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An examination of herd behavior in equity markets: An international perspective

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Abstract

We examine the investment behavior of market participants within different international markets (i.e., US, Hong Kong, Japan, South Korea, and Taiwan), specifically with regard to their tendency to exhibit herd behavior. We find no evidence of herding on the part of market participants in the US and Hong Kong and partial evidence of herding in Japan. However, for South Korea and Taiwan, the two emerging markets in our sample, we document significant evidence of herding. The results are robust across various size-based portfolios and over time. Furthermore, macroeconomic information rather than firm-specific information tends to have a more significant impact on investor behavior in markets which exhibit herding. In all five markets, the rate of increase in security return dispersion as a function of the aggregate market return is higher in up market, relative to down market days. This is consistent with the directional asymmetry documented by McQueen et al. (1996) (McQueen, G., Pinegar, M.A., Thorley, S., 1996. Journal of Finance 51, 889–919). © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

Academic researchers have devoted considerable effort in understanding the investment behavior of market participants and its ensuing impact on security prices. The investment behavior of market participants has been linked to factors such as investor's investment horizons, the benchmarks used to measure performance, the behavior of other market participants, the degree of underlying market volatility, and the presence of fads and speculative trading activity in the financial markets.

In this paper, we investigate the investment behavior of market participants within different international markets, specifically with regard to their tendency to mimic the actions of others, i.e., engage in herd behavior. Herding can be construed as being either a rational or irrational form of investor behavior. According to Devenow and Welch (1996), the irrational view focuses on investor psychology where investors disregard their prior beliefs and follow other investors blindly. The rational view, on the other hand, focuses on the principal–agent problem in which managers mimic the actions of others, completely ignoring their own private information to maintain their reputational capital in the market (Scharfstein and Stein, 1990; Rajan, 1994). [1] Bikhchandani et al. (1992) and Welch (1992) refer to this behavior as an informational cascade.

In a recent empirical study, Christie and Huang (1995) examine the investment behavior of market participants in the US equity market. By utilizing the cross-sectional standard deviation of returns (CSSD) as a measure of the average proximity of individual asset returns to the realized market average, they develop a test of herd behavior. In particular, they examine the behavior of CSSD under various market conditions. They argue that if market participants suppress their own predictions about asset prices during periods of large market movements and base their investment decisions solely on aggregate market behavior, individual asset returns will not diverge substantially from the overall market return, hence resulting in a smaller than normal CSSD.

In this paper, we extend the work of Christie and Huang (1995) along three dimensions. First, we propose a new and more powerful approach to detect herding based on equity return behavior. Using a non-linear regression specification, we examine the relation between the level of equity return dispersions (as measured by the cross-sectional absolute deviation of returns, i.e., CSAD), and the overall market return. In the presence of severe (moderate) herding, we

[1] Herd behavior can become increasingly important when the market is dominated by large institutional investors. Since institutional investors are evaluated with respect to the performance of a peer group, they have to be cautious about basing their decisions on their own priors and ignoring the decisions of other managers. In fact, Shiller and Pound (1989) document that institutional investors place significant weight on the advice of other professionals with regard to their buy and sell decisions for more volatile stock investments.

expect that return dispersions will decrease (or increase at a decreasing rate) with an increase in the market return. Second, we examine the presence of herding across both developed and developing financial markets including the US, Hong Kong, Japan, South Korea, and Taiwan. Examining herding is interesting in an international context since differences in factors such as the relative importance of institutional versus individual investors, the quality and level of information disclosure, the level of sophistication of derivatives markets, etc., can affect investor behavior in these markets. Third, we test for shifts in herd behavior subsequent to the liberalization of Asian financial markets.

Our empirical tests indicate that during periods of extreme price movements, equity return dispersions for the US and Hong Kong continue to increase linearly, hence providing evidence against the presence of herd behavior. The results for the US are consistent with those documented by Christie and Huang (1995). However, for South Korea and Taiwan, the two emerging markets in our sample, we find a significant non-linear relation between equity return dispersions and the underlying market price movement, i.e., the equity return dispersions either increase at a decreasing rate or decrease with an increase in the absolute value of the market return. Interestingly, in all five markets, the rate of increase in return dispersion (as measured by CSAD) as a function of the aggregate market return, is higher when the market is advancing than when it is declining. This is consistent with the directional asymmetry documented by McQueen et al. (1996) where all stocks tend to react quickly to negative macroeconomic news, but small stocks tend to exhibit delayed reaction to positive macroeconomic news.

We also document that in South Korea and Taiwan, where the evidence in favor of herding is most pronounced, systematic risk accounts for a relatively large portion of overall security risk. This evidence is consistent with the view that the relative scarcity of rapid and accurate firm-specific information in emerging financial markets may cause investors to focus more on macroeconomic information. However, to the extent that investors react to *any* useful information, whether it is firm specific or market related, such type of behavior can be viewed as being rational.

Furthermore, results of the size, i.e., market capitalization based portfolio tests, indicate that our herding results are not driven by either large or small capitalization stocks. In addition, the results for both South Korea and Taiwan remain relatively robust in various sub-period tests designed to capture shifts in investment behavior associated with the liberalization of these economies. We also conduct tests to examine whether the presence of daily price limits imposed on stocks in South Korea and Taiwan, are impacting our findings. Our additional tests do not alter the overall evidence in favor of herding in the equity markets of South Korea and Taiwan.

An important implication of investing in a financial market where market participants tend to herd around the aggregate market consensus, is that a larger number of securities are needed to achieve the same level of diversification than in an otherwise normal market.

The remainder of the paper is organized as follows. In Section 2, we provide methodological details and a description of the data. In Section 3, we provide a discussion of the empirical results and in Section 4 we provide concluding remarks and discuss implications of our findings.

2. Methodology and data description

2.1. Methodology

In this section, we develop an empirical methodology to detect the presence of herd behavior in international equity markets. Specifically, we propose an alternative, less stringent approach to the one suggested by Christie and Huang (1995) (henceforth referred as CH). While the two methods are similar in spirit, they do not always reach the same conclusion. We discuss the rationale behind the formulation of our approach and compare and contrast the two methods.

CH suggest the use of cross-sectional standard deviation of returns (CSSD) to detect herd behavior in a market setting. The CSSD measure is defined as

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

where $R_{i,t}$ is the observed stock return on firm i at time t and $R_{m,t}$ is the cross-sectional average of the N returns in the aggregate market portfolio at time t. This dispersion measure quantifies the average proximity of individual returns to the realized average. [2] CH argue that rational asset pricing models predict that the dispersion will increase with the absolute value of the market return since individual assets differ in their sensitivity to the market return. On the other hand, in the presence of herd behavior (where individuals suppress their own beliefs and base their investment decisions solely on the collective actions of the market), security returns will not deviate too far from the overall market return. This behavior will lead to an increase in dispersion at a decreasing rate, and if the herding is severe, it may lead to a decrease in dispersion. Therefore,

[2] Other academic studies have also used variants of the return dispersion measure. For example, Bessembinder et al. (1996) use the absolute deviation of individual firm returns from the market-model expected returns as a proxy for firm-specific information flows. Connolly and Stivers (1998) use the stock market's cross-sectional dispersion to measure the uncertainty with regard to the underlying market fundamentals. Stivers (1998) also employs the cross-sectional return dispersion as a measure of the uncertainty faced by imperfectly informed traders in attempting to infer common factor innovations from news and prices.

herd behavior and rational asset pricing models offer conflicting predictions with regard to the behavior of security return dispersions.

CH suggest that individuals are most likely to suppress their own beliefs in favor of the market consensus during periods of extreme market movements. Hence, CH empirically examine whether equity return dispersions are significantly lower than average during periods of extreme market movements. They estimate the following empirical specification:

$$\mathrm{CSSD}_t = \alpha + \beta^{\mathrm{L}} D_t^{\mathrm{L}} + \beta^{\mathrm{U}} D_t^{\mathrm{U}} + \varepsilon_t, \tag{2}$$

$D_t^{\mathrm{L}} = 1$, if the market return on day t lies in the extreme *lower* tail of the distribution; and equal to zero otherwise, and
$D_t^{\mathrm{U}} = 1$, if the market return on day t lies in the extreme *upper* tail of the distribution; and equal to zero otherwise.

The dummy variables are designed to capture differences in investor behavior in extreme up or down versus relatively normal markets. The presence of negative and statistically significant β^{L} and β^{U} coefficients would be indicative of herd behavior. CH use one or five percent of the observations in the upper and lower tail of the market return distribution to define extreme price movement days.

