2. WHICH TYPES OF STOCKS HERDED BY FOREIGN INSTITUTIONAL INVESTORS ARE INFORMATIONAL IN THE EMERGING STOCK MARKET?

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Abstract

This study analyses which types of the stocks herded by foreign institutional investors (FII) in buying side are informational in the stock markets of the emerging countries such as Taiwan. By employing a panel smooth transition regression (PSTR) model, we find that the FII buying herding patterns are informational for lower firms' unexpected earning and lower return stocks and undervalued value stocks. Next, the price effects of the FII buying herding on stock types are different in bull and bear periods. To improve portfolio performance, general investors can follow FII to purchase the stock types of FII buying herding in the emerging markets. The price persistence of institutional herding can be further integrated with the stock types of past firms' unexpected earnings, returns, and book-to-market ratio.

Keywords: price impact, herding, stock types, institutional investors, PSTR
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1. Introduction

Foreign institutional investors (FIIs) are better informed than other investors, and their share ownership and trading amount are larger than those of domestic institutional investors in the

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emerging stock markets, leading to greater market influence. Compared with domestic institutional investors, FIIs place greater emphasis on long-term trading strategies in the emerging stock markets. FII trading behaviour typically can be regarded as a guidance of general investors. FIIs also face largely competitive environments and a lack of confidence when they trade stocks because they are not native to the target country. These situations may cause FIIs to herd (*i.e.*, some FIIs may follow each other into and out of the same securities). Because there is a plain-plate stock market structure in the emerging markets such as Taiwan, the post-herding abnormal returns of the stocks herded by FII have greater influences in Taiwan. Hence, this paper first clarifies whether the stocks buying herding by FIIs result in the increase in the subsequent stock abnormal returns.

The herding indicator created by Lakonishok, Shleifer, and Vishny (LSV) (1992) has become a standard measure in the relevant herding studies. By using the adjusted LSV index, Wylie (2005) demonstrated the existence of UK fund manager herding in the largest and smallest stocks. However, the LSV measure does not divide buying and selling herding directions of investors. Wermers (1999) improves LSV index to include the respective directions. Zheng, Li and Zhu (2015) find that the herding effect of institutional investors occur more significantly on buy-side herding. Hung, Lu, and Lee (2010) find that post-herding returns are informational only for following buying herding of fund managers rather than following selling herding. Several studies demonstrate that abnormal returns driven by buying herding behaviour of institutional investors are larger than those driven by selling herding behaviour (Nofsinger and Sias, 1999; Wermers, 1999; Chen, Kao, and Liu, 2005). Additionally, in practice, since the total volumes of the securities the investors are intending to sell are limited to being smaller than the total volumes of the securities they would like to buy in the emerging stock market, the impact on price of institutional investors selling the stocks is smaller than the price impact of their buying the stocks. Hence, this study does not discuss the impact of FIIs on selling stocks.

Many studies have examined the price impacts of institutional herding, while their findings are different. Kremer and Nautz (2013) show that institutional buying herding evidently increases cumulative returns over the time horizon. Chiang *et al*. (2013) find that dynamic herding behaviours are positively associated with stock returns. However, several studies propose that the subsequent returns of institutional herding stemming from fads, reputation herding, or characteristic herding go through a significant reversal (Dennis and Weston, 2001; Chakravarty, 2001; Sias, Starks, and Titman, 2002).

Under the theoretical base, if institutional herding is informational, there is a price persistence of institutional herding behaviour (Hung, Lu, and Lee, 2010). Specifically, we examine whether the FII herding behaviour is informational by investigating whether their post-herding returns are positive. The different directions of post-herding returns in past studies denote that some critical variables can be ignored as analysing whether institutional herding is informational. Thus, this study further analyses which types of the stocks herded by FII in buying side are the main determinants of their higher post-herding abnormal returns.

Some studies have found that institutional investors use a return momentum strategy (Nofsinger and Sias, 1999; Grinblatt and Keloharju, 2001; Phansatan *et al*., 2012). Alternatively, many studies have demonstrated the evidence of a return contrarian strategy (De Bondt and Thaler, 1985, 1987; Lo and Mackinlay, 1990; Fama and French, 1996; Demirer, Yuksel and Yuksel, 2017). Demirer *et al.* (2017) illustrate that the subsequent reversal effect of investors buying the stocks with past low returns can be due to flight to quality stocks with low price multiples. However, the return reversal of the stocks with previous lower returns is necessary to further combine with the buying herding force of institutional investors, since the institutional investors can easily herd to buy the stocks with subsequent return increase. That is, we assume that post-herding abnormal returns of FII herding to buy the stocks with lower returns are higher.

Similarly, the variable of firms' unexpected earnings is a shorter persistence but better predictor of future return performance than are past returns (Chan, Jegadeesh, and Lakonishok, 1996). Some studies found the existence of earnings momentum (Bernard and Thomas, 1989; Chan, Jegadeesh, and Lakonishok, 1996). Conversely, there are some evidences of earnings contrarian (Demirer *et al*., 2017; Kho and Kim, 2007). Using the accruals measured by accounting earnings to show the degree of earnings quality, Kho and Kim (2007) find that the stocks for firms with low accruals outperform significantly than those with high accruals. Also, the effect of firms' unexpected earnings on stock price efficiency is associated with the trading force of institutional investors (Beaver, 1989). Hence, the subsequent price increase of the stocks with lower firms' unexpected earnings still need to combine with institutional herding force.

