. As a result, herding behavior leads to a group of investors moving in the same direction, pushing stock prices further away from their economic fundamentals and, in turn, causing price momentum and excess volatility (Bikhchandani et al. 1992; Nofsinger and Sias 1999). Thus, some technical analysts see the herding behavior of investors as an example of extreme market sentiment. Academic researchers of behavioral finance identify herding in the collective irrationality of investors, leading to misvaluations of economic fundamentals (Shiller 2005).

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A number of research papers examine herding behavior in global markets. Chen et al. (2008) study the herding behavior of institutional investors in the Taiwan securities market and report that investors herd on securities in specific industries and also prefer stocks with high past returns, supporting the argument for momentum traders. Chang et al. (2000) test herding behavior over a group of international markets and find evidence of herding behavior in South Korea and Taiwan during times of extreme market stress. However, the evidence of herding in the markets for Hong Kong, Japan, and the United States is rather weak.

Several research papers specifically examine herding activities in Chinese markets. By applying firm- and sector-level data in China, Demirer and Kutan (2006) find no evidence of herding formation, suggesting that participants in the Chinese market make investment choices rationally. However, Chen et al. (2003) present quite different empirical evidence. They report that during periods of extreme price movements, the relative equity return dispersions for both Shanghai and Shenzhen B-share markets decline, evidence that supports herding behavior. For both Shanghai and Shenzhen A-share markets, their results are mixed and the evidence to support herding behavior is weaker. Yet, using data from dual-listed firms to examine Chinese stock markets, Zhou (2007) documents the existence of significant herding in both A- and B-share markets; Tan et al. (2008) report that herding occurs under both rising and falling market conditions and the herding phenomenon is more profound in A-share investors. Taking these findings together, we find that the evidence on herding behavior in the Chinese markets is mixed.

Although the above-mentioned studies have made contributions to describing herding behavior in Chinese markets, these empirical analyses have two limitations. First, the existing literature on analyzing herding behavior focuses mainly on a single domestic market analysis; very few attempts have been made to evaluate the impact across national boundaries.[1] We are motivated by recent empirical evidence that greater co-movement of a group of investors often takes place during periods of high volatility. For instance, Boyer et al. (2006) and Chiang et al. (2007) find that the contagion effect spreads financial risk across different markets and herding activities aggravate market crises. The recent sub-prime crisis in the US market attests to the global nature of crisis transmission. Thus a study of herding behavior that does not consider cross-market repercussions is subject to missing information, and hence such a study is likely to commit a specification error.

Second, the conventional approach to conducting an empirical analysis of herding behavior in the above-mentioned literature basically uses a constant-coefficient model, which produces an average value over a specific sample period. This approach is based on the premise that herding behavior remains unchanged throughout the sample period under study. However, when the market undergoes extreme stress, the stress is likely to cause structural changes. Thus, the constant coefficient estimator can no longer provide

[1] The exception is Chiang and Zheng (2009) in their study of global markets based on industry stock returns.

updated information that reflects market dynamics. From this perspective, we need a model capable of reflecting the time-varying characteristic of herding behavior. Moreover, in the international context, we would like to examine whether the time-varying herding behavior in Chinese markets is correlated with herding behavior in global markets.

This paper attempts to provide new empirical evidence that helps to resolve the mixed findings of herding behavior in Chinese markets. In addition, while modeling herding behavior in a time-varying fashion, we test whether the herding behavior in Chinese stock markets is correlated with that in global markets.

The remainder of this paper is organized as follows. Section 2 presents the methodology used to detect herding behavior. Section 3 provides a brief description of the institutional arrangement for Chinese stock markets. Section 4 describes the data. Section 5 reports the evidence of herding behavior for Chinese markets. Section 6 generates a vector of herding coefficients by using a rolling regression analysis and tests the correlation of herding behavior. Section 7 contains concluding remarks.

2. Detecting herding behavior by investors

Two studies that have proposed methods of detecting herding behavior using stock return data are Christie and Huang (1995) (hereafter referred to as CH) and Chang et al. (2000) (hereafter referred to as CCK). CH suggests that the investment decision-making process used by market participants depends on overall market conditions. They contend that during normal periods, rational asset pricing models predict that the dispersion in returns will increase with the absolute value of the market return, since individual investors are trading based on their own private information, which is diverse. However, during periods of extreme market movements, individuals tend to suppress their own beliefs, and their investment decisions are more likely based on the collective actions in the market. Individual stock returns under these conditions tend to cluster around the overall market return. Thus CH argues that herding will be more prevalent during periods of market stress, which is defined as the occurrence of extreme returns on the market portfolio. Demirer and Kutan (2006) apply the CH method to examine herding in Chinese equity markets. They use daily stock return data from 1999 to 2002 for 375 Chinese stocks and find no evidence of herding. One of the challenges associated with the approach described above is that it requires a definition of extreme returns. CH notes that this approach is rather arbitrary by using a value of 1% or 5% as the cutoff point to identify the upper and lower tails of the return distribution. In practice, investors may differ in their opinions as to what constitutes an extreme return, and the characteristics of the return distribution may change over time. In addition, herding behavior may occur to some extent over the entire return distribution but may become more pronounced during periods of market stress. In fact, the CH method captures herding only during periods of extreme returns. Additional challenges arise when applying this method to Chinese stock market data, since the relatively short history of these markets makes it difficult for investors to identify when extreme returns occur.

Chang et al. (2000) propose an alternative approach to test for herding. CCK note that the CH approach is a more stringent test, which requires "a far greater magnitude of non-linearity" in order to find evidence of herding. CCK's herding test facilitates the detection of herding over the entire distribution of market returns with the following specification:

$$CSAD_t = \alpha + \gamma_1 \left| R_{m,t} \right| + \gamma_2 R_{m,t}^2 + \varepsilon_t \tag{1}$$

The left-hand-side variable, $CSAD_t$, is a measure of return dispersion, which is derived by calculating the cross-sectional absolute deviation:

$$CSAD_t = \frac{1}{N} \sum_{i=1}^{N} \left| R_{i,t} - R_{m,t} \right| \tag{2}$$

Where $R_{i,t}$ is the return of stock i at time t. $R_{m,t}$ is the equally weighted average stock return for all stocks listed in a market. Note that both $\left| R_{m,t} \right|$ and $R_{m,t}^2$ terms appear on the right-hand side of equation (1). This is based on the rationale that under normal conditions, a linear relationship between the return dispersion and market volatility is anticipated. However, during periods of relatively large price swings, in which market participants are more likely to herd around indicators such as the average consensus of all market opinions, the relation between *CSAD* and the average market return is more likely to be nonlinear. For this reason, a nonlinear market return, $R_{m,t}^2$, is included in the test equation. Thus, a significantly negative coefficient γ_2 in the empirical test will indicate the occurrence of herding behavior, since it reflects the phenomenon that during periods of market stress, a negative, nonlinear relationship between return dispersion and $R_{m,t}^2$ exists.

