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Anchoring effect on foreign institutional investors' momentum trading behavior: Evidence from the Taiwan stock market☆

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ABSTRACT

On Taiwan's stock market, foreign institutional investors hold over one-third of the total market value and have enjoyed remarkable returns on their investments. Hence, it is important to investigate the trading behavior of foreign institutional investors. Previous studies have found that foreign institutional investors are momentum traders. This study documents a cognitive bias – anchoring effect – on foreign institutional investors' trading decisions. Moreover, we document that foreign institutional investors' momentum behavior is influenced (anchored) by prior foreign ownership (anchor). We also show that foreign investors' momentum behavior is strengthened when prior foreign ownership is high. However, the anchoring effect cannot improve momentum profitability. In some cases, momentum profitability suffers because of the anchoring effect.

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1. Introduction

In financial literature, institutional investors are generally deemed to be informed traders. Hence, the behavior of institutional investors has attracted much interest from researchers; their decisions have become important indicators for retail investors in practice. Therefore, institutional trading has become a significant research issue over the past few decades. This issue is more noticeable in Taiwan's equity market since the proportion of trading by institutional investors (including foreign and local investors) in total trading volumes increased three fold between 1994 (10.2%) and 2011 (37.3%).

This paper investigates the trading behavior of foreign institutional investors in Taiwan. There are two reasons why the analysis is focused on foreign institutional investors. First, among all types of institutional investors, trading volumes for foreign institutional investors have dominated local institutional investors. More specifically, as at the end of 2011, foreign institutional investors held about one-third, by market value, of the listed equities in Taiwan, whereas local institutional investors held only about 2% of the market value. This implies that foreign institutional investors' trading behavior may have a larger impact on the stock market than the behavior of others. Second, as well as dominance in terms of trading volumes, foreign institutional investors' profits have also been remarkable. Barber, Lee, Liu, and Odean (2009) found that nearly half of the individual investors in Taiwan's stock market had suffered losses from trading, and a huge sum (about 2.2% of Taiwan's GDP), has been garnered by foreign institutional investors.[1] Therefore, it is important to look further into the trading behavior of foreign institutional investors in Taiwan.

A large number of research studies have investigated the behavior of institutional investors. Related literature can easily fall into two groups. Some researchers have examined the holdings of foreign investors in the local market (e.g. Białkowski & Otten, 2011; Dahlquist & Robertsson, 2001; Ferreira & Matos, 2008; Kang & Stulz, 1997; Lin & Swanson, 2003). These papers aimed to identify the characteristics of the stock holdings of foreign institutional investors. In general, their firm-level findings indicate that foreign institutional investors prefer to invest in stocks with high turnover rates and larger firm size. This disproportional holding of stocks reveals that global investors have particular preferences in terms of stock selection when forming their foreign asset combinations (Lin & Shiu, 2003).

The other group of researchers is interested in investigating the dynamic trading pattern of institutional investors, especially how they incorporate past stock returns into their trading strategies (Badrinath & Wahal, 2002; Griffin, Harris, & Topaloglu, 2003; Grinblatt, Titman, & Wermers, 1995; Ng & Wu, 2007). More specifically, these papers try to examine whether institutional investors are momentum traders or not. Most researchers have found that institutional investors are momentum traders (also referred to as positive feedback traders and trend followers), although the conclusions are still mixed. With respect to the related issue of foreign institutional investors, Grinblatt and Keloharju (2001) indicated that foreign investors tended to be momentum traders in the Finnish stock market.

Our study follows the later stream of literature in order to examine the trading behavior of foreign institutional investors in the Taiwan stock market. Specifically, this paper contributes to the literature by examining whether the behavior of foreign institutional investors is influenced by their ownership, a form of anchoring effect. From the viewpoint of traditional financial theory, investors act rationally and consider all available information in their decision-making process. Accordingly, this implies that investors should act consistently on receipt of similar information. However, considerable evidence indicates that human psychology leads investors to irrational behavior and causes market anomalies (e.g. Kahneman & Tversky, 1979; Maymin, 2012; Shleifer, 2000). Therefore, this paper uses a cognitive bias – 'anchoring effect' – to investigate whether foreign institutional investors act irrationally when they trade stocks that have similar attributes.

This question is raised because of the debate, in prior researches, over investors' investment behavior. For example, De Bondt (1993) suggested that investors expect a recent trend to continue and tend to

[1] The research covered the period from 1995 to 1999. During this period, the trading values of foreign institutional investors were only about 2% of all trades. To date, it is reasonable that foreign institutional investors have gained much more because their impact has increased in recent years.

make decisions that follow the trend. Andreassen (1988) showed that investors tend to sell stocks when the price is high and vice versa. In fact, this debate may be due to the differences between the participants' background and experimental designs. This study, however, uses a real world dataset to analyze the behavioral bias of participants (foreign institutional investors) who have similar backgrounds, within one stock market, the Taiwanese stock market.