Meanwhile, LSV (1994) indicate that due to agency problem, institutional investors tend to invest in glamour stocks rather than in value stocks with the current poor performance. However, book-to-market ratio can positively influence stock expected returns (Fama and French, 1992; 1993; 1995; 1996; Daniel and Titman, 1997). Furthermore, Zheng, Li and Zhu (2015) empirically show that the price effects of institutional investors who herd on value stocks are stronger. However, they do not consider stock types as transition variables, which easily produce the limitation that subsequent abnormal returns from institutional herding behaviour cannot be estimated for higher and lower regimes of stock types. Therefore, we use the PSTR model to analyse whether the return performance of FII herding to buy the stocks with previously lower returns, lower firms' unexpected earnings, or higher book-to-market ratios is superior, which can avoid the limitation and get more precise estimation.

Next, our final issue is to clarify whether price effects of FII buying herding for the stocks with various types are different in a bull and bear stock markets. Qiao, Chiang and Tan (2014) empirically indicate that herding behaviour of investors is time varying, and some studies propose that institutional investors' herding behaviour may change over time (Bennett, Sias, and Starks, 2003; Sias, 2004). The dynamic periods faced by institutional investors may be exhibited especially in the bull and bear periods of stock markets. The investors have different stock preferences during different market conditions (Kim and Nofsinger, 2007; Yasir, Aamir and Ahmad, 2014). Kim *et al*. (2007) indicate that investors prefer to invest the stocks with lower performance in the bull market, while they prefer to hold riskier stocks in the bear market. Accordingly, we assume that institutional investors herd to buy the stocks with different types during the two periods. This assumption is necessary to further combine with the price impact of institutional herding. Specifically, because the stock-type incentives of FII buying herding might differ during different trading periods, we explore whether value-relevant information of FII buying herding for various stock types is different in bull and bear periods.

In sum, we make the contributions in the following issues. First, we fill the gap in the literature that the price effects of institutional herding can be further integrated with various stock types. Second, general investors can purchase the stock types of buying herding by institutional investors so as to raise abnormal returns of investors' portfolios. The value-relevant information of institutional herding can be separately affected by past returns, earnings, and book-to-market ratio of individual stocks. Third, the panel smooth transition regression (PSTR) model adopted by this study can overcome the limitation that subsequent abnormal returns from institutional herding behaviour cannot be consecutively classified. Also, our smooth transition model can avoid the abrupt changes in estimated parameter of threshold model, which allows the smooth transition of transition variables.

The layout of this paper is as follows. Section 2 reports the methodology, which covers data range, variable definitions, and the model design. Section 3 shows our related results. Section 4 presents the conclusions.

2. Methodology

2.1 Data Range

Because FIIs tend to exhibit long-run trading, we use monthly frequency to measure their herding level. Our raw data include monthly stock returns of listed individual companies, the index returns of stock market, and FII trading details between January 2002 and May 2011. Our sample period ends at May 2011 because European debt crisis became seriously since May 2011. This phenomenon is due to the reason that Greece had difficulties in paying the debt of government bond at that time. Thus, the Central banks in Europe have carried out many measures in the open market and global credit rating institutions have continuously concealed bond rating, which have harmfully affected and even have spread out into financial markets of the emerging countries in subsequent several years.[2] These trading details are switched as stock abnormal returns and a buying herding measure of FIIs. Then, we download monthly returns, earnings, and book-to-market ratios. The data are taken from the Taiwanese Stock Exchange.

2.2 Variable Definitions

1: BHM

This paper uses the $BHM_{i,t}$ to catch the FII herding level that is higher than average ratio of FII buyers for all stocks in a given month *t*. By contrast, we do not measure FII selling herding direction since the herding effect of institutional investors more significantly occur on buy-side herd (Zheng *et al.*, 2015). Hence, the effect of FII selling herding on stock returns is not analysed. As $BHM_{i,t}$ attains the statistical significance, FII trading for stock *i* in month *t* exhibits a pattern of herding to buy over all stocks. The $BHM_{i,t}$ is shown in the following:

$$BHM_{i,t} = HM_{i,t} / p_{i,t} > E\left[p_{i,t}\right] \quad (1)$$

$$HM_{i,t} = \left|p_{i,t} - E\left[p_{i,t}\right]\right| - E\left|p_{i,t} - E\left[p_{i,t}\right]\right| \quad (2)$$

[2] *The persistent effect of European debt crisis can be series since the force of the crisis can be injected the force of previous subprime crisis. Thus, our sample end in May 2011. Meanwhile, the transforming the relevant herding measures is impossible because there were data on trading figures of foreign institutional investors since 2002.*

where: $p_{i,t}$ is the ratio of all FIIs buying stock *i* during month *t*, $p_{i,t} = \frac{B_{i,t}}{B_{i,t} + S_{i,t}}$, and $E\left[p_{i,t}\right]$ is the average proportion of all FIIs who are buyers in all traded stocks during *t* month.[3]

