Chiao Da Management Review
Vol. 35 No.1, 2015
pp. 25-46

現貨市場之投資人群聚行為與情緒變數對台灣股價指數期貨之影響

The Effect of Herding Behavior and the Sentiments of Investors on Taiwan Stock Index Futures

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摘要：過去研究忽略期貨市場受到情緒變數與現貨市場之群眾行為之影響，本研究分析台灣指數期貨之報酬率如何受到 14 個金融市場之情緒變數的影響，這些變數涵蓋現貨、期貨、與選擇權市場的變數，進而探討是否在期貨價格上漲或下跌時研究結果皆相似。首先，我們以橫斷面之絕對離散度(CSAD)模型、與狀態空間模型衡量台灣現貨市場的群聚現象，實證結果顯示，台灣現貨市場存在群眾行為。另外，實證結果發現，當現貨市場群聚程度較小時，指數期貨報酬降低，而當現貨市場群聚程度較大時，指數期貨之報酬增加。特別值得注意的是，在期貨報酬大幅下降期間，當現貨市場之群聚程度縮小，期貨報酬降低。此結果反映了在價格下降時，有較大的不確定性。而為考慮在期貨價格上漲或下跌期間，不同程度的群聚行為與其他的解釋變數的關聯性，呈現不同的結果，我們分別在正向、與負向之期貨報酬下，重新衡量前述的模型，而實證結果仍然是被支持的。

關鍵詞：群聚行為；橫斷面之絕對離散度；投資人情緒變數；狀態空間模型

Abstract：This paper addresses the impacts of sentiment variables and herding behavior on spot markets within the context of Taiwan Stock Index Futures. We

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examine the variance in the rates of return of the Taiwan index futures based on 14 sentiment variables. These 14 variables include the sentiment variables in the spot, futures, and options markets. This paper further examines whether the results are consistent during bear and bull market periods. This study uses the cross-sectional absolute deviation (CSAD) model and the state space model to measure the herding behavior phenomenon in the spot market in Taiwan. Our results reveal that herding behavior is present in the Taiwan stock market, with empirical results showing that the index returns on futures fall when herding behavior mitigates in the stock market and rise when herding behavior is prevalent in the stock market. Notably, sharp decreases in futures returns are associated with decreased herding behavior and lower futures returns. This finding may reflect a higher degree of uncertainty during downward price movements. The present study finds consistency in analysis results during both bull and bear market periods.

Keywords： Herding behavior; Cross-sectional absolute deviation; Investor sentiments; State space model

1.Introduction

Herding behavior, a phenomenon within behavioral economics, refers to the tendency of individuals to align their personal perspectives, judgments, and behavior with those of the group. Numerous studies have explored the impact of sentiments and of herding behavior in the stock market. However, studies of the futures market, particularly compared the spot market, have paid minimal attention to the impact of sentiment variables and herding behavior. This problem has left unclear an important factor that is generally acknowledged to affect futures-market operations.

This article examines the effects of 14 sentiment variables on the rates of return of Taiwan index futures. The findings are intended to give investors a better understanding of the impact of the herding behavior effect on other sentiment variables so that these variables may be taken into consideration when investing in Taiwan index futures. Additionally, the robustness of the results are examined under conditions of large movements both upward and downward in futures-market prices. Overall, this assessment of the impact of variables related to investor sentiments provides to futures investors a more comprehensive picture of market conditions.

The cost-of-carry theory defines the futures price as equal to the current spot price plus the carrying cost. Therefore, spot returns significantly influence futures returns. This article focuses on the issue of herding behavior in the context of the spot market. The herding behavior effect on the spot market has been studied previously. In the cross-sectional standard dispersion (CSSD) model, dummy variables were used to simulate various market conditions and to reveal the effects of herding behavior on individual asset returns in the US equity market (Christie and Huang, 1995). The CSSD model suggests that if herding behavior exists during periods of large price movements then the individual stock returns should not diverge from the overall market return. Chang, Cheng and Khorana (2000) subsequently created the cross-sectional absolute deviation (CSAD) model that, as a variant of the CSSD model, also explains herding behavior. The CSAD model uses changes in actual market returns in place of the dummy variables specified in the CSSD model in order to account for non-linear relationships. The model suggests that if herding behavior exists during periods of large price movements, then the standard cross-sectional dispersion increases in proportion to the overall market return. This study employs the CSAD model to measure the level of herding behavior in a spot market[2] and the associated effect of this behavior on futures returns.

State space is another model addressed in this paper by drawing on and Hwang and Salmon (2004)'s models as the basis for examining herding behavior in spot markets. In summary, this study has three research objectives this study has three research objectives. First, this study measures the extent of the herding behavior phenomenon in the spot market in Taiwan using regression and state space models. Second, this study evaluates the effects on futures returns of herding behavior and sentiment variables. Third, this study explores whether large upward/downward price swings in the futures market affect the abovementioned relationships.

The Taiwan Stock Exchange (TSE) provides a good example of an index futures market in a newly developed economy. We study this market using 14 sentiment variables. These variables are categorized into three sources: the spot market, the futures market, and the options market. The herding indicator facilitates the exploration of the effects of investor sentiments on futures returns. Additionally, this study considers the extent of herding behavior in the spot market to elicit the impact of large price movements in the futures market. The empirical results demonstrate that the positive relationship between level of herding behavior in the spot market and futures returns during sharp decreases in futures returns.

2.Literature Review

[2] Since the herding behavior model is based on stock market, herding behavior has not, yet, been identified in futures markets. This might because there is the only one kind of underlying asset (stock index) in stock index futures; while herding behavior is discussed in the context of aligning investors among "many individual investment targets (individual firms)".

The herding behavior effect is an irrational behavior that is often triggered by uncertainty. Herding behavior influences the investment behavior of individuals, ultimately resulting in the imitation or blind following of the decisions of others and the abandonment of preexisting information and decisions (Bikhchandani and Sharma, 2000). Nofsinger and Sias (1999) defined herding behavior as the tendency of investors to flock in the same direction at a specific time. Christie and Huang (1995), using the CSSD regression model, found no empirical evidence of herding behavior in the U.S. NYSE or AMEX. Chang, Cheng and Khorana (2000) modified the CSSD regression model and capital asset pricing model (CAPM) to create the CSAD model as a means of exploring herding behavior in developed economies including the U.S., Hong Kong, and Japan and in developing economies including South Korea and Taiwan.

