Journal of Banking & Finance 34 (2010) 1911–1921

Contents lists available at ScienceDirect

Journal of Banking & Finance

journal homepage: www.elsevier.com/locate/jbf

An empirical analysis of herd behavior in global stock markets

Thomas C. Chiang *, Dazhi Zheng

LeBow College of Business, Drexel University, PA 19104, United States

ARTICLE INFO

Article history:
Received 7 July 2009
Accepted 29 December 2009
Available online 4 January 2010

JEL classification:
G15
G14

Keywords:
Herding behavior
Cross-sectional stock dispersion
Financial crisis

ABSTRACT

This paper examines herding behavior in global markets. By applying daily data for 18 countries from May 25, 1988, through April 24, 2009, we find evidence of herding in advanced stock markets (except the US) and in Asian markets. No evidence of herding is found in Latin American markets. Evidence suggests that stock return dispersions in the US play a significant role in explaining the non-US market's herding activity. With the exceptions of the US and Latin American markets, herding is present in both up and down markets, although herding asymmetry is more profound in Asian markets during rising markets. Evidence suggests that crisis triggers herding activity in the crisis country of origin and then produces a contagion effect, which spreads the crisis to neighboring countries. During crisis periods, we find supportive evidence for herding formation in the US and Latin American markets.

1. Introduction

In the behavioral finance literature, herding is often used to describe the correlation in trades resulting from interactions between investors. This behavior is considered to be rational for less sophisticated investors, who attempt to mimic financial gurus or follow the activities of successful investors, since using their own information/knowledge would incur a higher cost.[1] The consequence of this herding behavior is, as Nofsinger and Sias (1999) note, "a group of investors trading in the same direction over a period of time". Empirically, this may lead to observed behavior patterns that are correlated across individuals and that bring about systematic, erroneous decision-making by entire populations (Bikhchandani et al., 1992). Thus, to achieve the same degree of diversification, investors need a larger selection of securities that constitute a lower degree of correlation. In addition, if market participants tend to herd around the market consensus, investors' trading behavior can cause asset prices to deviate from economic fundamentals. As a result, assets are not appropriately priced. Empirical investigations of herding behavior in financial markets have branched into two paths.[2] The first path focuses on co-movement behavior based on the measure of dynamic correlations. For instance, in their tests for financial contagion, Corsetti et al. (2005) find "some contagion, some interdependence" among Asian stock markets. Chiang et al. (2007) report that the contagion effect took place during the early stage of the Asian financial crisis and that herding behavior dominated the later stage of the crisis, as the bad news became widespread and investors realized the full impact of the crisis. Boyer et al. (2006) discover that in emerging stock markets, there is greater co-movement during high-volatility periods, suggesting that crises that spread through the

* Corresponding author. Tel.: +1 215 895 1745; fax: +1 215 895 2995.
E-mail addresses: chiangtc@drexel.edu (T.C. Chiang), dz37@drexel.edu (D. Zheng).

[1] Villatoro (2009) analyzes the relationship between financial intermediaries' (FI) reputation and herding and argues that financial intermediaries with high reputation are prone to invest in information, whereas those with poor reputation will tend to imitate other financial intermediaries' portfolio decisions.

[2] A number of research papers have focused on market participants' herding behavior, from mutual fund managers to institutional analysts. For instance, Grinblatt et al. (1995) find evidence of herding activity in mutual fund markets because fund managers tend to buy securities that can make a profit. Their evidence indicates that 77 percent of mutual fund investors are "momentum investors." Welch (2000) finds that the most recent revisions of investment recommendations have a positive influence on the next analyst's revision. His finding suggests that herding toward the consensus is less likely to be caused by fundamental information, implying that analysts herd based on little or no information. Wermers (1999) finds little herding by mutual funds in trading average stocks; he finds more evidence of herding in trades of small stocks and in trades by growth-oriented funds. Lakonishok et al. (1992) report that pension managers are buying (selling) the same stocks that other managers buy (sell) and follow a positive-feedback trading strategy. In contrast, some of the literature fails to detect herding behavior for certain market participants. In a paper by Gleason et al. (2004), investors do not herd during periods of extreme market movements using ETFs. Furthermore, they show that the market's reaction to news is not symmetric for up markets and down markets.

0378-4266/$ - see front matter © 2010 Elsevier B.V. All rights reserved.
doi:10.1016/j.jbankfin.2009.12.014

asset holdings of international investors are mainly due to contagion rather than to changes in fundamentals.[3]

The second path for examining herding behavior focuses on the cross-sectional correlation dispersion in stock returns in response to excessive changes in market conditions. By observing information asymmetry in emerging markets, researchers anticipate that investors in these markets are more likely to demonstrate herding behavior. In their study of international herding behavior, Chang et al. (2000) find significant evidence of herding in South Korea and Taiwan and partial evidence of herding in Japan. However, there is no evidence of herding on the part of market participants in the US and Hong Kong. By focusing on Hong Kong's stocks, Zhou and Lai (2009) discover that herding activity in Hong Kong's market tends to be more prevalent with small stocks and that investors are more likely to herd when selling rather than buying stocks. Turing to the Chinese markets, Demirer and Kutan (2006) investigate whether investors in Chinese markets, in making their investment decisions, are following market consensus rather than private information during periods of market stress. Their study reveals no evidence of herding formation, suggesting that market participants in Chinese stock markets make investment choices rationally. Yet, in a recent study of Chinese stock markets, Tan et al. (2008) report that herding occurs under both rising and falling market conditions and is especially present in A-share investors.[4] Thus, the evidence from the studies cited above shows mixed results and that most herding behavior is present in emerging markets and not in advanced markets.

Although the above-mentioned studies have made contributions to describing herding behavior in various aggregate markets, they are mainly restricted to a single market boundary. No attempts have been made to examine herding behavior across national borders. The empirical results based on such a setting are likely to produce two drawbacks. First, from an econometric point of view, there is the potential for bias in the OLS estimate when important variables are excluded. Sometimes, it could give rise to wrong signs (Kennedy, 2008, p. 368). Second, the empirical evidence derived from a few selected countries essentially shows local behavior, and hence, the testing results do not necessarily reflect a broader test for the validation of a global phenomenon.

Recent experience suggests that financial shocks do not stand alone in a country or region. Forbes and Rigobon (2002) find that financial markets are somehow interdependent during the high-volatility period. Chiang et al. (2007) find significant evidence of comovements among various stock markets during the financial turmoil at the later stage of the Asian crisis. In their study of cross-country variations in market-level stock volatility, Bekaert and Harvey (1997) report that a higher return dispersion is associated with higher market volatility for the more developed markets. They suggest that dispersions may reflect the magnitude of firm-/industry-level information flows for these markets. Motivated by these empirical studies, this paper examines herding behavior by testing the cross-sectional stock return dispersions in relation to a set of explanatory variables, including absolute domestic stock returns, excess domestic market conditions, and foreign market influences.

[3] In their investigation of the dynamic correlations among six international stock market indices (US, UK, France, Germany, Japan, and Hong Kong) and their relationship to inflation fluctuation and market volatility, Cai et al. (2009) find evidence that international stock correlations are significantly time-varying and the evolution among them is related to cyclical fluctuations of inflation rates and stock volatility.

[4] Hwang and Salmon (2006) examine herding behavior in the US, the UK, and the South Korean stock markets, and they find beta herding when investors believe they know where the market is heading rather than when the market is in crisis.

This paper differs from previous research in the following respects. First, the data set used by Chang et al. (2000), Demirer and Kutan (2006), Tan et al. (2008), and Zhou and Lai (2009) in their investigation of herding behavior is confined to a relatively small set of observations, and their studies are restricted to a few local markets. The current study contains 18 economic units categorized into advanced, Latin American, and Asian markets. Second, we identify the significance of the US market in examining local market herding behavior; the evidence shows that in the majority of cases, investors in each national market are herding around the US market. Third, employing a larger data set allows us to examine different investing behavior associated with different regions. Specifically, we find evidence of herding behavior occurring in countries classified as advanced markets and in Asian markets. However, we find less supportive evidence for herding behavior in the four Latin American markets. Fourth, we investigate the role of financial crisis in testing herding behavior. Specifically, consistent with common intuition, herding behavior appears to be more apparent during the period in which the crisis occurs. In particular, we find herding in the Mexican and Argentine stock markets, respectively, when the 1994 Mexican and 1999 Argentine crises took place. Otherwise, no evidence of herding is found in these Latin American countries over the entire sample period.