2: Abnormal Returns

Stock abnormal return in given month is computed based on the market model:[4]

$$R_i^a = \left(r_{i,t-s-}r_{f,t-s}\right) - \beta_i\left(r_{m,t-s} - r_{f,t-s}\right), \quad s=0,\ldots,11. \tag{3}$$

3: Definition of Earnings

To catch a firm's unexpected earnings in month frequency, we use 'standardized unexpected earnings' (SUE) addressed by Chan, Jegadeesh, and Lakonishok (1996) and transform quarterly earnings per share to monthly earnings per share.[5] A firm's SUE in a given month was presented as the following:

$$SUE_{it} = \frac{e_{im} - e_{im-12}}{\sigma_{it}}, \tag{4}$$

where: e_{im} and e_{im-12} denotes the monthly earnings per share of stock *i* in month *t*, and the preceding 12 months respectively, and σ_{it} means the standard deviation of the difference between e_{im} and e_{im-12} during the past two years of unexpected earnings.

4: Definition of Book-to-market Ratio

The book-to-market ratio is measured by dividing the net value per share by the closing price of ordinary shares, where the net value per share is the result of dividing the book value of common stock by the number of ordinary shares outstanding. The book-to-market ratio ($BM_{i,t}$) of stock *i* in month *t* is shown in the following:

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[3] $B_{i,t}$ ($S_{i,t}$) is the number of all FIIs who are buyers (sellers) for stock i during month t. An adjusting factor $E\left|p_{i,t} - E\left[p_{i,t}\right]\right|$ is then subtracted to allow for random variation around the expected value of $\left|\frac{B_{i,t}}{B_{i,t} + S_{i,t}} - E\left[p_{i,t}\right]\right|$ under the null hypothesis of no herding by FIIs. Because $B_{i,t}$ follows a binomial distribution with probability $E\left[p_{i,t}\right]$ of success, $E\left|p_{i,t} - E\left[p_{i,t}\right]\right|$ is calculated given $E\left[p_{i,t}\right]$ and the number of FIIs active in that stock over a given month t.

[4] $r_{i,t-s}$ means the monthly return of stock i in month t and previous eleven months; $r_{f,t-s}$ means risk-free rate in month t and previous eleven months, and $r_{m,t-s}$ denotes return of Taiwanese stock market index in month t and previous eleven months.

[5] Because information on changes in earnings forecasts by analysts in Taiwan did not exist prior to 1990 and because the objectivity and maturity of such earnings forecasts come into question when compared with mature markets, this study does not use 'changes in earnings forecasts by analysts' to measure the previous period's expected earnings.

$$BM_{i,t} = \frac{BE_{i,t}/Q_{i,t}}{P_{i,t}}. \tag{5}$$

where: $BE_{i,t}$ means book value of the equity for stock *i* in month *t* and $Q_{i,t}$ ($P_{i,t}$) denotes the corresponding number of shares outstanding (the closing price).

2.3 The Model Design

If FII buying herding is informational, the force of FII herding to buy raises stock prices. Alternatively, if FII buying herding is non-informational, the force reduces stock prices. Meanwhile, many studies that analysed price effect of stock types either demonstrated the evidences of return or earnings contrarian or found price persistence of book-to-market ratio. We can regard returns, earnings and book-to-market ratio as different stock types. To evaluate whether FII buying herding is informational for respective stock type, we first use both pooled and panel models to regresses stock abnormal returns ($R^a_{i,t}$) on FII buying herding ($BHM_{i,t-1}$) and respective returns ($R_{i,t-1}$), earnings ($SUE_{i,t-1}$) book-to-market ratio ($B/M_{i,t-1}$) of stock *i* in past one month respectively. The formula can be shown in the following:

$$R^a{}_{i,t} = u_i + \beta_1 BHM_{i,t-1} + \beta_2 q_{i,t-1} + \varepsilon_{i,t}, \tag{6}$$

where: $q_{i,t-1}$ represents the control variable (i.e., $R_{i,t-1}$, $SUE_{i,t-1}$, or $B/M_{i,t-1}$).

The β_1 shows the degree of the effect of FII buying herding on abnormal returns and the β_2 shows the degree of the impact of return, earnings, or book-to-market ratio on abnormal returns. Furthermore, we use the PSTR model to examine whether and how price effect of FII buying herding is affected by the three stock types of different time series and individual companies, respectively. Taking stock return as one kind of stock type for example, a company may originally be oriented towards a low-return regime but then gradually shifts towards a higher-return regime if the individual company's returns gradually increase. Therefore, this study adopts a generalization of the PSTR model to extend Equation (6) and to regard returns, SUE, and the book-to-market ratio as transition variables, respectively. The process is shown in the following:

$$R^a_{i,t} = u_i + \beta_0{}' x_{i,t} + \sum_{j=1}^{r} \beta_j{}' x_{it} g_j \left(q^j_{it}; \gamma_j, c_j \right) + \varepsilon_{i,t} \tag{7},$$

where: x_{it} are $BHM_{i,t-1}$ and q_{it} (i.e., $R_{i,t-1}$, $SUE_{i,t-1}$, or $B/M_{i,t-1}$). q_{it} denotes transition variables, and $\varepsilon_{i,t}$ means the errors. $g_j\left(q^j_{it}; \gamma_j, c_j\right)$ is a continuous function of

q_{it}, and the function can make the parameter in Equation (6) change smoothly with the change in q_{it} and be defined as the following:[6]

$$g_j\left(q_{it}^j;\gamma_j,c_j\right)=\left(1+\exp\left(-\gamma\prod_{j=1}^{m}\left(q_{it}-c_j\right)\right)\right)^{-1}, \quad (8)$$