Some studies have confirmed the influence of herding behavior in, such as Asia (Chiang and Zheng, 2010) and Greece (Caporale, Economou and Philippas, 2008). However, studies of the financial market in China have produced inconsistent empirical results. While Tan *et al*. (2008) found herding behavior as a factor of influence in the trading of A- and B- shares, Fu and Lin (2010) did not[3]. In sum, current evidence as assessed using the CSAD model supports that stock markets in developing economies tend to exhibit herding behavior and that this behavior has a less significant impact in developed economies. Beyond the CSAD model, Hwang and Salmon (2004) used the state space model to detect herding behavior in both the U.S. and South Korea. Their work provides another non-linear model besides CSAD to estimate herding behavior.

Chang, Cheng and Khorana (2000) found that herding behavior is more visible in upward than downward movements in the market. The degree of cross-section dispersion increased with the decay rate during periods of large market movement in developing countries such as Taiwan and South Korea, where a significant herding phenomenon exists. Their finding that herding behavior is largely absent in developed countries aligns with the findings of other studies (e.g., Christie and Huang, 1995). Chiang and Zheng (2010) found significant herding behavior in the two sub-markets of the U.S. and Latin America. Fu and Lin (2010) found that stocks affected by low turnover in the China market were affected by high levels of herding behavior during downward movements in the market. Gleason, Mathur and Peterson (2004) evaluated herding behavior in the Exchange Trade Fund (ETF) of the S&P Index under large price movement conditions, with empirical results showing no significant herding behavior in the ETF when the market exhibited extreme returns. Chang *et al*. (2012) reported that pronounced herding tendency of investor sentiments and trading for great events

[3] Tan *et al.* (2008) used data from July 1997 to December 2003. Fu and Lin (2010) used data from January 2004 to June 2009, a period marked by a financial panic.

in Taiwan. Lin and Ma (2014) mentioned the herding for individual investors in Taiwan changes depending on market transparency. Therefore, the herding behavior in Taiwan exists and it may influence the return of stock market.

Psychological factors and sentiments not related to herding behavior also help shape the decisions of investors. These variables must be considered as well to fully understand investor decisions. Brown and Cliff (2004) distinguish between direct and indirect sentiment variables. Direct sentiment variables are assessed through interviews or collected by scales such as the Investors Intelligence Sentiment Indicator and the American Association of Individual Investor (AAII) Sentiment Indicator. Indirect sentiment variables are measured using real-market trading data such as the interbank overnight interest rate, the difference between the buy and sell volumes of institutional investors, put/call ratios, and the volatility index (*VIX*).

Many studies have explored the relationship between indirect sentiments and asset returns. Baker and Wurgler (2007) found that the link between indirect investor sentiments and investors' sentiments is helpful in predicting stock returns. This suggests that investor sentiment readily affects those stocks that are relatively more difficult to evaluate. Yu and Yuan (2011) postulated that investor sentiment affects return-volatility tradeoff, especially in pessimistic periods. Kuhnen and Knutson (2011) report the effect of sentiment on financial decisions. As shown by Stambaugh, Yu and Yuan (2012), investor sentiment plays a negative predictor for the short legs of long-short investment strategies. Baker, Wurgler and Yuan (2012) found prediction power of investors sentiments among international markets. Because the preponderance of the literature to date has investigated the effect of sentiments on stock returns, there remains a lack of scholarly understanding of the impact of sentiments on futures returns.

The present study draws on measures of sentiment that were identified as significant in the literature. We outline the indicators and the reasons for choosing each of the measures in the following sections. First, we included sentiment indicators that relate to trading activity. Short-term lending rate percentages (i.e., the overnight interest rate) represent investor sentiment and share an inverse relationship with stock returns (Brown and Cliff, 2004). Second, we incorporated indicators of stock market trading activity (Brown and Cliff, 2004) such as the ratio of purchase-on-margin borrowing. We also adopted measures of trading activity from both the futures and options market because these measures relate to all three types of financial markets due to the sharing among these markets of the same underlying assets.

Additionally, the present study includes measures of open interest or the total unilateral power of pending statements in futures markets. The amount of open interest represents the potential market momentum and the total number of open interests represents the strength of short selling deadlocks and the degree of price fluctuations. Bessembinder and Seguin (1993)'s study of eight types of futures contracts found a significant and negative relationship between the expected prices of open interest and futures. The present study considers a range of variables aside from open interest that relate to trading activity in the futures market, including: trading volume, initial margin, the institutional investor short-sale ratio, and the difference between buy and sell volumes for individuals and institutional investors in the futures market.

The present study uses the spot price minus the futures price, called the "basis", to measure market performance. Hsu and Wang (2004) argue that rising expectations for futures market prices reflect a continuing contango and the opposite reflects a backwardation in that these expectations are heavily influenced by investor expectations with regard to stock prices. Both Inci and Lu (2007) and Gospodinov and Jamali (2011) confirmed the relationship between the return basis and futures returns. Investors frequently use the basis measure to help forecast futures returns in the real world.

Finally, the trading activity related to options is also an important indicator of investor sentiments. This study incorporates the frequently used *VIX* sentiment variable. Whaley (2000) highlights that *VIX* may broadly represent an index of investor expectations in the futures market or specifically represent a fear gauge for the securities market. A high value for *VIX* reflects pessimistic investor expectations and anticipates high market volatility. Simon and Wiggins (2001) also found the put/call ratio to be an important predictor of futures prices. In sum, all of the abovementioned factors were adopted and used in the present study to assess the effect of the financial-market-related sentiments of investors on futures returns.

3.Methodology

We combined the data on futures contracts with different expirations under the consideration of the maturity effect to obtain continuous data in the futures market. To avoid abnormal fluctuations in the data, we used data from the most recent month of index futures in Taiwan. This study employed a regression model to evaluate the relationship between sentiment indicators using herding measurement and futures returns. This study examined 14 investor sentiment variables across three financial markets (i.e., spot, futures and options market).

Data collected in the spot market included: the interbank overnight interest rates (*IR*), the ratio of purchase on margin (*MR*), the ratio of short sale (*SC*), and the herding behavior indicator (*HERD*). Data collected in the futures market included: basis (*BS*), open interest (*OI*), trading volume (*VOL*), initial margin (*MAR*), institutional investor short sale ratio (*TH_RATIO*), difference between the buy and sell volumes of individual investors (FUT^a), and the difference between the buy and sell volumes of institutional investors (FUT^p). Data collected in the options market included: the put/call ratio (*P_C*), the difference between the buy and sell volumes of individual investors in the options market (OPT^a), the difference between buy and sell volumes of institutional investors (OPT^p), and *VIX*. Table 1 shows the sentiment variables related to each market. Additionally, we added lag spot returns to explain futures returns because this variable is an important proxy of economic conditions[4].