In this study, we follow Duffee (2000) and Tan et al. (2008) by adding current stock return, $R_{m,t}$ to CCK's equation:[2]

$$CSAD_t = \delta + \alpha R_{m,t} + \beta \left| R_{m,t} \right| + \gamma R_{m,t}^2 + \varepsilon_t \tag{3}$$

where $R_{m,t}$ is the equally weighted market portfolio return at time t; $CSAD_t$ is the equally weighted cross-sectional absolute deviation. A significantly negative coefficient on $R_{m,t}^2$ would indicate the existence of herding behavior.

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[2] Duffee (2000) adds the $R_{m,t}$ to the equation as: $CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 \left| R_{m,t} \right| + \gamma_3 R_{m,t}^2 + \varepsilon_t$

It can be shown that $\gamma_2 + \gamma_1$ captures the relation between return dispersion and market return when $R_{m,t} > 0$, while $\gamma_2 - \gamma_1$ shows the relation when $R_{m,t} \leq 0$.

3. Chinese stock markets

China established the Shanghai Stock Exchange and the Shenzhen Stock Exchange (SZSE) in December 1990. Both exchanges issue two classes of shares: A-shares, which are purchased and traded only by domestic (Chinese) investors and are denominated in the local currency, the Renminbi (RMB); and B-shares, which were sold only to foreign investors before February 2001 but have been sold to both foreign and domestic investors since then. B-shares on the Shanghai exchange are denominated in US dollars, and B-shares on the Shenzhen exchange are denominated in Hong Kong dollars. A-shares and B-shares are traded simultaneously on the Shanghai and Shenzhen stock markets. The characteristics of their investors are very different. The A-share market is dominated by individual domestic investors (China Securities and Futures Statistical Yearbook, 2004). In contrast, the B-share market is dominated by foreign institutional investors.

4. Data

The stock data employed in this study are daily observations consisting of firm stock prices and industry and market price indices. We study herding behavior not only on firm level but also on industry level because by Bush, Mehdian and Perry (2010*)*, investors' reactions to information vary by industry or sector. The data span the period from January 1, 1996 to December 31, 2008. The samples cover four markets: China (CN), Hong Kong (HK), Japan (JP), and the United States (US).[3] The data exclude observations involving long holidays for the Chinese New Year, Labor Day, and National Day. The data set of stock indices contains 64 industries for China, 94 industries for Hong Kong, 145 industries for Japan, and 155 industries for the US. We also collect data on stock prices for all firms listed in these markets. By the end of 2008, there were 1160 Hong Kong firms, 2917 Japanese firms, and 6614 US firms. Stock indexes used for these markets are the Hang Sheng stock index (Hong Kong), the Nikkei 225 stock index (Japan), and the S&P500 index (US). All of the firm and industry data for China (CN), Hong Kong (HK), and Japan (JP*)* were taken from *Datastream International*. The data for the US were taken from the *CRSP* database.

We also collect data on A-share and B-share stock prices listed on the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE) over the period from January 1, 1996 to April 30, 2007. There are 861 Shanghai A-share firms (SHA), 55 Shanghai B-share firms (SHB), 639 Shenzhen A-share firms (SZA), and 59 Shenzhen B-share firms (SZB). These separate market data were taken from Shenying Wanguo Securities Company, China.

In this study, for the convenience of presentation and comparison, we shall employ aggregate Chinese stocks by summing up Shanghai A- and B-share and Shenzhen A- and B-share data using indices for both firm stocks and industry stocks. The United

[3] In this paper, we do not investigate A-share and B-share markets separately, since, on February 11, 2001, the China Securities Regulatory Commission (CSRC) announced that A-share investors may purchase B-shares, and B-shares stopped trading between the 20th and 23rd of February 2001.

States, Hong Kong, and Japan are considered the global market, since New York City, Hong Kong, and Tokyo are regarded as world financial centers in different regions.

5. Empirical analysis of herding behavior

5.1. Descriptive statistics

Table 1 contains a summary of statistics for cross-sectional absolute deviations (CSAD). Panel A reports the statistics for the aggregate market, which includes all listed firms for each market; Panel B contains similar statistics based on industry data. The statistics in Panel B show that the mean values and standard deviations of CSAD for the Chinese and Hong Kong markets are comparable; the statistics for the mean and standard deviations for the Japanese and U.S. markets are close to each other, especially in the industry data (Panel B). A similar feature can be found in the standard derivations of the firm-level data, as shown in panel A.

Table 1. Descriptive statistics of cross-sectional absolute deviations

Panel A. Measure based on firm data

	$CSAD_{CN}$	$CSAD_{HK}$	$CSAD_{JP}$	$CSAD_{US}$
Mean	1.405	1.758	1.420	2.104
Median	1.396	1.746	1.453	2.100
Maximum	4.297	4.657	2.921	4.954
Minimum	0.000	0.000	0.000	0.979
Std. Dev.	0.639	0.634	0.493	0.571
Skewness	0.053	-0.386	-0.939	0.580
Kurtosis	4.066	5.258	4.954	3.313
Sum	4541.157	5682.171	4592.407	6801.973
Observations	3233	3233	3233	3233

Panel B. Measure based on industry data

	$CSAD_{CN}$	$CSAD_{HK}$	$CSAD_{JP}$	$CSAD_{US}$
Mean	1.608	1.472	0.979	0.912
Median	1.448	1.349	0.943	0.810
Maximum	8.823	12.199	3.445	4.754
Minimum	0.000	0.000	0.000	0.000
Std. Dev.	0.860	0.813	0.455	0.468
Skewness	1.629	2.244	0.750	1.563
Kurtosis	8.909	19.210	6.058	8.650
Sum	5197.396	4760.017	3166.140	2947.121
Observations	3233	3233	3233	3233

Notes: This table reports descriptive statistics of $CSAD_t$ of China(CN), Hong Kong(HK), Japan(JP) and United States(US). $CSAD_t$ is the equally weighted cross-sectional absolute deviation derived from

$CSAD_t = \frac{1}{N}\sum_{i=1}^{N}\left|R_{i,t} - R_{m,t}\right|$ where $R_{m,t}$ is the equally weighted average stock return.