A smooth parameter γ determines the slope of the transition function and $\gamma\geq 0$. If m=1 in the transition function (8), a single monotonic smooth transition is allowed. If m=2, only the Euclidean distance between q_{it} and c_j has the effect on $R_{i,t}^a$.[7]

Following the approach of Gonzalez, Terasvirta, and Dijk (2005), we first test linearity against the PSTR model.[8] Testing linearity in the PSTR model (7) can be executed by testing $H_0^1:\beta_j=0$ or $H_0^2:\gamma=0$. However, $\left(\gamma_j,c_j\right)$ are not identified under H_0^1, and $\left(\beta_j,c_j\right)$ are not identified under H_0^2. We follow Luukkonen *et al.* (1988) and test the homogeneity using $H_0:\gamma=0$. To avoid the identification problem, we replace $g_j\left(q_{it}^j;\gamma_j,c_j\right)$ with its first-order Taylor expansion around $\gamma=0$. After replacing $g_j\left(q_{it}^j;\gamma_j,c_j\right)$ in (7) with its Taylor expansion and merging terms, we obtain the following auxiliary regression:

$$R_{i,t}^a=u_i+\beta_0^{'*}x_{i,t}+\beta_1^{'*}x_{i,t}q_{i,t}+\ldots+\beta_m^{'*}x_{i,t}q_{i,t}^m+\varepsilon_{i,t}^*, \quad (9)$$

where: the parameter vectors $\beta_1^*,\ldots,\beta_m^*$ are multiples of γ, and testing $H_0:\gamma=0$ in (10) is the equivalent to testing $H_0^*:\beta_1^*=\ldots=\beta_m^*=0$ in (9). Because this approach only requires the estimation of (9) under the null hypothesis H_0^*, this study uses the LM test to examine the null. Then, the LM test of linearity against the non-linear PSTR model is executed. In addition to the LM and LM_F tests, we compute an LRT statistic to increase the test power.

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[6] Where: $c_j=\left(c_1,\ldots,c_m\right)'$ is an m-dimensional vector of location parameters and $c_1\leq\ldots\leq c_m$ are identification restrictions.

[7] *When m=1 and $\gamma\rightarrow\infty$, (7) and (8) define Hansen's (1999a) two-regime PTR model. When m=2 and $\gamma\rightarrow\infty$, (7) and (8) define a three-regime model, the outer regimes of which are identical but differ from the mid-regime. When m>1 and $\gamma\rightarrow\infty$, there are still two identical regimes, whereas the function (8) switches between zero and one at $c_1,\ldots,c_m$. However, when $\gamma\rightarrow 0$, (8) becomes constant and the model is a standard linear model with fixed effects.*

[8] *The PSTR model is identified only if the data-generating process is non-linear.*

The next step is to test the number of transition functions in the model. The PSTR model is set as $r = r^*$, $H_0 : r = r^*$ against $H_1 : r = r^* + 1$ is examined. If H_0 is rejected, $H_0 : r = r^* + 1$ is examined against $H_1 : r = r^* + 2$. Then, we examine the sequence to find the fitted order m of the transition function in (8) (Granger and Terasvirta, 1993; Terasvirta, 1994). Using the auxiliary regression (9) with m=3, the non-linear PSTR is accepted if $H_0 : \beta_3 = \beta_2 = \beta_1 = 0$ is rejected. To select between m=1 and m=2, we simultaneously test $H_{03} : \beta_3 = 0$, $H_{02} : \beta_2 = 0$ and $H_{01} : \beta_1 = 0$. m=2 is selected if H_{02} is rejected, and m=1 is selected if H_{01} or H_{03} is rejected.

3. Empirical Results

3.1 Findings of the Panel Unit Root and Basic Statistics

To avoid spurious regressions, the variables in the pooled and panel regressions and the PSTR model must be stationary. The LLC (Levin, Lin, and Chu, 2002), IPS (Im, Pesaran, and Shin, 1997) and Hadri (2000) methods are used to proceed with the panel unit root test because this study only considers panel data. Regardless of the stationary test used, all panels ($SUE_{i,t-1}$, $return_{i,t-1}$, $B/M_{i,t-1}$, $BHM_{i,t-1}$ and $R^a_{i,t}$) are stationary, which are fit to use the pooled and panel regressions and the PSTR model.