Following the example of Chang, Cheng and Khorana (2000), the present study used the CSAD variables to formulate a non-linear model to investigate the herding behavior effect, as follows:

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

$$CSAD_t^{up} = c + \gamma_1^{up} \left| R_{m,t}^{up} \right| + \gamma_2 (R_{m,t}^{up})^2 + \varepsilon_t \tag{2}$$

$$CSAD_t^{down} = c + \gamma_1^{down} \left| R_{m,t}^{down} \right| + \gamma_2 (R_{m,t}^{down})^2 + \varepsilon_t \tag{3}$$

with $CSAD_t = \sum_{i=1}^{N} \left| R_{i,t} - R_{m,t} \right| / N$, the absolute mean deviation of the return on each stock *i* on day *t* and $R_{i,t}$ indicating the market return $R_{m,t}$ on day t. $R_{m,t} = \sum_{i=1}^{N} R_{i,t} / N$, represents the stock-market return on day *t*[5], with *N* equal to the total number of stocks. $R_{m,t}^{up}$ ($R_{m,t}^{down}$), and $CSAD_t^{up}$ ($CSAD_t^{down}$) represent dispersion indicators in the bull (bear) market. We recalculated the CASD using capitalization weights to confirm the signs of coefficients in order to improve the robustness of the results. The CAPM model assumes that market investors are rational in order that the securities returns form a linear relationship with market beta risk in and that the market returns forms a linear relationship with the cross-sectional dispersion of the security returns. If herding behavior exists, then the relationship between the cross-sectional dispersion and the market return should be non-linear. Under this scenario, the market return and dispersion indicator do not increase proportionally or the correlation between the variables may weaken (when the coefficient γ_2 is negative).

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4 When we experimented with adding current spot returns as an independent variable, the signs of the coefficients of the14 sentiment variables remained the same.

5 Due to the difficulties involved in categorizing the contributions to the stock market by investor type (e.g., overseas investors, securities dealers, mutual funds), the model does not make this distinction. Thus if the market is *Rm* = 3% on one day, the percentage of market return made on that day by different types of investors is unclear.

Table 1
Definitions of the Sentiment Variables

Panel A	Definitions of the Sentiment Variables			
	Variable Category	**Variable Name**	**Variable Symbol**	**Variable Description**
Dependent Variable		TAIEX index futures return	*FR*	(Settlement price of TAIEX index futures on day *t* - settlement price on day *t*-1) / (settlement price on day *t*-1)
Explanatory Variable		Return of TAIEX	*RM*	Daily return of TAIEX from TEJ database
	Sentiment Indicators in Spot Market	Interbank overnight interest rates	*IR*	Interbank overnight interest rates in Taiwan
		Ratio of purchase on margin	*MR*	(Purchase on margin - Redemption) / (trading volume of Taiwan stock market × 2)
		Ratio of short sale	*SC*	(Short Sale - Redemption) / (trading volume of Taiwan stock market × 2)
		Herding	*HERD*	The coefficient γ_2 of rolling regression of equation (1)
	Sentiment Indicators in Futures Market	Basis	*BS*	The daily price of Taiwan stock index – price of TAIEX index futures
		Open interest	*OI*	Open interest of TAIEX index futures
		Trading volume	*VOL*	Trading volume of TAIEX index futures
		Initial margin	*MAR*	Initial margin of TAIEX index futures
		Institutional investor short sale ratio	*TH_RATIO*	Short volume of TAIEX index futures of the major institutional investors including dealers, investment trust companies, and foreign institutional investors/ (trading volume of TAIEX index futures × 2)
		Difference between buy and sell volume of individual investors in futures market	FUT^a	Long volume of TAIEX index futures of individual investors – short volume of TAIEX index futures of individual investors
		Difference between buy and sell volume of institutional investors in futures market	FUT^p	Long volume of TAIEX index futures of institutional investors – short volume of TAIEX index futures of institutional investors
	Sentiment Indicators in Options Market	Put/call ratio	*P_C*	Trading volume of put options/ trading volume of call options
		Difference between buy and sell volume of individual investors in options market	OPT^a	Long volume of Taiwan stock index options of individual investors – short volume of TAIEX stock index options of individual investors
		Difference between buy and sell volume of institutional investors in options market	OPT^p	Long volume of Taiwan stock index options of institutional investors – short volume of TAIEX stock index options of institutional investors
		Volatility index	*VIX*	Volatility index on Taiwan stock index options
Panel B	**Definitions of the Dummy Variables**			
Explanatory Variable	Dummy Variable	Dummy variable of large falling market	*TD_dn*	*TD_dn* = 1 for return of TAIEX index futures falling exceed 2% *TD_dn* = 0 for other
		Dummy variable of large raising market	*TD_up*	*TD_up* = 1 for return of TAIEX index futures raising exceed 2% *TD_up* = 0 for other

We investigated the herding phenomenon in the stock market in Taiwan and then assessed its effect on futures returns. The γ_2 (i.e., "*HERD*") is a measure of herding behavior, with higher negative values associated with an increased prevalence of herding behavior (Chang, Cheng and Khorana, 2000). A rolling regression model was then used to observe dynamic herding behavior (i.e., γ_2) in the spot market based on a 60-day window. The coefficient, γ_2 used to represent herding behavior in the spot market, was then added into the regression model as an independent variable.

Next, the present study employed the state space model with Kalman filter estimation (Demirer, Kutan and Chen, 2010) to enable a more thorough exploration of herding behavior, as follows:

$$\log[Std(\beta_{imt})] = \mu_1 + H_{mt} + \xi_{mt} \tag{4}$$

$$H_{mt} = \mu_2 H_{mt-1} + \upsilon_{mt} \tag{5}$$

where $H_{mt} = \log(1 - h_{mt})$, $\xi_{mt} \sim iid(0, \sigma_\xi^2)$, and $\upsilon_{mt} \sim iid(0, \sigma_\upsilon^2)$, β_{imt} is the market's beta at time t. h_{mt} is a time-varying latent herding behavior parameter. When $0 < h_{mt} < 1$ or $\sigma_\upsilon \neq 0$, some degree of herding behavior exists in the market. There is no herding behavior when σ_υ = 0 and H_{mt} = 0 for all *t*. Both the regression model and state space model were used in this study, with consistent results on stock-market herding behavior between the two enhancing the rigor of findings.