5.2. Evidence on herding in Chinese domestic markets

Empirical examination of herding behavior is conducted by performing a significance test using a least squares method in terms of equation (3). A significantly negative coefficient on $R_{m,t}^2$ (γ) would indicate the existence of herding behavior. The logic of this approach is that as the market experiences large price swings, investors tend to suppress their private information and herd around the information emerging from the consensus of all market constituents. Stock returns under these conditions tend to converge, causing the return dispersion to either decrease or increase at a decreasing rate. Thus, if herding exists, we expect the coefficient γ to be negative and statistically significant in equation (3).[4]

Table 2 reports the statistical results by using a Newey-West (1987) consistent estimator.[5] Among the five models presented in Table 2, Model 1 exams Chinese market herding behavior using equation (3). The estimated statistics reported in Panel A of Table 2 are based on data consisting of firm stocks to construct the CSAD. The test result in Model 1 shows that the coefficient on the market return square, γ, is negative and statistically significant, suggesting that herding behavior exists in the Chinese market. A similar result for the herding coefficient can be found in Panel B, which uses industry data to measure *CSAD*, the dependent variable.

The findings in Model 1 agree with those documented by Zhou (2007) and Tan et al. (2008). They find evidence that Chinese stocks display herding behavior. Note that our findings contrast with those of Demirer and Kutan (2006), who find no evidence of herding using daily data from 1999 to 2002 for 375 Chinese stocks. Since our data contain more updated observations and cover the entire set of listed firms and industries, the current estimated results are more reliable. An obvious difference of the current study from the previous is that the CSAD series presents strong serial correlation. Model 2 expands Model 1 by incorporating the AR terms. The evidence indicates that by adding an AR(2) process into the model (Model 2), the magnitude of the herding coefficient has changed substantially, especially in the data based on firm stocks.

[4] The measure of the return dispersion, $CSAD_t$, in this study is similar to that in Christie and Huang (1995) and Gleason et al., (2004), which does not require the estimation of beta. CCK's measure relies on the accuracy of the specification of a single market factor of the CAPM, which may be questionable.

[5] We also estimated equation (1) separately on sub-periods before and after February 11, 2001, when A-share investors were allowed to invest in B-share markets. The results are very similar to those of the entire sample period. These tables are available upon request.

Table 2. Estimates of Chinese market herding behavior

Panel A. Firm-level data

	Model 1	Model 2	Model 3	Model 4	Model 5
C	1.001	1.233	1.232	1.232	1.234
	(30.10)***	(35.80)***	(38.20)***	(38.14)***	(38.19)***
$R_{m,t}$	-0.052	-0.070	-0.069	-0.069	-0.070
	(-9.95)***	(-14.54)***	(-23.16)***	(-23.21)***	(-23.29)***
$\lvert R_{m,t}\rvert$	0.421	0.185	0.185	0.185	0.185
	(15.84)***	(12.36)***	(19.44)***	(19.40)***	(19.43)***
$R^2_{m,t}$	-0.033	-0.016	-0.016	-0.016	-0.016
	(-8.72)***	(-5.74)***	(-10.58)***	(-10.54)***	(-10.56)***
$R^2_{m,HK,t}$			0.001		
			(0.99)		
$R^2_{m,JP,t}$				0.002	
				(1.14)	
$R^2_{m,US,t-1}$					-0.001
					(-0.39)
AR(1)		0.660	0.660	0.660	0.660
		(28.58)***	(37.67)***	(37.69)***	(37.71)***
AR(2)		0.139	0.139	0.139	0.139
		(5.28)***	(7.95)***	(7.95)***	(7.93)***
$\bar{R}^2$	0.32	0.69	0.69	0.69	0.69

Panel B. Industry-level data

	Model -1	Model-2	Model-3	Model-4	Model-5
C	1.117	1.246	1.237	1.249	1.245
	(57.34)***	(46.96)***	(46.98)***	(46.69)***	(46.84)***
$R_{m,t}$	0.041	0.036	0.041	0.036	0.037
	(7.06)***	(7.01)***	7.79	(6.84)***	(7.02)***
$\lvert R_{m,t}\rvert$	0.368	0.268	(0.270)***	0.267	0.267
	(23.79)***	(19.16)***	(19.36)***	(19.12)***	(19.04)***
$R^2_{m,t}$	-0.007	-0.004	-0.009	-0.004	-0.004
	(-3.64)***	(-2.61)***	-4.66)***	(-2.33)**	(-2.59)**
$R^2_{m,HK,t}$			0.010		
			(5.03)***		
$R^2_{m,JP,t}$				-0.003	
				(-1.01)	
$R^2_{m,US,t-1}$					0.001
					(0.39)
AR(1)		0.307	0.308	0.306	0.306
		(17.68)***	(17.71)***	(17.66)***	(17.63)***
AR(2)		0.191	0.186	0.193	0.191
		(11.06)***	(10.75)***	(11.14)***	(11.04)***
$\bar{R}^2$	0.35	0.44	0.45	0.44	0.44

Notes: This table reports results based on: $CSAD_t = \delta + \alpha R_{m,t} + \beta\lvert R_{m,t}\rvert + \gamma\ R^2_{m,t} + \varepsilon_t$ for model 1. Model 2 expands model 1 using AR term. Model 3, 4 and 5 incorporate global markets of Hong Kong, Japan and USA. $CSAD_t$ is the equally weighted cross-sectional absolute deviation. $R_{m,t}$ is the equally weighted market portfolio return at time *t*. Panel A is based on data consisting of firm stocks to construct the CSAD. Panel B uses industry data to measure CSAD. Numbers in parentheses are t-statistics based on Newey-West (1987) consistent standard errors. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

5.3. The role of foreign markets

The estimated equation proposed by CCK (2000) as represented by equation (3) is appropriate for a closed system in that no foreign repercussions are involved. However, in an integrated global financial market facilitated by high-tech devices and efficient information processing, trades and investment activities are unlikely to be insulated from the rest of the world. Thus, it is worthwhile to include major foreign variables in the model to identify the role and significance of global factors. Since the stocks are traded heavily in financial centers such as New York City, Tokyo, and Hong Kong, we shall include the market return squared and CSAD variable of these three global markets to serve as explanatory variables in the Chinese herding equation (Masih and Masih 2001).