TSEC-listed stocks in this study included a set of 188 listed firms, and the sample was designed for balanced panels. Table 1 reports the summary statistics of the main variables.

Table 1

Descriptive Statistics

Items	$SUE_{i,t-1}$	$return_{i,t-1}$	$B/M_{i,t-1}$	$BHM_{i,t-1}$	$R^a_{i,t}$
Mean	0.0083	1.5517	1.6614	0.1873	0.0101
Median	0.0318	0.6290	1.3400	0.1421	0.0061
Maximum	14.3534	148.1391	19.0900	0.8721	0.3868
Minimum	−7.7348	−51.3550	0.0000	0.0000	−0.1568
Std. Dev.	1.4582	12.8964	1.2326	0.1892	0.0340
Skewness	0.2466	1.1310	3.5404	1.0110	1.4399
Kurtosis	5.5718	9.7140	26.7813	3.4672	10.3866
Jarque-Bera	6.016E+03***	4.40E+04***	5.40E+05***	3.78E+03***	5.51E+04***

The means of $SUE_{i,t-1}$, $return_{i,t-1}$, $B/M_{i,t-1}$, $BHM_{i,t-1}$, and $R^a_{i,t}$ are 0.008, 1.552, 1.661, 0.187, and 0.010, respectively. The variable $return_{i,t-1}$ has the largest standard deviation, 12.896, whereas $R^a_{i,t}$ has the smallest standard deviation, 0.034. Moreover, the Jarque-Bera test results for all variables are significantly different from zero, indicating that the majority of variables do not conform to the normal distribution.

3.2 Results of the Whole Period

The coefficients and related *t*-values of pooled regression and panel regression in Equation (6) are shown in Table 2.

Table 2

Pooled and Panel Regressions of FIIs' Buying Herding Measure and Control Variables on Subsequent Abnormal Returns

Items	Intercept	The coefficient of BHM (β_1)	The coefficient of control variable (β_2)	Average R^2	Hausman test
Panel A: Pooled regression and panel regression when the control variable is SUE					
Pooled regression	0.0147	0.0194	0.0009	1.15%	5.7708
	(11.8389***)	(4.1095***)	(1.5583)		[0.0558*]
Fixed effects		0.0066	0.0016	78.82%	
		(2.4585**)	(5.0077***)		
Panel B: Pooled regression and panel regression when the control variable is return					
Pooled regression	0.0144	0.0158	0.0004	3.25%	18.5314
	(11.7657***)	(3.3692***)	(6.1031***)		[0.0001***]
fixed effects		0.0048	0.0002	79.17%	
		(1.7645*)	(7.0829***)		
Panel C: Pooled regression and panel regression when the control variable is B/M					
Pooled regression	0.0072	0.0211	0.0057	2.02%	10.8004
	(3.2968***)	(4.5067***)	(4.0808***)		[0.0045**]
Fixed effects		0.0078	0.0157	79.00%	
		(2.9142***)	(6.2168***)		

Note: 1. Numbers in ( ) and [ ] indicate the t-statistics and p-value.
2. ***, ** and * indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively.

Table 2 empirically show that subsequent abnormal returns of returns or book-to-market ratio and those of all FII buying herding are significantly positive. Meanwhile, the coefficient of lagged FII buying herding is greater than the coefficients of lagged SUE and returns. In other words, FII buying herding behaviour is informational regardless of what kinds of control variables. The price effect of FII buying herding is greater than that of stock SUE and returns. The results indicate that general investors may purchase the stocks of FII buying herding to obtain the abnormal returns. Even, the abnormal returns from FII buying herding are larger than those from firms' unexpected earnings and stock returns.

The results of the linearity tests in Tables 3-1, 3-2, and 3-3 provide significant evidence of non-linearity when SUE, returns, and the book-to-market ratio are regarded separately as transition variables. With the exception of the null hypothesis with r=2 (*i.e.,* two transitions with three regimes), which is not rejected when return is regarded as a transition variable, the null hypothesis with r=1 is not rejected when other transition variables are considered.

Table 3-1

Number of Regimes and m Selection Using the Linearity Test against the PSTR with SUE as the Transition Variable in the Entire Sample

Panel A: Number of regimes				
Items	H0: r = 0 vs. H1: at least r = 1		H0: r = 1 vs. H1: at least r = 2	
	Statistic value	p-value	Statistic value	p-value
LM	29.693	0	0.344	0.842
LMF	4.91	0	0.17	0.843
LRT	29.714	0	0.344	0.842
Panel B: The m selection of the PSTR model				
Items	F3	F2	F1	Final model
Statistic value	0.311	0.125	4.455	m=1
p-value	0.921	0.933	0	

This result denotes that our other model has a single transition with two regimes as considering other transition variables.