Besides the potential contribution to literatures mentioned above, this paper tends to bridge our empirical findings and policy implications. In order to encourage foreign institutional investors to invest in the Taiwan stock market, the Taiwanese government revoked the qualified foreign institutional investors (QFII) system in October, 2003. The government also expects that foreign institutional investors will hold more than 50% of the market value in 2020. Therefore, by analyzing the behavior of foreign institutional investors, this study will attempt to discover some policy implications that will benefit market regulators and policy makers.

The rest of this paper is organized as follows. Section 2 reviews the previous literature related to the anchoring effect on financial markets. Section 3 briefly introduces the research hypothesis and describes the data in detail. Section 4 provides an empirical analysis, and Section 5 concludes the study.

2. Anchoring effect and financial markets

The anchoring effect (or bias) was first introduced by Tversky and Kahneman (1974) and is described as the heuristics implemented when making judgments under uncertainty. They found that cognitive bias occurs when participants make their estimates by starting from an easily available reference value. Moreover, different initial values (or starting points) can yield different estimates that may be biased toward the initial values, even though the initial values may have been obtained in an irrelevant, irrational or questionable manner.

The anchoring effect has attracted much attention and has been applied in several research works. However, few research studies have taken a look at the anchoring effect in the financial markets. Fisher and Statman (2000) used forecasts based on P/E ratios and dividend yields to discuss the anchoring bias in market forecasts. They illustrated that mean historical P/E ratios and dividend yields serve as the anchors for forecasting future P/E ratios and dividend yields, although their relevance is exaggerated. Mussweiler and Schneller (2003) examined how charts influence the decision to buy or sell stocks and showed that charts with a salient high or a clear low can significantly affect individual investment decisions, whether participants are professionals or not, and whether the background information is limited or abundant.

George and Hwang (2004) investigated the relationship between the 52-week high price and profitability of the momentum investing strategy. Their findings indicated that the closeness of the current price to an anchor (the 52-week high price) can successfully explain price dynamics. They also suggested that the anchoring effect may be more powerful than existing theories based on overconfidence, conservatism or the slow diffusion of information. Törngren and Montgomery (2004) examined the differences between performance and the confidence of professionals and lay people in the stock market. They concluded that lay persons are usually influenced by the historical price movements of stocks, implying that past movements serve as anchors for their expectations.

More recently, Kaustia, Alho, and Puttonen (2008) explored the effect of anchoring bias on long-term stock return expectations. Based on their experiments, they concluded that, whether participants are students or professionals, their estimates are affected by an initial value. Campbell and Sharpe (2009) examined the systemic biases in expert consensus forecasts of monthly economic releases and attributed these biases to the anchoring effect, implying that current consensus forecasts are biased toward an anchor, the values in previous releases. According to their work, the anchoring bias is noteworthy across all key economic releases.

Park (2010) echoed George and Hwang (2004) when he examined the predictive power of a moving average ratio for future returns. It was shown that the ratio of a short-term moving average to a long-term moving average can explain most of the intermediate-term momentum. This paper suggests that investors regard moving average prices as their reference points, even though the fundamental price follows a random walk process. In addition, Cen, Hilary, and Wei (2013) explore the role of anchoring

bias in analysts' earnings forecasts. It was found that the forecast median industry EPS serves as an anchor, showing that analysts' earnings forecasts for firms with a low forecast EPS vis-à-vis the industry median are more optimistic than firms with a high forecast EPS.

In summary, to the best of our knowledge, this paper is the first to examine the role of the anchoring effect in the trading behavior of foreign institutional investors. Based on the time-series anchor used in Campbell and Sharpe (2009), this study suggests that the levels of foreign ownership can serve as anchors that influence foreign institutional investors' trading behavior. Hence, this study demonstrates why, and develops hypotheses in the following section.

3. Methodology and data

3.1. Hypotheses

This paper examines whether the anchor (previous ownership) affects foreign institutional investors' momentum trading behavior. More specifically, this paper investigates how previous ownership moderates the relationship between past stock returns and foreign institutional investors' trading behavior. Accordingly, we establish three hypotheses to examine our research questions and illustrate these hypotheses, as follows.

Hypothesis 1 (H1) examines the relationship between past stock returns and foreign institutional investors' trading behavior. First, it is assumed that foreign institutional investors buy a specific stock in order to gain its positive future returns. This assumption also implies that foreign institutional investors' trading is not based on improving the variance-covariance matrix of their portfolio. It is noted that this assumption may not hold but it is not possible to acquire information about each foreign institutional investor's portfolio. Therefore, this paper suggests that the decisions of foreign institutional investors' trading strategy depend on their attitudes toward the future movement of stock prices.