In this paper, using the cross-sectional absolute deviation of returns (CSAD) as the measure of dispersion, we demonstrate that rational asset pricing models predict not only that equity return dispersions are an *increasing* function of the market return but also that the relation is *linear*. If market participants tend to follow aggregate market behavior and ignore their own priors during periods of large average price movements, then the linear and increasing relation between dispersion and market return will no longer hold. Instead, the relation can become non-linearly increasing or even decreasing. Our empirical model builds on this intuition.

As a starting point in the analysis, we illustrate the relation between CSAD and the market return. Let R_i denote the return on any asset i, R_m be the return on the market portfolio, and $E_t(\cdot)$ denote the expectation in period t. A conditional version of the Black (1972) CAPM can be expressed as follows:

$$E_t(R_i) = \gamma_0 + \beta_i E_t(R_m - \gamma_0), \tag{3}$$

where γ_0 is the return on the zero-beta portfolio, β_i is the time-invariant systematic risk measure of the security, $i = 1, \ldots, N$ and $t = 1, \ldots, T$. Also, let β_m be the systematic risk of an equally-weighted market portfolio. Hence,

$$\beta_m = \frac{1}{N}\sum_{i=1}^{N}\beta_i.$$

The absolute value of the deviation (AVD) of security i's expected return in period t from the tth period portfolio expected return can be expressed as

$$\mathrm{AVD}_{i,t} = |\beta_i - \beta_m| E_t(R_m - \gamma_0). \tag{4}$$

Hence, we can define the expected cross-sectional absolute deviation of stock returns (ECSAD) in period t as follows:

$$\mathrm{ECSAD}_t = \frac{1}{N}\sum_{i=1}^{N}\mathrm{AVD}_{i,t} = \frac{1}{N}\sum_{i=1}^{N}|\beta_i - \beta_m| E_t(R_m - \gamma_0). \tag{5}$$

The increasing and linear relation between dispersion and the time-varying market expected returns can be easily shown as follows:

$$\frac{\partial\,\mathrm{ECSAD}_t}{\partial E_t(R_m)} = \frac{1}{N}\sum_{i=1}^{N}|\beta_i - \beta_m| > 0, \tag{6}$$

$$\frac{\partial^2\,\mathrm{ECSAD}_t}{\partial E_t(R_m)^2} = 0. \tag{7}$$

Based on the above results we propose an alternate test of herding which requires an additional regression parameter to capture any possible non-linear relation between security return dispersions and the market return. In fact, our empirical test is similar in spirit to the market timing model proposed by Treynor and Mazuy (1966).

We use the CSAD_t and $R_{m,t}$ to proxy for the unobservable ECSAD_t and $E_t(R_{m,t})$. If market participants are more likely to herd during periods of large price movements, there would be a less than proportional increase (or even decrease) in the CSAD measure. Note that we are using the conditional version of the CAPM merely to establish the presence of a linear relation between ECSAD_t and $E_t(R_{m,t})$. We use ex post data to test for the presence of herd behavior in our sample via the average relationship between realized CSAD_t and $R_{m,t}$. CSAD is not a measure of herding, instead the relationship between CSAD_t and $R_{m,\mathrm{t}}$ is used to detect herd behavior.

To allow for the possibility that the degree of herding may be asymmetric in the up-versus the down-market, we run the following empirical specification:

$$\mathrm{CSAD}_t^{\mathrm{UP}} = \alpha + \gamma_1^{\mathrm{UP}}\left|R_{m,t}^{\mathrm{UP}}\right| + \gamma_2^{\mathrm{UP}}(R_{m,t}^{\mathrm{UP}})^2 + \varepsilon_t, \tag{8}$$

$$\mathrm{CSAD}_t^{\mathrm{DOWN}} = \alpha + \gamma_1^{\mathrm{DOWN}}\left|R_{m,t}^{\mathrm{DOWN}}\right| + \gamma_2^{\mathrm{DOWN}}(R_{m,t}^{\mathrm{DOWN}})^2 + \varepsilon_t, \tag{9}$$

where CSAD_t is the average AVD_t of each stock relative to the return of the equally-weighted market portfolio, $R_{m,t}$ in period t, and $|R_{m,t}^{\mathrm{UP}}|(|R_{m,t}^{\mathrm{DOWN}}|)$ is the absolute value of an equally-weighted realized return of all available securities on day t when the market is up (down). Both variables are computed on a daily basis. Note that to facilitate a comparison of the coefficients of the linear term, absolute values are used in Eqs. (8) and (9). If during periods of relatively large price swings, market participants do indeed herd around indicators such as the average consensus of all market constituents, a non-linear relation between CSAD_t and the average market return would result. The non-linearity would be captured by a *negative* and statistically significant γ_2 coefficient. [3]

For a comparison of the two methods, in Fig. 1, we plot the CSAD measure for each day and the corresponding equally-weighted market return for Hong Kong using stock return data over the period from January 1981 to December 1995. The CSAD-market return relation does indeed appear to be linearly positive. Focusing on the right hand side area where realized average daily returns were all positive, the estimated coefficients and the corresponding t-statistics for our model are:

$$\mathrm{CSAD}_t = 0.0143 + \underset{(14.08)^{**}}{0.3562}\, R_{m,t}^{\mathrm{UP}} - \underset{(-0.11)}{0.0515}(R_{m,t}^{\mathrm{UP}})^2 + \varepsilon_t.$$

The results indicate the presence of a positive and statistically significant linear term. However, since the non-linear term is not significantly negative, CSAD_t has not increased at a *decreasing rate* or decreased as the average price movement increases. Hence, the prediction of rational asset pricing models (as suggested by the above analysis) has not been violated.

The same conclusion can also be reached using the methodology suggested by CH. Using the one percent criterion, the estimated coefficients for their model are:

$$CSAD_t = 0.0171 + \underset{(5.06)^{**}}{0.0254}\, D_t^{\mathrm{L}} + \underset{(5.73)^{**}}{0.0239}\, D_t^{\mathrm{U}} + \varepsilon_t.$$

Both estimates of the dummy variable coefficients are positive and statistically significant. Thus the CH method also provides no evidence of herd behavior in Hong Kong.

However, the two methods may provide conflicting results with regard to the presence of herd behavior. For illustration purposes, for all positive $R_{m,t}$ values, let us consider a general quadratic relationship between CSAD_t and $R_{m,t}$ of the following form:

$$\mathrm{CSAD}_t = \alpha + \gamma_1 R_{m,t} + \gamma_2 R_{m,t}^2, \tag{10}$$

where the presence of a negative γ_2 parameter is an indication of herd behavior in our model. The quadratic relation suggests that CSAD_t reaches its maximum value when $R_{m,t}^* = -(\gamma_1/2\gamma_2)$. That is, as $R_{m,t}$ increases, over the range where realized average daily returns are less (greater) than $R_{m,t}^*$, CSAD_t is trending up (down). Unless some, if not all, of the $R_{m,t}$ values during periods of

[3] An alternative explanation to the herding argument, could be the presence of a non-linear market model.

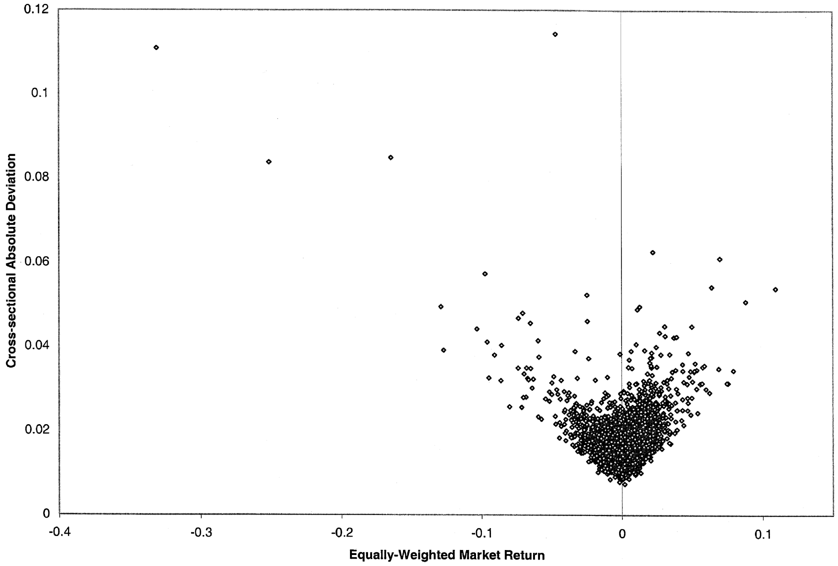

Fig. 1. Relationship between the daily cross-sectional absolute deviation ($CSAD_t$) and the corresponding equally-weighted market return ($R_{m,t}$) for Hong Kong (January 1981–December 1995).

market stress fall in the region where $CSAD_t$ is trending down, β^U in the CH model will never be negative. For example, using a 3% average market return as a threshold of market stress, with $\gamma_1 = 0.3562$, the estimated value of the γ_2 parameter needs to be -5.937 or smaller before there is a possibility that the β^U parameter would be negative. Thus, the CH approach requires a far greater magnitude of non-linearity in the return dispersion and mean return relationship for evidence of herding than suggested by rational asset pricing models.