We created a five-part categorization of the empirical models. Parts one to three addressed sentiment indicators that are exclusive, respectively, to the spot, futures, and options markets. Part four addressed sentiment indicators that relate to both the spot and futures markets. Part five addressed sentiment indicators that relate to all three markets. These models provide a basis to explore the connections between the trading activities and behavior of investors in each market and the returns earned on futures. Once herding behavior had been confirmed, the regression model was used to examine the results. This step integrated all of the sentiment variables from the spot, futures, and options markets as explanatory variables:

$$\begin{aligned} FR_t = {} & \beta_0 + \beta_1 IR_t + \beta_2 MR_t + \beta_3 SC_t + \beta_4 HERD_t + \beta_5 BS_t + \beta_6 OI_t \\ & + \beta_7 VOL_t + \beta_8 MAR_t + \beta_9 TH\_RATIO_t + \beta_{10} FUT_t^a + \beta_{11} FUT_t^p \\ & + \beta_{12} P\_C_t + \beta_{13} OPT_t^a + \beta_{14} OPT_t^p + \beta_{15} VIX_t + \varepsilon_t \end{aligned} \tag{6}$$

where β_j is the coefficient to estimate the value of *j* between 0~15, ε_t is the error term, and $\varepsilon_t \sim N(0, \sigma)$. In order to account for the potential impact of large price movements, extreme futures returns were included in the model with the addition of dummy variables designed to explore the effect of large movements in futures returns. The *TD_dn* dummy variable is equal to one if the returns in the index futures in Taiwan falls more than 2% and zero if not. The *TD_up* dummy variable is equal to one for returns if the rise exceeds 2% and zero if not[6]. The models that describe the impact of extreme returns are:

$$\begin{aligned} FR_t &= \beta_0 + \beta_1 IR_t + \beta_2 MR_t + \beta_3 SC_t + \beta_4 HERD_t + \theta_1 TD\_dn \times HERD_t \\ &+ \beta_5 BS_t + \beta_6 OI_t + \beta_7 VOL_t + \beta_8 MAR_t + \beta_9 TH\_RATIO_t + \beta_{10} FUT_t^a \\ &+ \beta_{11} FUT_t^p + \beta_{12} P\_C_t + \beta_{13} OPT_t^a + \beta_{14} OPT_t^p + \beta_{15} VIX_t + \varepsilon_t \end{aligned} \tag{7}$$

$$\begin{aligned} FR_t &= \beta_0 + \beta_1 IR_t + \beta_2 MR_t + \beta_3 SC_t + \beta_4 HERD_t + \theta_1 TD\_up \times HERD_t \\ &+ \beta_5 BS_t + \beta_6 OI_t + \beta_7 VOL_t + \beta_8 MAR_t + \beta_9 TH\_RATIO_t + \beta_{10} FUT_t^a \\ &+ \beta_{11} FUT_t^p + \beta_{12} P\_C_t + \beta_{13} OPT_t^a + \beta_{14} OPT_t^p + \beta_{15} VIX_t + \varepsilon_t \end{aligned} \tag{8}$$

where β_j is the coefficient used to estimate the value of j between 0~15, ε_t is the error term, and $\varepsilon_t \sim N(0, \sigma)$. θ_1 is the coefficient of the dummy variable. The term $TD\_dn \times HERD_t$ and $TD\_up \times HERD_t$ are included to observe the relationship between the *HERD* and the futures returns under conditions when futures returns move sharply. Hence, for relatively large fluctuations in futures returns ($\geq \pm 2\%$), the coefficients for the *HERD* are $\beta_4 + \theta_1$. For relatively small fluctuations in futures returns ($< \pm 2\%$), the coefficient is β_4.

We added the lag spot returns, RM_{t-1}, as an independent variable and reexamined equations (6), (7), and (8) in order to observe whether the coefficients associated with the sentiment variables had changed. This was done because the lag-stock returns are fairly good predictors of futures returns and because stock returns may be used as a proxy for the economy situation. Finally, to allow for the possibility that the level of herding behavior and other explanations may be asymmetric in the bear/bull futures market, we reexamined the model under two scenarios: positive futures returns and negative futures returns.

4.Data and Empirical Results

The data used in this study was drawn from the Taiwan Economic Journal (TEJ) Data Bank. The empirical test covers the period from July 21, 1998 (the day

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6 The proportions of *TD_dn* and *TD_up* to all data are 10.25% and 10.94%, respectively. The two proportions are approximately the same and it is fair to use the two dummy variables to represent positive and negative extreme futures returns. The size is appropriate to observe the extreme returns (about 1/10) even we also used different thresholds of, say +/- 3%. The sample sizes of dummy variables that exceed 3% or -3% are 5.76% and 4.63%, respectively and the coefficients of the two dummy variables in the regression model are the same.

that index futures were inaugurated in Taiwan) to December 31, 2009 with a total of 2895 single-day data points. Because the institutional investor short sale ratio was made available only from July 2, 2007, the models related to this ratio cover only the period from July 2, 2007 to December 31, 2009. Additionally, because the *VIX* of options in Taiwan was made available only from December 1, 2006, the time frame of the models related to this variable was similarly shortened to match the available data. Table 2 reports the descriptive statistics for sentiment variables, spot returns, and futures returns. Over the sample period, the mean for futures returns was slightly positive (0.0244%), with a standard deviation of 1.87% and excess kurtosis.

4.1 Herding Behavior in the Spot Market

This study implemented the CSAD regression model and the state space model. To investigate herding behavior in the stock market. The results are shown in Table 3. The coefficients in Panel A, Table 3 reveal that a non-linear relationship exists between stock-market returns and cross-section dispersions of equity return due to the significant negative coefficient (-0.028) of the quadratics term in equation (1). The results support that the cross-sectional dispersion of return increases at a decreasing rate and then decreases after a specified peak as the stock returns become larger in absolute value. According to Chang, Cheng and Khorana (2000), the nonlinear relationship evidences the presence of herding behavior in the Taiwan stock market. The empirical results of this study are similar to Chang, Cheng and Khorana (2000), which suggested that the presence of large numbers of relatively short-term speculators as a cause of herding behavior in the TSE.

To allow the different coefficients under positive and negative returns, the two scenarios were examined and we included the same signs of the γ_2 coefficients in equation (2) and equation (3). Investors were found to exhibit significant herding behavior in cases of both positive and negative stock returns (-0.018, and -0.031, respectively). The larger negative coefficient γ_2 in the downward market indicates that herding behavior is stronger for negative stock returns than for positive stock returns. The results in Panel A for equally weighted CSAD and in Panel B for capitalization-weighted CSAD are similar in terms of signs.