Our estimations attempt to examine whether the return dispersions in domestic markets can be explained by those in major international markets. For this reason, we add a return squared variable for each global market to the test equation to test their impact on the herding equation. The columns labeled Model 3 through Model 5 in Table 2 report the new estimated results. Model 3 considers the effect of Hong Kong market on Chinese market. Model 4 factors in the effect of Japanese market on Chinese market. Model 5 exams the effect of United States' market on Chinese market. Consistent with our earlier findings, we again find that the herding activity shown in the coefficient on $R_{m,t}^2$ is continuously present in all of the test equations and the adjusted R-squares are quite stable. This evidence suggests that the incremental variables do not add much explanatory power to the herding equation. Inspecting each t-statistic shows that none of the foreign market-return-squared variables are statistically significant, indicating no apparent evidence that investors in the Chinese market closely follow investors in foreign markets.[6]

6. Analysis of herding coefficients

6.1. Is herding behavior time-varying?

In the previous section, we find significant evidence of herding behavior in Chinese stock markets. Note that these findings are essentially derived from a constant-coefficient model, reflecting an average result over the observed sample period. However, we should interpret the result with caution. First, the evidence is based on the presumption that herding behavior remains unchanged throughout the sample period. It follows that the estimated coefficient fails to capture the dynamic movements in response to ongoing market disturbances. Second, even after we add a foreign stock return squared variable to the test equation, the specification may not sufficiently capture the dynamic interdependence of herding behavior between Chinese markets and global markets. In the following section, we shall address these two issues.

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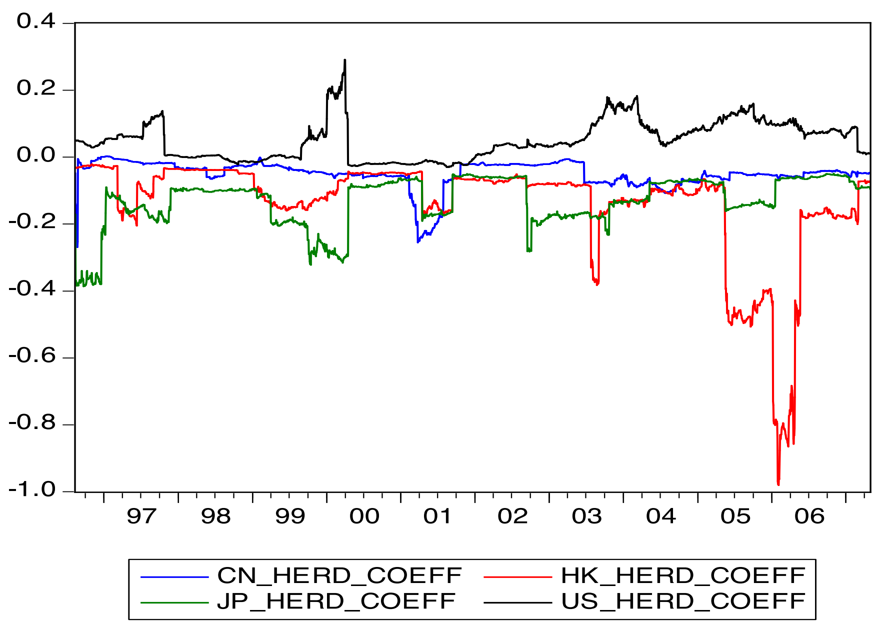
[6] We shall provide additional analysis by investigating investors' behavior in A-share and B-share markets at a later point.

6.2. Rolling regression estimations

A number of econometric methods have been proposed to estimate the behavior of time-varying coefficients (Tsay, 2005; Chiang et al., 2007). The rolling regression method provides a simple, yet convenient way to estimate changing behavior when new information is included in the sample (Chiang, 1988). One important decision in conducting rolling regression estimations is the choice of window length. In Figures 1 and 2, we present herding coefficients for different markets based on the window length of one year by employing a rolling regression method. This window length is short enough to keep the estimation sensitive; however, it is long enough to preserve large sample properties.[7] The time-path plots of the herding coefficient (γ) in Figures 1 and 2 are for the Chinese (CN), Hong Kong (HK), Japanese (JP), and US markets using firm-level and industry-level data in deriving CSAD.

Figure 1. Plots of herding coefficients for four markets based on firm data.



[7] We also produce estimations of 60 days' length and 120 days' length with similar results. These estimations are available upon request.

Figure 2. Plots of herding coefficients for four markets based on industry data

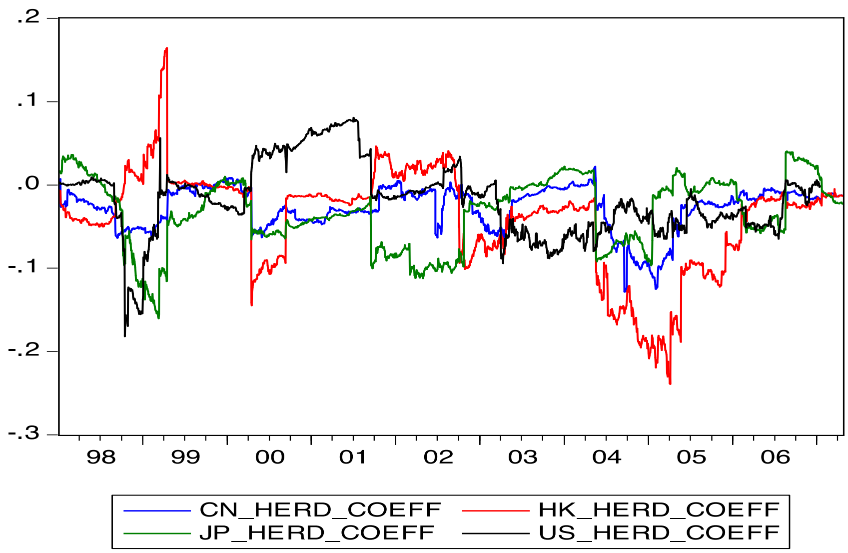
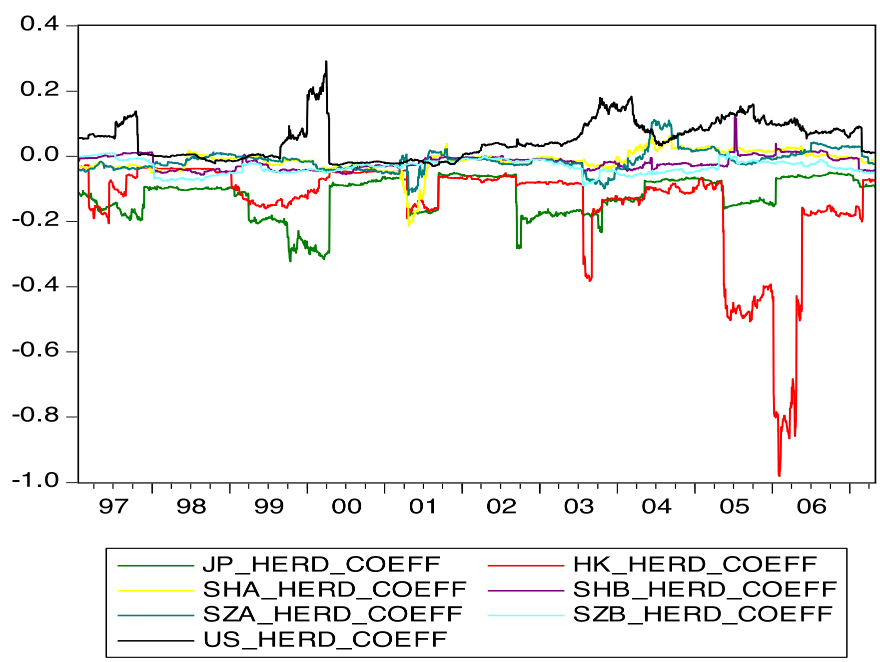