2.2. Data

We obtain daily stock price data for the entire population of US firms and the equally-weighted market index along with year-end market capitalizations for each firm from the Center for Research in Securities Prices (CRSP) at the University of Chicago. Daily stock price data for all NYSE and AMEX firms is used over the January 1963–December 1997 period. The daily price and returns series along with the year-end market capitalization for each firm and the equally-weighted index return for Hong Kong (January 1981–December 1995), Japan (January 1976–December 1995), South Korea (January 1978–December 1995), and Taiwan (January 1976–December 1995) is obtained from the

Pacific-Basin Capital Markets Research Center (PACAP) tapes of the University of Rhode Island.

3. Empirical results

3.1. Descriptive statistics

In Table 1, we report univariate statistics for daily mean returns and the CSAD of returns for the US, Hong Kong, Japan, South Korea and Taiwan. The data availability periods range from 180 months (January 1981–December 1995) for Hong Kong to 420 months (January 1963–December 1997) for the US. The average daily return ranges from a low of 0.0751% for the US to a high of 0.1577% for South Korea. In general, Asian equity market returns are characterized by higher magnitudes of volatility with standard deviations ranging from 0.8002% (Japan) to 1.7109% (Hong Kong), relative to 0.7402% for the US. Daily returns for all four Asian countries have a first order autocorrelation coefficient less than the US (0.34).

We also report the maximum and minimum values of the average daily return and CSAD measure along with the corresponding event dates. For instance, as expected, the largest price decline of 14.19% for the US over the 1963–1997 period occurred on Black Monday, 19 October 1987. The very next day, Japan experienced its largest decline of 13.65% and a week later, the Hong Kong financial markets had their largest one day price decline of 33.11%. Hong Kong closed its stock market for four business days following the US crash of October 1987. However, the market was still not immunized from the contagion effect. In fact, the policy intervention seemed to have exacerbated the effect. For South Korea and Taiwan, the largest price decline of 6.79% and 6.68% occurred on 27 October 1979 and 15 January 1991, respectively.

In Table 1, we also report univariate statistics on the CSAD measure. By definition, when all returns move in perfect unison with the market, CSADs are bounded from below by zero. As individual returns begin to deviate from the market return, the level of CSAD increases. The average daily CSAD for our sample ranges from a low of 1.2615% (Taiwan) to a high of 1.8066% (US). A comparison of the maximum and minimum values of the daily CSAD shows that Hong Kong exhibits the highest (11.43%) value. On the other hand, Taiwan has the lowest *maximum* value (4.76%) among the five equity markets. All five of the time-series of CSAD appear to be highly autocorrelated. The first order autocorrelation of CSAD ranges from a low of 0.52 for Taiwan to a high of 0.86 for the US. Hence, all standard errors of the estimated regression coefficients in subsequent tests are adjusted for heteroscedasticity and autocorrelation, based on the approach suggested by Newey and West (1987).

Table 1
Summary statistics of returns (R_t) and cross-sectional absolute deviations ($CSAD_t$) for the US, Hong Kong, Japan, South Korea and Taiwan[a]

Country/ variables	Sample period (number of observations)	Mean (%)	S.D. (%)	Maximum (%) (Date)	Minimum (%) (Date)	Serial correlation at lag					
						1	2	3	5	20	DF-test
US											
R_t	01/02/63–	0.0751	0.7402	9.83 (10/21/87)	−14.19 (10/19/87)	0.34	0.09	0.08	0.09	0.03	−55.64**
$CSAD_t$	12/31/97 (8813)	1.8066	0.3918	7.48 (10/20/87)	1.15 (11/24/95)	0.86	0.78	0.74	0.70	0.57	−20.97**
Hong Kong											
R_t	01/02/81–	0.1366	1.7109	10.92 (05/23/89)	−33.11 (10/26/87)	0.16	0.08	0.12	0.01	0.01	−37.52**
$CSAD_t$	12/29/95 (3708)	1.7352	0.6034	11.43 (10/27/87)	0.74 (07/21/82)	0.73	0.63	0.57	0.52	0.29	−18.17**
Japan[b]											
R_t	01/05/76–	0.0866	0.8002	8.42 (10/21/87)	−13.65 (10/20/87)	0.27	0.02	0.05	0.03	−0.03	−47.23**
$CSAD_t$	12/29/95 (5412)	1.5615	0.3227	5.71 (10/02/90)	0.88 (08/15/94)	0.78	0.66	0.59	0.56	0.37	−21.18**
South Korea											
R_t	01/04/78–	0.1577	1.2018	8.07 (06/28/82)	−6.79 (10/27/79)	0.23	0.00	0.04	0.02	0.00	−47.65**
$CSAD_t$	12/27/95 (5271)	1.5949	0.5298	6.59 (01/05/81)	0.49 (12/12/89)	0.69	0.63	0.59	0.52	0.33	−21.02**
Taiwan[b]											
R_t	01/05/76–	0.0836	1.6865	6.76 (01/17/91)	−6.68 (01/15/91)	0.16	0.04	0.12	0.01	0.00	−48.78**
$CSAD_t$	12/29/95 (5771)	1.2615	0.4656	4.76 (05/26/90)	0.13 (08/28/90)	0.52	0.51	0.53	0.50	0.38	−26.51**

[a] This table reports the daily mean, standard deviation, and the maximum and minimum values of returns (R_t) and the cross-sectional absolute deviation of returns ($CSAD_t$) over the sample period for the five countries in our sample. In addition, the serial correlation of R_t and $CSAD_t$ is reported for lags 1, 2, 3, 5, and 20 along with test-statistics of the Dickey–Fuller test.
[b] The difference in sample size for Japan and Taiwan is due to the elimination of trading on Saturdays in Japan in the latter part of the sample period.
** The coefficient is significant at the 1% level.

Furthermore, the unit root (Dickey–Fuller) tests indicate that the CSAD series exhibits stationarity for all countries.

3.2. Dummy variable regression results

We begin our investigation of the presence of herd behavior in the five equity markets by employing dummy variable regression tests that are similar to CH. The primary modification is that instead of the CSSD we use the CSAD as our measure of dispersion. [4] The coefficients on the dummy variables capture differences in the CSADs and shed light on the extent of herd behavior across trading days with extreme upward or downward price movements. Eq. (2) is estimated using the 1%, 2%, and 5% of the price movement days as our definition of extreme price movement. [5] In Table 2, we report the parameter estimates along with heteroscedasticity consistent t-statistics.

Our findings for the US are consistent with CH. The positive and statistically significant β^{L} and β^{U} coefficients across all three models indicate that equity return dispersions actually tend to increase rather than decrease during market environments characterized by extreme price movements. This is inconsistent with their operational definition of herding which requires a decrease in dispersion levels. The evidence for Hong Kong and Japan is similar to the US. Given the similarity in terms of the level of economic development in these countries and the degree of integration among their financial markets, these results are not surprising. In fact, as evidence of capital market integration, Campbell and Hamao (1992) find a comovement in expected excess returns across the US and Japan.

On the other hand, Taiwan exhibits substantially different results. The β^{U} coefficient which captures the change in investor behavior associated with extreme upward price movements, is significantly negative in two of the three models. The negative coefficient is indicative of a decrease in the CSAD measure during days corresponding with extreme upward price movements, hence providing evidence in favor of herd behavior. Moreover, the β^{L} coefficient is also significantly negative for Taiwan in the model that uses the 1% cut off criterion. The results for South Korea are largely similar to the developed countries in our sample. The β^{U} coefficient is significantly positive in all three

[4] Christie and Huang (1995) also employed the CSAD as a substitute for the CSSD in a robustness test. Similar to their earlier results, they document that the regression coefficients are positive and statistically different from zero for the U.S. equity market.