The remainder of this paper is organized as follows. Section 2 presents the estimation model for examining herding behavior. Section 3 describes the data. Section 4 reports the empirical evidence of herding behavior and estimates the effect of the US market. Section 5 examines herding behavior under different market conditions. Section 6 contains a summary and conclusions.

2. Basis of the estimated model

Two studies have proposed methods for detecting herding behavior using cross-sectional data on stock returns: Christie and Huang (1995) and Chang et al. (CCK) (2000). Christie and Huang suggest that the investment decision-making process used by market participants depends on overall market conditions. During normal periods, rational asset-pricing models predict that the dispersion in cross-sectional returns will increase with the absolute value of the market returns, 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 private information, and their investment decisions are more likely to mimic collective actions in the market. Individual stock returns under these conditions tend to cluster around the overall market return. Thus, it can be observed that herding will be more prevalent during periods of market stress, which is defined as the occurrence of extreme returns in a market portfolio. To measure the return dispersion, Christie and Huang (1995) propose the cross-sectional standard deviation (*CSSD*) method, which is expressed as:

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

where N is the number of firms in the portfolio, $R_{i,t}$ is the observed stock return of industry i at time t, and $R_{m,t}$ is the cross-sectional average stock of N returns in the portfolio at time t. Since the $CSSD_t$ calculated by squared return-deviations tends to be sensitive to outliers, in a later study, CCK propose the cross-sectional absolute deviation, which is measured by:

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

To conduct a test for detecting herding activity, we modify CCK's specification and write:

Table 1
Descriptive statistics of *CSAD*.

Statistics	AU_*CSAD*	FR_*CSAD*	GR_*CSAD*	HK_*CSAD*	JP_*CSAD*	UK_*CSAD*	US_*CSAD*
Panel A – Advanced markets							
Minimum	0.3302	0.4075	0.2896	0.1510	0.3333	0.2518	0.2891
Maximum	3.8431	4.8636	5.1736	12.1986	3.4446	3.7054	4.754
Mean	0.9151	1.0874	0.9737	1.3538	0.8793	0.8798	0.8486
Std. dev	0.3936	0.4829	0.4843	0.7681	0.4323	0.4454	0.4185
Skewness	1.4364	1.1706	1.4453	2.8124	0.9443	1.5496	1.8174
Kurtosis	5.8602	3.6874	5.3574	23.7349	3.2835	4.4836	7.32
N	109	138	125	91	145	140	155

	AR_*CSAD*	BR_*CSAD*	CL_*CSAD*	MX_*CSAD*
Panel B – Latin American markets				
Minimum	0.1085	0.1001	0.1026	0.1517
Maximum	11.6078	23.017	22.9257	13.4588
Mean	1.2533	1.3746	0.9337	0.9648
Std. dev	0.7562	1.1024	0.6771	0.5793
Skewness	2.8387	9.546	9.1771	4.3776
Kurtosis	20.4048	152.81	235.7591	60.7498
N	59	70	59	67

	CN_*CSAD*	KR_*CSAD*	ID_*CSAD*	MY_*CSAD*	SG_*CSAD*	TH_*CSAD*	TW_*CSAD*
Panel C – Asian markets							
Minimum	0.1049	0.1159	0.1366	0.2990	0.1045	0.4421	0.1018
Maximum	8.8230	7.0653	11.788	14.2281	5.3095	8.6513	5.2958
Mean	1.6100	1.3973	1.6987	1.0271	1.0726	1.4406	1.0881
Std. dev	0.8546	0.7423	1.2185	0.6296	0.5288	0.8286	0.5979
Skewness	1.6067	0.9867	1.8156	5.2985	1.5073	1.5327	0.9446
Kurtosis	5.928	3.2550	6.1089	83.2615	5.6615	5.7073	3.0638
N	64	88	53	74	89	63	56

This table lists descriptive statistics of daily, equally weighted cross-sectional absolute deviations ($CSAD_t$) for seven developed markets, including Australia (AU), France (FR), Germany (GR), Hong Kong (HK), Japan (JP), the UK and the US; four Latin American markets, including Argentina (AR), Brazil (BR), Chile (CL) and Mexico (MX); seven Asian markets, including China (CN), S. Korea (KR), Taiwan (TW), Indonesia (ID), Malaysia (MY), Singapore (SG) and Thailand (TH). The data range is from 4/25/1989 to 4/24/2009 for markets in Germany, the United Kingdom, the United States, Japan, Korea, Australia, France, Hong Kong, Malaysia and Singapore; because of data availability problems, the starting date for Argentina is 7/28/1993, for Brazil, 7/5/1994, for Chile, 7/5/1989, for Mexico, 6/19/1991, for China, 8/12/1996, for Taiwan, 7/4/1989, for Indonesia, 6/16/1992, and for Thailand, 9/3/1990. Calculations of *CSAD* are given by Eq. (2). Missing information for holidays is carefully inspected or interpolated. The stock return dispersion is defined as $CSAD_t = \frac{1}{N}\sum_{i=1}^{N}|R_{i,t} - R_{m,t}|$.

$$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \varepsilon_t \tag{3}$$

where $CSAD_t$ is a measure of return dispersion, $R_{m,t}$ is the value of an equally weighted realized return of all industry indexes on day t, and $|R_{m,t}|$ is the absolute term.[5] Eq. (3) differs from the original equation proposed by CCK (2000) in that a $R_{m,t}$ term is included on the right-hand side of Eq. (3). This specification allows us to take care of the asymmetric investor behavior under different market conditions. We show 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 $R_{m,t} \leqslant 0$. The ratio of $(\gamma_2 + \gamma_1)/(\gamma_2 - \gamma_1)$ can be viewed as the relative amount of asymmetry between stock return dispersion and the market's return (Duffee, 2001).

CCK note that rational asset-pricing models imply a linear relation between the dispersion in individual asset returns and the return on a market portfolio. As the absolute value of the market return increases, so should the dispersion in individual asset returns. During periods of relatively large movements in market prices, investors may react in a more uniform manner, exhibiting herding behavior. This behavior is likely to increase the correlation among asset returns, and the corresponding dispersion among returns will decrease or at least increase at a less-than-proportional rate with the market return. For this reason, a non-linear market return, $R_{m,t}^2$, is included in the test equation, and a significantly negative coefficient γ_3 in the empirical test would be consistent with the occurrence of herding behavior.

3. The data

The daily data employed in this study consist of industry and market price indices. The samples cover the advanced markets: Australia (AU), France (FR), Germany (GR), Hong Kong (HK), Japan (JP), the United Kingdom (UK), and the United States (US); Latin American markets: Argentina (AR), Brazil (BR), Chile (CL), and Mexico MX); Asian markets: China (CN), Indonesia (ID), Malaysia (MY), Singapore (SG), South Korea (KR), Taiwan (TW), and Thailand (TL).

The data range is from 4/25/1989 to 4/24/2009 for markets in Australia, France, Germany, the United Kingdom, the United States, Hong Kong, Japan, Korea, Malaysia, and Singapore. Because of the limited availability of data, the starting dates for some of the other markets vary from one another. For Argentina, the starting date is 7/28/1993; for Brazil, 7/5/1994; for Chile, 7/5/1989; for Mexico, 6/19/1991; for China, 8/12/1996; for Taiwan, 7/4/1989; for Indonesia, 6/16/1992, and for Thailand, 9/3/1990. The stock return is calculated as $R_t = 100 \times (\log(P_t) - \log(P_{t-1}))$, where P_t denotes the industrial stock index. All of the data are taken from *DataStream International*.

Table 1 provides a summary of statistics of *CSAD* in industrial stock returns for different markets.[6] The number of industries ranges from 53 to 155. Apparently, the number of industries in the

[5] Although our test for herding is similar to that of CCK's, our measure of *CSAD* differs from theirs. Their measure was derived from the conditional version of the CAPM, whereas ours follows the method used by Christie and Huang (1995) and Gleason et al. (2004), which does not require the estimation of beta. This avoids the possible specification error associated with a single-factor capital asset-pricing model.

[6] We also calculated *CSSD*. The evidence indicates that the *CSSD* measure has a greater mean value and a higher standard deviation compared with the *CSAD* measure.

Table 2
Estimates of herding behavior in global markets.

