Stock Characteristics and Herding Formation: Evidence from the United States Equity Market

Chih-Hsiang Chang, Fang-Jyun Su

Abstract—This paper explores whether stock characteristics influence the herding formation among investors in the US equity market. To extend the research scope of the existing literature, this paper further examines the role that stock risk characteristics play in the US equity market, and the way they influence investors' decision-making. First, empirical results show that whether general stocks or high-risk stocks, there are no herding behaviors among the investors in the US equity market during the whole research period or during four great events. Moreover, stock characteristics have great influence on investors' trading decisions. Finally, there is a bidirectional lead-lag relationship of the herding formation between high-risk stocks and low-risk stocks, but the influence of high-risk stocks on the low-risk stocks is stronger than that of low-risk stocks on the high-risk stocks.

Keywords—Stock characteristics, herding formation, investment decision, US equity market, lead-lag relationship

I. INTRODUCTION

STOCK price volatility possibly arises from changes in corporate intrinsic value or may be induced by investor psychology. In the early research on stock price variation induced by psychological factors, herding behaviors were always a topic of great concern. In the opinion of [1], [2], herding behaviors were a phenomenon where most investors conducted same-direction transactions, and made the same decisions within a certain period of time in respect to specific assets without any basic reason. Herding behaviors are possibly an irrational phenomenon, so they bring about a rise in investment risks and irrational fluctuation in stock prices, and even cause stock prices to deviate from their fundamental value. Reference [3] found that in the equity markets of the US and South Korea, herding behaviors bring about a significant fluctuation in stock prices in both bull and bear markets. Reference [4] believed that, to accomplish the same degree of diversification, investors must invest in low-correlation securities; specifically, if market participants were prone to follow the market consensus, investors' trading behaviors would cause asset prices to deviate from their fundamental value, and thus assets could not be priced correctly. In sum, if investors had no confidence in private information or had some doubt about the quality of public information, they were prone

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to give up on the private information and follow the popular opinions; therefore, transactions were carried out at inefficient prices [1], [5].

In addition to the influence of herding behaviors, the previous relevant literature also revealed that there existed a considerable difference in the herding tendency among investors in different markets. Reference [6] found that there was some evidence of significant herding behaviors in the equity markets of South Korea and Taiwan, but there were no herding behaviors in the US and Hong Kong equity markets. Reference [4] studied the equity markets of 18 countries across the world, finding the following phenomenon: insignificant herding behaviors existed in the US equity market but significant herding behaviors existed in the equity markets of Asian countries, and the changes in stock returns in the US equity market had a certain influence on herding behaviors in the non-US equity markets. Reference [7] found that there existed an obvious herding phenomenon in the Spanish stock market. Reference [8] found that there existed significant herding behaviors in the equity markets that were heavily influenced by Confucian culture or were of low maturity. As set forth in the prior relevant literature above, the more mature a financial market is, then the less tendency investors have for herding behavior.

In addition to market sophistication, it can be reasonably inferred that stock characteristics may influence investors' herding behaviors and trading decisions. Reference [9] found that managers of mutual funds showed an obvious herding tendency in respect to growth stocks, small-cap stocks, and stocks with good previous performance. Reference [10] found that investors in the Hong Kong equity market showed more obvious herding behaviors in respect to small-cap stocks, and were more likely to have herding behaviors in selling stocks. After checking each transaction conducted by the financial institutions in the German stock market, [11] found that institutional investors showed obvious herding behaviors, and the degree of their herding depended upon the characteristics of the traded stocks, such as historical returns and risk characteristics. Reference [12] found that stock characteristics significantly influenced the performance of stock prices and trading decisions of investors. Therefore, the role of stock risk characteristics in herding behaviors is a topic that deserves to be thoroughly studied.

This study discusses the herding behaviors of investors in the US equity market, and the influence of stock characteristics on investors' decision-making. As compared with the previous relevant literature, the present research primarily has three characteristics. First, this paper analyzes the herding behaviors

during four great events (including the rise of the cyber economy, the bubbling of the cyber economy, the Global Financial Tsunami, and the US quantitative easing). Second, this paper studies the influence of stock characteristics on herding tendency. Finally, this paper investigates the lead-lag relationship of herding formation between low-risk stocks and high-risk stocks.

The full text is organized as follows: Section II describes the data and methodology used in the present research. Section III provides the empirical results, and Section IV summarizes the research conclusions.