[5] In up (down) markets, to satisfy the 1% criterion, the daily realized return of the equally-weighted market portfolio has to exceed (be less than) 2.55% (−2.55%) for the US, 5.97% (−5.96%) for Hong Kong, 3.25% (−3.25%) for Japan, 4.05% (−4.09%) for South Korea and 5.92% (−5.96%) for Taiwan.

Table 2
Regression results of the daily cross-sectional absolute deviation during periods of market stress[a]

Country (sample period)	1% Criterion			2% Criterion			5% Criterion		
	α	β^{L}	β^{U}	α	β^{L}	β^{U}	α	β^{L}	β^{U}
US	0.0179	0.0122	0.0198	0.0178	0.0091	0.0156	0.0176	0.0063	0.0109
(01/02/63–12/31/97)	(154.4)**	(5.71)**	(11.06)**	(159.87)**	(7.11)**	(12.14)**	(171.36)**	(8.95)**	(14.93)**
Hong Kong	0.0171	0.0254	0.0239	0.0169	0.0223	0.0179	0.0167	0.0136	0.0131
(01/02/81–12/29/95)	(75.17)**	(5.06)**	(5.73)**	(80.22)**	(4.35)**	(10.51)**	(84.19)**	(5.02)**	(12.39)**
Japan	0.0155	0.0099	0.0157	0.0154	0.008	0.012	0.0153	0.0049	0.0085
(01/05/76–12/29/95)	(140.85)**	(10.41)**	(9.27)**	(146.26)**	(10.47)**	(10.22)**	(150.87)**	(9.73)**	(11.77)**
South Korea	0.0159	−0.0006	0.0067	0.0159	0.0003	0.0062	0.0157	0.0023	0.0059
(01/04/78–12/27/95)	(80.99)**	(−0.25)	(2.25)*	(80.84)**	(0.15)	(3.41)**	(80.84)**	(2.76)**	(6.12)**
Taiwan	0.0127	−0.0050	−0.0073	0.0127	−0.0009	−0.0028	0.0126	0.0016	−0.0018
(01/05/76–12/29/95)	(75.73)**	(−10.73)**	(−10.70)**	(75.96)**	(−1.28)	(−3.38)**	(76.06)**	(2.38)*	(−1.37)

[a] This table reports the estimated coefficients of the following regression model: $\mathrm{CSAD}_t = \alpha + \beta^{L} D_t^{L} + \beta^{U} D_t^{U} + \varepsilon_t$, where $D_t^{L}(D_t^{U})$ equals 1 if the market return on day t lies in the extreme lower (upper) tail of the return distribution, otherwise $D_t^{L}(D_t^{U})$ equals 0. The 1%, 2% and 5% criterion refers to the percentage of observations in the upper and lower tail of the market return distribution used to define extreme price movement days. Heteroscedasticity consistent t-statistics are reported in parentheses.

* The coefficient is significant at the 5% level.

** The coefficient is significant at the 1% level.

models, whereas the β^{L} coefficient is significantly positive in one of the three model specifications.

In the next section, we reexamine the equity return dispersion and market return relationships for the countries in our sample using our newly developed approach.

3.3. Examining the non-linearity in the CSAD-market return relationship

Table 3 provides results of the empirical specification in Eqs. (8) and (9) estimated separately for subsamples of up (Model A) and down (Model B) market price movement days for each of the five markets. We use the absolute value of $R_{m,t}$ to facilitate a comparison of the coefficients of the linear term in the up and down market for each country. The F_1 and F_2 statistics are also reported for each market to test the null hypothesis that $\gamma_1^{\mathrm{UP}} = \gamma_1^{\mathrm{DOWN}}$ and $\gamma_2^{\mathrm{UP}} = \gamma_2^{\mathrm{DOWN}}$, respectively.

The average level of equity return dispersions (as measured by the regression α's) in a stagnant market where $R_{m,t}$ is equal to zero, range from a high of 1.56% for the US to a low of 1.06% for Taiwan. Furthermore, we find that all coefficients on the linear term of $|R_{m,t}|$ are significantly positive. These results strongly confirm the prediction that CSAD_t increases with $|R_{m,t}|$. In the up market, the rate of increase is highest for the US (0.5611) and lowest for Taiwan (0.3047). Furthermore, in all five markets, the rate of increase in the up market is higher than that of the down market. However, the null hypothesis of $\gamma_1^{\mathrm{UP}} = \gamma_1^{\mathrm{DOWN}}$ is only rejected for the three developed markets. This suggests that the dispersions in security returns are on average wider in an up, relative to a down market day. This finding appears to be consistent with the directional asymmetry documented by McQueen et al. (1996). Their evidence indicates that in the US, all stocks, large and small, react quickly to negative macroeconomic news, but some small stocks adjust to positive news about the economy with a delay. The asymmetric reaction to good and bad macroeconomic news is consistent with a wider than average CSAD in up versus down markets.

The statistically insignificant γ_2^{UP} estimates in model A for the US, Hong Kong and Japan support the predictions of the rational capital asset pricing model. That is, CSAD_t in general *increases linearly* with the average market realized return of the day. This evidence is consistent with the significantly positive β^{U} coefficients estimated from the dummy variable regressions in Table 2. The parameter estimate of γ_2^{DOWN} for the US and Hong Kong is also insignificant, hence, providing no evidence of any non-linearity in the CSAD-mean return relationship.

We now turn our attention to the two emerging financial markets in our sample. The parameter estimates of the non-linear term for South Korea and Taiwan indicate dramatically different results. For both countries, the γ_2^{UP} and

Table 3

Regression results of the daily cross-sectional absolute deviation on the linear and squared term of the market portfolio return: Up and down markets[a]

Country (sample period)	Model A				Model B				Test statistics	
	α	γ_1^{UP}	γ_2^{UP}	Adjusted R^2	α	γ_1^{DOWN}	γ_2^{DOWN}	Adusted R^2	F_1	F_2
US	0.0156	0.5611	0.7444	0.515	0.0158	0.3327	0.628	0.369	189.45**	0.11
(01/02/63–12/31/97)	(129.84)**	(19.53)**	(1.49)		(96.05)**	(10.33)**	(1.65)			
Hong Kong	0.0143	0.3562	−0.0515	0.405	0.0135	0.2690	0.1156	0.552	16.45**	0.23
(01/02/81–12/29/95)	(61.86)**	(14.08)**	(−0.11)		(38.98)**	(6.28)**	(0.82)			
Japan	0.0141	0.4188	−0.5347	0.478	0.0135	0.2669	−0.5718	0.338	76.16**	0.01
(01/05/76–12/29/95)	(106.00)**	(17.03)**	(−0.65)		(86.43)**	(12.08)**	(−1.98)*			
South Korea	0.0135	0.4106	−4.0382	0.192	0.0127	0.3636	−5.6286	0.100	1.57	2.33
(01/04/78–12/27/95)	(46.79)**	(13.16)**	(−3.50)**		(40.38)**	(10.48)**	(−4.51)**			
Taiwan	0.0106	0.3047	−5.5951	0.096	0.0103	0.2770	−4.0286	0.081	1.14	9.29**
(01/05/76–12/30/95)	(42.10)**	(10.22)**	(−11.56)**		(32.85)**	(7.36)**	(−6.43)**			

[a] This table reports the estimated coefficients of the following regression models:

$$\text{Model A}: \ \mathrm{CSAD}_t^{UP} = \alpha + \gamma_1^{UP}|R_{m,t}^{UP}| + \gamma_2^{UP}(R_{m,t}^{UP})^2 + \varepsilon_t,$$

$$\text{Model B}: \ \mathrm{CSAD}_t^{DOWN} = \alpha + \gamma_1^{DOWN}|R_{m,t}^{DOWN}| + \gamma_2^{DOWN}(R_{m,t}^{DOWN})^2 + \varepsilon_t,$$

where $|R_{m,t}^{UP}|\left[|R_{m,t}^{DOWN}|\right]$ is the absolute value of an equally-weighted realized return of all available securities on day t when the market is up [down] and $(R_{m,t}^{UP})^2\left[(R_{m,t}^{DOWN})^2\right]$ is the squared value of this term. Heteroscedasticity consistent t-statistics are reported in parentheses. The F_1 and F_2 statistics test the null hypotheses that $\gamma_1^{UP} = \gamma_1^{DOWN}$ and $\gamma_2^{UP} = \gamma_2^{DOWN}$, respectively.

* The coefficient is significant at the 5% level.