Regions	Market	Constant	$R_{m,t}$	$\lvert R_{m,t}\rvert$	$R^2_{m,t}$	$\bar{R}^2$
Advanced markets	AU	0.7051***		0.3981***	−0.0123***	0.28
		(95.32)		(29.30)	(−3.57)	
		0.7051***	−0.0007	0.3982***	−0.0124***	0.28
		(95.30)	(−0.11)	(29.16)	(−3.51)	
	FR	0.7846***		0.4994***	−0.0228***	0.38
		(90.31)		(33.49)	(−5.91)	
		0.7827***	0.0314***	0.4992***	−0.0209***	0.38
		(90.29)	(5.58)	(33.58)	(−5.44)	
	GR	0.6502***		0.5880***	−0.0283***	0.45
		(84.99)		(47.45)	(−10.99)	
		0.6476***	0.0384***	0.5880***	−0.0258***	0.45
		(84.88)	(6.67)	(47.65)	(−9.97)	
	HK	0.9206***		0.4527***	−0.0053***	0.40
		(74.30)		(37.67)	(−3.45)	
		0.9184***	0.0517***	0.4467***	−0.0023	0.41
		(74.70)	(9.19)	(37.41)	(−1.46)	
	JP	0.6477***		0.3042***	−0.0089***	0.28
		(76.09)		(27.45)	(−3.91)	
		0.6470***	0.0183***	0.3048***	−0.0086***	0.29
		(76.12)	(4.07)	(27.54)	(−3.79)	
	UK	0.6121***		0.4784***	−0.0195***	0.38
		(77.72)		(32.91)	(−5.04)	
		0.6102***	0.0316***	0.4789***	−0.0180***	0.38
		(77.65)	(5.70)	(33.05)	(−4.67)	
	US	0.6374***		0.2992***	−0.0018	0.35
		(88.20)		(29.25)	(−0.95)	
		0.6366***	0.0140***	0.2992***	−0.0015	0.35
		(88.13)	(3.29)	(29.29)	(−0.78)	
Latin American markets	AR	0.8052***		0.4696***	0.0105***	0.48
		(59.25)		(29.10)	(3.57)	
		0.7982***	0.0565***	0.4777***	0.0097***	0.48
		(59.22)	(9.02)	(29.84)	(3.35)	
	BR	0.9944***		0.2747***	0.0432***	0.45
		(54.41)		(14.02)	(14.17)	
		0.9947***	−0.0046	0.2750***	0.0431***	0.45
		(54.39)	(−0.57)	(14.03)	(14.10)	
	CL	0.6065***		0.4301***	0.0970***	0.55
		(62.45)		(26.91)	(25.16)	
		0.6040***	0.0476***	0.4342***	0.0935***	0.55
		(62.39)	(6.45)	(27.25)	(24.09)	
	MX	0.6070***		0.4776***	0.0282***	0.53
		(63.53)		(30.63)	(7.06)	
		0.6047***	0.0404***	0.4776***	0.0285***	0.53
		(63.57)	(6.98)	(30.79)	(7.17)	
Asian markets	CN	1.1202***		0.3666***	−0.0077***	0.33
		(57.78)		(24.02)	(−4.09)	
		1.1232***	0.0390***	0.3592***	−0.0064***	0.34
		(58.32)	(6.85)	(23.64)	(−3.43)	
	KR	0.9663***		0.4135***	−0.0210***	0.29
		(67.98)		(29.30)	(−9.36)	
		0.9664***	0.0087*	0.4127***	−0.0208***	0.29
		(68.00)	(1.78)	(29.24)	(−9.27)	
	TW	0.6997***		0.4570***	−0.0618***	0.22
		(58.02)		(30.79)	(−19.52)	
		0.7004***	0.0099**	0.4551***	−0.0613***	0.22
		(58.08)	(2.19)	(30.62)	(−19.32)	
	ID	0.9011***		0.8199***	−0.0273***	0.49
		(44.96)		(40.24)	(−9.20)	
		0.9032***	0.0486***	0.8107***	−0.0251***	0.49
		(45.25)	(6.14)	(39.84)	(−8.43)	
	MY	0.6592***		0.4890***	−0.0099***	0.52
		(78.18)		(55.27)	(−12.01)	
		0.6576***	0.0239***	0.4912***	−0.0103***	0.52
		(78.15)	(5.36)	(55.61)	(−12.47)	
	SG	0.7582***		0.4372***	−0.0134***	0.40
		(86.56)		(37.52)	(−6.39)	
		0.7574***	0.0221***	0.4374***	−0.0131***	0.40
		(86.60)	(4.55)	(37.60)	(−6.26)	
	TH	0.8953***		0.6119***	−0.0299***	0.40
		(61.15)		(38.45)	(−11.60)	
		0.8961***	0.0308***	0.6102***	−0.0297***	0.40
		(61.35)	(5.02)	(38.43)	(−11.55)	

Table 2 (*continued*)

This table reports the regression results of *CSAD* based on the following equation.

$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R^2_{m,t} + \varepsilon_t$

The equation is estimated twice. First, we impose the restriction, $\gamma_1 = 0$, consistent with the equation of CCK (2000). Second, we relax the restriction. $\gamma_1 = 0.R_{m,t}$ is the value of an equally weighted realized return of all industry indexes on day *t* and $R^2_{m,t}$ is the squared term. AU, FR, GR, UK, US, AR, BR, CL, MX, CN, HK, JP, KR, TW, ID, MY, SG and TH denote the markets for Australia, France, Germany, the United Kingdom, the United States, Argentina, Brazil, Chile, Mexico, China, Hong Kong, Japan, South Korea, Taiwan, Indonesia, Malaysia, Singapore and Thailand, respectively. The data range is from 4/25/1989 to 4/24/2009 for markets in Germany, the United Kingdom, the United States, Japan, Korea, Australia, France, Hong Kong, Malaysia and Singapore; because of data availability problems, the starting date for Argentina is 7/28/1993, for Brazil, 7/5/1994, for Chile, 7/5/1989, for Mexico, 6/19/1991, for China, 8/12/1996, for Taiwan, 7/4/1989, for Indonesia, 6/16/1992, and for Thailand, 9/3/1990. $\bar{R}^2$ is the adjusted R^2. The numbers in the parentheses are *t*-statistics.

* Statistical significance at the 10% level.

** Statistical significance at the 5% level.

*** Statistical significance at the 1% level.

advanced markets is almost double that in the emerging markets. By checking the mean values of *CSAD*, we find that the emerging markets (both Asian and Latin American) have higher mean values compared with those of the advanced markets. A higher mean value suggests significantly higher market variations across industrial returns for the emerging markets compared with those of advanced markets. A higher standard deviation may suggest that the market had unusual cross-sectional variations due to unexpected news or shocks.

4. Empirical evidence

4.1. Estimates of herding behavior

We estimate Eq. (3) using a Newey–West consistent estimator (1987).[7] This equation is estimated twice. First, we impose the restriction, $\gamma_1 = 0$, consistent with the equation proposed by CCK (2000). Second, we relax the restriction $\gamma_1 = 0$. Table 2 contains estimated results for markets grouped into three categories: Advanced, Latin American, and Asian.[8] As stated earlier, a negative value on the coefficient of $R^2_{m,t}$ is consistent with herding. The evidence in Table 2 shows that except for the US and Hong Kong markets,[9] all the values of γ_3 are statistically significant at the conventional levels. For the significant estimates, the statistics show that the sign of γ_3 is negative for the advanced and Asian markets, indicating that herding behavior exists in these markets.[10] This finding is in contrast to the results reported by CCK (2000), who find no evidence of herding in the Hong Kong market and only partial evidence of herding in the Japanese market.[11] The finding for the Chinese markets also goes against the evidence reported by Demirer and Kutan (2006), who conclude that participants in Chinese stock markets make rational investment choices.

A rather distinctive finding emerging from Table 2 is that none of the values of γ_3 for the Latin American markets shows a negative sign. This suggests that using the market return squared as a measure for extreme market movements results in no supportive evidence of herding behavior in Latin American markets.

The question then is: why is herding present in the Asian and advanced markets but not in the Latin American markets? One possible explanation is that due to global information processing, investors in each Asian market tend to follow the news and form their investment strategies based on those of the institutional investors on Wall Street, which is considered to be a center for processing and disseminating global investment information. Thus, if investors in global markets believe that news from Wall Street is valuable and they form a consensus about investment decisions, herding formation follows. On the contrary, the finding of a lack of herding activity in the US market may be attributable to the existence of the diverse opinions offered by different leading financial firms or the media. This setup may generate different beliefs, producing heterogeneous investors who make investment decisions based on their own private information, reducing the likelihood of forming herding activity.