4.2 The Connection between Herding Behavior in the Spot Market and the Return on Futures

We checked the correlations of variables to avoid the problem of collinearity in the regression model as shown in Table 4. None of the absolute values of correlation was larger than 0.7. Therefore, no significant collinearity

Table 2
Descriptive Statistics of Sentiment Variables

FR is Taiwan index futures return. *RM* is Taiwan stock return. *IR* is interbank overnight interest rates. *MR* is ratio of purchase on margin. *SC* is ratio of short sale. *HERD* is herding indicator. *BS* is basis. *OI* is open interest. *VOL* is trading volume. *MAR* is initial margin. *TH_RATIO* is institutional investor short sale ratio. FUT^a is the difference between buy and sell volume of individual investors in futures market. FUT^p is the difference between buy and sell volume of institutional investors in futures market. *P_C* is put/call ratio. OPT^a is the difference between buy and sell volume of individual Investors in options market. OPT^p is the difference between buy and sell volume of institutional investors in options market. *VIX* is volatility index.

Panel A Sentiment Variables in Spot Market

Variable Symbol	*FR*	*RM*	*IR*	*MR*	*SC*	*HERD*
Sample Period	1998/07/21 to 2009/12/31					
Sample Size	2,985.00	2,985.00	2,985.00	2,985.00	2,985.00	2,895.00
Mean	0.02	0.01	2.39	26.13	2.15	1.94
Standard Deviation	1.87	1.62	1.66	8.53	1.30	0.43
Kurtosis	2.52	4.74	-0.63	-0.58	9.66	0.65
Skewness	-0.01	-0.01	0.72	0.51	2.20	0.79
Minimum	-7.00	-6.67	0.10	9.45	0.00	0.43
Maximum	6.99	6.74	7.07	50.26	12.72	3.98

Panel B Sentiment Variables in Futures Market

Variable Symbol	*BS*	*OI*	*VOL*	*MAR*	*TH_RATIO*	FUT^a	FUT^p
Sample Period	1998/07/21 to 2009/12/31				2007/07/02 to 2009/12/31		
Sample Size	2,895.00	2,895.00	2,895.00	2,895.00	628.00	628.00	628.00
Mean	5.27	23,219.00	25,591.00	11,081.00	13.71	670.26	-1,162.99
Standard Deviation	58.96	18,566.00	28,900.00	25,495.00	3.44	15,692.90	5,735.81
Kurtosis	2.44	-0.76	2.91	0.02	5.21	0.48	2.81
Skewness	-0.27	0.52	1.71	0.74	1.34	0.65	-1.43
Minimum	-377.76	36.00	0.00	75,000.00	0.00	-23,631.00	-19,282.00
Maximum	332.87	83,020.00	172,208.00	195,000.00	38.13	44,512.00	8,521.00

Panel C Sentiment Variables in Options Market

Variable Symbol	*P_C*	OPT^a	OPT^p	*VIX*
Sample Period	2006/12/01 to 2009/12/31			
Sample Size	767.00	767.00	767.00	767.00
Mean	0.87	-2,667.52	3,648.72	29.48
Standard Deviation	0.26	114,069.00	17,434.00	9.13
Kurtosis	-0.25	-0.05	3.50	0.16
Skewness	0.22	0.20	0.54	0.46
Minimum	0.22	-238,850.00	-40,648.00	11.74
Maximum	1.80	285,642.00	61,356.00	60.41

Table 3
Empirical Non-Linear Relationships between Market Returns and Stock Dispersion Indicators

Panel A and B show the regressions of the following forms are estimated using:

$$CSAD_t = c + \gamma_1 \left| R_{m,t} \right| + \gamma_2 R_{m,t}^2 + \varepsilon_t \quad (1)$$

$$CSAD_t^{up} = c + \gamma_1^{up} \left| R_{m,t}^{up} \right| + \gamma_2 (R_{m,t}^{up})^2 + \varepsilon_t \quad (2)$$

$$CSAD_t^{down} = c + \gamma_1^{down} \left| R_{m,t}^{down} \right| + \gamma_2 (R_{m,t}^{down})^2 + \varepsilon_t \quad (3)$$

where $CSAD_t = \sum_{i=1}^{N} \left| R_{i,t} - R_{m,t} \right| / N$, is the mean absolute deviation of the return of each stock *i*, $R_{i,t}$, relative to the market return, $R_{m,t}$. $R_{m,t}^{up}$ ($R_{m,t}^{down}$) and $CSAD_t^{up}$ ($CSAD_t^{down}$) represent dispersion indicator on bull (bear) market. The CSAD variable in Panel A is calculated by equally weighted base, while it in Panel B is calculated by market-value-weighted base. Panel C show the results of the following state space model:

$$\log(\mathrm{S}td(\beta_{imt})) = \mu_1 + H_{mt} + \xi_{mt} \quad (4)$$

$$H_{mt} = \mu_2 H_{mt-1} + \upsilon_{mt} \quad (5)$$

where $H_{mt} = \log(1 - h_{mt})$, $\xi_{mt} \sim iid(0, \sigma_\xi^2)$, and $\upsilon_{mt} \sim iid(0, \sigma_\upsilon^2)$. When σ_υ = 0, there is no herding and the H_{mt} = 0. When 0< h_{mt} <1, the herding exists in the market.

Variable	equation (1)	equation (2)	equation (3)
Panel A Regression Model with Equally Weighted CSAD			
c	1.7350 ***	1.6769 ***	1.8310 ***
	(122.6305)	(99.4797)	(80.0290)
γ_1	0.2394 ***	0.2023 ***	0.2296 ***
	(13.5467)	(8.9287)	(8.6136)
γ_2	-0.0289 ***	-0.0188 ***	-0.0314 ***
	(-7.4023)	(-3.7328)	(-5.4191)
Adjusted R^2	10.97%	12.10%	7.71%
Panel B Regression Model with Capitalization-Weighted CSAD			
c	1.5305 ***	1.6747 ***	1.4308 ***
	(78.1901)	(67.3070)	(78.1902)
γ_1	0.3163 ***	0.2795 ***	0.2941 ***
	(16.3153)	(9.6414)	(11.8956)
γ_2	-0.0491 ***	-0.0487 ***	-0.0395
	(-11.4484)	(-7.7271)	(-7.1859)
Adjusted R^2	10.84%	6.61%	13.38%
Panel C State Space Model			
μ_1	-0.7344 ***		
	(-22.0048)		
μ_2	0.8449 ***		
	(187.0759)		
σ_ξ	0.3095		
	(0.0042)		
σ_υ	0.0275 ***		
	(4.7489)		

Note: Parentheses indicate *t*-values, and *** indicates significance at the 1 % level.

Table 4
Correlation Matrix

FR is Taiwan index futures return. *RM* is Taiwan stock return. *IR* is interbank overnight interest rates. *MR* is ratio of purchase on margin. *SC* is ratio of short sale. *HERD* is herding indicator. *BS* is basis. *OI* is open interest. *VOL* is trading volume. *MAR* is initial margin. *TH_RATIO* is institutional investor short sale ratio. FUT^a is the difference between buy and sell volume of individual investors in futures market. FUT^p is the difference between buy and sell volume of institutional investors in futures market. *P_C* is put/call ratio. OPT^a is the difference between buy and sell volume of individual Investors in options market. OPT^p is the difference between buy and sell volume of institutional investors in options market. *VIX* is volatility index.

