New Measures of Herding Behavior and Cross-sectional Time Dispersion (CSTD) by IPO Firms in Chinese IPO Markets

Sunghwan Kim*   Professor, Kyungpook National University
Dongmin Lim   Professor, Gyeongsang National University
Jihyun Kim   Ph.D. Candidate, University of Missouri-Columbia

Abstract   In this paper, we develop a new way of measuring the herding behavior of market participants and test herding behavior among investors in Chinese IPO firms, compared with prior methods of herding measure developed by Christie and Huang (1995), Chang, Chen, and Khorana (2000), and Hwang and Salmon (2009). Our proposed new non-parametric herding measure, cross sectional time dispersion (CSTD), is defined differently as dispersion in IPO issuance timing, compared with traditional definitions of herding as dispersion in IPO returns or risk measure. Traditional CSSD, CSAD and beta herding measures do not provide statistically significant or consistent relationship between the herding measures and the IPO firms' initial or long-term returns. In contrast, the new measure of time herding, CSTD clearly and consistently indicates that investors are affected more by the herding behaviors of IPO firms than by those of investors in the IPO markets in China.

Ⅰ. Introduction

Researchers have long studied the behaviors of stock market participants and the effects that their behaviors have on stock prices. The behaviors of stock market participants have been influenced by factors like attitudes toward risk, investment horizons, risk-return dynamics, relative market performance, and behaviors of other market participants. Without perfect certainty with respect to future markets, investors tend to behave in a similar manner to their peers in many situations, behaviors usually called 'herding'.

A number of prior studies have proposed herding measures based on changes in daily returns in the secondary markets where a huge number of market participants determine their investment strategies mimicking others' behaviors. Those studies have usually assumed that the dispersions in stock returns and risks are related to herding measures but rarely test whether the measures are related to actual herding behaviors in the markets and applicable in predicting the behaviors of investors.

The measures of current herding, CSSD (cross-sectional standard deviation of returns), CSAD (cross-sectional absolute deviation of returns) and cross-sectional beta herding measures developed based on the behaviors of market participants by Christie and Huang (1995), Chang, Chen, and Khorana (2000), and Hwang and Salmon (2009) respectively, might be used as indicators of the market sentiments, but do not actually depict or represent the mimicking behaviors of actual market participants.

The purpose of this paper is to address this gap in the literature by providing an alternative way of measuring herding behaviors of buyers and sellers in the markets, as opposed to the currently used measures which only reflect the stock market returns as an indirect indicators of the market sentiment. To develop a new measure of herding in the stock market, unlike those developed for the secondary markets with a continuum of investors and buyers, we focus on the herding behavior of market participants in the context of Chinese IPOs, with specific attention given to the financing decisions

of IPO firms.

In the case of IPO markets like one in China, where the timing and amount of issuance are endogenously determined by prior market information in a government-controlled market, the traditional measures of investors' herding developed for the secondary market may not be applicable to the IPO market herding (Su and Fleisher, 1997; Fang, Shi, and Xu, 2012; Tan and Kim, 2016).

In this paper, we calculate herding applying the previous work of Christie and Huang (1995), Chang, Chen, and Khorana (2000), and Hwang and Salmon (2009) to the Chinese IPO markets and propose a new, our own non-parametric herding measure, "time herding," focusing on the cross-sectional with dispersion in timing of IPOs. In addition, we formally test the validity of our new measure, CSTD or cross-sectional time dispersion, by comparing those herding measures in terms of consistency as measures to apply in predicting market returns in the short-run and long-run after IPOs. We find that the new herding factor is very robust and consistent and thus outperforms traditional ones in estimating returns even in the Chinese markets with severe cyclical patterns as well as many other endogenous factors like government interventions in the stock markets.

Our study will contribute to the understanding of the herding behaviors in an IPO market more clearly, provide a new critical factor in asset pricing, and introduce a various types of intertemporal herding measure in asset pricing in addition to stock returns, risks and other market and institutional factors. Most importantly, the new measure can be applied to various future studies in predicting the behaviors of both investors and issuing firms of securities in addition to the behaviors in the traditional measures such as returns and risks in asset pricing.

The remainder of the paper is organized as follows. In Section Ⅱ, we study related literature, followed by the proposition of hypotheses and empirical models in Section Ⅲ. In Section Ⅳ, we describe data and provide results in the interest of a discussion of empirical tests. Finally, in Section Ⅴ, we conclude and discuss our findings.

Ⅱ. Literature Review

1. Herding Behavior

Herding can be a rational or irrational form of investor behavior. The rational aspect of herding focuses on the principal-agent problem, in which investors mimic the actions of others, completely disregarding their own belief in the market (Scharfstein and Stein, 1990; Rajan, 1994). The irrational aspect focuses on the psychological phenomenon of investors' following others by ignoring their own prior beliefs and blindly trusting in those of others (Bikhchandani et al., 1992; Welch, 1992).

According to early literature (Smidt, 1968; Zweig, 1973; Black, 1986; Baker and Wurgler, 2006), sentiment is linked to speculative bubbles, biased expectations, and noise. While there is still no agreed-upon definition in the literature, DeLong et al. (1990a) defined it as the investors' formation of beliefs on future cash flows and investment risks, with no justification given existing facts. Shleifer (2000) claims that sentiment reflects the common judgment errors made by a substantial number of investors, rather than uncorrelated random mistakes, while Baker and Wurgler (2006) define sentiment as the tendency of investors to speculate based on waves of optimism and pessimism.

Similar to those waves of optimistic and pessimistic sentiment (Baker and Wurgler 2007), financial markets are influenced by the herding behavior of investors or financial institutions. In this paper, we focus on herding behaviors in the stock market as defined by Lakonishok, Shleifer and Vishny (hereafter LSV, 1992), as the average tendency of a group of investors selling or buying at the same time.

Generally, there are two major streams of study regarding herding behavior in the financial market. One fixates on investors' herding behavior at individual stock level, as was the case in LSV (1992). They measured the herding factor conditioned on past stock performance and using the investment behavior panel data of 341 fund managers

at 769 different tax-exempt equity funds to find evidence of herding behavior in the United States. However, they reported no significant herding behavior and concluded that it is hard to evaluate the impact of herding behavior without knowing the price elasticity of demand for each stock. Grinblatt, Titman, and Wermers (1995) examined fund portfolio data from 1974-1984 applying the LSV method. Their results were consistent for the fund market, with an average herding factor of 2.7, demonstrating no herding behavior. Wermers (1999) extended the LSV method to mutual funds between 1975 and 1994 in an effort to identify herding behavior in mutual funds. Wermers (1999) concluded that the herding behavior in mutual funds affects stock returns.

The other one focuses on market-level investor herding behavior as in the study of Christie and Huang (1995). Christie and Huang (1995) captured herding behavior and its effect on equity returns under market stress situations using the cross-sectional standard deviation (CSSD) of market returns. They used two sets of return data—daily and monthly—in their study of NYSE and AMEX firms from July 1962 to December 1988, and the monthly returns from NYSE firms from December 1925 to December 1988. They concluded that herding behavior does not appear during periods of market stress, evidenced by its insignificant effect on equity returns. Chang, Chen, and Khorana (2000) further developed the model using the cross-sectional absolute deviation (CSAD) of returns to capture herding behavior in Japan, South Korea, Hong Kong, and Taiwan, but only found strong evidence of herding behavior in South Korea and Taiwan.