4.2. The role of the US market

The estimated equation proposed by CCK (2000) 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.[12] It is reasonable to include major foreign variables in the model to identify the role and significance of the global factor (Longin and Solnik, 2001; Connolly and Wang, 2003). Since the US market plays a significant role in financial transactions across global markets, it motivates us to use the US market return squared as an argument in the test equation (Masih and Masih, 2001). Thus, we write:

$$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R^2_{m,t} + \gamma_4 CSAD_{us,t} + \gamma_5 R^2_{us,m,t} + \varepsilon_t \tag{4}$$

where the subscript with US in *CSAD* and $R^2_{m,t}$ refers to the US market variables. When estimating the herding equation with Asian markets, including Japan and Hong Kong, we employ $CSAD_{us,t-1}$ and $R^2_{us,m,t-1}$ due to the time lag in the US market. All of the other variables are defined in the same way as before. Table 3 reports the estimated results of Eq. (4). Consistent with our earlier findings, we still find that herding behavior is present in each market as reflected in a negative value of the coefficients of $R^2_{m,t}$ and statistical significance. The exceptions are the four Latin American markets

[7] A similar result is achieved by using a weighted least squared estimator. The results are available upon request.

[8] Since both the *CSAD* and *CSSD* measures generate similar results, we report only the results from *CSAD* to save space. Regression results using *CSSD* measures are available upon request.

[9] As we will show in the next table, we find that Hong Kong herds with the US market.

[10] Connolly and Stivers (2006), Statman et al. (2006), and Griffin et al. (2007) find evidence that stock volatility is correlated with the volume turnover variable. To incorporate this variable into the test equation, we cannot find significant evidence to support the notion that excess trading volume plays an important role in describing the movements of the cross-sectional stock return dispersions. Moreover, by adding macroeconomic variables – a change in the three-month interest rate, and a dummy variable that signifies a change in the target funds rate by the Fed – to the test equation, we cannot find any measurable impact on the estimated parameters and the test result.

[11] Our data on industrial stock returns are different from the data used by CCK. They use daily firm returns over the January 1963 – December 1997 period. Our data cover more recent observations: from 4/25/1989 to 4/24/2009. CCK cover five markets: US, Hong Kong, Japan, South Korea, and Taiwan. Our data consist of 18 markets. No European and Latin American markets were examined in CCK's study.

[12] It is likely to be connected through cross-listing effects (Chandar et al., 2009).

Table 3
Regression estimates of herding behavior by incorporating the US factor.

Regions	Market	Constant	$R_{m,t}$	$\|R_{m,t}\|$	$R^2_{m,t}$	$CSAD_{us,t}$	$R^2_{us,m,t}$	$\bar{R}^2$
Advanced markets	AU	0.4189***	−0.0010	0.2982***	−0.0112*	0.3956***	0.0039*	0.46
		(21.81)	(−0.14)	(15.88)	(−1.66)	(17.47)	(1.87)	
	FR	0.3981***	0.0271***	0.4160***	−0.0204***	0.5286***	−0.0085***	0.54
		(18.71)	(4.22)	(21.74)	(−4.06)	(19.77)	(−4.75)	
	GR	0.2984***	0.0365***	0.4901***	−0.0225***	0.4776***	−0.0007	0.60
		(17.09)	(5.61)	(30.29)	(−11.30)	(19.27)	(−0.23)	
	HK	0.5945***	0.0471***	0.4021***	0.0006	0.4445***	−0.0130***	0.45
		(18.13)	(4.69)	(13.93)	(0.11)	(11.09)	(−2.65)	
	JP	0.3422***	0.0172***	0.2692***	−0.0107***	0.3993***	−0.0053***	0.42
		(16.76)	(4.11)	(23.15)	(−5.14)	(15.15)	(−2.87)	
	UK	0.2222***	0.0287***	0.3797***	−0.0210***	0.5319***	−0.0017	0.60
		(11.05)	(4.79)	(23.02)	(−4.55)	(20.49)	(−1.05)	
Latin American markets	AR	0.6201***	0.0604***	0.4622***	0.0109	0.2155***	−0.0001	0.50
		(21.30)	(5.61)	(12.27)	(1.10)	(7.30)	(−0.04)	
	BR	0.6965***	0.0159	0.2789***	0.0737***	0.3351***	−0.0379***	0.59
		(17.05)	(0.49)	(3.54)	(3.23)	(7.98)	(−3.94)	
	CL	0.5515***	0.0428**	0.4380***	0.0975***	0.0779***	−0.0154***	0.56
		(19.18)	(2.20)	(5.31)	(2.74)	(3.58)	(−2.94)	
	MX	0.3721***	0.0449***	0.4253***	0.0349	0.3158***	−0.0088**	0.57
		(14.02)	(3.01)	(6.62)	(1.25)	(13.44)	(−2.28)	
Asian markets	CN	0.9135***	0.0370***	0.3416***	−0.0056	0.2610***	−0.0068**	0.36
		(21.79)	(4.49)	(11.26)	(−1.10)	(6.20)	(−2.00)	
	KR	0.6693***	0.0061	0.3850***	−0.0204***	0.3962***	−0.0057	0.33
		(19.33)	(0.93)	(17.95)	(−5.76)	(9.62)	(−1.38)	
	TW	0.5904***	0.0084	0.3756***	−0.0414***	0.2033***	−0.0018	0.21
		(20.66)	(1.43)	(14.46)	(−7.63)	(7.66)	(−0.61)	
	ID	0.6709***	0.0491***	0.7885***	−0.0235***	0.3084***	−0.0132**	0.50
		(14.04)	(3.97)	(22.43)	(−3.91)	(6.09)	(−2.36)	
	MY	0.5874***	0.0217*	0.4862***	−0.0099***	0.0954***	−0.0062***	0.52
		(21.50)	(1.96)	(18.68)	(−8.19)	(4.34)	(−3.13)	
	SG	0.4937***	0.0215***	0.3763***	−0.0098**	0.3593***	0.0008	0.48
		(21.36)	(3.16)	(21.56)	(−2.07)	(13.03)	(0.29)	
	TH	0.7766***	0.0293***	0.6003***	−0.0287***	0.1564***	−0.0062**	0.40
		(23.32)	(2.73)	(19.74)	(−3.89)	(4.46)	(−2.16)	

$CSAD_{us,t-1}$ and $R^2_{us,m,t-1}$ are used for estimating Asian markets. The numbers in the parentheses are *t*-statistics.
See Table 2 for other notations.
* Statistical significance at the 10% level.
** Statistical significance at the 5% level.
*** Statistical significance at the 1% level.

plus the Hong Kong and Chinese markets. However, these markets are found to herd with the US market, as shown by a negative sign of the estimated coefficient, and to be statistically significant. Thus, adding $CSAD_{us,t}$ and $R^2_{us,m,t}$ into the test equation enhances the explanatory power, as evidenced by the greater adjusted *R*-squared statistics.

In addition, the coefficients of $CSAD_{us,t}$ are positive and highly significant across all the markets, suggesting a dominant influence of the US return dispersions in international markets.[13] A significant positive correlation also implies a co-varying risk associated with industry sectors in global markets. One possible interpretation is that a shock in a similar sector tends to be transmitted to or fluctuate in a similar fashion across borders.

Noticeably, we find negative values on the coefficients of $R^2_{us,m,t}$ for all of the markets except Australia (AU). Since this variable is a measure of extreme movements in the US market, a significantly negative value would indicate that herding formation for each non-US market is also influenced by market conditions in the US. Particularly, evidence suggests that BR, CL, MX, CH, and HK show more significant herding around the US market, while in our earlier report, no herding phenomenon can be found in the Latin American markets such as BR, CL, and MX. A further test on the joint significance of $\gamma_4 = \gamma_5 = 0$ in Eq. (4) by using a Chi-squared test (not reported) suggests that the null is rejected at the 1% level.[14] Thus, it can be concluded that in analyzing herding activity, one cannot rule out the role of the US market. Previous empirical studies have not uncovered this line of analysis.

5. Herding under different market conditions

5.1. Herding behavior under up and down markets

The bulk of empirical papers demonstrates the asymmetric characteristics of asset returns (Ball and Kothari, 1989; Conrad et al.,1991; and Bekaert and Wu, 2000). Longin and Solnik (2001) and Tan et al. (2008) test investor behavior under different market conditions. To test whether investors react differently on days when the market is up vis-à-vis days when the market is down, we divide the data into two groups by using a dummy variable. The equation is:

[13] As noted by an anonymous referee, the Hong Kong market in recent years has been influenced by both US and Chinese markets. Following this argument, we estimate the Hong Kong herding equation by placing the Chinese market as a foreign variable. The evidence indicates that the estimated herding coefficient in the test equation is – 0.0099 with an absolute *t*-value of 3.52. Thus, the Hong Kong market indeed also herds around the Chinese market. However, testing the reverse herding direction, that the Chinese market is affected by the Hong Kong market, we find no significant evidence.