	FR	*RM*	*IR*	*MR*	*SC*	*HERD*	*BS*	*OI*	*VOL*	*MAR*	*TH_RATIO*	FUT^a	FUT^p	*P_C*	OPT^a	OPT^p	*VIX*
FR	1.00																
RM	0.96	1.00															
IR	-0.11	-0.12	1.00														
MR	0.10	0.12	-0.64	1.00													
SC	0.00	-0.01	-0.36	-0.16	1.00												
HERD	-0.05	-0.05	0.12	-0.18	-0.01	1.00											
BS	-0.39	-0.34	0.05	-0.09	-0.01	-0.08	1.00										
OI	0.01	0.00	0.00	-0.05	0.03	-0.05	0.05	1.00									
VOL	0.04	0.01	-0.33	0.21	0.11	-0.06	-0.07	0.67	1.00								
MAR	0.00	0.01	0.50	-0.21	-0.22	0.07	-0.21	-0.22	-0.34	1.00							
TH_RATIO	-0.25	-0.26	0.10	-0.06	0.00	-0.06	0.12	-0.26	-0.31	0.07	1.00						
FUT^a	0.00	0.00	0.08	0.05	-0.02	0.03	-0.33	-0.04	0.01	0.12	0.08	1.00					
FUT^p	0.11	0.12	-0.12	0.23	-0.23	-0.05	-0.01	0.04	0.05	0.00	-0.05	-0.10	1.00				
P_C	-0.09	-0.08	-0.51	0.51	0.05	0.04	-0.16	-0.20	0.08	-0.11	0.04	0.10	0.11	1.00			
OPT^a	-0.10	-0.11	0.33	-0.30	0.12	0.20	0.28	0.17	0.05	-0.25	0.08	0.00	-0.18	-0.32	1.00		
OPT^p	-0.01	0.00	-0.05	0.00	0.41	0.07	-0.13	0.06	-0.02	-0.21	0.03	0.29	-0.48	0.04	0.28	1.00	
VIX	-0.05	-0.06	-0.05	-0.06	0.02	-0.23	0.24	0.21	0.26	0.03	0.06	-0.09	-0.03	-0.33	0.14	-0.20	1.00

problem was noted. After confirming the presence of herding behavior in the spot market, we adopted rolling regression models with a window size of 60 days in order to obtain a dynamic sequence of coefficients γ_2.The dynamic sequence of coefficients γ_2, called *HERD*, was re-estimated every 60 days. Equation (1) used 2836 (= 2895 – 60 + 1) regression-model calculations to find the continuous time varying herding behavior. Next, the series of coefficients γ_2 were incorporated with other sentiment variables in equation (6) of Table 5 to investigate the relationship between return on futures and sentiment variables. Equations (7) and (8) in Table 5 were added *TD_up* × *HERD* and *TD_dn* × *HERD*, respectively.

The coefficients on the *HERD* are significantly negative in Table 5, with the exception of equation (7). The larger (less negative) *HERD*, the smaller the level of herding behavior in the spot market. Thus, the negative signs of coefficients of *HERD* show the positive connection between the level of herding behavior in spot market and the return on futures. The futures return index declines when herding behavior mitigates the stock market and the futures return index rises when herding behavior more seriously affects the stock market. Irrational herding behavior occurs in the spot market due to investors seeking potential gain from returns on futures. Herding behavior in the spot market exhibits a significant impact on future returns. This impact did not disappear after lag spot returns were added as a control variable, although we don't show the results in the table.

As shown in Table 5, the coefficients of interbank overnight interest rates (*IR*) were significant negative, indicating that the sentiments of investors tend to be higher when the investing opportunity costs, such as *IR*, are lower. The negative coefficient of *IR* means that the returns on futures fall when investor sentiment is low. The basis (*BS*) has the expected negative sign, indicating that the low futures price coupled with low investors' sentiment negatively affects futures returns. The coefficients of the futures trading volume (*VOL*) have negative signs in Table 5, regardless of whether spot returns or extreme future returns are added as an independent variable. This is unexpected, because the large trading volume often represents high sentiments. Therefore, investors should carefully judge the impacts of trading volume on futures returns.

Additionally, the short sales by the institutional investors (*TH_RATIO*) were found to have an inverse association with Taiwan stock futures returns. The positive coefficient of the difference between buy and sell of institutional investors (FUT^p) suggests that Taiwan futures returns increased as the net number of futures purchases made by institutional investors increased. The low *TH_RATIO* and high FUT^p represent high sentiment. Another unexpected sign is the negative coefficients of FUT^a. The low sentiments of individuals were accompanied by high futures returns. The possible reason for this phenomenon is that the individual represents only one type of market participant. The put/call ratio (*P_C*) has negative sign and OPT^a has a positive sign. Lower investor sentiments in the options market coupled with higher *P_C* and lower OPT^a were associated with higher futures returns.[7]

[7] We also re-estimated equation (6) based on three categorizes of sentiment variables: spot,

Equations (7) and (8) show the cross-term of herding behavior and large upward versus downward swings of futures returns. The effect of sharpfluctuations in futures returns on herding behavior is interesting to observe. The dummy variable *TD_up* sets to 1 if futures returns increase more than 2 % in equation (7), whereas the dummy variable *TD_dn* sets to 1 if futures returns decline by more than 2% in equation (8). In Table 5, the signs of the cross-terms in equation (7) are the opposite of those in equation (8). The coefficients of these cross-terms reveal that the effect of herding behavior is negative (-14.98) when futures returns fall more than 2%. When futures returns decrease sharply, the larger levels of herding behavior (smaller *HERD* or larger magnitude of negative *HERD*) are concurrent with higher futures returns.

The coefficients of cross-term reveal that the effect of herding behavior is positive (15.23) when futures returns rise more than 2%. For the case in which futures returns rise sharply, the high level of herding behavior in spot market is accompanied by increasing futures returns. When futures returns do not decrease extremely, as in equations (7) and (8), the negative value of *HERD* means that the high level of herding behavior in spot market is accompanied by decreasing futures returns.