Similarly, Hwang, and Salmon (2009) reported that herding behavior does not appear in market stress situations, using their new non-parametric herding measure, "beta herding." As the name itself indicates, beta herding measure focuses on the cross-sectional variability of betas. Using the beta herding measure, they empirically proved that herding significantly appears when investors are assured of the market's future direction, rather than in uncertain market stress situations.

2. IPO and Chinese Market

Su and Fleisher (1997) identified some unique features of the Chinese IPO markets. First, the government, or the China Securities Regulatory Commission (CSRC), sets the number of shares to be issued initially each year. Second, many state-owned enterprises (SOEs) have been privatized through IPO markets. Third, the IPOs in Chinese markets have shown very extreme underpricing patterns. Fourth, in practice, the CSRC generally intervenes in the IPO market by delaying IPO applications during secondary market recessions and reopening IPO applications during secondary markets booms.

The CSRC was established to stabilize markets and support equity financing through the markets efficiently. To achieve its goals, the Commission tends to control the timing and quantity of IPO issuance. Sometimes, the Commission orders the shut-down of markets for a period of time before later reopening them. The CSRC changes the supply and demand of stocks in IPO markets, while also impacting supply and demand in the secondary stock market, thus distorting the market system (Fang, Shi, and Xu, 2012).

Fang et al. (2012) claimed that Chinese IPO markets are limited in capacity and closed for foreign investors at least some of the time. As such, the timing and size of an IPO can have a major influence on the supply of stocks, the market return, and investor sentiment, thus affecting long-term investments. The IPO firms that enjoyed higher initial returns reportedly experienced a larger decline in the long-term post-IPO market (Ritter, 1991; Loughran and Ritter, 1995; Lyandres et al., 2008; Tan and Kim, 2016).

Chen et al. (2015) recently reported that the lead-lag relationship between initial returns and IPO stock supply is not statistically significant due, perhaps, because of many institutional differences in Chinese IPO markets. They also report that in many other market economies like Hong Kong or the USA, IPO issuance size affects past and future IPO market performance.

Zheng, Li, and Zhu (2015) examined how institutional investor herding affects future

excess stock returns in Chinese stock markets. Using the collected data of institutional investors' holding period information in Chinese stock markets, they further examined whether the herding effect differs by various time horizons in future excess stock returns. They concluded that herding is positively correlated with both short- and medium-term excess returns, but is negatively correlated with long-term excess returns.

Unlike most previous studies in this area focusing on stock market returns, Tan and Kim (2016) focus on lags in IPO timing and IPO volume between IPOs during a specific period of time for the first time in a way to reflect IPO-firm herding behavior as opposed to the behavior of investors, who use stock market returns as a signal of herding. They report that IPO firms that file following many previous IPOs contribute to a hot period in IPO markets characterized by high initial returns and volume that is extremely underpriced, ultimately leading to firms underperforming in the long run.

Ⅲ. Hypotheses and Test Models

1. Hypotheses

Following Hwang and Salmon (2009) and Zheng et. al (2015), the following hypothesis is posited to identify the effects of herding on firm performance. Specifically, we will use the three herding measures (CSSD, CSAD, and beta herding) used in prior studies.

Hypothesis 1: Herding positively affects the initial market returns of IPO firms.

According to Christie and Huang (1995), herding can be proxied by the volatility of returns, which is the intuition of the CSSD (cross-sectional standard deviation of returns) measure. Thus, when this dispersion of returns is low, herding behavior can be observed in the market. When herding behavior is present in the market, the initial market

return will be low due to the irrational behavior. Therefore, the correlation between CSSD measures and an IPO firm's initial market returns would be positively correlated and move in the same direction. While they are developed for cross-sectional return data for the same period, IPO returns are provided on a time span with lags and leads. Without considering timing effects, we simply test the effects of simultaneous cross-sectional herding, CSSD, using our test models and dataset.

Hypothesis 1-1: Herding measured by CSSD is positively correlated with the initial market returns of IPO firms.

Chang et. al (2000) proposed the CSAD (cross-sectional absolute deviation of returns) measure, a similar but slightly different measure, as a means of detecting herding behavior. They claimed that when individuals make irrational decisions, the assumption of a linear and increasing relationship would no longer hold, and that using CSSD as a measure would be less accurate. We use the CSAD measure to examine the robustness of the relationship between herding behavior and the performance of IPO firms.

Hypothesis 1-2: Herding measured by CSAD is positively correlated with the initial market returns of IPO firms.

In introducing "beta herding," a new herding measure, Hwang and Salmon (2009) focused on the cross-sectional variability of betas rather than focusing on the cross-sectional variability of returns. By doing this, we can reflect the herding behavior impact more directly, relative to precious measures.

Hypothesis 1-3: Herding measured using the beta herding factor is positively correlated with the initial market returns of IPO firms.

According to Zheng et al. (2015), the effect of herding on stock market returns differs on the basis of time length. When examining the correlation between stock market returns and herding in the long run, the results were opposite those seen in the short-run market return case.

Similarly, Tan and Kim (2016) reported that this reversal in results also occurs in the IPO market case. As noted previously, we observe higher herding measured by any methods of cross-sectional standard deviation, cross-sectional absolute deviation and beta herding indicates, less irrational decisions. The effect of herding on market returns will decrease over time, which means that the traditional herding measures and long-term market returns are negatively correlated and move in opposite directions. Based on these prior studies we posit the following hypothesis:

Hypothesis 2: Herding measured by CSSD, CSAD or beta is negatively related to the long-term market returns of IPO firms.

Unlike most previous studies in this area focusing on stock market returns, Tan and Kim (2016) focus on lags in IPO timing and IPO volume between IPOs during a specific period of time for the first time in a way to reflect IPO-firm herding behavior as opposed to the behavior of investors, who use stock market returns as a signal of herding.

They report that IPO firms that file following many previous IPOs contribute to a hot period in IPO markets characterized by high initial returns and volume that is extremely underpriced, ultimately leading to firms underperforming in the long run. Because of the distinctive characteristics of the IPO data, our models apply CSTD, a new herding factor, using the distance in the IPO period developed similarly to the CSSD measures of Christie and Huang (1995).

Hypothesis 3: Herding measured by CSTD negatively affects the initial market returns of IPO firms.

As in the many prior studies supporting the winners' curse due to information asymmetry, the IPO firms in herding in a specific period of time will have higher initial stock market prices resulting on severe underpricing enough to conceal the higher offer price due to hot sentiments in the early stage of the secondary markets, the effect of herding on stock market returns differs on the basis of time length (Zheng et al., 2015).

When examining the correlation between stock market returns and herding in the long run, the results were opposite those seen in the short-run market return case. Similarly, Tan and Kim (2016) reported that this reversal in results also occurs in the IPO market case. Based on these prior studies we posit the following hypothesis:

Hypothesis 3-1: Herding measured by CSTD positively affects the long-term market returns of IPO firms.