[14] The Chi-squared test statistics are not reported due to space limitations. However, they are available upon request.

Table 4
Estimates of herding behavior in rising and declining stock markets.

Regions	Market	Constant	$(1\text{-}D)R_{m,t}$	$DR_{m,t}$	$(1-D)R^2_{m,t}$	$DR^2_{m,t}$	$CSAD_{us,t}$	$R^2_{us,m,t}$	$\bar{R}^2$
Panel A – Regression estimations									
Advanced markets	AU	0.4210***	0.2854***	−0.3023***	−0.0053	−0.0128	0.3945***	0.0040*	0.46
		(22.57)	(16.29)	(−13.88)	(−0.90)	(−1.63)	(17.60)	(1.87)	
	FR	0.3983***	0.4415***	−0.3904***	−0.0196***	−0.0210***	0.5284***	−0.0085***	0.54
		(18.69)	(20.22)	(−19.23)	(−2.65)	(−4.38)	(19.76)	(−4.74)	
	GR	0.2978***	0.5292***	−0.4523***	−0.0236***	−0.0220***	0.4780***	−0.0007	0.60
		(16.95)	(28.98)	(−26.79)	(−8.04)	(−9.48)	(19.11)	(−0.24)	
	HK	0.5785***	0.5074***	−0.3437***	−0.0143***	0.0035	0.4486***	−0.0132***	0.45
		(18.54)	(20.00)	(−13.29)	(−2.96)	(0.88)	(11.29)	(−2.75)	
	JP	0.3440***	0.3025***	−0.2248***	−0.0164***	−0.0024	0.4002***	−0.0054***	0.42
		(16.83)	(24.37)	(−16.57)	(−7.68)	(−0.94)	(15.21)	(−2.87)	
	UK	0.2522***	0.6231***	−0.7135***	−0.0882***	−0.0942***	0.0129**	−0.0016***	0.64
		(42.36)	(23.30)	(−27.94)	(−4.50)	(−14.18)	(2.51)	(−4.03)	
	US	0.6364***	0.3179***	−0.2820***	−0.0027	−0.0005			0.35
		(56.28)	(15.77)	(−15.55)	(−0.62)	(−0.16)			
Latin American markets	AR	0.6196***	0.4973***	−0.4523***	0.0189**	−0.0031	0.2096***	0.0007	0.50
		(22.54)	(14.87)	(−16.35)	(2.06)	(−0.47)	(7.11)	(0.22)	
	BR	0.6819***	0.4056***	−0.1921**	0.0452	0.0885***	0.3349***	−0.0358***	0.59
		(17.58)	(4.94)	(−2.23)	(1.56)	(3.57)	(8.30)	(−3.95)	
	CL	0.5366***	0.4801***	−0.5105***	0.1023***	0.0463	0.0766***	−0.0151***	0.56
		(21.02)	(6.51)	(−6.39)	(3.00)	(1.07)	(3.48)	(−2.78)	
	MX	0.3721***	0.4411***	−0.4223***	0.0473	0.0185	0.3145***	−0.0087**	0.58
		(14.18)	(5.27)	(−10.19)	(1.16)	(1.03)	(12.79)	(−2.35)	
Asian markets	CN	0.9057***	0.4000***	−0.2915***	−0.0098***	−0.0031	0.2669***	−0.0073**	0.36
		(22.77)	(15.71)	(−8.30)	(−2.79)	(−0.48)	(6.29)	(−2.11)	
	KR	0.6659***	0.4171***	−0.3583***	−0.0266***	−0.0154***	0.3985***	−0.0060	0.33
		(19.40)	(16.36)	(−16.45)	(−5.01)	(−4.62)	(9.75)	(−1.48)	
	TW	0.5906***	0.3926***	−0.3557***	−0.0436***	−0.0386***	0.2040***	−0.0018	0.21
		(20.57)	(12.76)	(−11.81)	(−6.16)	(−5.57)	(7.66)	(−0.63)	
	ID	0.6599***	0.8886***	−0.7140***	−0.0351***	−0.0179***	0.3126***	−0.0131**	0.50
		(14.25)	(24.81)	(−19.32)	(−4.73)	(−2.99)	(6.24)	(−2.39)	
	MY	0.5859***	0.5251***	−0.4444***	−0.0125***	−0.0065***	0.0974***	−0.0063***	0.62
		(21.54)	(19.41)	(−16.66)	(−8.37)	(−3.37)	(4.47)	(−3.12)	
	SG	0.4944***	0.3878***	−0.3671***	−0.0068**	−0.0133*	0.3577***	0.0011	0.48
		(21.79)	(24.59)	(−16.24)	(−2.12)	(−1.85)	(12.99)	(0.39)	
	TH	0.7731***	0.6546***	−0.5558***	−0.0348***	−0.0246***	0.1573***	−0.0063**	0.40
		(22.83)	(16.43)	(−18.42)	(−2.92)	(−3.99)	(4.46)	(−2.20)	

Countries	Herding coefficients for up market	Herding coefficients for down market	Difference in coefficients	Chi-square	*P*-value
Panel B – Test equality of herding coefficients of $R^2_{m,t}$ between up and down markets: $\gamma_3 = \gamma_4$					
AU	−0.0053	−0.0128	0.0075	0.9543	0.3286
FR	−0.0196***	−0.0210***	0.0014	0.0388	0.8439
GR	−0.0236***	−0.0220***	−0.0016	0.2212	0.6381
HK	−0.0143***	0.0035	−0.0178***	9.4240	0.0021
JP	−0.0164***	−0.0024	−0.0140***	21.4971	0.0000
UK	−0.0882***	−0.0942***	0.0060	0.1386	0.7097
US	−0.0027	−0.0005	−0.0022	0.2224	0.6372
AR	0.0189**	−0.0031	0.0220**	4.8874	0.0271
BR	0.0452	0.0885***	−0.0433	1.6422	0.2000
CL	0.1023***	0.0463	0.0560	1.4237	0.2328
MX	0.0473	0.0185	0.0288	0.5755	0.4481
CN	−0.0098***	−0.0031	−0.0067	1.1438	0.2848
KR	−0.0266***	−0.0154***	−0.0112**	4.3726	0.0365
TW	−0.0436***	−0.0386***	−0.0050	0.3404	0.5596
ID	−0.0351***	−0.0179***	−0.0172*	3.7981	0.0513
MY	−0.0125***	−0.0065***	−0.0060**	5.5246	0.0188
SG	−0.0068**	−0.0133*	0.0065	0.9169	0.3383
TH	−0.0348***	−0.0246***	−0.0102	0.8056	0.3694

Panel A of this table reports the regression results for testing different herding behavior between up markets and down markets.

$$CSAD_t = \gamma_0 + \gamma_1(1-D)R_{m,t} + \gamma_2 DR_{m,t} + \gamma_3(1-D)R^2_{m,t} + \gamma_4 DR^2_{m,t} + \gamma_5 CSAD_{us,t} + \gamma_6 R^2_{us,m,t} + \varepsilon_t$$

where $R_{m,t}$ is the value of an equally weighted realized return of all industry indexes on date t and $R^2_{m,t}$ is the market return squared term. $CSAD_{us,t}$ and $R^2_{us,t}$ are the US stock return dispersion and market return squared, respectively. We use $CSAD_{us,t-1}$ and $R^2_{us,m,t-1}$ in testing Asian markets, including HK and JP. D is a dummy variable that equals one when market return is negative and zero, otherwise. Panel B presents statistics for testing the restriction of $\gamma_3 = \gamma_4$, which is used to examine the equality of herding coefficients ($R^2_{m,t}$) between up markets (γ_3) and down markets (γ_4). AU, FR, GR, UK, US, AR, BR, CL, MX, CN, HK, JP, KR, TW, ID, MY, SG and TH denote the markets for Australia, France, Germany, the United Kingdom, the United States, Argentina, Brazil, Chile, Mexico, China, Hong Kong, Japan, South Korea, Taiwan, Indonesia, Malaysia, Singapore and Thailand, respectively. $\bar{R}^2$ is the adjusted R^2. The numbers in the parentheses are *t*-statistics.

* Statistical significance at the 10% level.

** Statistical significance at the 5% level.

*** Statistical significance at the 1% level.

Table 5
Estimates of herding behavior during financial crisis period.