II. DATA AND METHODOLOGIES

A. Data and Research Period

This study aims to investigate the relationship between stock characteristics and investor herding formation. The objects of this study are all stocks listed on the New York Stock Exchange (NYSE), the research period is from January 1, 1972 to May 31, 2013, and the data (daily data) used are available from the Mergent Online database. We acquired the data on 3,790 listed companies and 10,448 observations of cross-sectional absolute deviation of returns (CSAD) during the above research period from the Mergent Online database.

TABLE I
INDUSTRY DISTRIBUTION OF THE SAMPLE COMPANIES

Mergent Online Industry Code	Industry	Number of Companies
1311	Crude petroleum and natural gas	119
2834	Pharmaceutical preparations	40
2911	Petroleum refining	33
3714	Motor vehicle parts and accessories	26
3841	Surgical and medical instruments	25
4813	Telephone communications, exc. radio	29
4911	Electric services	72
4922	Natural gas transmission	40
4924	Natural gas distribution	32
4931	Electric and other services combined	44
5812	Eating places	31
6021	National commercial banks	57
6022	State commercial banks	30
6035	Federal savings institutions	20
6211	Security brokers and dealers	41
6282	Investment advice	29
6311	Life insurance	46
6324	Hospital and medical service plans	26
6331	Fire, marine, and casualty insurance	52
6726	Investment offices, Nec	733
6798	Real estate investment trusts	268
7011	Hotels and motels	31
7372	Prepackaged software	34
7374	Data processing and preparation	20
7389	Business services, Nec	41

The industry codes from the Mergent Online database are used to discriminate the 332 industries that cover the sample companies. Table I describes the distribution of the industries that each include at least 20 listed companies. As described in Table I, the financial industry includes the largest number of listed companies. This is consistent with the composition of listed companies in the NYSE.

B. Research Methodology

Some previous studies such as [8], [13], [14] have applied the CSAD proposed by [6] to explore herding intensity. Referring to the methods of [4], this paper uses the CSAD to analyze whether significant herding behaviors exist in regard to general stocks and high-risk stocks among investors in the US stock market. In addition, this study also examines whether investors' herding tendencies changed when they traded the above stocks during the four great events. The method for studying herding behavior is described as follows:

$$CSAD_t + \sum_{i=1}^{N} \left| R_{i,t} - R_{m,t} \right| / N \qquad (1)$$

$$CSAD_t = \alpha_0 + \alpha_1 R_{m,t} + \alpha_2 \left| R_{m,t} \right| + \alpha_3 R_{m,t}^2 + \varepsilon_t \qquad (2)$$

where, $CSAD_t$ indicates the CSAD of all stocks on the day t, $R_{i,t}$ indicates the returns of stock i on the day t, $R_{m,t}$ indicates the market index based returns (the S&P 500 index is used as the market index), N indicates the number of listed companies, $\alpha_0, \alpha_1, \alpha_2,$ and α_3 are regression coefficients, and ε_t indicates the residual term of (2). According to this equation, stock investors have the significant herding behavior when α_3 is a statistically significant negative value [4]. In addition to herding behaviors in respect to all stocks in an equity market, this study uses (2) to examine herding behaviors in respect to high-risk stocks, and discuss whether investors have significant herding behavior in respect to general stocks and high-risk stocks during the four great events. It is impossible to judge whether stock investors have significant herding behaviors according to the CSAD alone (the judgment criterion is whether α_3 is significantly less than zero); however, CSAD indicates the degree of synchronous rise or fall in the prices of different stocks in an equity market. Therefore, [4] and [8] respectively, defined CSAD as herding formation and herding tendency.

To further ascertain whether the risk characteristics of stocks will influence investors' trading decisions, this study considers the lead-lag relationship of herding formation between high-risk stocks and low-risk stocks by referring to the method proposed by [15]. References [16]-[18] also used the method of [15] to investigate the lead-lag relationship between the two time series. The method is described as follows:

$$CSAD_{H,t} = a_0 + a_1 CSAD_{H,t-1} + csad_{h,t} \qquad (3)$$

$$CSAD_{L,t} = b_0 + b_1 CSAD_{L,t-1} + csad_{l,t} \qquad (4)$$

where, $CSAD_{H,t}$ indicates the CSAD of the high-risk stocks on the day t, $CSAD_{L,t}$ indicates the CSAD of low-risk stocks on