Figure 3. Plots of herding coefficients for seven markets based on firm data



A summary of statistics of herding coefficients derived from rolling regressions are reported in Table 3. The rolling regression is based on equation (3) using one-year moving window. Panels A and B contain both firm and industry data. Several empirical observations deserve our attention. First, although the estimated values of the herding coefficients range from negative to positive, the mean value for each individual market is negative; the exception is the US market in Panel A. This is consistent with our earlier finding that an estimated coefficient derived from the sample is negative, confirming the existence of herding behavior. Second, the estimated coefficients are sensitive to new information being included in the estimation and, hence, display a time-varying property as seen in the standard deviations. In all of the series, the mean values (in absolute value) in the HK market appear to be the highest and the standard deviations show the greatest volatility, especially in the case based on firm-level data (Panel A). The high mean value indicates that investors in the HK market have a higher probability of forming herding activity.

Table 3. Summary statistics of herding coefficients derived from rolling regressions

Panel A. Firm level

	γ_{CN}	γ_{HK}	γ_{JP}	γ_{US}
Mean	-0.055	-0.151	-0.121	0.048
Median	-0.051	-0.096	-0.099	0.039
Maximum	-0.001	-0.035	-0.050	0.292
Minimum	-0.255	-0.981	-0.322	-0.030
Std. Dev.	0.040	0.164	0.064	0.060
Skewness	-2.648	-2.690	-1.058	0.695
Kurtosis	11.688	10.382	3.494	2.881
Sum	-129.655	-354.819	-286.279	114.153
Observations	2973	2973	2973	2973

Panel B. Industry level

	γ_{CN}	γ_{HK}	γ_{JP}	γ_{US}
Mean	-0.028	-0.041	-0.034	-0.018
Median	-0.022	-0.025	-0.031	-0.015
Maximum	0.021	0.164	0.040	0.080
Minimum	-0.129	-0.239	-0.160	-0.182
Std. Dev.	0.026	0.061	0.042	0.043
Skewness	-1.176	-0.691	-0.418	-0.098
Kurtosis	4.282	3.961	2.395	3.688
Sum	-66.110	-97.131	-79.942	-42.338
Observations	2973	2973	2973	2973

Panel C. Chinese A- and B-share markets

	γ_{SHA}	γ_{SHB}	γ_{SZA}	γ_{SZB}
Mean	-0.005	-0.019	-0.003	-0.032
Median	-0.004	-0.017	-0.009	-0.028
Maximum	0.212	0.198	0.211	0.153
Minimum	-0.271	-0.163	-0.247	-0.150
Std. Dev.	0.060	0.036	0.064	0.034
Skewness	-0.689	1.262	0.318	0.490
Kurtosis	6.944	11.447	4.261	9.033
Sum	-13.318	-49.179	-7.871	-84.523
Observations	2610	2610	2610	2610

Notes: This table reports the statistics of the various markets' herding coefficient (γ) series from the one year rolling regression window on the following equation: $CSAD_t = \delta + \alpha R_{m,t} + \beta |R_{m,t}| + \gamma R_{m,t}^2 + \varepsilon_t$ where $CSAD_t$ is the equally weighted cross-sectional absolute deviation. $R_{m,t}$ is the equally weighted market portfolio return at time *t*. γ_{CN} refers to herding coefficient series generated from one-year rolling regression based on the above equation on Chinese market. γ_{HK}, γ_{JP} and γ_{US} are those from markets of Hong Kong, Japan and USA accordingly. Panel A is based on data consisting of firm stocks to construct the CSAD. Panel B is based on industry data of stocks. Panel C reports Shanghai A-share (SHA), Shanghai B-share(SHB), Shenzhen A-share (SZA) and Shenzhen B-share (SZB) separately. Numbers in parentheses are t-statistics based on Newey-West (1987) consistent standard errors. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

6.3. Evidence on correlations of herding behavior

In this section we conduct a regression analysis to investigate the correlation of herding behavior between Chinese ($i = CN$) and global markets. The estimated equation is given by:

$$\gamma_{i,t} = c + \eta\gamma_{j,t} + \theta\varepsilon_{i,t-1} + \varepsilon_{i,t} \tag{4}$$

where the dependent variable is the series of herding coefficients of the Chinese market, and the independent variable is the series of herding coefficients of global markets; $\gamma_{i,t}$ is the series of herding coefficients of the Chinese market; $\gamma_{j,t}$ is the series of herding coefficients of global markets (j = *US, HK* and *JP*); C, ϕ, θ , and η are constant coefficients; and $\varepsilon_{i,t}$ is the random shock term. To recall, both $\gamma_{i,t}$ and $\gamma_{j,t}$ were generated by rolling regressions in the model form of equation (3). These herding coefficients are likely to have serial correlation and should be filtered by fitting an MA(1) process as indicated by equation (4). The estimations were made by assuming a generalized error distribution (GED)[8] (Nelson 1991).

Table 4 contains the statistical results from examining herding correlations between the Chinese domestic markets and foreign markets.[9] The evidence clearly indicates that herding behavior in the Chinese market is positively correlated with that in the Hong Kong market in both measures of CSAD, while the correlation of herding behavior with that in the Japanese market is exhibited only at the industry level. However, we cannot find significant evidence to support a correlation of herding behavior between the Chinese market and the US market.

[8] In most cases, we fixed the scale of parameters in the GED to be 1.5 to maintain consistency. Brooks (2008, p. 406) notes that the GED is a very broad family of distributions that can be used for many types of series.

[9] Hong Kong is treated as foreign in the sense that is outside mainland China and has more mature and more open capital markets.