4.3 The Connection between Herding Behavior in the Spot Market and Futures Returns during Bear and Bull Markets

Considering that herding behavior may affect positive/negative futures returns differently, we further divided the bear/bull futures market in Tables 6 to consider the different impacts of herding behavior. The second and third columns show tests of the effects of sentiment variables on negative futures returns (bear market), while the fourth and fifth columns show the effects of the same variables on positive futures returns (bull market). As stated earlier, larger (less negative) values for γ_2 are associated with smaller levels of herding behavior in the spot market. With regard to the case without cross-terms in Table 6, the coefficient of *HERD* in equations (6) was not significant during the bull market. The negative sign of *HERD* (-3.72) shows a positive connection between the level of herding behavior in the spot market and the futures returns during a bear market. The negative coefficients of *HERD* indicate that the futures returns, which do not

futures, and options market. In other words, only the intercept term, *IR*, *MR*, *SC*, and *HERD* variables are included in the regression model in the first round of estimation. For the second round of estimation, only the intercept, *BS*, *OI*, *VOL*, *MAR*, *TH_RATIO*, FUT^a, and FUT^p are included in the model. Finally, only the intercept, *P_C*, OPT^a, OPT^p, *VIX* variables are included in the third round. The signs are the same as the results of all 14 variables in the models.

decrease sharply during bear markets, tend to increase as with herding behavior in the spot market.

When futures returns increase sharply during a bull market, the empirical results are similar to those shown in Table 5.[8] The coefficient of the cross-term remains negative (-15.61) when futures returns fall more than 2% during a bear market and turns positive (10.016) when futures returns rise more than 2% during a bull market. In Table 6, a positive value for *TD_up* × *HERD* means that sharp increases in futures returns during a bull market is accompanied by decreased levels of herding behavior (larger γ_2 or small magnitude of negative γ_2) and higher futures returns. The negative coefficient of *TD_dn* × *HERD* indicates that when futures returns decrease sharply during a bear market, the smaller level of herding behavior (larger γ_2 or small magnitude of negative γ_2) is accompanied by lower futures returns.

In summary, sharp rises in futures returns resulted in herding behavior in spot markets accompanied by decreasing futures returns. Sharp decreases in futures resulted in herding behavior in the spot market accompanied by increasing futures returns. Comparing other sentiment variables in Tables 6, we find that the signs of some variables such as *IR*, *SC*, *MAR*, and *VIX* are different during bear/ bull markets. That shows that investors hold different views of the same sentiment variable in the contexts of both positive and negative futures returns. For example, the *VIX*s are negative during the bear market and positive in the bull market. When market volatility increases during bear market conditions, investor panic related to market increased, reducing futures market returns. However, when market volatility increased during a bull market, investors may associate this increase with an opportunity to get more profits. Thus higher *VIX* values are associated with higher returns on futures.

Finally, sentiment variables including *BS* and *P_C* had the same signs regardless of whether the market was bull or bear. The two variables also represent the futures and options markets, respectively. The consistency in value of these variables in both bull and bear markets indicate that either investor sentiments affect futures returns or that a common factor ties these three financial markets together. Although forecasting the trend of futures returns in advance, the common variable through two scenarios identifies co-movement factors that are associated with futures returns.

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[8] It is not appropriate to add the *TD_dn* variable in markets with positive futures returns because the dummy variable *TD_dn* equals one in cases where the decline in futures returns exceeds 2% and zero for others. Thus, All data show that *TD_dn* equals zero for positive futures returns, which creates the problem of collinearity. Similarly, the dummy variable, *TD_up* is not appropriate for use in markets with negative futures returns.

Table 5
Estimation of the Regression Models for All Samples

The regression of the following equation (6) is estimated using:

$$FR_t = \beta_0 + \beta_1 IR_t + \beta_2 MR_t + \beta_3 SC_t + \beta_4 HERD_t + \beta_5 BS_t + \beta_6 OI_t + \beta_7 VOL_t + \beta_8 MAR_t + \beta_9 TH\_RATIO_t + \beta_{10} FUT_t^a + \beta_{11} FUT_t^p + \beta_{12} P\_C_t + \beta_{13} OPT_t^a + \beta_{14} OPT_t^p + \beta_{15} VIX_t + \varepsilon \quad (6)$$

where FR_t is the dependent variable representing the daily futures returns and the independent variables can be found in Table 1. The equations (7) and (8) are added $TD\_dn \times HERD$ and $TD\_up \times HERD$, respectively.

Variable	equation (6)	equation (7)	equation (8)
Intercept	5.3338 ***	5.0750 ***	5.1978 ***
	(4.6337)	(4.4139)	(4.5301)
IR	-0.5212 ***	-0.5083 ***	-0.4925 ***
	(-2.7967)	(-2.7399)	(-2.6492)
MR	0.0366	0.0351	0.0401
	(0.9871)	(0.9496)	(1.0842)
SC	-0.1449	-0.1538	-0.1337
	(-0.7611)	(-0.8116)	(-0.7054)
HERD	-4.8451 **	-2.4997	-6.8597 ***
	(-2.0852)	(-1.0084)	(-2.8005)
$TD\_dn \times HERD$		-14.9789 ***	
		(-2.6253)	
$TD\_up \times HERD$			15.2294 **
			(2.5087)
BS	-0.0187 ***	-0.0182 ***	-0.0186 ***
	(-11.2961)	(-10.9538)	(-11.2959)
OI	-0.0462×10^{-5}	-0.0624×10^{-5}	-0.0472×10^{-5}
	(-0.0672)	(-0.0912)	(-0.0689)
VOL	-0.751×10^{-5} **	-0.686×10^{-5} **	-0.714×10^{-5} **
	(-2.1551)	(-1.9716)	(-2.0542)
MAR	0.0033×10^{-5}	0.027×10^{-5}	0.0108×10^{-5}
	(0.0087)	(0.0729)	(0.0293)
TH_RATIO	-0.1236 ***	-0.1172 ***	-0.1220 ***
	(-5.2002)	(-4.9578)	(-5.1810)
FUT^a	-1.16×10^{-5} **	-1.18×10^{-5} **	-1.14×10^{-5} **
	(-2.1538)	(-2.0431)	(-2.1201)
FUT^p	2.92×10^{-5} *	3.34×10^{-5} **	2.94×10^{-5} *
	(1.8738)	(2.1201)	(1.8965)
P_C	-2.1982 ***	-2.1169 ***	-2.1563 ***
	(-5.4660)	(-5.2742)	(-5.3812)
OPT^a	0.207×10^{-5} **	0.206×10^{-5} **	0.201×10^{-5} **
	(2.1582)	(2.1568)	(2.1017)
OPT^p	-0.271×10^{-5}	-0.167×10^{-5}	-0.222×10^{-5}
	(-0.4658)	(-0.2865)	(-0.3828)
VIX	-0.0082	-0.0072	-0.0095
	(-0.6346)	(-0.5429)	(-0.7400)
Adjusted R^2	26.88%	27.59%	27.52%

Note: ***, **, * denote statistical significances at the 1%, 5%, and 10% levels, respectively.
The *t*-statistics calculated are in parentheses.