the day t, a_0, a_1, b_0, and b_1 are regression coefficients, $csad_{h,t}$ indicates the residual term of (3) and proxy variable of $CSAD_{H,t}$ and $csad_{l,t}$ indicates the residual term of (4) and proxy variable of $CSAD_{L,t}$. After obtaining the proxy variables ($csad_{h,t}$ and $csad_{l,t}$) of $CSAD_{H,t}$ and $CSAD_{L,t}$, this study uses the previously mentioned proxy variables to examine the lead-lag relationship of herding formation between high-risk stocks and low-risk stocks:

$$csad_{h,t} = c_{-1}csad_{l,t-4} + c_{-3}csad_{l,t-3} + c_{-2}csad_{l,t-2} + c_{-1}csad_{l,t-1}$$
$$+ c_0 csad_{l,t} + c_1 csad_{l,t+1} + c_2 csad_{l,t+2} + c_3 csad_{l,t+3}$$
$$+ c_4 csad_{l,t+4} + \xi_t$$

$$(5)$$

where, $c_{-4}, c_{-3}, c_{-2}, c_{-1}, c_0, c_1, c_2, c_3$, and c_4 are regression coefficients estimated by a generalized method of moment (GMM), and ξ_t indicates the residual term of (5). According to (5), if c_1, c_2, c_3, or c_4 is significantly different from zero, high-risk stocks are one, two, three, or four days ahead of low-risk stocks in terms of herding formation; if c_{-1}, c_{-2}, c_{-3}, or c_{-4} is significantly different from zero, high-risk stocks lag one, two, three, or four days behind low-risk stocks in terms of herding formation. In addition, if c_0 is significantly different from zero, there exists a significant concurrent correlation of herding formation between high-risk stocks and low-risk stocks.

III. EMPIRICAL RESULTS

A. Herding Behavior, Stock Characteristics, and Great Events

Using (1) and (2), this study considers whether investors in the US stock market have significant herding behaviors in respect to general stocks and high-risk stocks, and analyzes the influence of great events on investors' herding tendency. Table II presents the estimation results for (2). As described in Panel A of Table II, the coefficient α_1 is significantly negative in respect to all sample stocks. Evidently, the higher the market index based returns, the more obvious herding formation is (the smaller the CSAD is). Panel A of Table II also indicates that the coefficient α_2 is significantly positive. This implies that the greater the market index change, the more insignificant herding formation is (the larger the CSAD is). Finally, Panel A of Table II indicates that the coefficient α_3 is significantly positive. This means that investors in the US stock market have no significant herding behavior. According to the empirical results above, the synchronous rise in the prices of a few stocks is very obvious when the US stock market is soaring; the prices of the few stocks do not fall synchronously when the US stock market is crashing. Therefore, there exists no evidence of herding in the US stock market.

Panel A of Table II also indicates the influence of great events. Likewise, investors in the US stock market have no significant herding behavior during the four great events (specifically, the rise of the cyber economy from January 1, 1995 to December 31, 2001, bubbling of the cyber economy from January 1, 2000 to December 31, 2001, global financial tsunami from January 1, 2007 to December 31, 2009, and US quantitative easing from March 1, 2009 to May 31, 2013). Evidently, these four great events do not strengthen investors' herding tendency.

TABLE II
HERDING BEHAVIORS OF INVESTORS IN THE US EQUITY MARKET

Research Period	α_0	α_1	α_2	α_3	F-statistic	Adj-R^2
Panel A: All stocks						
1972/1/1-2013/5/31	1.37 (85.99)*	-0.03 (-2.67)*	0.71 (37.55)*	0.03 (9.38)*	1400.65*	0.29
1995/1/1-2001/12/31	1.50 (42.86)*	-0.01 (-0.83)	0.66 (12.29)*	0.02 (1.45)	272.96*	0.32
2000/1/1-2001/12/31	1.78 (18.34)*	0.01 (0.20)	0.56 (4.15)*	0.04 (1.04)	54.13*	0.24
2007/1/1-2009/12/31	1.52 (18.09)*	-0.02 (-0.76)	0.89 (11.14)*	-0.001 (-0.16)	193.04*	0.43
2009/3/1-2013/5/31	1.30 (29.59)*	0.01 (0.31)	0.62 (9.68)*	0.02 (1.50)	194.33*	0.35
Panel B: High-risk stocks						
1972/1/1-2013/5/31	2.83 (22.58)*	-0.04 (-0.46)	0.64 (4.27)*	0.04 (1.66)*	21.91*	0.006
1995/1/1-2001/12/31	3.84 (19.34)*	-0.004 (-0.04)	0.64 (2.11)*	0.01 (0.09)	7.06*	0.01
2000/1/1-2001/12/31	4.21 (33.25)*	-0.03 (-0.68)	0.37 (2.10)*	0.06 (1.35)	23.58*	0.12
2007/1/1-2009/12/31	2.48 (6.86)*	-0.16 (-1.14)	0.91 (2.33)*	-0.04 (-0.49)	5.83*	0.05
2009/3/1-2013/5/31	2.17 (32.39)*	-0.01 (-0.17)	0.62 (6.32)*	0.02 (1.04)	83.79*	0.19