Table 4. The relation between Chinese and global markets' herding behavior

Panel A: Firm level						
Market	*C*	$\gamma_{HK,t}$	$\gamma_{JP,t}$	$\gamma_{US,t-1}$	MA(1)	$\overline{R}^2$
$\gamma_{CN,t}$	-0.047 (-43.73)***	0.025 (5.04)***			0.934 (162.98)***	0.71
$\gamma_{CN,t}$	-0.054 (-15.49)***		0.003 (0.10)		0.945 (81.89)***	0.72
$\gamma_{CN,t}$	-0.055 (-52.52)***			0.003 (0.23)	0.946 (142.95)***	0.72

Panel B: Industry level						
Market	*C*	$\gamma_{HK,t}$	$\gamma_{JP,t}$	$\gamma_{US,t-1}$	MA(1)	$\overline{R}^2$
$\gamma_{CN,t}$	-0.018 (-10.01)***	0.244 (8.24)***			0.901 (35.47)***	0.80
$\gamma_{CN,t}$	-0.022 (-14.06)***		0.168 (5.50)***		0.912 (48.07)***	0.72
$\gamma_{CN,t}$	-0.028 (-19.46)***			0.015 (0.56)	0.918 (53.37)***	0.70

Notes: The estimated equation for examining the correlation of herding behavior between the Chinese market (i = CN) and global markets (j = US, HK and JP) is given by $\gamma_{i,t} = c + \eta\gamma_{j,t} + \theta\varepsilon_{i,t-1} + \varepsilon_{i,t}$ where the dependent variable is the series of herding coefficient of the Chinese markets, and the independent variable is the series of herding coefficients of global markets. The herding coefficient is derived by fitting a rolling regression model expressed by: $CSAD_t = \delta + \alpha R_{m,t} + \beta|R_{m,t}| + \gamma R^2_{m,t} + \varepsilon_t$ where $CSAD_t$ is the equally weighted cross-sectional absolute deviation. $R_{m,t}$ is the equally weighted market portfolio return at time t. Numbers in parentheses are t-statistics based on Newey-West (1987) consistent standard errors. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

The lack of uniformly significant evidence may be clouded by the data aggregation. For instance, if the behavior of A-share investors in the Shanghai market is negatively correlated with that of investors in the US market, and the behavior of B-share investors in the Shanghai market is positively correlated with the behavior of investors in the US market, pooling all of the investors together may produce a less significant result in statistical inference. Thus, focusing on individual markets by dividing the entire market into A-share and B-share investors allows us to identify the underlying herding behavior and individual reactions to the US market. This approach can avoid information lost in aggregated data.

6.4. Evidence from Chinese A-share and B-share markets

To focus on individual market relationships, we develop estimations of equation (3) by separating the sample into A-share and B-share markets, and each market is further sorted into a listing on the Shanghai and Shenzhen stock exchanges, respectively. Panel A through Panel D in Table 5 report the estimates of Shanghai A (SHA), Shanghai B

(SHB), Shenzhen A (SZA), and Shenzhen B (SZB), respectively. The evidence shows that the coefficient on the $R_{m,t}^2$ term is negative and statistically significant in all of the test equations, suggesting that herding behavior exists in each of the Chinese markets.

Table 5. Estimates of herding equation based on firm data

Panel A: Shanghai A-share market

SHA	Model 1	Model 2	Model 3	Model 4	Model 5
C	2.093	2.331	2.327	2.320	2.328
	(40.36)***	(41.72)***	(41.66)***	(41.12)***	(41.60)***
$R_{m,t}$	-0.046	-0.073	-0.073	-0.073	-0.073
	(-3.98)***	(-7.18)***	(-7.14)***	(-7.16)***	(-7.18)***
$\left\|R_{m,t}\right\|$	0.293	0.091	0.091	0.090	0.091
	(6.48)***	(2.42)**	(2.42)**	(2.40)**	(2.41)**
$R^2_{m,t}$	-0.026	-0.020	-0.020	-0.020	-0.020
	(-3.73)***	(-2.69)***	(-2.69)***	(-2.68)***	(-2.69)***
$R^2_{m,HK,t}$			0.003		
			(1.80)*		
$R^2_{m,JP,t}$				0.015	
				(2.58)***	
$R^2_{m,US,t-1}$					0.003
					(0.64)
AR(1)		0.421	0.420	0.421	0.421
		(18.15)***	(18.12)***	(18.14)***	(18.10)***
AR(2)		0.291	0.291	0.292	0.291
		(10.73)***	(10.73)***	(10.85)***	(10.75)***
$\overline{R}^2$	0.05	0.41	0.41	0.41	0.41

Panel B: Shanghai B-share market

SHB	Model 1	Model 2	Model 3	Model 4	Model 5
C	1.661	3.125	3.184	3.095	3.135
	(34.77)***	(6.81)***	(6.85)***	(6.93)***	(6.63)***
$R_{m,t}$	-0.040	-0.028	-0.031	-0.028	-0.028
	(-3.11)***	(-9.98)***	(-11.05)***	(-9.54)***	(-9.63)***
$\left\|R_{m,t}\right\|$	0.245	0.116	0.119	0.114	0.117
	(5.68)***	(12.11)***	(12.64)***	(11.34)***	(11.36)***
$R^2_{m,t}$	-0.016	-0.014	-0.014	-0.013	-0.014
	(-2.43)**	(-13.26)***	(-13.81)***	(-12.97)***	(-12.7)***
$R^2_{m,HK,t}$			-0.008		
			(-10.09)***		
$R^2_{m,JP,t}$				0.008	
				(2.90)***	
$R^2_{m,US,t-1}$					0.007
					(1.59)
AR(1)		0.458	0.456	0.459	0.456
		(20.15)***	(19.88)***	(20.25)***	(19.75)***
AR(2)		0.500	0.502	0.497	0.502
		(22.67)***	(22.64)***	(22.51)***	(22.54)***
$\overline{R}^2$	0.07	0.47	0.48	0.48	0.48