** The coefficient is significant at the 1% level.

γ_2^{DOWN} coefficients are negative and statistically significant. Thus, the linear relation between CSAD_t and $|R_{m,t}|$ clearly does not hold in both up and down markets. This suggests that as the average market return becomes large in absolute terms, the cross-sectional return dispersion increases at a decreasing rate. Indeed, the coefficients indicate that beyond a certain threshold, the CSAD_t may decline as $|R_{m,t}|$ becomes large. For example, substituting the estimated coefficients for Taiwan ($\gamma_1 = 0.3047$ and $\gamma_2 = -5.5951$) into the quadratic relation specified in Eq. (10) indicates that CSAD_t reaches a maximum when $R_{m,t} = 2.72\%$. This suggests that for large swings in the market return that surpass this threshold level, CSAD_t has a tendency to become narrower. This is consistent with the intuition of CH that during these periods of extreme market movements, individuals suppress their own beliefs in favor of the market consensus. The degree of suppression associated with an increase in $R_{m,t}$ is so severe that it more than offsets the would be increase in dispersion due to the differences in market sensitivities. We also capture limited evidence of herding for Japan in down markets.

In order to further illustrate the magnitude of the non-linearity in the CSAD-market relation (as captured by the γ_2^{UP} and γ_2^{DOWN} coefficients), in Fig. 1 (Hong Kong) and Fig. 2 (South Korea), we plot the CSAD measure for each day and the corresponding equally-weighted market return. Readers are reminded that due to different ranges covered by these measures, the scales of

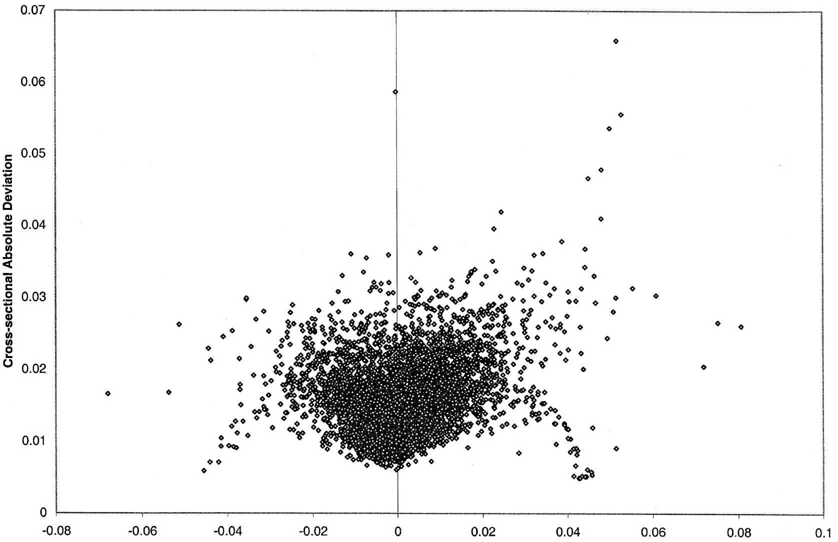

Fig. 2. Relationship between the daily cross-sectional absolute deviation (CSAD_t) and the corresponding equally-weighted market return ($R_{m,t}$) for Korea (January 1978–December 1995).

these figures differ between the two countries. While the linear CSAD-market relation is evident for Hong Kong, the plot for South Korea is indicative of a relation that is far from linear. Moreover, the slightly steeper slopes in the up than in the down market for both countries can also be visualized.

An important investment implication of our finding is that when investing in an economy where participants tend to herd around the market consensus, one needs a larger number of securities to achieve the same degree of diversification than in an otherwise normal market.

A more challenging question to ask is what makes South Korea and Taiwan different from the US and Hong Kong? First, the differences in herd behavior may be the result of a relatively high degree of government intervention, either through relatively frequent monetary policy changes or through large direct buy or sell orders in the emerging financial markets. Second, herding differences could result due to the paucity of reliable micro-information in these markets. To the extent that our evidence of herding is indicative of relative market inefficiencies, the market can be improved by enhancing the quality of information disclosure. In the presence of inefficient information disclosure, market participants will tend to lack fundamental information on firms, which may consequently cause them to trade based on other signals. [6] Third, South Korea and Taiwan may exhibit herding due to the presence of more speculators with relatively short investment horizons. Froot et al. (1992) demonstrate that the existence of short-term speculators can lead to certain types of informational inefficiencies. They suggest, for example, that traders may focus on one source of information rather than on a diverse set of data, hence resulting in a relatively narrow return dispersion. [7]

3.4. Role of macroeconomic vs firm-specific information

In order to further explore the evidence in favor of herding in Section 3.3, we address the following question: Does systematic risk play a greater role than unsystematic risk in markets like South Korea and Taiwan where we detect evidence of herd behavior?

[6] In fact, as part of the 1995 action plan, the TSE plans to implement the following: (1) strengthening the information disclosure of listed companies, (2) establishment of a local futures market, (3) enhancing the internal control system and implementing an evaluation system for securities firms.

[7] Bekaert and Harvey (1997a) report that, out of 20 emerging equity markets, Taiwan and South Korea ranked second and third in terms of the monthly turnover rate. The average monthly turnover rates of the TSE and the South KSE are 22.2% and 7.6%, respectively. These turnover rates are substantially greater in magnitude relative to other countries, hence providing indirect evidence on the presence of relatively short investment horizons of participants in these markets.

Specifically, we examine the R^2 values from the market model regressions estimated by regressing the daily individual stock returns on the equally-weighted return for the underlying benchmark. If systematic risk does play a relatively more important role, R^2 values would be higher for South Korea and Taiwan. Consistent with our priors we do indeed find that both South Korea and Taiwan, which exhibit the strongest evidence in favor of herding, have significantly higher average R^2 values of 23.2% and 42.1% for the full sample (Table 4). In contrast, the corresponding R^2 values for the US, Hong Kong, and Japan are 7.4%, 19.5%, and 11.4%, respectively. The results are robust across the sub-sample of up versus down market days. Higher R^2 values in emerging markets are also consistent with the view that the relative scarcity of rapid and accurate firm-specific information in developing markets may cause investors to focus more on macroeconomic information. However, to the

Table 4
Market model regression results[a]

	Market model adjusted R^2		
	Mean	Minimum	Maximum
US			
Full sample	0.0739	−0.0142	0.6724
Up market	0.0312	−0.0156	0.4366
Down market	0.0624	−0.0157	0.5718
Hong Kong			
Full sample	0.1953	−0.0144	0.6801
Up market	0.0787	−0.0124	0.5740
Down market	0.2063	−0.0150	0.7040
Japan			
Full sample	0.1144	−0.0145	0.3756
Up market	0.0608	−0.0123	0.3705
Down market	0.1011	−0.0094	0.3047
South Korea			
Full sample	0.2315	−0.0072	0.4721
Up market	0.1334	−0.0147	0.3118
Down market	0.1029	−0.0137	0.3198
Taiwan			
Full sample	0.4214	0.0849	0.6776
Up market	0.2631	0.0009	0.4836
Down market	0.2862	−0.0038	0.5217

[a] This table reports the mean, minimum, and maximum adjusted R^2 value of the individual firm market model regressions of all stocks that comprise a particular country's index. The equally-weighted market proxy for each country is used as the underlying market benchmark in the market model regressions. The adjusted R^2 values are reported separately for the full sample and the up (down) market where the equally-weighted market return is positive (negative).

extent that investors react to any useful information, whether the information is firm specific or market related, such type of behavior can be viewed as being rational.

3.5. Robustness tests

3.5.1. Size-based portfolio tests

Since we employ an equally-weighted measure, the aggregate results reported in Table 3 may be influenced by the smaller stocks in each country. Examining the relative influence of small versus large stocks is especially important in light of the fact that small stock portfolios may react differently under different conditions relative to large stock portfolios. For instance, McQueen et al. (1996) document that small stocks respond slowly to good news, and this slowness could result in extra dispersion in up markets, and bias against detecting evidence of herding in Table 3. Hence, for US, Hong Kong and Japan, the presence of an insignificant γ_2 coefficient for *large* stock portfolios would provide stronger support for the lack of herding. Similarly, for Taiwan and South Korea, a significantly negative γ_2 coefficient for the *small* stock portfolios would further substantiate our evidence in favor of herding in the emerging financial markets.

In panels A–E of Table 5, we reexamine the non-linearity in the CSAD-market return relationship using size-based quintile portfolios for each of the five countries in our sample. We categorize stocks for a given country into quintiles based on the market capitalization of each stock at the end of the year immediately preceding the measurement year. These portfolios are reconstructed each year to reflect any changes in market capitalization of individual stocks in the aggregate portfolio.