2. Empirical Models

Our study focuses on two issues in the context of IPOs that are still under debate with respect to short-term underpricing in the primary market and long-term underperformance in the secondary market. We examine these issues with a specific focus on the effects of IPO-firm herding behavior among firms that file for IPO issuance during or after a hot period in IPO markets that are characterized by high initial returns and high volume.

These firms do this in order to take advantage of easy fund raising with high initial returns for themselves and new investors, though such returns can often come at the expense of long term-oriented investors. In effect, we are studying whether herding in Chinese IPO markets by IPO firms can adversely affect underpricing in the initial issuance market, and whether herding has long-lasting effects in China following an IPO.

To introduce herding as market information the way that Tan and Kim (2016) did

for this empirical study, we revise their empirical test models as follows. We use the initial returns (IR) as a measure of underpricing, calculated as the difference between the opening price in the secondary market minus the IPO price, divided by the IPO price, as in the empirical models used in Tan and Kim (2016). The models for each regression that uses different herding proxies are as follows:

[Model 1]

$$IR_{i,t} = \beta_0 + \beta_1 CSSD_{i,t} + \beta_2 Shenzhen\_D_{i,t} + \beta_3 State\_SH_{i,t-1} + \beta_4 Fgn\_SH_{i,t-1}$$
$$+ \beta_5 MktSh\_Uw_{i,t} + \beta_6 Mkt\_Return_{i,t} + \beta_7 Numb\_IPO_{i,t} + \beta_8 Sub\_R_{i,t}$$
$$+ \beta_9 ROA_{i,t-1} + \beta_{10} Debt\_R_{i,t-1} + \beta_{11} LnMV_{i,t} + \varepsilon_i \tag{1}$$

Note: i denotes firm i, while t denotes year t

$IR_{i,t}$: Initial returns of IPO firms, [(Open price−Offer price)/Offer price]

$CSSD_{i,t}$: Cross−sectional standard deviation of returns

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

$Shenzhen_{i,t}$: Dummy variable for firms listed on Shenzhen Exchange

$State\_SH_{i,t-1}$: State share variable

$Fgn\_SH_{i,t-1}$: Foreign share variable

$MktSH\_Uw_{i,t}$: IPO underwriter's market share during the year

$Mkt\_Return_{i,t}$: Value−weighted market return 30 days prior to the IPO

$Numb\_IPO_{i,t}$: Number of IPO firms in a month that went public prior to the IPO

$Sub\_R_{i,t}$: Subscription ratio of the IPO

$ROA_{i,t-1}$: Return on assets. [Net Income(t−1)/Assets(t−2)]

$Debt\_R_{i,t-1}$: Leverage ratio. [Debts(t−1)/Assets(t−1)]

$LnMV_{i,t}$: Market value of the firm in natural logarithm

$\varepsilon_{i,t}$: Error terms in estimated returns

[Model 2]

$$IR_{i,t} = \beta_0 + \beta_1 CSAD_{i,t} + \beta_2 Shenzhen\_D_{i,t} + \beta_3 State\_SH_{i,t-1} + \beta_4 Fgn\_SH_{i,t-1}$$
$$+ \beta_5 MktSH\_Uw_{i,t} + \beta_6 Mkt\_Return_{i,t} + \beta_7 Numb\_IPO_{i,t} + \beta_8 Sub\_R_{i,t}$$
$$+ \beta_9 ROA_{i,t-1} + \beta_{10} Debt\_R_{i,t-1} + \beta_{11} LnMV_{i,t} + \varepsilon_{i,t} \tag{2}$$

$CSAD_{i,t}$: Cross-sectional absolute deviation of returns

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

[Model 3]

$$IR_{i,t} = \beta_0 + \beta_1 H\_Beta_{i,t} + \beta_2 Shenzhen\_D_{i,t} + \beta_3 State\_SH_{i,t-1} + \beta_4 Fgn\_SH_{i,t-1}$$
$$+ \beta_5 MktSH\_Uw_{i,t} + \beta_6 Mkt\_Return_{i,t} + \beta_7 Numb\_IPO_{i,t} + \beta_8 Sub\_R_{i,t}$$
$$+ \beta_9 ROA_{i,t-1} + \beta_{10} Debt\_R_{i,t-1} + \beta_{11} LnMV_{i,t} + \varepsilon_{i,t} \tag{3}$$

$H\_Beta_{i,t}$: Cross-sectional beta herding measure of individual and market returns

$$H\_Beta_{m,t} = \frac{1}{N_t} \sum_{t=1}^{N_t} (\beta_{i,m,t} - 1)^2$$

[Model 4]

$$IR_{i,t} = \beta_0 + \beta_1 CSTD_{i,t} + \beta_2 Shenzhen\_D_{i,t} + \beta_3 State\_SH_{i,t-1} + \beta_4 Fgn\_SH_{i,t-1}$$
$$+ \beta_5 MktSH\_Uw_{i,t} + \beta_6 Mkt\_Return_{i,t} + \beta_7 Numb\_IPO_{i,t} + \beta_8 Sub\_R_{i,t}$$
$$+ \beta_9 ROA_{i,t-1} + \beta_{10} Debt\_R_{i,t-1} + \beta_{11} LnMV_{i,t} + \varepsilon_{i,t} \tag{4}$$

$CSTD_{i,t}$: Cross-sectional time dispersion in IPO timing for 30 previous IPOs, measured as the number of days in natural logarithm between the specific IPO i and its immediately-preceding IPO j

$$CSTD_t = ln\left[\sqrt{\frac{\sum_{i=2}^{30}(d_{i,j} - \bar{d}_{i,30})^2}{N-1}}\right]$$

To test the long-term effect of IPO firm herding behaviors, we introduce the following empirical models below using buy-and-hold abnormal returns (BHAR) for each year, three years, and five years after IPOs for brevity in reporting, following Tan and Kim (2016) for regression models.

$$
\begin{aligned}
BHAR_{i,t} = {}& \beta 0 + \beta_1 CSSD_{i,t-k} + \beta_2 H\_Beta_{i,t-k} + \beta_3 CSTD_{i,t-k} + \beta_4 State\_SH_{i,t-1} + \beta_5 Fgn\_SH_{i,t-1} \\
& + \beta_6 MktSH\_Uw_{i,t} + \beta_7 Mkt\_Return_{i,t} + \beta_8 Numb\_IPO_{i,t} + \beta_9 Sub\_R_{i,t} + \beta_{10} Debt\_R_{i,t-1} \\
& + \beta_{11} ROA_{i,t-1} + \beta_{12} LnMV_{i,t} + \varepsilon_{i,t} \quad\quad\quad\quad\quad (5)
\end{aligned}
$$

$BHAR_{i,t-k}$: Buy-and-hold abnormal returns of an IPO firm for k years after IPOs

where $BHAR_{i,d} = \prod_{d=1}^{n}(1 + r_{i,d}) - \prod_{d=1}^{n}(1 + r_{m,d})$, for n days after IPO.