Table 3-2

Number of Regimes and m Selection Using the Linearity Test against the PSTR with Returns as the Transition Variable in the Entire Sample

Panel A: Number of regimes						
Items	H0: r = 0 vs. H1: at least r = 1		H0: r = 1 vs. H1: at least r = 2		H0: r = 2 vs. H1: at least r =3	
	Statistic value	p-value	Statistic value	p-value	Statistic value	p-value
LM	677.234	0	22.441	0.008	0.787	0.675
LMF	115.549	0	11.129	0.018	0.39	0.677
LRT	688.365	0	22.441	0.008	0.787	0.675

Panel B: The m selection of the PSTR model				
Items	F3	F2	F1	Final model
Statistic value	1.278	27.329	86.241	m=1
p-value	0.264	0	0	

Table 3-3

Number of Regimes and m Selection Using the Linearity Test against the PSTR with B/M as the Transition Variable in the Entire Sample

Panel A: Number of regimes				
Items	H0: r=0 vs. H1: at least r=1		H0: r=1 vs. H1: at least r=2	
	Statistic value	p-value	Statistic value	p-value
LM	417.823	0	4.612	0.1
LMF	70.392	0	2.285	0.102
LRT	422.024	0	4.613	0.1
Panel B: The m selection of the PSTR model				
Items	F3	F2	F1	Final model
Statistic value	0.263	3.504	66.567	m=1
p-value	0.954	0.002	0	

Tables 4-1, 4-2, and 4-3 show parameter estimates of the single- or two-transition models. In detail, FII buying herding and specific control variable affect abnormal returns in the lower regime with a lower transition variable (*i.e.*, $SUE_{i,t-1} < 1.194$, $return_{i,t-1} < -12.209$, or $B/M_{i,t-1} < 5.656$, and $g_1\left(q^1_{it-1}; \gamma_1, c_1\right) \rightarrow 0$), respectively.

Table 4-1

Parameter Estimates of the PSTR Model with SUE as the Transition Variable

Regressor	Coefficient	T-value
$BHM_{i,t-1}$	0.013	8.716
$BHM_{i,t-1}\ g_1\left(SUE^1_{i,t-1}; \gamma_1, c_1\right)$	−0.007	−2.366
$SUE_{i,t-1}$	0.003	11.771
$SUE_{i,t-1}\ g_1\left(SUE^1_{i,t-1}; \gamma_1, c_1\right)$	0.002	6.045
Transition Functions	Coefficient	
γ_j	414460	
c_j	1.194	

Table 4-2

Parameter Estimates of the PSTR Model with Returns as the Transition Variable

Regressor	Coefficient	T-value
$BHM_{i,t-1}$	0.038	5.224
$BHM_{i,t-1}\ g_1\left(\mathrm{Re}turn^1_{i,t-1}; \gamma_1, c_1\right)$	0.059	2.629
$BHM_{i,t-1}\ g_2\left(\mathrm{Re}turn^2_{i,t-1}; \gamma_2, c_2\right)$	−0.038	−4.35
$return_{i,t-1}$	0	−5.108
$return_{i,t-1}\ g_1\left(\mathrm{Re}turn^1_{i,t-1}; \gamma_1, c_1\right)$	0	1.715
$return_{i,t-1}\ g_2\left(\mathrm{Re}turn^2_{i,t-1}; \gamma_2, c_2\right)$	0.001	11.862
Transition Functions		
γ_j	0.079	0.16
c_j	44.652	−12.209

Table 4-3

Parameter Estimates of the PSTR Model with B/M as the Transition Variable

Regressor	Coefficient	T-value
$BHM_{i,t-1}$	0.008	4.02
$BHM_{i,t-1}\, g_1\left(B/M^{1}_{i,t-1};\gamma_1,c_1\right)$	0.058	4.399
$B/M_{i,t-1}$	0.017	28.315
$B/M_{i,t-1}\, g_1\left(B/M^{1}_{i,t-1};\gamma_1,c_1\right)$	−0.013	−19.167
Transition Functions		
γ_j	0.572	
c_j	5.656	

In contrast, FII buying herding and specific control variable affect abnormal returns in the higher regime with a higher transition variable (*i.e.,* $SUE_{i,t-1}>1.194$, $return_{i,t-1}>44.652$, or $B/M_{i,t-1}>5.656$, and $g_1\left(q^{1}_{it-1};\gamma_1,c_1\right)\rightarrow 1$), respectively. The results provide all the parameters of a lagged FIIs buying herding measure, $BHM_{i,t-1}$, and a lagged control variable, $q_{i,t-1}$, as a function of the previous SUE, returns, and book-to-market ratio, respectively. Notably, our findings present that the price effect of FII buying herding is different depending upon the level of transition variable. Our results indicate that whether and how FII buying herding behaviour is informational is affected by the degree of various stock types.

More importantly, when SUE (returns) is regarded as a transition variable, FII buying herding behaviour is informational in the lower regime (lower and middle regimes) and non-informational in the higher regime. Specifically, the positive price effect of FII buying herding centres on the stocks with lower firms' unexpected earnings (lower returns) but their negative price effect centres on the stocks with higher firms' unexpected earnings (higher returns). The former result may be due to market under-reaction to FII buying herding on the stocks with lower firms' unexpected earnings or lower returns, while the latter result may be due to market overreaction to FII buying herding on those with contrary characteristics. By contrast, the positive price impact of SUE (return) focuses on stock with higher firms' unexpected earnings (higher returns). The phenomenon is possible because there are the evidences of return momentum and earnings momentum but there is price persistence for the stocks with lower firms' unexpected earnings or lower returns of FII buying herding. When book-to-market ratio is considered as a transition variable, the positive price effect of FII buying herding is larger in the higher regime, whereas the positive price effect of book-to-market ratio is larger in the lower regime. Specifically, the positive price impact of FII buying herding focuses on value stocks undervalued. This finding may be due to the momentum effect of institutional herding related to long-term price recovery. By contrast, the positive price impact of the book-to-market ratio centres on glamour stocks that are overvalued, which may occur because investors tend to evaluate short-term performance based on the agency problem.