Countries	Constant	$R_{m,t}$	$\|R_{m,t}\|$	$R^2_{m,t}$	$CSAD_{us,t}$	$R^2_{us,m,t}$	$CSAD_{th,t}$	$R^2_{th,m,t}$	$\bar{R}^2$
Panel A1 – Herding behavior during the Asian crisis period, 7/1/1997–12/31/1998									
TH	1.5059***	0.0102	0.6876***	−0.0392*	0.2602	−0.0082			0.37
	(7.91)	(0.40)	(6.50)	(−1.90)	(1.51)	(−0.58)			
US	0.6422***	0.0153	0.2261***	−0.0012			0.0223**	−0.0007	0.30
	(16.52)	(1.17)	(4.38)	(−0.11)			(2.35)	(−0.45)	
ID	0.8126**	0.0579**	0.6211***	−0.0042	0.9265***	−0.0523***	0.1528***	−0.0083	0.53
	(2.53)	(2.27)	(8.29)	(−0.50)	(3.29)	(−3.66)	(3.03)	(−1.26)	
KR	0.8877***	0.0014	0.3804***	−0.0271**	0.2416	−0.0220*	0.1308*	−0.0018	0.22
	(3.91)	(0.07)	(4.93)	(−2.51)	(1.19)	(−1.76)	(1.93)	(−0.34)	
MY	1.0864***	−0.0010	0.4327***	−0.0080***	−0.1485	0.0051	0.0476	−0.0030	0.61
	(7.99)	(−0.07)	(11.21)	(−4.03)	(−1.20)	(0.25)	(1.21)	(−0.80)	
SG	0.7939***	0.0040	0.2830***	0.0018	0.2382**	−0.0075	0.1062***	−0.0062***	0.50
	(8.00)	(0.24)	(7.59)	(0.37)	(2.38)	(−0.69)	(4.55)	(−2.92)	

Countries	Constant	$R_{m,t}$	$\|R_{m,t}\|$	$R^2_{m,t}$	$CSAD_{us,t}$	$R^2_{us,m,t}$	$CSAD_{mx,t}$	$R^2_{mx,m,t}$	$\bar{R}^2$
Panel A2 – Herding behavior during the Mexican crisis period, 12/22/1994–12/31/1995									
MX	0.7161***	0.0398*	0.5969***	−0.0497**	0.1719	−0.0515			0.48
	(5.44)	(1.90)	(6.35)	(−2.06)	(1.02)	(−0.90)			
US	0.5238***	−0.0030	0.4617***	−0.2074***			0.0313	−0.0042	0.16
	(11.93)	(−0.14)	(4.52)	(−2.88)			(1.36)	(−1.15)	
AR	0.8081***	0.0201	0.4025***	0.0279*	−0.4779**	0.1446	0.2654***	−0.0350***	0.67
	(4.86)	(0.97)	(6.71)	(1.79)	(−2.13)	(0.96)	(3.60)	(−2.99)	
BR	0.6474***	−0.0476	0.1674	0.1085***	0.1142	−0.1488*	0.1502	−0.0190	0.79
	(4.29)	(−0.93)	(1.03)	(5.36)	(0.48)	(−1.87)	(1.55)	(−1.21)	
CL	0.6694***	−0.0597	−0.0598	0.1784***	0.3479*	−0.0900	0.0216	−0.0095	0.85
	(4.27)	(−0.63)	(−0.36)	(11.61)	(1.79)	(−1.07)	(0.29)	(−0.66)	

Countries	Constant	$R_{m,t}$	$\|R_{m,t}\|$	$R^2_{m,t}$	$CSAD_{us,t}$	$R^2_{us,m,t}$	$CSAD_{ar,t}$	$R^2_{ar,m,t}$	$\bar{R}^2$
Panel A3 – Herding behavior during the Argentine crisis period, 1/1/1999–12/31/1999									
AR	0.6219***	0.0595*	0.7027***	−0.0397**	0.0953	0.0319			0.46
	(5.99)	(1.77)	(5.61)	(−2.56)	(0.91)	(1.10)			
US	0.9078***	0.0847***	0.3520**	−0.1231*			0.0658	−0.0053**	0.09
	(11.65)	(4.94)	(2.43)	(−1.84)			(1.58)	(−2.32)	
BR	0.7623***	−0.1597**	0.5371***	0.0546***	0.2896**	−0.1574***	0.1950***	−0.0517***	0.76
	(4.84)	(−2.54)	(5.62)	(2.90)	(2.46)	(−3.07)	(2.68)	(−2.81)	
CL	0.4071***	0.0121	0.4504***	0.1008***	0.2037***	0.0122	0.0207	0.0055*	0.66
	(6.58)	(0.21)	(6.25)	(2.63)	(3.61)	(0.69)	(0.81)	(1.72)	
MX	0.6099***	−0.0358	0.3240**	0.1437	0.1758**	0.0003	−0.0007	−0.0134	0.50
	(4.73)	(−0.52)	(2.42)	(1.58)	(2.09)	(0.01)	(−0.01)	(−1.30)	

Countries	Constant	$R_{m,t}$	$\|R_{m,t}\|$	$R^2_{m,t}$	$CSAD_{us,t}$	$R^2_{us,m,t}$	$\bar{R}^2$
Panel A4 – Herding behavior during the credit market crisis period, 3/1/2008–3/31/2009							
US	0.9807***	0.0110	0.2949***	−0.0074**			0.53
	(15.65)	(1.39)	(9.67)	(−1.99)			
AU	0.8393***	0.0011	0.2642***	−0.0243**	0.3870***	0.0022	0.47
	(9.42)	(0.08)	(4.35)	(−2.37)	(6.92)	(1.15)	
FR	0.5280***	0.0352***	0.3464***	−0.0103	0.3770***	−0.0026	0.67
	(5.50)	(2.71)	(6.72)	(−1.26)	(6.84)	(−1.64)	
GR	0.4912***	0.0405*	0.4649***	−0.0131	0.2970***	0.0051	0.68
	(6.29)	(1.84)	(6.21)	(−1.35)	(5.05)	(1.40)	
HK	0.6980***	0.0467***	0.4055***	−0.0152**	0.3133***	0.0013	0.51
	(6.70)	(2.69)	(7.00)	(−2.27)	(4.03)	(0.31)	
JP	0.5096***	0.0073	0.3086***	−0.0115***	0.2709***	−0.0037	0.51
	(6.46)	(0.73)	(7.67)	(−2.67)	(4.07)	(−1.46)	
UK	0.6131***	0.0236*	0.2607***	−0.0079	0.4357***	−0.0007	0.56
	(5.93)	(1.77)	(4.86)	(−0.86)	(7.54)	(−0.45)	
AR	0.5051***	0.0026	0.5968***	−0.0284	0.2955***	−0.0044	0.56
	(5.97)	(0.06)	(5.51)	(−0.80)	(3.95)	(−1.37)	
BR	0.5340***	0.0089	0.4245***	−0.0185***	0.4108***	−0.0040	0.62
	(6.43)	(0.55)	(7.29)	(−2.64)	(5.69)	(−1.24)	
CL	0.5137***	0.0358*	0.4551***	−0.0226***	0.0854*	0.0004	0.55
	(7.66)	(1.84)	(9.34)	(−2.88)	(1.80)	(0.31)	
MX	0.3366***	0.0288	0.3707***	0.0457***	0.3598***	−0.0083**	0.75
	(3.48)	(1.39)	(5.36)	(3.37)	(4.53)	(−2.10)	
CN	0.8184***	0.0224**	0.2034***	0.0001	0.3400***	0.0025	0.49
	(7.16)	(2.14)	(4.57)	(0.03)	(4.91)	(0.86)	
KR	0.8940***	0.0049	0.3432***	−0.0149**	0.1502**	0.0067	0.45
	(8.60)	(0.38)	(5.50)	(−2.01)	(2.00)	(1.48)	
TW	0.7168***	0.0128	0.4251***	−0.0709***	0.1680***	−0.0001	0.21
	(6.96)	(1.11)	(4.56)	(−4.29)	(2.66)	(−0.02)	
ID	0.8380***	0.0479***	0.3713***	0.0097*	0.3146**	−0.0051	0.58
	(5.32)	(2.73)	(7.31)	(1.78)	(2.37)	(−0.75)	
MY	0.5659***	0.0369**	0.3783***	0.0075*	0.0736**	−0.0008	0.57
	(9.96)	(2.11)	(10.30)	(1.72)	(2.06)	(−0.49)	

Table 5 (*continued*)