Note: The number in parentheses is the t-statistic. "*" refers to significance at the 10% level.

Panel B of Table II indicates the influence of stock risk characteristics. The coefficient α_3 is negative but statistically insignificant during the global financial tsunami, but is positive and statistically insignificant during the other three great events. This implies that investors nevertheless have no significant herding behavior in respect to high-risk stocks during the entire research period or during the four great events.

B. The Lead-Lag Relationship of Herding Formation between High-Risk and Low-Risk Stocks

Using (3)-(5), this study examines the interrelationship of herding formation between high-risk stocks and low-risk stocks. The estimation results for (5) are described in Table III. As described in Table III, the coefficient c_0 is significantly positive, and the statistical significance of c_0 is obviously higher than that of other coefficients. This shows that there mainly exists a concurrent correlation of herding formation between high-risk stocks and low-risk stocks. In other words, the synchronous rise or fall in the prices of a few high-risk stocks is highly similar to that of a few low-risk stocks.

As described in Table III, the coefficients c_1, c_2, and c_3 are all significantly positive, indicating that high-risk stocks are three days ahead of low-risk stocks in terms of herding formation. As described in Table III, the coefficient c_{-1} is significantly positive, indicating that low-risk stocks are one day ahead of high-risk stocks in terms of herding formation. According to the previously mentioned results, there exists a lead-lag relationship of herding formation between high-risk stocks and low-risk stocks. However, high-risk stocks are more obviously ahead of low-risk stocks in terms of herding formation. That is to say, the decisions of investors who trade low-risk stocks obviously follow the decisions of investors who trade high-risk stocks.

TABLE III
THE LEAD-LAG RELATIONSHIP OF HERDING FORMATION BETWEEN HIGH-RISK AND LOW-RISK STOCKS

Coefficients	Estimated value	Standard error	t-statistic
Constant	0.0008	0.0824	0.0092
c_{-4}	-0.0118	0.1142	-0.1035
c_{-3}	0.1109	0.1151	0.9634
c_{-2}	-0.0087	0.1147	-0.0755
c_{-1}	0.4324	0.1134	3.8121*
c_0	1.1444	0.1137	10.0658*
c_1	0.6505	0.1134	5.7350*
c_2	0.4901	0.1147	4.2713*
c_3	0.2770	0.1151	2.4062*
c_4	0.1854	0.1142	1.6242

Note: "*" refers to significance at the 10% level.

According to the empirical results in Table III, herding formation regarding high-risk stocks plays an important role compared to that regarding low-risk stocks. Interestingly, the herding formation regarding high-risk stocks is obviously ahead of that regarding low-risk stocks, and provides an important reference for investors' decisions in respect to low-risk stocks. In other words, participants in the US stock market can observe the trading behaviors of investors in high-risk stocks and price performance of high-risk stocks. This is beneficial for predicting the trading behaviors of investors of low-risk stocks and improving the performance of portfolios.

IV. CONCLUSIONS

The objects of this study are all stocks listed on the NYSE during the period of January 1, 1972 to May 31, 2013. Using the methods proposed by [4], [13], [14], this study examines the influence of stock risk characteristics on the herding tendency of investors in the US stock market, and explores the role of high-risk stocks. As compared to the previous relevant literature, this study has three characteristics. First, this study considers the herding behaviors of investors in the US stock market during great events. Second, this study analyzes the influence of stock risk characteristics on the significance of herding behaviors. Finally, this study investigates the lead-lag relationship of herding formation between low-risk stocks and high-risk stocks.