Ⅳ. Empirical Studies

1. Data and Samples

The data used in this study are obtained from the China Center for Financial Research (CCFR), China Stock Market and Stock Research Database, and the GTA Information Technology, Ltd. database. The sample period includes years 2003 to 2015, and 1,409 firms with the financial and non-financial information required for this study out of a possible 1,676 included in the original dataset. We additionally excluded firms with extreme values five standard deviations outside of the mean from the sample, as well as those in the financial sector that applied different accounting principles.

The numeric information of all firms in the database and samples used by year are presented in ⟨Table 1⟩. The IPO markets were distinctively small in 2005 and 2013 with only 14 and 1 firms in the sample, respectively. Additionally, the numbers of firms

〈Table 1〉 Number of Samples Used by Year and Exchange

Year	All Firms (A)	Sample Used (B)	Proportion (C=B/A)	Shenzhen (D)	Shanghai (E)	Proportion (F=D/A)
2003	67	38	56.7%	0	38	0.0%
2004	100	83	83.0%	39	44	47.0%
2005	15	14	93.3%	12	2	85.7%
2006	66	61	92.4%	52	9	85.2%
2007	126	112	88.9%	92	20	82.1%
2008	77	61	79.2%	55	6	90.2%
2009	99	96	97.0%	88	8	91.7%
2010	349	295	84.5%	277	18	93.9%
2011	282	274	97.2%	241	33	88.0%
2012	155	130	83.9%	112	18	86.2%
2013	2	1	50.0%	1	0	100.0%
2014	125	106	84.8%	76	30	71.7%
2015	213	138	64.8%	93	45	67.4%
Total	1,676	1,409	84.1%	1,138	271	80.8%

〈Table 2〉 Summary Statistics for Variables Used

Variable	Observation	Mean	Median	Std. Dev.	Min	Max
IR	1,409	0.583	0.4400	0.665	−0.263	5.381
BHAR_3Y	1,409	0.591	0.0965	1.813	−5.671	33.131
CSSD	1,409	1.779	0.4183	6.818	0.000	82.946
CSAD	1,409	1.007	0.3466	2.065	0.086	22.032
H_Beta	1,409	1.278	1.0941	0.742	0.193	5.101
CSTD	1,409	2.624	2.5334	1.687	0.414	9.667
Shenzhen	1,409	0.769	1.0000	0.421	0.000	1.000
State_SH	1,409	0.039	0.0000	0.160	0.000	1.000
Foreign_SH	1,409	0.011	0.0000	0.058	0.000	0.589
MktSH_Uw	1,409	0.031	0.0147	0.047	0.000	0.224
Mkt_Return	1,409	0.781	0.5839	0.655	−0.050	3.703
Numb_IPO	1,409	22.382	23.0000	11.386	1.000	48.000
Sub_R	1,409	509.525	190.3917	791.383	0.000	7050.695
Debt_R	1,409	0.481	0.4871	0.171	0.000	0.948
ROA	1,409	0.149	0.1237	0.109	−0.005	0.951
Ln_MV	1,409	21.974	21.8117	0.990	20.086	29.716

in each stock market are provided.

〈Table 2〉 presents the mean, median, standard deviation, and range with the minimum

and maximum values of most variables used in this study. Some extreme values are still included when the exclusion of exorbitant outliers does not affect the result of empirical tests substantially.

We mainly focus on two stock return variables, the initial returns (IR) and buy-and-hold abnormal returns (BHAR_3Y). The four proxies of herding behavior used in this study are the cross-sectional standard deviation (CSSD), cross-sectional absolute deviation (CSAD), beta herding (H_Beta), and natural logarithm of cross-sectional distance dispersion (CSTD).

The average of the initial return (IR) for the selected sample of 1,409 IPO firms is 58.3%. The mean of BHAR_3Y is about 59.1%, the median is 9.65%, the minimum is −567.1%, and the maximum is 331.31%. The CSSD had a mean of 177.9% and a median of 41.83%. Similarly, the mean of the CSAD was 100.7% and the median was 34.66%. The number of days in time herding in natural logarithm is 2.624 on average while that of beta herding in return is 127.8%. The mean of the firm's government share variable (State_SH), was about 3.9%, and the average of the firm's foreign share (Foreign_SH) was about 1.1%.

2. Correlation Analyses

⟨Table 3⟩ presents the Pearson correlations between the variables used in this study. For brevity, we only explain those correlations between dependent variables (IR and BHAR_3Y) and other major independent variables of concern.

The correlation between initial returns (IR) and three-year buy-and-hold abnormal return (BHAR_3Y) was negative and statistically significant at the 1% level. The correlation between initial return (IR) and CSSD factor was negative, but statistically insignificant.

That between initial return (IR) and CSAD was negative, statistically significant at the 5% level. However, the correlation between initial return (IR) and three other proxies (CSSD, H_Beta, and CSTD) were all positive and statistically significant. On the other hand, all four proxies showed a significant positive correlation with the three-year return (BHAR_3Y).

〈Table 3〉 Pearson Correlation Coefficients between Variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
BHAR_3Y	−0.124 ***														
CSSD	−0.043	0.081 **													
CSAD	−0.079 **	0.077 **	0.865 ***												
H_Beta	−0.138 ***	0.068 *	0.295 ***	0.269 ***											
CSTD	−0.244 ***	0.223 ***	0.513 ***	0.621 ***	0.152 ***										
Shenzhen	0.010	−0.006	−0.364 ***	−0.602 ***	−0.181 ***	−0.409 ***									
State_SH	0.099 ***	−0.054 **	0.015	0.095 ***	−0.043	−0.006	−0.269 ***								
Foreign_SH	−0.075 ***	0.068 ***	0.058 **	0.079 ***	0.014	0.178 ***	0.000	−0.034							
MktSH_Uw	−0.034	0.030	0.104 ***	0.163 ***	0.001	0.139 ***	−0.176 ***	0.132 ***	0.046 *						
Mkt_Rturn	0.454 ***	−0.046 *	0.002	−0.052 **	−0.038	−0.212 ***	−0.120 ***	0.128 ***	−0.062 **	0.002 *					
Numb_IPO	−0.282 ***	0.141 ***	0.064 **	0.058 **	0.069 ***	0.217 ***	0.216 ***	−0.161 ***	0.052 **	−0.005	−0.318 ***				
Sub_R	0.356 ***	−0.046 **	−0.068 ***	−0.119 ***	−0.064 **	−0.249 ***	−0.136 ***	0.063 **	−0.078 ***	−0.105 ***	0.492 ***	−0.370 ***			
Debt_R	0.078 **	−0.109 ***	−0.002	0.048 *	−0.047 *	−0.143 ***	−0.221 ***	0.109 ***	−0.082 ***	−0.019	0.150 ***	−0.173 ***	0.126 ***		
ROA	−0.108 ***	0.001	−0.044 *	−0.096 ***	0.014	−0.015	0.241 ***	−0.148 ***	0.035	0.021	−0.043	0.049 *	−0.118 ***	−0.549 ***	
Ln_MV	0.055 **	−0.194 ***	0.070 ***	0.209 ***	−0.047 *	0.019	−0.247 ***	0.291 ***	−0.037	0.304 ***	0.041	0.041	−0.310 ***	0.172 ***	0.042

Notes:1. Numbers in parentheses: (1) for IR, (2) for BHAR_3Y, (3) for CSSD, (4) for CSAD, (5) for H_Beta, etc., respectively.
2. ***, ** and * denote a statistical significance at 1%, 5% and 10% in two-tailed tests, respectively.