Countries	Constant	$R_{m,t}$	$\lvert R_{m,t}\rvert$	$R^2_{m,t}$	$CSAD_{us,t}$	$R^2_{us,m,t}$	$\overline{R}^2$
SG	0.6236***	0.0321**	0.3666***	−0.0104	0.4072***	0.0006	0.52
	(5.08)	(2.02)	(5.14)	(−0.98)	(4.63)	(0.16)	
TH	0.5894***	0.0284**	0.4382***	−0.0094	0.1560***	0.0015	0.74
	(8.37)	(2.16)	(10.47)	(−1.08)	(2.88)	(0.48)	

Countries	Herding coefficients during crisis period	Herding coefficients during tranquil period	Difference in herding coefficients	Chi-square	*P*-value
Panel B1 – Test equality of herding coefficients ($R^2_{m,t}$) between tranquil period and Asian crisis period					
TH	−0.0392*	−0.0038	−0.0354*	2.9499	0.0859
US	−0.0012	0.0040	−0.0052	0.2213	0.6381
ID	−0.0042	−0.0275*	0.0233***	7.7048	0.0055
KR	−0.0271**	−0.0236	−0.0035	0.1032	0.7480
MY	−0.0080***	0.0035	−0.0115***	33.5567	0.0000
SG	0.0018	−0.0293	0.0311***	39.2472	0.0000

Countries	Herding coefficients during crisis period	Herding coefficients during tranquil period	Difference in herding coefficients	Chi-square	*P*-value
Panel B2 – Test equality of herding coefficients ($R^2_{m,t}$) between tranquil period and Mexican crisis period					
MX	−0.0497**	0.0183	−0.0679***	7.9449	0.0048
US	−0.2074***	0.0040	−0.2114***	8.6333	0.0033
AR	0.0279*	−0.0179	0.0458***	8.5902	0.0034
BR	0.1085***	0.1660***	−0.0575***	8.0750	0.0045
CL	0.1784***	0.3399***	−0.1615***	110.3898	0.000

Countries	Herding coefficients during crisis period	Herding coefficients during tranquil period	Difference in herding coefficients	Chi-square	*P*-value
Panel B3 – Test equality of herding coefficients ($R^2_{m,t}$) between tranquil period and Argentine crisis period					
AR	−0.0397**	0.0047	−0.0444***	8.1825	0.0042
US	−0.1231*	0.0040	−0.1271*	3.5944	0.0580
BR	0.0546***	0.1660***	−0.1114***	34.9369	0.0000
CL	0.1008***	0.3399***	−0.2391***	38.9317	0.0000
MX	0.1437	0.0183	0.1255	1.9054	0.1675

Countries	Herding coefficients during crisis period	Herding coefficients during tranquil period	Difference in herding coefficients	Chi-square	*P*-value
Panel B4 – Test equality of herding coefficients ($R^2_{m,t}$) between tranquil period and credit crisis period					
US	−0.0074**	0.0040	−0.0114***	9.3989	0.0022
AU	−0.0243**	0.0341**	−0.0584***	32.3368	0.0000
FR	−0.0103	−0.0179	0.0076	0.8493	0.3568
GR	−0.0131	0.0199*	−0.0330***	11.5662	0.0007
UK	−0.0152**	−0.0187	0.0035	0.2782	0.5979
AR	−0.0115***	0.0236	−0.0351***	66.4793	0.0000
BR	−0.0079	−0.0048	−0.0031	0.1127	0.7371
CL	−0.0284	−0.0412**	0.0128	0.1306	0.7178
MX	−0.0185***	−0.0853***	0.0668***	91.1237	0.0000
CN	−0.0226***	−0.0047	−0.0179**	5.2024	0.0226
HK	0.0457***	0.0190	0.0267**	3.8801	0.0489
JP	0.0001	−0.0104	0.0105***	10.7768	0.0010
KR	−0.0149**	−0.0279*	0.0130*	3.0903	0.0788
TW	−0.0709***	−0.0555***	−0.0154	0.8658	0.3521
ID	0.0097*	−0.0309**	0.0406***	55.8135	0.0000
MY	0.0075*	−0.0091	0.0166***	14.6179	0.0001
SG	−0.0104	−0.0090	−0.0014	0.0171	0.8959
TH	−0.0094	−0.0718***	0.0624***	51.0218	0.0000

This table reports regression results by incorporating leading crisis market factors. The regression model is as follows:

$$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R^2_{m,t} + \gamma_4 CSAD_{us,t} + \gamma_5 R^2_{us,m,t} + \gamma_6 CSAD_{c,,m,t} + \gamma_7 R^2_{c,m,t} + \varepsilon_t$$

where $R_{m,t}$ is the value of an equally weighted realized return of all industry indexes on date t and $R^2_{m,t}$ is the return squared term. $CSAD_{us,t}$ and $R^2_{us,m,t}$ are return dispersion and market return squared for the US. For the Asian markets, we use a one-period lag for these two variables. $CSAD_{c,m,t}$ and $R^2_{c,m,t}$ are the variables for crisis country of origin, including Thailand (Asian crisis: 7/1/1997–12/31/1998), Mexico (12/22/1994–12/31/1995), Argentina (1/1/1999–12/31/1999), and the US (3/1/2008–3/31/2009). For other notations, please refer to Table 2.
Panels A1–A4 present the regression results of the herding equation during different financial crisis periods.
Panels B1–B4 test equality of herding coefficients ($R^2_{m,t}$) between tranquil and each financial crisis period.
$\overline{R}^2$ is the adjusted R-squared. The numbers in the parentheses are t-statistics.
* The coefficient is significant at the 10% level.
** The coefficient is significant at the 5% level.
*** The coefficient is significant at the 1% level.

$$\begin{aligned} CSAD_t = {} & \gamma_0 + \gamma_1(1-D)R_{m,t} + \gamma_2 DR_{m,t} + \gamma_3(1-D)R^2_{m,t} \\ & + \gamma_4 DR^2_{m,t} + \gamma_5 CSAD_{us,t} + \gamma_6 R^2_{us,m,t} + \varepsilon_t \end{aligned} \tag{5}$$

where D is a dummy variable. In Eq. (5), we consider asymmetry in both linear and non-linear terms by setting $D = 1$ if $R_{m,t} < 0$, and 0 otherwise.

Table 4 reports the herding regression results under asymmetric market conditions. Focusing on the coefficients of market return squared, we find evidence that is quite consistent with the results we presented earlier. Particularly, most coefficients are negative and statistically significant except the US and Latin American markets. That is, we continue to find a significant negative sign for the herding coefficient, regardless of whether the equation is estimated during up or down markets. Although the herding coefficients present similar evidence for the advanced markets, we find the herding effect for a group of Asian countries to be stronger in up markets than in down markets, especially in China, Japan, and Hong Kong.

To test the equality of the herding coefficients between up and down markets, we conduct an equality test by subtracting the coefficient on the down markets from the coefficient on the up markets. The results are reported in Panel B of Table 4. The evidence suggests that herding asymmetry is more apparent in five Asian markets (that contains Japan and Hong Kong), since the estimated values are negative and statistically significant. The testing results also indicate that no asymmetry exists in the advanced markets, except Japan and Hong Kong.

5.2. Herding behavior during tranquil and turbulent periods

The approach used by Christie and Huang (1995) suggests that herding will be more prevalent during periods of market stress, which is defined as the occurrence of extreme returns on market portfolios. The time period of extreme returns is assumed to be captured by testing the significance of a dummy variable. Recent experience suggests that extreme return movements persistently occur in crisis periods. Therefore, it is relevant to investigate whether extreme market movements, such as financial crises, could alter the parametric relation in the test equation. For this purpose, we examine the impact of recent financial crises on herding behavior. The events we examine include the 1994 Mexican crisis, the 1997 Asian distress, the 1999 Argentine turmoil, and the 2008 credit market crisis.[15] The estimates are based on the equation expressed as (6):

$$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \gamma_4 CSAD_{us,t} + \gamma_5 R_{us,m,t}^2 + \gamma_6 CSAD_{c,,m,t} + \gamma_7 R_{c,m,t}^2 + \varepsilon_t \tag{6}$$

where the subscript c for $CSAD$ and $R_{m,t}^2$ refers to the crisis market. The statistical significance of these two terms across markets implies a contagion effect.[16,17] Panels A1 through A4 in Table 5 contain regression estimates under different crises; the first row of each panel reports the estimates of the country of origin for each crisis. Interestingly, all of the crisis countries, including Thailand (TH) in Panel A1, Mexico (MX) in Panel A2, Argentina (AR) in Panel A3, and the US in Panel A4, show negative signs for the coefficients of $R_{m,t}^2$ and are statistically significant, meaning that these markets display herding behavior when a crisis is taking place. Several additional empirical findings are worth noting. First, during the Asian crisis, the evidence suggests that the neighboring markets were highly influenced by the crisis in Thailand, as evidenced by the positive correlations between the stock return dispersions ($CSAD_{th,t}$); an exception is Malaysia. We also find some herding activity in these markets, while Singapore is more significant with a strong negative sign. This evidence is consistent with the notion that stock market contagion operates through a domino effect (Markwat et al., 2009). Apparently, the effect of the US market on other markets has been weakened, as evidenced by the reduced statistical significance of the coefficient of $R_{us,m,t}^2$ on the domestic $CSAD_t$ in each test equation (compared with the results in Table 3).