The size-based tests in Table 5 provide further support to the full sample results. For all portfolios, ranging from the smallest (Portfolio 1) to the largest (Portfolio 5), we find strong evidence in favor of herding in Taiwan and South Korea. These results are robust across both up and down market price movement days. For Taiwan (Panel E), in four out of the five portfolios, the F-test rejects the null hypothesis that $\gamma_2^{\mathrm{UP}} = \gamma_2^{\mathrm{DOWN}}$. In addition, the γ_2^{UP} coefficient is more negative suggesting that herding is more prevalent in rapidly rising market conditions. For South Korea (Panel D), on the other hand, the magnitude of the γ_2^{DOWN} coefficient is larger in most of the quintile-based portfolios. However, the γ_2^{DOWN} coefficient is significantly different from the γ_2^{UP} coefficient, in portfolios 1 and 3 only. Hence, for South Korea, the evidence in favor of herding tends to be slightly stronger in the down market movement days. Furthermore, for South Korea, the γ_2^{DOWN} coefficients are negative and statistically significant for all five portfolios. The γ_2^{UP} coefficients are also negative and statistically significant in all portfolios except portfolio 1. For Japan (Panel C), we find evidence of herding in three of the five largest port-

Table 5
Regression results of the daily cross-sectional absolute deviation on the linear and squared term of the market portfolio: up and down markets (size ranked portfolios)[a]

Country	Model A				Model B				Test statistics	
	α	γ_1^{UP}	γ_2^{UP}	Adjusted R^2	α	γ_1^{DOWN}	γ_2^{DOWN}	Adjusted R^2	F_1	F_2
Panel A: US										
Portfolio 1	0.0261	0.6385	2.5264	0.222	0.0261	0.2763	1.4011	0.097	89.65**	1.88
(Smallest)	(84.16)**	(9.95)**	(2.69)**		(65.14)**	(5.11)**	(2.16)*			
Portfolio 2	0.0168	0.6489	0.6890	0.474	0.0170	0.3815	0.2262	0.323	173.27**	1.12
	(111.24)**	(19.76)**	(1.32)		(89.73)**	(11.32)**	(0.57)			
Portfolio 3	0.0138	0.5923	0.3792	0.529	0.0141	0.3832	0.0393	0.408	160.99**	0.92
	(115.10)**	(22.89)**	(0.69)		(94.31)**	(13.49)**	(0.12)			
Portfolio 4	0.0119	0.5064	0.2898	0.531	0.0122	0.3489	0.2144	0.457	127.36**	0.06
	(117.22)**	(21.70)**	(0.60)		(93.42)**	(13.10)**	(0.77)			
Portfolio 5	0.0100	0.4162	−0.0416	0.454	0.0103	0.2724	1.2636	0.421	113.79**	20.31**
(Largest)	(97.87)**	(19.52)**	(−0.10)		(70.72)**	(9.02)**	(3.68)**			
Panel B: Hong Kong										
Portfolio 1	0.0196	0.5239	−1.4118	0.217	0.0188	0.3208	0.2046	0.359	23.62**	5.76*
(Smallest)	(47.47)**	(10.68)**	(−1.95)		(32.41)**	(4.86)**	(0.93)			
Portfolio 2	0.0156	0.3501	0.5330	0.269	0.0106	0.3044	−0.0695	0.442	2.42	1.62
	(48.80)**	(9.59)**	(0.63)		(42.32)**	(7.64)**	(−0.56)			
Portfolio 3	0.0139	0.3280	0.7252	0.3030	0.0130	0.2543	0.3201	0.512	7.77**	0.91
	(53.40)**	(11.02)**	(1.12)		(32.76)**	(5.24)**	(2.04)*			
Portfolio 4	0.0119	0.3210	−0.0002	0.342	0.0114	0.2465	0.1591	0.496	10.93**	0.19
	(50.29)**	(13.61)**	(−0.01)		(37.53)**	(6.80)**	(1.46)			

Table 5 (Continued)

Country	Model A				Model B				Test statistics	
	α	γ_1^{UP}	γ_2^{UP}	Adjusted R^2	α	γ_1^{DOWN}	γ_2^{DOWN}	Adjusted R^2	F_1	F_2
Portfolio 5	0.0102	0.2436	−0.0072	0.269	0.0094	0.2122	−0.0112	0.422	2.41	0.01
(Largest)	(46.94)**	(11.14)**	(−0.02)		(34.99)**	(6.95)**	(−0.09)			
Panel C: Japan										
Portfolio 1	0.0186	0.3193	1.0328	0.210	0.0175	0.1418	0.5763	0.121	43.13**	0.69
(Smallest)	(76.28)**	(9.55)**	(1.07)		(67.16)**	(5.66)**	(1.71)			
Portfolio 2	0.0153	0.4392	−1.2837	0.380	0.0145	0.2483	−0.4088	0.275	88.27**	4.52**
	(91.95)**	(18.09)**	(−1.90)		(78.74)**	(11.02)**	(−1.52)			
Portfolio 3	0.0138	0.4554	−1.2418	0.431	0.0130	0.2968	−0.9114	0.323	66.32**	0.72
	(97.97)**	(17.57)**	(−1.38)		(77.90)**	(12.07)**	(−2.63)**			
Portfolio 4	0.0123	0.4386	−0.4842	0.450	0.0118	0.3093	−0.8264	0.344	44.31**	0.76
	(88.56)**	(15.72)**	(−0.50)		(71.96)**	(13.33)**	(−3.02)**			
Portfolio 5	0.0107	0.4419	−0.7050	0.345	0.0106	0.3387	−1.2936	0.257	18.10**	1.43
(Largest)	(61.50)**	(13.08)**	(−0.65)		(50.31)**	(12.46)**	(−5.02)**			
Panel D: South Korea										
Portfolio 1	0.0169	0.3455	−1.2892	0.134	0.0157	0.3487	−4.9775	0.058	0.01	6.74**
(Smallest)	(43.95)**	(8.24)**	(−0.82)		(39.03)**	(7.39)**	(−3.08)**			
Portfolio 2	0.0141	0.4151	−4.2477	0.166	0.0133	0.3705	−5.7948	0.083	1.17	1.82
	(46.41)**	(12.57)**	(−3.59)**		(38.32)**	(9.64)**	(−4.24)**			
Portfolio 3	0.0130	0.4239	−4.3503	0.174	0.0122	0.4170	−6.9329	0.110	0.03	5.43**
	(42.14)**	(12.00)**	(−3.44)**		(38.17)**	(12.07)**	(−5.98)**			
Portfolio 4	0.0125	0.4292	−5.4294	0.144	0.0118	0.3597	−5.7530	0.084	2.94	0.08
	(40.18)**	(12.77)**	(−4.84)**		(34.58)**	(9.43)**	(−4.69)**			

Portfolio 5	0.0112	0.4407	−4.9310	0.163	0.0107	0.3229	−4.7091	0.072	8.06**	0.04
(Largest)	(37.48)**	(13.86)**	(−4.46)**		(34.63)**	(8.47)**	(−3.39)**			
Panel E: Taiwan										
Portfolio 1	0.0141	0.3252	−6.3281	0.058	0.0137	0.2937	−4.5106	0.048	0.78	6.60**
(Smallest)	(41.11)**	(9.54)**	(−10.84)**		(32.59)**	(6.48)**	(−5.74)**			
Portfolio 2	0.0114	0.2586	−5.3888	0.062	0.0109	0.2772	−4.4575	0.057	0.41	2.61
	(40.72)**	(8.54)**	(−11.16)**		(32.56)**	(6.69)**	(−6.44)**			
Portfolio 3	0.0104	0.2721	−5.2783	0.066	0.0099	0.2685	−4.0265	0.066	0.02	5.11**
	(39.38)**	(8.74)**	(−10.53)**		(31.21)**	(7.05)**	(−6.28)**			
Portfolio 4	0.0091	0.2955	−5.2228	0.083	0.0089	0.2592	−3.5381	0.071	1.76	9.64**
	(35.43)**	(9.78)**	(−10.86)**		(27.85)**	(7.07)**	(−5.78)**			
Portfolio 5	0.0079	0.3745	−5.7489	0.132	0.0080	0.2865	−3.5788	0.094	9.58**	14.85**
(Largest)	(29.40)**	(11.56)**	(−10.25)**		(24.12)**	(7.70)**	(−5.90)**			