The correlation between the three-year buy-and-hold return and government ownership (State_SH) was positively significant at the 1% level, while The correlation between the three-year buy-and-hold return and the foreign share (Foreign_SH) was negatively correlated at the 1% level. There was no significant correlation between the underwriter's market share and the three-year buy-and-hold return (BHAR_3Y). The correlation between initial returns (IR) and the number of IPOs in a previous month

(Numb_IPO) was negative and significant at 1% level.

The correlations between the initial return and subscription ratio (Sub_R), leverage (Debt_R), and natural logarithm of market value of IPO firm (Ln_MV) were all positive and statistically significant. The significantly high multilateral correlations among independent variables might cause a serious multicollinearity problem with distorted test results in multivariate regressions.

3. Group Mean Tests

⟨Table 4⟩ presents the results from group mean tests, assuming unequal variances, for differences in the means of the two groups: IPO firms on the Shenzhen Exchange and IPO firms on the Shanghai Exchange. There are two major exchanges in mainland China with the second largest in the world after that of the United States. The Shanghai exchange is the largest in China with mostly large, state-owned firms, while the Shenzhen exchange usually trades the shares of smaller, more entrepreneurial and privately owned firms, more innovative and more profitable than the state-owned ones.

⟨Table 4⟩ Group Mean Comparison Tests between Shenzhen and Shanghai Exchanges

Variables	Shenzhen (A)	Shanghai (B)	Difference (B-A)	t-statistic
IR	0.586	0.571	−0.001	−0.37
BHAR_3Y	0.585	0.610	0.025	0.21
CSSD	0.422	6.322	5.810***	15.03
CSAD	0.348	3.350	3.002***	28.76
H_Beta	1.206	1.531	0.325***	7.027
CSTD	2.247	3.887	1.640***	17.24
State_SH	0.157	0.118	0.102	10.75
Foreign_SH	0.011	0.011	0.000	−0.01
MktSH_Uw	0.027	0.046	0.019***	6.85
Mkt_Return	0.738	0.925	0.187***	4.66
Numb_IPO	23.728	12.889	−5.840***	−8.51
Sub_R	450.715	705.788	255.073***	5.27
Debt_R	0.461	0.550	0.081***	8.71
ROA	0.163	0.101	−0.062***	−9.54
Ln_MV	21.840	22.420	0.580***	9.80

Therefore most hi-tech firms are listed on Shenzhen Exchange, as in the cases of NASDAQ or KOSDAQ. With such differences between the two, we surmise that IPO firms are different in many traits and thus in their behaviors of those IPO firms in timing and pricing, and that the investors respond differently to the market and corporate decisions. Most prior studies mentioned in this study regarding the Chinese IPO markets study the markets as a whole and in two separate groups (Lowry and Schwert, 2002; Tan and Kim, 2016).

Considering two different major stock exchanges in mainland China, we test whether there are differences between the Shanghai and Shenzhen exchanges.

The initial returns (IR) from IPOs in the Shenzhen market were higher, on average, by 0.1% than returns for IPO firms that listed in the Shenzhen market. The buy-and-hold abnormal return for three years (BHAR_3Y) was relatively larger, on average, for Shanghai-listed firms. However, both results are insignificant. The result of other variables was generally larger for the firms in the Shanghai market, although some were not statistically significant. The differences between the two groups of IPO firms tested in this section lead to subgroup regressions in the following empirical test part.

4. Regression Analysis

4.1. Effects of Herding on IPO Underpricing

⟨Table 5⟩ shows the effects of traditional cross-sectional standard deviation (CSSD) in stock returns on IPO underpricing. It is used to measure investor herding behavior during extreme market moments (upper 1% and lower 1% market return observations), where investors mimic others whenever market returns reach a peak or trough. When investors observe maximum returns in the markets, they start to follow each other's behavior to realize maximal returns on their investments. The same is true when investors observe minimum returns in the market, as they mimic others to avoid the maximal losses on their investments. Thus, in the context of the full sample and separately,

〈Table 5〉 Effect of IPO Herding Using Cross Sectional Standard Deviation on Initial Returns

Variables	(1) Full Samples		(1-1) Shenzhen Exchange		(1-2) Shanghai Exchange	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
CSSD	0.0031**	2.25	−0.1752***	−2.58	0.0011	1.14
Shenzhen	0.2849***	6.46	−	−	−	−
Govt_SH	0.0075	0.06	0.2012	0.74	0.0924	0.70
Foreign_SH	−0.2968**	−2.51	−0.2465	−1.62	−0.2705*	−1.84
MktSH_Uw	−0.5971	−1.51	−0.4226	−0.81	−1.0891**	−2.20
Mkt_Return	0.3243***	8.30	0.3790***	7.95	0.1114**	1.98
Numb_IPO	−0.0094***	−6.88	−0.0091***	−5.29	−0.0069***	−3.34
Sub_R	0.0002***	5.54	0.0002***	4.20	0.0001***	2.93
Debt_R	−0.4550***	−4.29	−0.4597***	−3.43	−0.7044***	−3.54
ROA	−1.0533***	−6.50	−1.0428***	−5.45	−1.2410***	−3.33
Ln_MV	0.1316***	5.98	−0.1753***	5.15	0.0782***	2.71
Constant	−2.2725***	−4.99	−2.9125***	−4.24	−0.7193	−1.29
Obs. (Firms)	1,478		1,138		340	
R^2	0.2908		0.3303		0.2175	
F test	26.38***		23.80***		8.89***	
VIF	1.49		1.37		1.47	

Notes: ***, ** and * denote statistical significances at the 1%, 5%, and 10% levels in two-tailed tests, respectively.

we examine the cases of the two stock exchanges in mainland China. For the test statistics, we use White (1980) heteroskedasticity-consistent standard errors in regressions.

In the full sample case, CSSD shows a positive effect on the initial returns of IPOs at the 5% significance level, which might indicate more severe IPO underpricing or plausible overpricing of the beginning price in the secondary market due to investor herding behavior.

However, for firms listed on the Shenzhen Exchange, CSSD shows a significant negative effect on IPO underpricing due, perhaps, to IPO-firm herding behavior for higher offer prices, which could lead to less herding behavior in the initial market. The results for IPO firms on the Shanghai Exchange were very similar to those of the whole sample, though they were not statistically significant for the CSSD herding factor at the 10% level in a two-tailed test.

Government shareholdings (Govt_SH) have an insignificant positive effect on the initial returns of the full sample and two sub-samples. On the contrary, the foreign share

(Foreign_SH) has a negative influence on the initial returns of IPOs, though that influence is only significant at the 10% level in the Shanghai context.