Second, turning to the estimates of Panels A2 and A3, we find that investors in the Mexican and Argentine markets show herding behavior as the crisis hits their own markets. The spillover to the US market may be attributable to a contagion effect or to the close interactions between these markets. The gravity/contagion effect is present in the neighboring countries: we find that Argentina herds with Mexico in the 1994–1995 crisis, and Brazil herds with Argentina during the 1999 Argentine crisis. The evidence suggests that during these crises, the impact from the US market weakened.

Third, the statistics in Panel A4 report that in the credit market crisis, the US, the origin of the credit crisis, exhibits herding behavior. The stock return dispersions in the US market are transmitted to the rest of the world markets. The evidence is shown in the estimated coefficients of $CSAD_{us,t}$ with a positive and significant sign. However, we find very little evidence that these markets herded with the US market during this instance. This may result from the fact that the crisis appears to be worldwide, so the information of $R_{us,m,t}^2$ has been reflected in the local $R_{m,t}^2$ that renders the estimated coefficient of $R_{us,m,t}^2$ to be insignificant.

Before concluding this section, it is worthwhile to evaluate whether the coefficients in the crisis periods are significantly different from those present in tranquil periods. To this end, we compute Chi-squared statistics for testing the difference of the herding coefficients between crisis and tranquil periods. The testing results for different sub-periods are reported in Panels B1–B4 of Table 5. In these panels, we present herding coefficients for both crisis and tranquil periods and conduct a significance test on the difference (subtracting the estimated coefficient of the non-crisis period from that of the crisis period) of the herding coefficients using Chi-squared statistics. To provide a less biased comparison, we employ a sample size of the non-crisis data equivalent to that of the crisis period, either before or after the time of the crisis, depending on the appropriateness of the sample period. The evidence from Panels B1–B4 suggests that in the majority of the cases, we reject the null hypothesis of no difference in the herding coefficients between crisis and tranquil periods. However, with one exception, we find a negative sign present in both the Mexican (Panel B2) and the Argentine (Panel B3) crises, confirming the earlier findings that herding behavior is more apparent for the Latin and US markets in crisis periods and this phenomenon is less obvious in other advanced and Asian markets.

6. Summary and conclusions

This study examines investors' herding activity for 18 countries divided into three groups: the advanced stock markets (Australia, France, Germany, Hong Kong, Japan, the United Kingdom, and the United States); Latin American markets (Argentina, Brazil, Chile, and Mexico); and Asian markets (China, South Korea, Taiwan, Indonesia, Malaysia, Singapore, and Thailand). By applying daily data from May 25, 1988, through April 24, 2009, for industrial stock returns, this study finds significant evidence to support the existence of herding in each national market except the US and Latin America. This result stands in contrast to the earlier literature that shows no herding in advanced markets (Chang et al. 2000) and in Chinese markets (Demirer and Kutan, 2006).

This paper pioneers research by extending the investigation of herding behavior from domestic markets to global markets. In particular, we find significant evidence that most investors herd with the US market in addition to their domestic markets. Thus, the traditional approach of excluding foreign markets in testing herding behavior is likely to produce biased estimates. Interestingly, this study finds that most market participants investing in the Latin American markets herd with the US market, not their own markets.

[15] There is no uniform term to represent the world financial crisis from 2007 to 2009. It started with the sub-prime mortgage crisis, which has been an ongoing financial problem triggered by a dramatic rise in mortgage delinquencies and foreclosures in the United States. Its adverse effect caused a credit crunch in banks and financial markets in the US and around the globe (Claessens et al., 2009).

[16] We did not include the Russian crisis due to a lack of industry data and the timing, which is too close to the Argentine crisis.

[17] These two terms will vanish if the crisis occurs in domestic (origin of the crisis) markets or, in some cases, in the US market.

While testing the performance of sub-samples, we find that with the exception of the US and Latin American markets, herding is present in both up and down markets, although herding asymmetry is more profound in Asian markets during rising markets. By examining the data from financial crises, we find that crisis triggers herding activity in the crisis country of origin and then produces a contagion effect, which spreads the crisis to neighboring countries. The evidence also reveals herding formation in the US and Latin American markets during crisis periods.

Acknowledgements

We would like to thank the editor, Ike Mathur; the referees; Daniel Dorn, Edward Nelling, and Daniel Naveen; and participants at the Drexel Finance seminar for helpful comments and suggestions. All remaining errors are our own. Thomas C. Chiang would like to acknowledge support from the Marshall Austin Chair.

References

Ball, R., Kothari, S.P., 1989. Nonstationary expected returns: implications for tests of market efficiency and serial correlation in returns. Journal of Financial Economics 25, 51–74.

Bekaert, G., Harvey, C., 1997. Emerging equity market volatility. Journal of Financial Economics 43, 29–77.

Bekaert, G., Wu, G., 2000. Asymmetric volatility and risk in equity markets. Review of Financial Studies 13, 1–42.

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.

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

Cai, Y., Chou, R.Y., Li, D., 2009. Explaining international stock correlations with CPI fluctuations and market volatility. Journal of Banking and Finance 33, 2026–2035.

Chandar, N., Patro, D., Yezegel, A., 2009. Crises, contagion and cross-listings. Journal of Banking and Finance 33, 1709–1729.

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.

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.

Claessens, S., Demirgüç-Kunt, A., Moshirian, F., 2009. Global financial crisis, risk analysis and risk measurement. Journal of Banking and Finance 33, 1949–1952.

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

Connolly, R., Stivers, C., 2006. Information content and other characteristics of daily cross-sectional dispersion in stock returns. Journal of Empirical Finance 13, 79–112.

Connolly, R., Wang, F., 2003. International equity market comovements: economic news or contagion. Pacific Basin Finance Journal 11, 23–43.

Conrad, J., Gultekin, M., Kaul, G., 1991. Asymmetric predictability of conditional variances. Review of Financial Studies 4, 597–622.

Corsetti, G., Pericoli, M., Sbracia, M., 2005. Some contagion, some interdependence: More pitfalls in tests of financial contagion. Journal of International Money and Finance 24, 1177–1199.

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., 2001. Asymmetric cross-sectional dispersion in stock returns: evidence and implications. Federal Reserve Bank of San Francisco Working Papers in Applied Economic Theory 2000-18.

Forbes, K., Rigobon, R., 2002. No contagion, only interdependence: Measuring stock market comovements. Journal of Finance 57, 2223–2261.

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

Griffin, J., Nardari, F., Stulz, R., 2007. Do investors trade more when stocks have performed well? Evidence from 46 countries. Review of Financial Studies 20, 905–951.

Grinblatt, M., Titman, S., Wermers, R., 1995. Momentum investment strategies, portfolio performance, and herding: a study of mutual fund behavior. American Economic Review 85, 1088–1105.

Hwang, S., Salmon, M., 2006. Sentiment and beta herding. Working paper, University of Warwick.

Kennedy, P., 2008. A Guide to Econometrics. Blackwell Publishing, Malden, MA.

Lakonishok, J., Shleifer, A., Vishny, R.W., 1992. The impact of institutional trading on stock prices. Journal of Financial Economics 32, 23–44.

Longin, F., Solnik, B., 2001. Extreme correlation of international equity markets. Journal of Finance 56, 649–676.

Markwat, T., Kole, E., van Dijk, D., 2009. Contagion as a domino effect in global stock markets. Journal of Banking and Finance 33, 1996–2012.

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

Newey, W., 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.

Statman, M., Thorley, S., Vorkink, K., 2006. Investor overconfidence and trading volume. Review of Financial Studies 19, 1531–1565.

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.

Villatoro, F., 2009. The delegated portfolio management problem: reputation and herding. Journal of Banking and Finance 33, 2062–2069.

Welch, I., 2000. Herding among security analysts. Journal of Financial Economics 58, 369–396.

Wermers, R., 1999. Mutual fund herding and the impact on stock prices. Journal of Finance 54, 581–622.

Zhou, R., Lai, R., 2009. Herding and information based trading. Journal of Empirical Finance 16, 388–393.