[a] This table reports the estimated coefficients of the following regression models:

$$\text{Model A}: \ \mathrm{CSAD}_t^{\mathrm{UP}} = \alpha + \gamma_1^{\mathrm{UP}}|R_{m,t}^{\mathrm{UP}}| + \gamma_2^{\mathrm{UP}}\left(R_{m,t}^{\mathrm{UP}}\right)^2 + \varepsilon_t,$$

$$\text{Model B}: \ \mathrm{CSAD}_t^{\mathrm{DOWN}} = \alpha + \gamma_1^{\mathrm{DOWN}}|R_{m,t}^{\mathrm{DOWN}}| + \gamma_2^{\mathrm{DOWN}}(R_{m,t}^{\mathrm{DOWN}})^2 + \varepsilon_t,$$

where $|R_{m,t}^{\mathrm{UP}}|\left[|R_{m,t}^{\mathrm{DOWN}}|\right]$ is the absolute value of an equally-weighted realized return of all available securities on day t when the market is up [down] and $\left(R_{m,t}^{\mathrm{UP}}\right)^2\left[(R_{m,t}^{\mathrm{DOWN}})^2\right]$ is the squared value of this term. The size-based quintile portfolios are constructed based on the year-end market capitalization of each stock at the end of the year immediately preceding the measurement year. The portfolios are reconstructed each year to reflect any changes in the market capitalization of individual stocks in the aggregate portfolio. Heteroscedasticity consistent t-statistics are reported in parentheses. The F_1 and F_2 statistics test the null hypotheses that $\gamma_1^{\mathrm{UP}} = \gamma_1^{\mathrm{DOWN}}$ and $\gamma_2^{\mathrm{UP}} = \gamma_2^{\mathrm{DOWN}}$, respectively.

* The coefficient is significant at the 5% level.

** The coefficient is significant at the 1% level.

folios in the down market days; however, we find no evidence during the up market days.

Finally, consistent with our full sample results in Table 3, we do not find any evidence of herding in the US and Hong Kong (Panels A and B). [8] These results are robust across both the up and down market days.

3.5.2. Impact of the daily price limit on the South Korea and Taiwan Stock Exchange

In Taiwan, the daily trading range for any stock that trades on the exchange (TSE) cannot exceed a certain pre-specified percentage of the stock's closing price on the previous trading day. Once a particular stock hits the limit, all future transactions for the day can only occur at that limit price. These trading limits are similar in spirit to trading halts imposed on the NYSE with regard to intraday movements in the Dow Jones Industrial Average. Over our sample period, the trading limit for stocks trading on the TSE has ranged from a low of 2.5% during 1978–1979 to a high of 7% from 1989 to the present. [9] Similar to the TSE, the South Korea Stock Exchange (KSE) has a 6% daily price limit.

Table 6 reports our robustness tests to examine whether the trading range limits in South Korea and Taiwan, affect our overall evidence in favor of herding in the emerging financial markets. For South Korea, out of the 1,920,229 observations, 25,749 observations exhibit returns with absolute values greater than 6%. We re-estimate all the models after excluding these firm-day observations. For Taiwan, we eliminate observations for which the absolute value of a stock's return is greater than or equal to the trading limit minus 0.2%. These cutoffs are used to account for the fact that TSE revises the trading limit downward to ensure that the next tick move does not push the stock's price outside the trading limit. Consequently, out of a total of 814,025 firm-day observations, 46,008 observations are eliminated to account for the downward revision rule based on our adjustment factors of 0.2%.

The elimination of these extreme observations does not alter our prior findings. In conformance with evidence of herding, Table 6 shows that our methodology yields negative and statistically significant γ_2^{UP} and γ_2^{DOWN} coef-

[8] Note that the γ_2^{UP} coefficient for the smallest US portfolio is significantly positive. This could be the consequence of extra dispersion caused by the slow response of small stocks to good news (McQueen et al., 1996).

[9] The TSE allows for a relaxation of the trading range limit of a listed company on its ex-rights trading day. Earlier, due to the cash capitalization on the ex-rights day, the calculation of the 7% range on the ex-rights trading day was based on the previous closing price of the stock minus the value of the right. However, in case that all rights are not exercised and the company is unable to raise all the requisite cash via the rights offering, the deduction in the value of the right would be deemed inappropriate for the shareholders of the original stock. In light of this, the TSE has relaxed the limit with regard to the 7% trading range on the ex-rights trading day of a stock.

Table 6
Daily price limit tests for South Korea and Taiwan[a]

Country (sample period)	Model A				Model B				Test statistics	
	α	γ_1^{UP}	γ_2^{UP}	Adjusted R^2	α	γ_1^{DOWN}	γ_2^{DOWN}	Adjusted R^2	F_1	F_2
South Korea (01/04/78–12/27/95)	0.0132 (42.07)**	0.2482 (5.42)**	−0.7521 (−0.46)	0.186	0.0121 (37.80)**	0.3314 (7.19)**	−4.8648 (−2.67)**	0.110	6.67**	21.11**
Taiwan (01/05/76–12/30/95)	0.0100 (45.19)**	0.2669 (9.88)**	−4.7204 (−10.52)**	0.093	0.0098 (35.59)**	0.2401 (6.88)**	−3.0874 (−5.15)**	0.091	1.32	12.47**

[a] This table reports the regression results for Taiwan and South Korea based on a sample which eliminates all observations which reached the daily price limit at the close of trading. The following regression models are estimated:

$$\text{Model A}: \ \mathrm{CSAD}_t^{UP} = \alpha + \gamma_1^{UP}|R_{m,t}^{UP}| + \gamma_2^{UP}\left(R_{m,t}^{UP}\right)^2 + \varepsilon_t,$$

$$\text{Model B}: \ \mathrm{CSAD}_t^{DOWN} = \alpha + \gamma_1^{DOWN}|R_{m,t}^{DOWN}| + \gamma_2^{DOWN}\left(R_{m,t}^{DOWN}\right)^2 + \varepsilon_t.$$

Out of a total of 1,920,229 firm-day observations, 25,749 observations were eliminated for the South Korea sample. Out of a total of 814,025 firm-day observations, 46,008 observations were eliminated for the Taiwan sample.
* The coefficint is significant at the 5% level.
** The coefficient is significant at the 1% level.

ficients with one exception. The γ_2 parameter for South Korea in the up market is negative but not statistically significant. However, our results are robust across tests which use either the PACAP equally-weighted market proxy or the self-constructed market proxy (which excludes these extreme observations) to compute the CSAD measure. [10]

3.5.3. Pre-post liberalization effects for emerging stock markets

The emerging stock markets of South Korea and Taiwan have undertaken liberalization efforts in recent years. In fact, both markets have increased access to foreign investments either directly or indirectly via country funds. Specifically, investment restrictions on foreign investments in South Korea were partially eased in January 1992. Over the later part of our sample period, foreign ownership was allowed up to 10% in unlimited industries and 8% in the limited (more strategic) industries. In Taiwan, direct investments by foreign institutional investors were allowed in January 1991. Nevertheless, various investment restrictions in the form of lack of access to certain industries and the presence of a 5% ownership limit in a given firm by a single foreign investor over our sample period continue to remain in place. [11]

Since it is difficult to ascertain the exact timing and the true impact of these liberalization efforts on the respective financial markets of these countries, we conduct sub-period tests to see if we can detect any changes in herding patterns over time. The sub-period results are reported in Table 7. For South Korea, we conduct sub-sample tests on a two-year by two-year basis. We do not find any patterns in the two-year by two-year α's. Most of the γ_2 coefficients in up and down markets are negative and statistically significant. Hence, we are unable to detect any impact of liberalization efforts on investor herd behavior in South Korea's equity market.

For Taiwan, we estimate separate models for each sub-period within which the constancy of the price limit is maintained. For the sub-period tests we report results for the sample which excludes observations for which the absolute value of a stock's return is greater than or equal to the trading limit minus 0.2%. [12] The evidence for Taiwan provides no clear pattern in the sub-period α's. Moreover, in all models, the coefficients on the γ_2 parameter in the

[10] For brevity, we do not report the results based on the self-constructed market proxy.

[11] Bekaert and Harvey (1997b) indicate that the liberalization of South Korea and Taiwan occurred in September 1988 and January 1991, respectively.

[12] Out of the 5771 sample days, 4976 days have at least one firm with the absolute value of the return being greater than or equal to the price limit minus 0.2%. The number of firms with an absolute return greater than or equal to the price limit minus 0.2% in any given day ranges from a single firm to 115 firms (on 17 August 1990) with an average of 9.94 firms exceeding the price limit on a given day. Note that there are 1098 sample days with one firm with the absolute value of the return exceeding the corresponding limit minus 0.2%.