3.3 Results of the Bull and Bear Periods

First, this paper adopts the criterion offered by Fabozzi and Francis (1979), proposing that the stock price index increased for three consecutive months in a bull market and reduced for three consecutive months in a bear market. We use this approach to classify the whole period into bull and bear periods.[9] By using pooled regressions, we first examine whether FII herding is informational regardless of the bull or bear period. The results in Table 5 confirm that FII buying herding is informational regardless of whether a bear or bull period is analysed, even as considering respective control variable.

Table 5

Pooled Regressions of FIIs' Buying Herding Measure and Control Variables on Subsequent Abnormal Returns during Bull and Bear Periods

Panel A1: Pooled regression when the control variable is SUE			
Period	BHM (β_1)	q (β_2)	Average R^2
During the bull period	0.0243	7.3773	10.57%
	(3.0038) ***	(5.7812) ***	
During the bear period	0.0936	−0.0006	24.48%
	(17.1639) ***	(−0.6501)	
Panel A2: Pooled regression when the control variable is returns			
Period	BHM (β_1)	q (β_2)	Average R^2
During the bull period	0.0202	0.0006	12.95%
	(6.0336) ***	(7.6948) ***	
During the bear period	0.0892	0.0004	25.74%
	(16.1948) ***	(3.9831) ***	
Panel A3: Pooled regression when the control variable is B/M			
Period	BHM (β_1)	q (β_2)	Average R^2
During the bull period	0.0202	0.0006	12.95%
	(6.0336) ***	(7.6948) ***	
During the bear period	0.0600	0.0099	28.93%
	(8.7139) ***	(7.5775) ***	

Note: 1. Numbers in parentheses indicate the t-statistics.

2. ***, ** and * indicate statistical significance at the 1, 5, and 10% levels, respectively.Then, this paper separately tests whether the price effects of FII buying herding and specific control variable on stock types are different during bull and bear periods. The PSTR model is still used to test the results during the bull and bear periods, respectively. Our results of linearity tests for the bull and bear periods all show significant existence of nonlinearity for all the transition variables. The results of $return_{i,t-1}$ in the bull and bear periods show m=2, m=1, indicating that the bull model is appropriate with exponential PSTR while the bear model is appropriate with logistic PSTR. Next, the results in Tables 6-1 to 6-3 indicate that FII buying herding and specific control variable affect abnormal

[9] *The criterion should be similar to market changes because it uses the weighted stock index to be constructed.*

returns in the lower regime with lower transition variables (*i.e.*, $SUE_{i,t-1} < -0.703$, $return_{i,t-1} < -4.510$, and $B/M_{i,t-1} < 6.799$ during the bull period and $SUE_{i,t-1} < -3.200$, $return_{i,t-1} < -14.435$, and $B/M_{i,t-1} < 0.260$ during the bear period), and $g\left(q_{it-1};\gamma,c\right) \to 0$, respectively. Conversely, FII buying herding and specific control variable affect abnormal returns in the higher regime with higher transition variables (*i.e.*, $SUE_{i,t-1} > -0.703$, $return_{i,t-1} > 25.475$, and $B/M_{i,t-1} > 6.799$ during the bull period and $SUE_{i,t-1} > -3.200$, $return_{i,t-1} > 31.794$, and $B/M_{i,t-1} > 0.260$ during the bear period), and $g\left(q_{it-1};\gamma,c\right) \to 1$, respectively.

Table 6-1

Parameter Estimates of the PSTR Model with SUE as the Transition Variable during Bull and Bear Periods

Regressor	During the bull period		During the bear period	
	Coefficient	T-value	Coefficient	T-value
$BHM_{i,t-1}$	0.003	4.81	−0.001	−0.48
$BHM_{i,t-1}\, g_1\left(SUE^1_{i,t-1};\gamma_1,c_1\right)$	−0.002	−3.1	0.002	2.02
$SUE_{i,t-1}$	0.014	3.1	0.009	0.61
$SUE_{i,t-1}\, g_1\left(SUE^1_{i,t-1};\gamma_1,c_1\right)$	−0.008	−1.73	0.012	0.79
Transition Functions				
γ_j	250,000.00		11,900.00	
c_j	−0.703		−3.2	

Table 6-2

Parameter Estimates of the PSTR Model with Returns as the Transition Variable during Bull and Bear Periods