The market share of underwriters (MktSH_Uw) only has a negative effect on initial returns (IR) at a significance level of 10% for the Shanghai-listed firms, while the results for full-sample and Shenzhen Exchange-listed firms are statistically insignificant. The value-weighted monthly market return (Mkt_Return) has a positive effect on initial returns, significant for all three groups.

The number of prior IPOs for a month (Numb_IPO), leverage (Debt_R) and return on assets (ROA) shows a significant negative effect on the initial return of a subsequent IPO, for the full sample and both sub-samples. On the contrary, the subscription ratio (Sub_R) and the IPO firm's market value (Ln_MV) shows a significant positive impact on initial returns (IR) for the full sample and both sub-samples.

⟨Table 6⟩ shows the regression results for the effect of CSAD measure on an

⟨Table 6⟩ Effect of IPO Herding Using Cross Sectional Absolute Deviation on Initial Returns

Variables	(1) Full Samples		(1-1) Shenzhen Exchange		(1-2) Shanghai Exchange	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
CSAD	0.0185**	2.97	−0.1365***	−1.63	0.0036	0.59
Shenzhen	0.3382***	6.26	−	−	−	−
State_SH	0.0301	0.24	0.2049	0.76	0.1131	0.86
Foreign_SH	−0.3042**	−2.50	−0.2496	−1.66	−0.2806*	−1.66
MktSH_Uw	−0.6005	−1.50	−0.4580	−0.88	−1.0763**	−2.14
Mkt_Return	0.3336***	8.35	0.3778***	7.81	0.1339**	2.14
Numb_IPO	−0.0098***	−7.10	−0.0097***	−5.51	−0.0072***	−3.24
Sub_R	0.0002***	5.43	0.0002***	4.31	0.0001***	2.56
Debt_R	−0.4254***	−4.04	−0.4490***	−3.35	−0.6377***	−3.24
ROA	−1.0239***	−6.42	−1.0618***	−5.52	−1.1349***	−3.17
Ln_MV	0.1258***	5.77	0.1798***	5.25	0.0681***	2.39
Constant	−2.2197***	−4.88	−3.0265***	−4.37	−0.5635	−1.00
Obs. (Firms)	1,458		1,138		320	
R^2	0.2947		0.3287		0.2191	
F test	26.55***		24.62***		8.93***	
VIF	1.51		1.38		1.56	

Notes: ***, ** and * denote statistical significances at the 1%, 5%, and 10% levels in two-tailed tests, respectively.

IPO's initial return. The overall results are similar to those in ⟨Table 5⟩. Cross-sectional absolute deviation (CSAD), which is another proxy for herding behavior, shows a significant positive influence on an IPO's initial returns for the full sample and an insignificant positive influence for the Shanghai sample. As mentioned, the results are similar to those in ⟨Table 5⟩, thus all other explanations are skipped for brevity.

The results reported in ⟨Table 7⟩ show the effect of beta herding measure on an IPO's initial returns. The beta herding factor (H_Beta) has a negative effect on initial returns and it is statistically significant for the full sample and Shenzhen Exchange. In the Shanghai Exchange case, it has a positive influence which is not statistically significant. The results of other independent variables are effectively the same as those from ⟨Table 5⟩ and ⟨Table 6⟩.

⟨Table 7⟩ Effect of IPO Herding Using Beta Herding Factor on Initial Returns

Variables	(1) Full Samples		(1-1) Shenzhen Exchange		(1-2) Shanghai Exchange	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
H_Beta	−0.0627**	−3.00	−0.1104***	−4.03	0.0159	0.55
Shenzhen	0.2433***	5.98	−	−	−	−
State_SH	−0.0010	−0.01	0.1713	0.64	0.1153	0.87
Foreign_SH	−0.2707**	−2.12	−0.2760*	−1.79	−0.2514	−1.48
MktSH_Uw	−0.5808	−1.46	−0.4941	−0.96	−1.0783**	−2.14
Mkt_Return	0.3368***	8.45	0.3733***	8.18	0.1304**	2.07
Numb_IPO	−0.0089***	−6.53	−0.0099***	−5.98	−0.0070***	−3.12
Sub_R	0.0002***	5.02	0.0002***	4.38	0.0001**	2.48
Debt_R	−0.4481***	−4.26	−0.4218***	−3.19	−0.6348***	−3.20
ROA	−1.0053***	−6.33	−1.0373***	−5.46	−1.1177***	−3.10
Ln_MV	0.1195***	5.53	0.1810***	5.44	0.0694**	2.44
Constant	−1.9146***	−4.26	−2.9704***	−4.45	−0.6070	−1.07
Obs. (Firms)	1,458		1,138		320	
R^2	0.2974		0.3378		0.2194	
F test	26.79***		23.93***		9.01***	
VIF	1.38		1.29		1.48	

Notes: ***, ** and * denote statistical significances at the 1%, 5%, and 10% levels in two-tailed tests, respectively.

The results reported in ⟨Table 8⟩ show the effect of the new herding measure, cross-sectional time distance in natural logarithm (CSTD), we propose, instead of other measures on an IPO's initial returns. The CSTD herding factor (CSTD) has a negative effect on initial returns and is statistically significant for the full sample as well as the Shenzhen Exchange. In the Shanghai Exchange case, it has a positive influence, significant statistically at the significance level of 5% in tow tailed tests. The results of other independent variables are essentially the same as those from ⟨Table 5⟩ and ⟨Table 6⟩.

⟨Table 9⟩ shows the regression results for the effect of three measures (CSSD, H_Beta, and CSTD) on an IPO's initial return, which is slightly different from previous results. Other than the CSSD results, the overall results consistently show a negative correlation with the initial return. Only in the full-sample and CSTD cases do we observe a positive correlation with the initial return.

However, we find that the effects of time herding (CSTD) are best predicted in sign, and most clear in statistical significance for the full sample and sub-groups. We find the evidence of herding, measured in time herding, to be most compelling, and beta herding on some level, leading to higher initial returns at smaller deviations or lower

⟨Table 8⟩ Effect of IPO Herding Using Cross Sectional Time Deviation on Initial Returns

Variables	(1) Full Samples		(1-1) Shenzhen Exchange		(1-2) Shanghai Exchange	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
CSTD	−0.0223**	−2.49	−0.0702***	−6.47	0.0293**	2.53
Shenzhen	0.2122***	4.61				
State_SH	−0.0105	−0.09	0.2183	0.81	0.1094	0.83
Foreign_SH	−0.2057*	−1.74	−0.0429	−0.32	−0.3502***	−2.67
MktSH_Uw	−0.5261	−1.33	−0.2437	−0.47	−1.0340**	−2.12
Mkt_Return	0.3233***	8.30	0.3548***	7.65	0.1094*	1.95
Numb_IPO	−0.0085***	−6.17	−0.0091***	−5.47	−0.0080***	−3.63
Sub_R	0.0002***	4.88	0.0002***	3.86	0.0002***	3.26
Debt_R	−0.4948***	−4.61	−0.5127***	−3.85	−0.6440***	−3.33
ROA	−1.0541***	−6.48	−1.0805***	−5.62	−1.2769***	−3.42
Ln_MV	0.1233***	5.40	0.1606***	4.71	0.0863***	2.91
Constant	−1.9652***	−4.01	−2.4624***	−3.53	−1.0418*	−1.71
Obs. (Firms)	1,458		1,138		320	
R²	0.2919		0.3396		0.2262	
F test	29.62***		31.30***		9.09***	
VIF	1.48		1.35		1.56	

Notes: ***, ** and * denote statistical significances at the 1%, 5%, and 10% levels in two-tailed tests, respectively.