Panel C: Shenzhen A-share market						Panel D: Shenzhen B-share market					
SZA	Model 1	Model 2	Model 3	Model 4	Model 5	*SZB*	Model 1	Model 2	Model 3	Model 4	Model 5
C	2.003	2.294	2.290	2.292	2.297	C	1.837	2.437	2.508	2.442	2.099
	(38.58)***	(43.38)***	(43.47)***	(43.25)***	(42.86)***		(39.49)***	(32.27)***	(14.67)***	(30.97)***	(29.57)***
$R_{m,t}$	-0.043	-0.074	-0.074	-0.074	-0.074	$R_{m,t}$	-0.039	-0.053	-0.054	-0.053	-0.049
	(-3.35)***	(-6.77)***	(-6.75)***	(-6.76)***	(-6.77)***		(-4.44)***	(-17.79)***	(-5.27)***	(-17.12)***	(-4.10)***
$\lvert R_{m,t}\rvert$	0.383	0.154	0.154	0.154	0.154	$\lvert R_{m,t}\rvert$	0.233	0.175	0.175	0.175	0.166
	(7.89)***	(4.32)***	(4.32)***	(4.32)***	(4.32)***		(5.62)***	(22.03)***	(4.09)***	(17.83)***	(2.90)***
$R^2_{m,t}$	-0.030	-0.023	-0.023	-0.023	-0.023	$R^2_{m,t}$	-0.019	-0.028	-0.028	-0.028	-0.019
	(-4.12)***	(-3.84)***	(-3.84)***	(-3.84)***	(-3.84)***		(-3.56)***	(-26.09)***	(-5.46)***	(-22.16)***	(-2.30)**
$R^2_{m,HK,t}$			0.003			$R^2_{m,HK,t}$			-0.002		
			(1.18)						(-0.55)		
$R^2_{m,JP,t}$				0.003		$R^2_{m,JP,t}$				-0.003	
				(0.47)						(-0.62)	
$R^2_{m,US,t-1}$					-0.004	$R^2_{m,US,t-1}$					-0.013
					(-0.59)						(-1.74)*
AR(1)		0.411	0.411	0.411	0.411	*AR(1)*		0.500	0.504	0.500	0.417
		(19.83)***	(19.81)***	(19.82)***	(19.76)***			(24.90)***	(13.35)***	(25.00)***	(10.51)***
AR(2)		0.292	0.291	0.292	0.292	*AR(2)*		0.377	0.377	0.378	0.299
		(9.90)***	(9.86)***	(9.89)***	(9.87)***			(18.05)***	(11.06)***	(17.92)***	(5.97)***
$\overline{R}^2$	0.10	0.41	0.41	0.41	0.41	$\overline{R}^2$	0.04	0.40	0.40	0.40	0.43

Notes: This table reports the regression estimates based on the following equation for Chinese markets. $CSAD_t = \delta + \alpha R_{m,t} + \beta\lvert R_{m,t}\rvert + \gamma R^2_{m,t} + \lambda R^2_{m,t} + \varepsilon_t$, where $CSAD_t$ is the equally weighted cross-sectional absolute deviation. $R_{m,t}$ is the equally weighted market portfolio return at time t. Numbers in parentheses are absolute t-statistics based on consistent standard errors. However, in some cases in the B-share markets, the GARCH(1,1) procedure is used in estimations, since the GARCH(1,1) effect is apparent. The estimated variance components are available upon request. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

By adding an incremental variable, the foreign stock return squared, to the estimated equation, as seen in the columns labeled Model 3 to Model 5 in Table 5, we find that only the coefficient on $R^2_{m,HK,t}$ in SHB and the coefficient on $R^2_{m,US,t-1}$ in SZB exhibit a negative sign and are statistically significant, meaning that only B-share investors herd with the Hong Kong market and the US market, and there is no evidence indicating that Chinese A-share investors herd with foreign markets.

As we noted in section 5, the empirical analysis based on equation (3) is static in nature, because using an incremental variable, foreign stock return squared, to explain the return dispersions of Chinese stocks does not wholly capture the dynamic herding behavior in Chinese markets in reaction to that in foreign markets. By employing a similar specification as represented by equation (4), we examine the relationship of the herding behavior in each Chinese market (*i = SHA, SHB, SZA, SZB)*) with that in each global market by conducting a significance test on the correlations of the herding coefficient series.[10] The estimated results are reported in Table 6. The testing results are rather impressive, as all of the equations show high *R*-squared values, ranging from 0.61 to 0.97; the null hypothesis that herding behavior in the Chinese market is independent of that in global markets is rejected. This is evident from the estimated values of the coefficients of γ. Interestingly, the herding behavior in A-share markets is negatively correlated with that in the foreign markets. This may reflect the difference in investors' reactions to market stresses. A possible reason for this negative correlation may be that movements of investors in the Chinese market are driven more by domestic government policy or regulatory changes than by global news, analyst reports, or media commentary as seen in the foreign markets.

The evidence in the B-share markets is quite contrary. The finding reported in Table 6 indicates that herding behavior in the B-share Chinese markets is positively correlated with that of global markets. This is not surprising, since the Chinese B-share markets are dominated by institutional investors from developed countries. Thus, we expect that these two groups react in a similar way and, in turn, display consistent behavior. This evidence leads to the conclusion that herding activity in B-share markets is not independent of global market behavior.

[10] The time series plots of herding coefficients for each Chinese market along with other foreign markets are present in Figure 3.

Does herding behavior in Chinese markets react to global markets?

Table 6. The relation between Chinese and global markets' herding behavior

Market	C	$\gamma_{HK,t}$	AR(1)	AR(2)	MA(1)	$\overline{R}^2$
Panel A: China and Hong Kong herding relation						
$\gamma_{SHA,t}$	-0.011 (-66.21)***	-0.028 (-18.05)***			0.847 (92.17)***	0.68
$\gamma_{SHB,t}$	-0.026 (-4.73)***	0.001 (0.52)	0.994 (791.96)***			0.95
$\gamma_{SZA,t}$	-0.014 (-126.76)***	-0.062 (-58.50)***	0.533 (207.27)**		0.505 (49.84)**	0.97
$\gamma_{SZB,t}$	-0.023 (-411.66)***	0.016 (18.09)***			0.858 (218.28)***	0.66

Market	C	$\gamma_{JP,t}$	AR(1)	AR(2)	MA(1)	$\overline{R}^2$
Panel B: China and Japan herding relation						
$\gamma_{SHA,t}$	-0.011 (-66.46)***	-0.095 (-57.10)***			0.838 (87.35)***	0.67
$\gamma_{SHB,t}$	-0.007 (-51.66)***	0.070 (56.29)***			0.879 (241.81)***	0.64
$\gamma_{SZA,t}$	-0.034 (-160.28)***	-0.099 (-36.67)***			0.854 (109.11)***	0.62
$\gamma_{SZB,t}$	-0.015 (-434.49)***	0.059 (51.87)***			0.840 (96.35)***	0.62