Table 7
An examination of the effects of liberalization for South Korea and Taiwan[a]

Sample period	Model A				Model B				Test statistics	
	α	γ_1^{UP}	γ_2^{UP}	Adjusted R^2	α	γ_1^{DOWN}	γ_2^{DOWN}	Adjusted R^2	F_1	F_2
Panel A: South Korea										
01/78–12/79	0.0131	0.3380	−1.9059	0.392	0.0129	0.2891	−1.2167	0.300	0.55	0.19
	(24.14)**	(4.41)**	(−0.76)		(29.55)**	(6.57)**	(−1.83)			
01/80–12/81	0.011	0.3959	0.1643	0.689	0.0101	0.5208	−4.9827	0.522	3.50	8.62**
	(22.30)**	(13.10)**	(0.31)		(19.15)**	(8.45)**	(−2.89)**			
01/82–12/83	0.0105	0.3016	2.2345	0.667	0.0094	0.3855	−1.6675	0.466	1.47	3.88*
	(24.91)**	(6.37)**	(2.39)**		(22.89)**	(7.27)**	(−1.09)			
01/84–12/85	0.0112	0.4426	−2.5429	0.470	0.0109	0.2741	1.5351	0.274	2.63	0.59
	(28.79)**	(9.70)**	(−2.16)**		(23.69)**	(2.93)**	(0.31)			
01/86–12/87	0.0148	0.4189	−10.1131	0.127	0.0147	0.1806	−3.8410	0.039	7.99**	6.33*
	(23.97)**	(6.41)**	(−4.84)**		(22.99)**	(3.11)**	(−2.76)**			
01/88–12/89	0.0100	0.5411	−13.3439	0.261	0.0105	0.0606	1.4455	0.017	24.11**	16.79**
	(21.01)**	(7.90)**	(−4.90)**		(20.67)**	(0.72)	(0.33)			
01/90–12/91	0.0106	0.5063	−13.3246	0.238	0.0098	0.4346	−10.0776	0.161	0.76	2.23
	(12.80)**	(7.31)**	(−9.29)**		(20.09)**	(7.03)**	(−6.88)**			
01/92–12/93	0.0152	0.3966	−11.5146	0.066	0.0169	0.1928	−8.4234	0.03	2.64	0.68
	(14.61)**	(4.79)**	(−6.04)**		(13.53)**	(2.03)**	(−4.18)**			
01/94–12/95	0.0173	0.2994	−8.5232	0.063	0.0166	0.2934	−10.0954	0.027	0.01	0.16
	(27.34)**	(6.37)**	(−6.64)**		(29.37)**	(3.11)**	(−2.89)**			
01/86–12/87	0.0146	0.4252	−10.3053	0.129	0.0147	0.1833	−3.8723	0.040	7.95**	6.51*
(Excluding 10/87)	(22.29)**	(6.37)**	(−4.91)**		(22.83)**	(3.14)**	(−2.78)**			
Panel B: Taiwan										
01/05/76–12/18/78	0.0085	0.2976	−5.1407	0.215	0.0084	0.2612	−3.9288	0.237	0.48	0.65
	(26.88)**	(7.62)**	(−4.32)**		(20.28)**	(3.80)**	(−1.68)			
12/19/78–01/03/79[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
01/04/79–10/26/87	0.0091	0.3289	−7.8139	0.135	0.0090	0.1966	−2.7836	0.093	13.50**	22.09**
	(41.39)**	(9.84)**	(−8.49)**		(32.18)**	(3.71)**	(−1.51)			

Table 7 (Continued)

Sample period	Model A				Model B				Test statistics	
	α	γ_1^{UP}	γ_2^{UP}	Adjusted R^2	α	γ_1^{DOWN}	γ_2^{DOWN}	Adjusted R^2	F_1	F_2
10/27/87–11/13/88	0.0157	0.0713	−20.1401	0.833	0.0145	0.4132	−32.7273	0.838	8.80**	9.95**
	(22.20)**	(0.76)	(−6.36)**		(15.91)**	(4.04)**	(−9.81)**			
11/14/88–10/10/89	0.0176	0.2598	−11.2050	0.588	0.0209	0.1414	−9.4407	0.602	1.17	0.51
	(20.73)**	(3.29)**	(−6.58)**		(19.66)**	(1.20)	(−3.20)**			
10/11/89–12/30/95	0.0104	0.4060	−6.9360	0.203	0.0100	0.4456	−6.6024	0.182	0.87	0.21
	(26.86)**	(9.55)**	(−10.04)**		(21.41)**	(8.20)**	(−7.59)**			
01/04/79–10/26/87	0.0091	0.3249	−7.6040	0.141	0.0093	0.1260	−0.2833	0.100	30.08**	39.80**
(Excluding 10/87)	(40.21)**	(9.58)**	(−8.23)**		(37.77)**	(4.39)**	(−0.31)			
10/27/87–11/13/88	0.0157	0.0595	−19.6760	0.836	0.0145	0.4096	−32.4348	0.840	9.40**	10.40**
(Excluding 10/87)	(22.28)**	(0.64)	(−6.38)**		(15.82)**	(4.02)**	(−9.75)**			

[a] This table reports regression results across various pre- and post-liberalization sub-periods. For South Korea, the sub-sample tests are conducted on a two year-by-two year basis. For Taiwan, on the other hand, the sub-periods are constructed in a manner that the constancy of the price limit rule is maintained within the sub-period. Specifically, the sub-periods are based on the following effective regimes of different price limit rules: 5.0% price limit (01/06/75–12/18/78), 2.5% price limit (12/19/78–01/03/79), 5.0% price limit (01/04/79–10/26/87), 3.0% price limit (10/27/87–11/13/88), 5.0% price limit (11/14/88–10/10/89) and 7.0% price limit (10/11/89–12/30/95).

[b] The estimation was not performed during this sub-period because of a small sample of nine observations.

* The coefficient is significant at the 5%level.

** The coefficient is significant at the 1%level.

1990s continue to remain negative and statistically significant. Hence, even in the most recent sample period when presumably the effects of liberalization may have occurred, market participants still tended to converge towards the overall consensus of the market during large price movement days.

4. Conclusion

In this paper, we examine the investment behavior of market participants within different international markets (US, Hong Kong, Japan, South Korea, and Taiwan), specifically with regard to their tendency to conform with aggregate market behavior, i.e., exhibit herding.

In our empirical tests, we use a variant of the methodology used by Christie and Huang (1995). The underlying intuition behind our approach is as follows. We show that when equity return dispersion is measured by the cross-sectional absolute deviation of returns, rational asset pricing models predict not only that dispersion is an increasing function of the market return but also that the relation is linear. Furthermore, an increased tendency on the part of market participants to herd around the market consensus during periods of large price movements is sufficient to convert the linear relation into a non-linear one. To capture this effect, we employ a non-linear regression specification, which is similar in spirit to the market timing measure of Treynor and Mazuy (1966).

Our empirical tests indicate that during periods of extreme price movements, equity return dispersions for the US, Hong Kong and Japan actually tend to increase rather than decrease, hence providing evidence against the presence of any herd behavior. The results for the US are consistent with those documented by Christie and Huang (1995). However, for South Korea and Taiwan, the two emerging economies in our sample, we find dramatically different results. For both countries, we document the presence of smaller equity return dispersions (and hence herding) during both extreme up and down price movement days. The differences in return dispersions across the developed and emerging markets may partly be the result of incomplete information disclosure in the emerging markets. In fact, our empirical tests suggest that in South Korea and Taiwan, where the evidence in favor of herding is most pronounced, macroeconomic information tends to play a significantly greater role in the decision making process of market participants.

The results of market capitalization based portfolio tests indicate that our herding results are not driven by either the large or small capitalization stocks. In addition, the results for both South Korea and Taiwan remain relatively robust in various sub-period tests designed to capture shifts in investment behavior associated with the liberalization of these economies. Lastly, we conduct tests to examine whether the presence of daily price limits imposed on stocks in South Korea and Taiwan may be impacting our findings. However, these tests do not alter our overall evidence in favor of herding in the equity markets of South Korea and Taiwan.

An important investment implication of our study is that in economies such as South Korea and Taiwan where market participants tend to herd around the aggregate market consensus, a larger number of securities are needed to achieve the same level of diversification than in an otherwise normal market.

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