Table 6
Estimation of the Regression Models for the Bear and Bull Market

The regression of the following equation (6) is estimated using:

$$FR_t=\beta_0+\beta_1 IR_t+\beta_2 MR_t+\beta_3 SC_t+\beta_4 HERD_t+\beta_5 BS_t+\beta_6 OI_t+\beta_7 VOL_t+\beta_8 MAR_t+\beta_9 TH\_RATIO_t+\beta_{10} FUT_t^a +\beta_{11} FUT_t^p +\beta_{12} P\_C_t+\beta_{13} OPT_t^a +\beta_{14} OPT_t^p +\beta_{15} VIX_t+\varepsilon \quad (6)$$

where FR_t is the dependent variable representing the daily futures returns and the independent variables can be found in Table 1. The equations (7) and (8) are added *TD_dn*×*HERD* and *TD_up*×*HERD*, respectively.

Variable	Bear Market	Bull Market		
	equation (6)	**equation (7)**	**equation (6)**	**equation (8)**
Intercept	5.3822 ***	5.1182 ***	-0.7418	-0.7573
	(4.8754)	(4.7343)	(-0.6469)	(-0.6648)
IR	-0.7661 ***	-0.7530 ***	0.5850 ***	0.6100 ***
	(-4.1220)	(-4.1457)	(3.3646)	(3.5244)
MR	-0.0394	-0.0503	0.1146 ***	0.1167 ***
	(-1.0253)	(-1.3351)	(3.3680)	(3.4513)
SC	-0.3129 *	-0.3528 *	0.4422 **	0.4561 **
	(-1.6818)	(-1.9373)	(2.3968)	(2.4870)
HERD	-3.7171 *	0.8303	0.4560	-2.2666
	(-1.6748)	(0.3320)	(0.2013)	(-0.8916)
TD_up×*HERD*				10.0157 **
				(2.3052)
TD_dn×*HERD*		-15.6096 ***		
		(-3.6512)		
BS	-0.0106 ***	-0.0096 ***	-0.0062 ***	-0.0063 ***
	(-5.9514)	(-5.4228)	(-3.8336)	(-3.9243)
OI	0.352×10^{-5}	0.298×10^{-5}	-1.08×10^{-5} *	-1.08×10^{-5} *
	(0.5030)	(0.4359)	(-1.6876)	(-1.6970)
VOL	-0.583×10^{-5}	-0.454×10^{-5}	0.29×10^{-5}	0.32×10^{-5}
	(-1.5776)	(-1.2527)	(0.9204)	(1.0229)
MAR	0.806×10^{-5} **	0.833×10^{-5} **	-1.21×10^{-5} ***	-1.21×10^{-5} ***
	(2.1199)	(2.2440)	(-3.6329)	(-3.6577)
TH_RATIO	-0.1148 ***	-0.1076 ***	0.0231	0.0214
	(-5.0611)	(-4.8333)	(0.9524)	(0.8895)
FUT^a	-0.286×10^{-5}	-0.068×10^{-5}	-0.778×10^{-5}	-0.755×10^{-5}
	(-0.5083)	(-0.1227)	(-1.6002)	(-1.5620)
FUT^p	1.86×10^{-5}	2.6×10^{-5} *	0.481×10^{-5}	0.394×10^{-5}
	(1.1935)	(1.6916)	(0.3287)	(0.2711)
P_C	-1.2149 ***	-1.0226 **	-1.5454 ***	-1.5104 ***
	(-3.0157)	(-2.5749)	(-4.1303)	(-4.0608)
OPT^a	0.081×10^{-5}	0.094×10^{-5}	-0.058×10^{-5}	-0.058×10^{-5}
	(0.8038)	(0.9637)	(-0.6605)	(-0.6753)
OPT^p	-0.488×10^{-5}	-0.316×10^{-5}	-0.621×10^{-5}	-0.615×10^{-5}
	(-0.8107)	(-0.5351)	(-1.1611)	(-1.1566)
VIX	-0.0696 ***	-0.0683 ***	0.0543 ***	0.0517 ***
	(-5.5801)	(-5.6029)	(4.4900)	(4.3110)
Adjusted R^2	37.48%	40.31%	22.46%	23.46%

Note: ***, **, * denote statistical significances at the 1%, 5%, and 10% levels, respectively.
The *t*-statistics calculated are in parentheses.

5.Conclusions

This study initially examined the connection between herding behavior in the Taiwan spot market and futures returns. After observing the relationship between equal-weighted/capitalization-weighted cross-section dispersion and stock returns, the empirical results of this study, obtained using the regression and state-space models, indicate that herding behavior exists in the spot market. After confirming that herding behavior exists in the Taiwan spot market, the dynamic herding behavior measure was included in the regression model as an investor sentiment variable in order to examine the association between sentiment variables and the Taiwan index futures returns. Considering 14 sentiment variables related to trading activity covering the spot, futures, and options markets, the empirical results support that herding behavior in the spot market has a significant impact on futures returns. This finding is one of the critical contributions of this study. Additionally, the empirical results showed that the index futures return is higher when the level of herding behavior in the stock market is higher and is lower when herding behavior mitigates the stock market. The empirical results are the same whether or not the spot returns are added to the models used to explain futures returns.

In terms of the large swings in futures returns, when futures returns decrease sharply, a low level of herding behavior accompanies lower futures returns. However, when the futures returns increase sharply, the herding behavior in the spot market is associated with decreasing futures returns. Furthermore, it is worth noting that an examination of the futures market shows that the coefficient of herding behavior is insignificant when the bull market and that the herding behavior effect of spot-to-futures returns is larger in bear markets than in bull markets. A partial explanation for the asymmetric effects of herding behavior between bull and bear markets is that the investors have a greater tendency to follow others blindly during bear markets owing the greater levels of uncertainty.

The authors hope that the administrative authority may reference the empirical results of this study when developing plans to improve the management of financial markets. The impact of herding behavior in the spot market suggests the importance of transparency and other market conditions to herding behavior in the stock market and, by extension, the futures market. Considering what factors lead to herding behavior in the spot market in order to develop strategies to minimize herding behavior is critical to decreasing volatility in futures markets. Caution is advised before applying the empirical results of this study to investing in terms of the actual connections among spot, futures, and options markets, which is another critical contribution of this study. Certain sentiment variables that are observed in different financial markets have a significant impact on the futures market and should be considered among the comprehensive factors that affect financial markets when investing in futures.

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