Regressor	During the bull period		During the bear period	
	Coefficient	T-value	Coefficient	T-value
$BHM_{i,t-1}$	0.001	4.257	−0.0005	−4.498
$BHM_{i,t-1}\, g_1\left(return^1_{i,t-1};\gamma_1,c_1\right)$	0.0002	3.13	0.001	8.45
$BHM_{i,t-1}\, g_2\left(return^2_{i,t-1};\gamma_2,c_2\right)$	−0.001	−3.569	0.0004	2.265
$BHM_{i,t-1}\, g_3\left(return^3_{i,t-1};\gamma_3,c_3\right)$	−0.001	−2.972		
$return_{i,t-1}$	0.019	2.716	0.048	3.065
$return_{i,t-1}\, g_1\left(return^1_{i,t-1};\gamma_1,c_1\right)$	0.05	6.015	0.003	−1.945
$return_{i,t-1}\, g_2\left(return^2_{i,t-1};\gamma_2,c_2\right)$	0.012	1.972	0.003	0.593

$return_{i,t-1}\, g_3\left(return^3_{i,t-1};\gamma_3,c_3\right)$	−0.032	−3.411		
Transition Functions				
γ_1	1.997		0.235	
γ_2	100		730.443	
γ_3	138.308			
c_1	−4.51		−14.435	
c_2	−2.772		31.794	
c_3	25.475			

Table 6-3

Parameter Estimates of the PSTR Model with B/M as the Transition Variable during Bull and Bear Periods

Regressor	During the bull period		During the bear period	
	Coefficient	T-value	Coefficient	T-value
$BHM_{i,t-1}$	0.02	22.7	−0.071	−3.52
$BHM_{i,t-1}\, g_1\left(B/M^1_{i,t-1};\gamma_1,c_1\right)$	−0.015	−18	0.074	3.85
$B/M_{\,i,t-1}$	0.013	5.77	−0.078	−4.43
$B/M_{\,i,t-1}\; g_1\left(B/M^1_{i,t-1};\gamma_1,c_1\right)$	−0.032	−1.06	0.128	5.79
Transition Functions				
γ_j	0.648		1.69	
c_j	6.799		0.26	

We demonstrate that the price effects of FII buying herding on stock types is different in bull and bear periods since dynamic environments can influence FII incentives to engage in buying herding behaviour for different stock types.

In detail, when SUE and returns are regarded separately as transition variables, the results of the price effect of FII buying herding in the bull period are similar to those in the whole period, whereas the opposite scenario holds for results during the bear period. That is, FII buying herding is informational on lower SUE and lower return stocks (higher SUE and higher return stocks) during the bull (bear) period. The results may be due to the possibility that investors' optimistic sentiments (cautious attitudes) easily lead to momentum persistence to abnormal returns from FII buying herding on past lower firms' unexpected earnings and lower return stocks (past higher firms' unexpected earnings and higher return stocks) during periods with greater optimistic (pessimistic) investor sentiment. When book-to-market ratio is considered as a transition variable, our results for the price effect of FII buying herding in the bear period are similar to those in the whole period, whereas the opposite scenario is the case for those during the bull period. That is, the positive price effects of FII buying herding centre on glamour stocks (value stocks) during the bull (bear) period. This phenomenon may be the result that high market liquidity (low market liquidity) promotes market under-reaction for FII buying herding on overvalued glamour stocks (undervalued value stocks) in periods with higher (lower) market liquidity.

4. Conclusion

By using a buying herding measure and PSTR model, this study explores which types of the stocks of FII buying herding are informational in emerging stock markets such like Taiwanese market. Our results confirm that FII buying herding is informational determined by their buying herding of what kinds of stock types. The value-relevant information of FII buying herding centres on the stocks with lower SUE and lower returns, and is also centred on the stocks with higher book-to-market ratio. The findings indicate that the price persistence of institutional buying herding focuses on the stocks with lower firms' unexpected earnings, lower returns or value stocks undervalued.

By dividing the whole sample period into bull and bear periods, we demonstrate that FII buying herding is most informational after adding respective stock types as control variables for both the bear and bull periods. However, the price effects of FII buying herding on stock types are different in bull and bear periods. In detail, the value-relevant information of FII buying herding behaviour stems primarily from lower SUE and lower return stocks and glamour stocks during the bull period but from higher SUE and higher return stocks and value stocks in the bear period. The results denote that the momentum persistence from FII buying herding on past lower firms' unexpected earnings and lower return stocks (past higher firms' unexpected earnings and higher return stocks) is easily accelerated (cautiously maintained) during periods with greater optimistic (pessimistic) investor sentiment. Also, the price persistence of FII buying herding on overvalued glamour stocks is raised in periods with higher market liquidity, while that on undervalued value stocks is raised in periods with lower market liquidity.

Investors may follow FII to purchase the stock types of FII buying herding to improve the performance of their portfolios in emerging markets such as Taiwanese market. Moreover, the price persistence of institutional herding can be determined by past stock types on firms' unexpected earnings, returns and book-to-market ratio respectively. Using the nonlinear and continual PSTR model, this paper can overcome the inefficiency and unsuitability of calculating price impacts by discretely dividing institutional herding. This study also fills the gap in the literature on whether institutional herding behaviour is informational and integrates these results with a series of studies on stock types.

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