〈Table 9〉 Comparisons on the Effects of Various IPO Herding Measures on Initial Returns

Variables	(1) Full Samples		(1-1) Shenzhen Exchange		(1-2) Shanghai Exchange	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
CSSD	0.0174***	5.74	−0.0170	−0.26	−0.0033	−0.97
H_Beta	−0.0775***	−3.54	−0.1263***	−4.66	0.0099	0.30
CSTD	−0.0480***	−5.03	−0.0789***	−7.33	0.0318**	2.30
Shenzhen	0.2170***	4.63				
State_SH	0.0053	0.04	0.1898	0.72	0.1223	0.93
Foreign_SH	−0.1684	−1.33	−0.0197	−0.14	−0.3111**	−2.00
MktSH_Uw	−0.5505	−1.39	−0.2329	−0.46	−0.9857**	−1.98
Mkt_Return	0.3261***	8.23	0.3551***	7.60	0.1345**	2.12
Numb_IPO	−0.0082***	−5.95	−0.0078***	−4.58	−0.0078***	−3.25
Sub_R	0.0002***	4.39	0.0001***	3.39	0.0002***	2.80
Debt_R	−0.4863***	−4.57	−0.5157***	−3.91	−0.6081***	−3.08
ROA	−1.0004***	−6.31	−1.0215***	−5.42	−1.1556***	−3.23
Ln_MV	0.1053***	4.78	0.1471***	4.38	0.0747***	2.56
Constant	−1.4481***	−3.05	−2.0198***	−2.92	−0.8370	−1.39
Obs. (Firms)	1,458		1,138		320	
R²	0.3061		0.3531		0.2251	
F test	27.45***		32.28***		7.66***	
VIF	1.94		1.69		2.58	

Notes: ***, ** and * denote statistical significances at the 1%, 5%, and 10% levels in two-tailed tests, respectively.

levels of herding, consistent with the definition of herding and its expected effects on market returns from investments.

4.2. Effects of Herding on Long-term Returns

〈Table 10〉 shows the results for the effect of three measures (CSSD, H_Beta, and CSTD) on an IPO's buy-and-hold returns. As we assumed in Hypothesis 2, the herding effect weakens after time, and is less likely to affect market returns in the long run. The results for CSSD do not show any statistical significance. However, the results for beta herding and the natural logarithm of CSTD exhibit a positively significant relationship with BHAR.

We find the evidence of herding to support long term poor performance with higher time herding (positively significant) being the most compelling, and beta herding on some level also leading to a lower long-term BHAR at smaller deviations or lower levels of herding. This is consistent with the definition of herding and its expected effects

⟨Table 10⟩ Effects of Various IPO Herding Measures on Long−term Returns

Variables	(1) 1Yr BHAR		(2) 3Yr BHAR		(3) 5Yr BHAR	
	Coefficient	t−stat	Coefficient	t−stat	Coefficient	t−stat
CSSD	0.0103	0.85	−0.0143	−1.15	−0.0123	−0.94
H_Beta	0.1221***	3.25	0.0650	1.34	0.0262	0.43
CSTD	0.1806***	8.34	0.2450***	6.82	0.1648***	4.04
Shenzhen	−0.0591	−0.75	0.0181	0.10	−0.1596	−0.86
State_SH	0.1362	1.03	0.2358	1.04	0.4576	1.31
Foreign_SH	1.0502	1.50	0.5213	0.71	0.2996	0.35
MktSH_Uw	1.4506**	1.96	2.8097***	3.19	3.5865***	2.57
Mkt_Return	0.2834***	6.81	0.2126***	3.08	0.1439*	1.64
Numb_IPO	0.0236***	6.63	0.0165***	3.66	0.0173***	3.77
Sub_R	−0.0001***	−3.33	−0.0001	−0.92	0.0000	−0.06
Debt_R	−0.4353*	−1.74	−0.3064	−0.87	−0.1672	−0.39
ROA	−0.8562***	−2.81	−0.2010	−0.45	0.7279	1.28
Ln_MV	−0.2723***	−6.69	−0.4307***	−6.74	−0.6188***	−8.30
Constant	5.2448***	5.98	8.9493***	5.68	13.5423***	7.75
Obs. (Firms)	1,458		1,458		1,458	
R^2	0.2134		0.1095		0.0955	
F test	20.86***		18.91***		18.51***	
VIF	1.94		1.94		1.94	

Notes: ***, ** and * denote statistical significances at the 1%, 5%, and 10% levels in two−tailed tests, respectively.

on market returns from investments as established in Tan and Kim (2016) as well as in other studies.

⟨Table 11⟩ shows the results for the effect of three measures (CSSD, H_Beta, and CSTD) on an IPO's buy−and−hold returns by exchange. As we assumed in Hypothesis 2, the herding effect weakens after time, and is less likely to affect market returns in the long run. The results for CSSD on Shenzhen Stock Exchange show positive for a long time, but do not show any statistical significance for CSSD on Shanghai Stock Exchange for any period of time after IPOs. However, the results for beta herding do not show any statistically significant relationship with BHAR on either of the two exchanges.

Thus, the effects of traditional measures of herding on IPO firms' returns are not consistent in the results between the two exchanges and not statistically significant

〈Table 11〉 Effects of IPO Herding Measures on Long-term Returns by Exchange

Variables	(1) 1Yr BHAR		(2) 3Yr BHAR		(3) 5Yr BHAR	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
A. Shenzhen						
CSSD	1.1878***	6.23	0.6234***	2.88	0.6978***	2.69
H_Beta	0.0759*	1.89	0.0838*	1.65	−0.0035	−0.05
CSTD	0.0897***	3.92	0.2397***	5.72	0.1329***	2.57
B. Shanghai						
CSSD	0.0006	0.05	0.0053	0.37	0.0076	0.56
H_Beta	0.0577	0.78	0.0167	0.16	0.0379	0.36
CSTD	0.2622***	4.82	0.1303*	1.94	0.0918	1.53

Notes: ***, ** and * denote statistical significances at the 1%, 5%, and 10% levels in two-tailed tests, respectively.

in the long-term, especially in the case of Shanghai Stock Exchange.

On the contrary, the new measure of herding, CSTD or cross-sectional time dispersion, show very consistent results across regressions with same signs and strong statistical significance for both of the exchanges. Clearly, we can be assured that the time herding measure CSTD predicts the behaviors of investors with robustness in the IPO markets and the secondary markets in terms of stock market returns in China over the sample period.