Market	C	$\gamma_{US,t-1}$	AR(1)	AR(2)	MA(1)	$\overline{R}^2$
Panel C: China and US herding relation						
$\gamma_{SHA,t}$	0.017 (9.15)***	-0.129 (-35.97)***	0.474 (2.50)**	0.474 (2.58)**	0.539 (2.92)***	0.97
$\gamma_{SHB,t}$	-0.006 (-180.56)***	0.012 (17.65)***			0.795 (98.56)***	0.62
$\gamma_{SZA,t}$	-0.015 (-2.34)**	-0.0043 (-2.59)***	0.966 (1117.4)		0.037 (3.34)***	0.97
$\gamma_{SZB,t}$	-0.031 (-40.34)***	0.046 (5.14)***			0.879 (94.36)***	0.69

Notes: The estimated equation for examining the correlation of herding behavior between Chinese markets (*i = SHA, SHB, SZA, SZB)* and global markets (*j = US*, *HK* and *JP*) is given by:

$\gamma_{i,t} = c + \sum_{s=1}^{p} \phi_i \gamma_{i,t-s} + \theta \varepsilon_{i,t-1} + \eta \gamma_{j,t} + \varepsilon_{i,t}$ where the dependent variable is the series of herding coefficients of the Chinese markets, and the independent variable is the series of herding coefficients of global markets. The herding coefficient is derived by fitting a rolling regression model expressed by: $CSAD_t = \delta + \alpha R_{m,t} + \beta |R_{m,t}| + \gamma R_{m,t}^2 + \varepsilon_t$ where $CSAD_t$ is the equally weighted cross-sectional absolute deviation. $R_{m,t}$ is the equally weighted market portfolio return at time *t*. Numbers in parentheses are t-statistics based on Newey-West (1987) consistent standard errors. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

7. Concluding remarks

This study examines the possibility of herding behavior among investors in the stocks listed on Chinese exchanges. Results based on daily data indicate that Chinese markets display herding behavior. This holds true whether stock dispersions are measured using firm-level data or industry-level data. This study finds that the stock return dispersion series, CSAD, display strong serial correlation. Not filtering the autocorrelation is likely to produce biased estimators. We further examine the possible impact arising from global markets. By controlling the foreign variables in the test equation, we find that the estimated herding coefficients remain significant and stable across different models.

Using a rolling regression method to estimate the herding equation, we find that the herding coefficient is sensitive to new information, displaying a time-varying property. By examining the possible co-variance of herding behavior across different markets, we find evidence that herding behavior in the aggregate Chinese markets is positively correlated with that of the Hong Kong market. Checking individual markets, we find that herding behavior in both the Shanghai and the Shenzhen A-share markets is negatively correlated with that of foreign markets, reflecting differences in the possession of information among the different groups of investors and differences in their reactions to the agents whose herding behavior they imitate. The evidence suggests that herding behavior in both B-share Chinese markets is positively correlated with that in the foreign markets. This evidence reinforces the finding that herding behavior in Chinese B-share markets is dominated by extreme movements developed in the global markets.

References

Bikhchandani, S., Hirshleifer, D., & Welch, I., 1992. A theory of fads, fashion, custom, and cultural change as informational cascades. Journal of Political Economy，100:992–1026.

Bush, Peter J., Mehdian, Seyed M. and Perry, Mark J., 2010. A Cross-Industry Analysis of Investors' Reaction to Information Surprises: Evidence from NASDAQ Sectors. The International Review of Accounting, Banking and Finance, Vol 2, No. 2, Summer 2010:85~103.

Boyer, B., Kumagai, T., &Yuan, K., 2006. How do crises spread? Evidence from accessible and inaccessible stock indices. Journal of Finance， 61:957-1003.

Brooks, C., 2008. Introductory econometrics for finance. Cambridge, UK: Cambridge University Press.

Chang, E.C., Cheng, J.W., & Khorana, A., 2000. An examination of herd behavior in equity markets: an international perspective. Journal of Banking and Finance，24:1651-1679.

Chen, G, Rui, O, & Xu, Y., 2003. When will investors herd? Evidence from the Chinese stock markets. Working Paper, University of Texas at Dallas. Retrieved from http://www.utdallas.edu/~yexiaoxu。

Chen, Y., Wang, C.-Y, & Lin, F.-L., 2008. Do qualified foreign institutional investors herd in Taiwan's securities market? Emerging Markets Finance and Trade，44: 62-74.

Chiang, T.C., 1988. The forward rate as a predictor of the future spot rate: a stochastic coefficient approach. Journal of Money, Credit and Banking， 20: 210-232.

Chiang, T.C., Jeon, B.N., & Li, H., 2007. Dynamic correlation analysis of financial contagion: evidence from Asian markets, Journal of International Money and Finance，26:1206-1228.

Chiang, T.C., & Zheng, D.Z., 2009. Empirical analysis of herd behavior in global equity markets: Evidence from industry stock returns, the 2009th ASSA Meetings, San Francisco, January 3-4, 2009.

Christie, W.G., & Huang, R.D., 1995. Following the pied piper: do individual returns herd around the market? Financial Analysts Journal， 51: 31–37.

Demirer, R., & Kutan, A.M., 2006. Does herding behavior exist in Chinese stock markets? Journal of International Financial Markets, Institutions and Money， 16:123-142.

Duffee, G.R., 2000. Asymmetric cross-sectional dispersion in stock returns: evidence and implications, Working Paper, U.C. Berkeley. www.haas.berkeley.edu/~duffee.

Gleason, K.., Mathur, I., & Peterson, M.A., 2004. Analysis of intraday herding behavior among the sector ETFs. Journal of Empirical Finance， 11:681-694.

Masih, R., & Masih, A. M., 2001. Long and short term dynamic causal transmission amongst international stock markets. Journal of International Money and Finance， 20: 563-587.

Nelson, D.B., 1991, Conditional heteroskedasticity in asset returns: A new approach. Econometrica 59(2): 347-70.

Newey, W.K., & West, K., 1987. A simple positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica， 55: 703-708.

Nofsinger, J., & Sias, R., 1999. Herding and feedback trading by institutional and individual investors. Journal of Finance， 54:2263-2295.

Shiller, R.J., 2005. Irrational exuberance. New York: Currency Doubleday.

Tan, L., Chiang, T.C., Mason, J, & Nelling, E., 2008. Herding behavior in Chinese stock markets: an examination of A and B shares. Pacific-Basin Finance Journal,16: 61-77.

Tsay, R.S., 2005. Analysis of financial time series. New York: Wiley.

Zhou, H., 2007. Herding in dual-share stock markets: evidence from China. Journal of Emerging Markets， 12:5-15.