The empirical results reveal some phenomena. First, investors in the US stock market have no herding behaviors, and even in respect to high-risk stocks, there exists no evidence of significant herding. Second, investors' herding tendency is not influenced by the four great events. Finally, the herding formation regarding high-risk stocks not only influences that regarding low-risk stocks, but also is more significantly ahead of that regarding low-risk stocks. Therefore, it can be concluded that the trading behaviors of investors of high-risk stocks have a significant influence upon the trading behaviors of investors of low-risk stocks; that is to say, the herding formation regarding high-risk stocks plays a very important role in the US stock market. To trade properly in the US stock market and manage their portfolios well, people must be aware that investors in the US stock market are not likely to have herding behaviors, and that investor behaviors and price performance regarding high-risk stocks may influence the trading decisions of investors of low-risk stocks.

REFERENCES

[1] A. V. Banerjee, "A simple model of herd behavior", *Quarterly Journal of Economics,* vol. 107, no. 3, pp. 797-817, 1992.
[2] J. R. Nofsinger, and R. W. Sias, "Herding and feedback trading by institutional and individual investors", *Journal of Finance*, vol. 54, no. 6, pp. 2263-2295, 1999.
[3] S. Hwang, and M. Salmon, "Market stress and herding", *Journal of Empirical Finance*, vol. 11, no.4, pp. 585-616, 2004.
[4] T. C. Chiang, and D. Zheng, "An empirical analysis of herd behavior in global stock markets", *Journal of Banking & Finance*, vol. 34, no. 8, pp. 1911-1921, 2010.
[5] S. Bikhchandani, D. Hirshleifer, and I. Welch, "A theory of fads, fashion, custom, and cultural change as informational cascades", J*ournal of Political Economy*, vol. 100, no. 5, pp. 992-1026, 1992.
[6] E. C. Chang, 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, pp. 1651-1679, 2000.
[7] N. Blasco, P. Corredor, and S. Ferreruela, "Does herding affect volatility? Implications for the Spanish stock market", *Quantitative Finance*, vol. 12, no. 2, pp. 311-327, 2012.
[8] C.-H. Chang, and S.-J. Lin, "The effects of national culture and behavioral pitfalls on investors' decision-making: Herding behavior in international stock markets", *International Review of Economics &*

Finance, vol. 37, pp. 380-392, 2015.

[9]   R. Wermers, "Mutual fund herding and the impact on stock prices", *Journal of Finance*, vol. 54, no. 2, pp. 581-622, 1999.

[10] R. T. Zhou, and R. N. Lai, "Herding and information based trading", *Journal of Empirical Finance*, vol. 16, no. 3, pp. 388-393, 2009.

[11] S. Kremer, and D. Nautz, "Causes and consequences of short-term institutional herding", *Journal of Banking & Finance*, vol. 37, no. 5, pp. 1676-1686, 2013.

[12] C.-H. Chang, H.-H. Huang, Y.-C. Chang, and T.-Y. Lin, "Stock characteristics, trading behavior, and psychological pitfalls", *Managerial Finance*, vol. 41, no. 12, pp. 1298-1317, 2015.

[13] L. Tan, T. C. Chiang, J. R. Mason, and E. Nelling, "Herding behavior in Chinese stock markets: An examination of A and B shares", *Pacific-Basin Finance Journal,* vol. 16, no.1-2, pp. 61-77, 2008.

[14] T. C. Chiang, J. Li, and L. Tan, "Empirical investigation of herding behavior in Chinese stock markets: Evidence from quantile regression analysis", *Global Finance Journal,* vol. 21, no. 1, pp. 111-124, 2010.

[15] R. Chiang, and W. Fong, "Relative informational efficiency of cash, futures, and options markets: the case of an emerging market", *Journal of Banking & Finance*, vol. 25, no. 2, pp. 355-375, 2001.

[16] C.-H. Chang, H.-I. Cheng, I.-H. Huang, and H.-H. Huang, "Lead-lag relationship, volatility asymmetry, and overreaction phenomenon", *Managerial Finance*, vol. 37, no. 1, pp. 47-71, 2011.

[17] C.-H. Chang, "The relationship between the disposition effect and herding behavior: Evidence from Taiwan's information technology stocks," *World Academy of Science, Engineering and Technology*: *International Journal of Social, Behavioral, Educational, Economics, Business and Industrial Engineering,*vol. 7, no. 7, pp. 1971-1975, 2013.

[18] C.-H. Chang, S.-S. Chen, and S.-L. Hsieh, "Asymmetric reinforcement learning and conditioned responses during the 2007–2009 global financial crisis: Evidence from Taiwan", *Review of Pacific Basin Financial Markets and Policies*, vol. 20, no. 2, pp. 1750010-1~1750010-44, 2017.

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