Ⅴ. Conclusion

In this study, we have investigated the validity of traditional herding measures CSSD (cross-sectional standard deviation of returns), CSAD (cross-sectional absolute deviation of returns) and cross-sectional beta herding measures developed based on the behaviors of market participants by Christie and Huang (1995), Chang, Chen, and Khorana (2000), and Hwang and Salmon (2009) respectively to the Chinese IPO markets, in comparison with a new measure of "time herding" or CSTD (cross-sectional time dispersion) in IPO timing we have developed.

The previous measures of herding behaviors of investors are based on standardized

volatility or deviations in individual firms' stock returns and the market returns. However, such herding measures do not provide statistically significant or consistent information with respect to the relationship between the herding measures and the IPO firms' initial returns and long-term returns. In contrast, the new herding measure, proposed in this study, CSTD (cross-sectional time dispersion) in IPO timing show negative effects on initial returns and reverse results in the long-run performance, which is very much consistent with those of prior studies on the behaviors of IPO firms' stock returns in China. Thus, the new herding measure outperforms traditional ones in consistency in estimating returns of IPO stocks in the primary and secondary markets.

The new measure may contribute to the understanding of the herding behaviors in an IPO market more clearly. Most importantly, the new measure can be applied to various future studies in predicting the behaviors of both investors and issuing firms of securities in addition to the behaviors in the traditional measures such as returns and risks in asset pricing.

As mentioned before, the new measure might be applicable only to less developed financial markets with a limited number of participants like IPO firms in China. However, the tests for validity of the measure may not be guaranteed in other financial markets or in those with different institutional factors. Our future studies include additional empirical tests for the validity of the measure in other countries like Korea, Japan, USA, to name a few, and developing new measures of herding in different markets with various types of investors, sellers and brokers of securities.

References

Baker, M. and J. Wurgler, "Investor Sentiment and the Cross-section of Stock Returns," *The Journal of Finance*, Vol. 61, No. 4 (2006), pp. 1645-1680.

Baker, M. and J. Wurgler, "Investor Sentiment in the Stock Market," *Journal of Economic Perspectives*, Vol. 21, No. 2 (2007), pp. 129-152.

Bikhchandani, S., D. Hirshleifer, and I. Welch, "A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades," *Journal of Political Economy*, Vol. 100, No. 5 (1992), pp. 992-1026.

Black, F., "Noise," *The Journal of Finance*, Vol. 41, No. 3 (1986), pp. 528-543.

Chang, E. C., J. W. Cheng, and A. Khorana, "An Examination of Herd Behavior in Equity Markets: An International Perspective," *Journal of Banking & Finance*, Vol. 24, No. 10 (2000), pp. 1651-1679.

Chiang, Y. M., V. Tai, and W. Zhang, "A Review of Asia's IPO Research," *Asian Review of Financial Research*, Vol. 34, No. 1 (2021), pp. 1-79.

Choe, H. and J. H. Kim, "Fund Managers' Skill and Herding in the Korean Active Fund Market," *Asian Review of Financial Research*, Vol. 24, No. 2 (2011), pp. 411-453.

Christie, W. G. and R. D. Huang, "Following the Pied Piper: Do Individual Returns Herd around the Market?," *Financial Analysts Journal*, Vol. 51, No. 4 (1995), pp. 31-37.

Chung, J. and J. Kim, "Underwriter-investor Relationships and IPO Holding Periods in Korea," *Asian Review of Financial Research*, Vol. 31, No. 3 (2018), pp. 303-350.

Daniel, K., M. Grinblatt, S. Grinblatt, and R. Wermers, "Measuring Mutual Fund Performance with Characteristic-based Benchmarks," *The Journal of Finance*, Vol. 52, No. 3 (1997), pp. 1035-1058.

De Long, J. B., A. Shleifer, L. H. Summers, and R. J. Waldmann, "Noise Trader Risk in Financial Markets," *Journal of Political Economy*, Vol. 98, No. 4 (1990), pp. 703-738.

Fang, J., H. Shi, and H. Xu, "The Determinants and Consequences of IPOs in a Regulated Economy: Evidence from China," *Journal of Multinational Financial Management*, Vol. 22, No. 4 (2012), pp. 131-150.

Hwang, S. and M. Salmon, *Sentiment and Beta Herding*, SSRN: http://ssrn.com/abtract, 299919, 2009.

Lakonishok, J., A. Shleifer, and R. W. Vishny, "The Impact of Institutional Trading on Stock Prices," *Journal of Financial Economics*, Vol. 32, No. 1 (1992), pp. 23-43.

Lee, H. J., "Impact of Investor Sentiment on the Cross-section of Stock Returns," *Asian Review of Financial Research*, Vol. 33, No. 1 (2020), pp. 61-95.

Loughran, T. and J. R. Ritter, "The New Issues Puzzle," *The Journal of Finance*, Vol. 50, No. 1 (1995), pp. 23-51.

Lyandres, E., L. Sun, and L. Zhang, "The New Issues Puzzle: Testing the Investment-based Explanation," *The Review of Financial Studies*, Vol. 21, No. 6 (2007), pp. 2825-2855.

Rajan, R. G., "Why Bank Credit Policies Fluctuate?: A Theory and Some Evidence," *The Quarterly Journal of Economics*, Vol. 109, No. 2 (1994), pp. 399-441.

Ritter, J. R., "The Long-run Performance of Initial Public Offerings," *The Journal of Finance*, Vol. 46, No. 1 (1991), pp. 3-27.

Scharfstein, D. S. and J. C. Stein, "Herd Behavior and Investment," *The American Economic Review*, Vol. 80, No. 3 (1990), pp. 465-479.

Shleifer, A., *Inefficient Markets: An Introduction to Behavioral Finance*, OUP Oxford, 2000.

Smidt, S., "A New Look at the Random Walk Hypothesis," *Journal of Financial and Quantitative Analysis*, Vol. 3, No. 3 (1968), pp. 235-261.

Spiess, D. K. and J. Affleck-Graves, "Underperformance in Long-run Stock Returns Following Seasoned Equity Offerings," *Journal of Financial Economics*, Vol. 38, No. 3 (1995), pp. 243-267.

Su, D. and B. M. Fleisher, "Risk, Return and Regulation in Chinese Stock Markets," *Journal of Economics and Business*, Vol. 50, No. 3 (1998), pp. 239-256.

Tan, J. and K. Kim, "The Information Effect of Time-span and Magnitude of Returns on Underpricing, Volume and Cycles in the IPO Market: An Empirical Analysis on Chinese Stock Market," *Global Business and Finance Review*, Vol. 21 (2016), pp. 109-131.

Welch, I., "Sequential Sales, Learning, and Cascades," *The Journal of Finance*, Vol. 47, No. 2 (1992), pp. 695-732.

Wermers, R., "Mutual Fund Herding and the Impact on Stock Prices," *The Journal of Finance*, Vol. 54, No. 2 (1999), pp. 581-622.

Zweig, M. E., "An Investor Expectations Stock Price Predictive Model Using Closed-end Fund Premiums," *The Journal of Finance*, Vol. 28, No. 1 (1973), pp. 67-78.