In fact, existing evidence shows that investors' trading decisions may be influenced by the past returns of a specific stock (Ng & Wu, 2007), which means that under the uncertainty of price movement, investors gather information about past stock returns to enhance their belief that past stock returns can predict future movement. Griffin, Nardari, and Stulz (2007) suggested that for investors who do not have access to private information, past returns may contain signals regarding expected returns. In addition, a large number of empirical studies have found momentum trading by institutional investors in developed (Badrinath & Wahal, 2002; Griffin et al., 2003; Grinblatt et al., 1995) and developing markets (Ng & Wu, 2007). As a result, the first hypothesis is:

H1. Foreign institutional investors behave as momentum traders, meaning that their trading behavior is positively associated with past stock returns.

It is also interesting to investigate the determinants of foreign institutional investors' momentum trading behavior (Badrinath & Wahal, 2002; and Svedsater, Karlsson, & Garling, 2009). From a behavioral finance viewpoint, Hypothesis 2 (H2) is proposed, i.e. prior foreign ownership may affect foreign investors' momentum behavior. In order to develop this hypothesis, this study first illustrates why foreign ownership matters and then describes the expectation that foreign investors' momentum behavior is anchored by prior foreign ownership.

Regarding the literature on home bias, foreign investors are willing to invest in stocks that have rich information in order to reduce the information asymmetry problem in the local market (Dahlquist & Robertsson, 2001; Kang & Stulz, 1997). Kalev, Nguyen, and Oh (2008) claimed that the asymmetric information problem plays a bigger role in emerging markets than in developed markets because of the barriers of distance, regulation, language and culture. Therefore, it is assumed that firms with high foreign ownership issue more information than those with low foreign ownership in Taiwan. Moreover, Bushee and Goodman (2007) claimed that foreign ownership can be deemed as a proxy, which presents ownership information about a specific stock. Hence, it is reasonable that foreign investors' trading behavior would be affected (or anchored) by prior foreign ownership. For instance, with regard to the liquidity problem, foreign institutional investors favor firms with high turnover rates when their ownership is very high.

How does prior foreign ownership affect foreign investors' momentum behavior? Gervais and Odean (2001) argued that overconfidence increases when investors have experienced success in the market in the past, implying that investors will be extremely overconfident if they have gained good profits. Griffin et al. (2007) considered that overconfidence is a major driving force behind investors' trading activities. They suggested that trading volume grows following past successes that have built investors' confidence. Sequentially, O'Connell and Teo (2009) also found that institutional investors would aggressively reduce risk following losses and moderately increase risk following gains. The above-mentioned findings imply that the higher the prior ownership and past stock returns, the more institutional investors would like to buy in the following period because it is possible to measure past performance by multiplying prior ownership by past stock returns, Thus, it is logical that momentum behavior is intensified when prior ownership is higher and ceteris paribus Therefore, this study suggests that prior foreign ownership may moderate the relationship between past stock returns and foreign investors' trading behavior. It will also examine whether foreign institutional investors are overconfident in some instances. Hence our second hypothesis is:

H2. Foreign institutional investors' momentum trading will increase if their prior ownership is higher.

Hypothesis 3 (H3) is similar to H1. However, H3 aims to examine the relationship between past stock returns and sequential stock returns in the Taiwan stock market. Specifically, H3 aims to detect whether there is a price momentum effect in the Taiwan stock market. This hypothesis is proposed to investigate the profitability of foreign investors' momentum trading behavior. In other words, it seeks to confirm whether foreign investors' momentum behavior is profitable if there is a price momentum effect in the market. This momentum effect is well-documented in finance literature (e.g. Jegadeesh & Titman, 1993, 2001). Therefore, the study proposes the third hypothesis:

H3. The price momentum effect is significant in the Taiwan stock market.

We are also interested in whether prior foreign ownership can influence momentum profitability. It is noted that, besides H3, we attempt to test whether the anchoring effect on foreign investors' momentum behavior (H2) yielded profit. Existing literature has listed factors that can influence momentum profitability. For example, Chordia and Shivakumar (2002), Sagi and Seasholes (2007) and Liu and Zhang (2008) showed that macroeconomic variables and firm characteristics are the sources of momentum profit. From a viewpoint of behavioral finance, in addition, momentum profitability considers whether investors underreact to new information and that this then results in inefficient prices. However, Boehmer and Kelley (2009) considered that institutional ownership can improve the quality and efficiency of the pricing process and further mitigate stock return anomalies in the U.S. market. Accordingly, it is expected that higher institutional ownership cannot increase momentum profitability. In some cases, momentum profitability may even reduce profits as a higher institutional ownership mitigates anomalies in the stock market.

To sum up, H1 and H3 examine foreign investors' momentum behavior and price momentum effect, respectively. These two hypotheses are expected to hold given the widely reported evidence in the literature. This paper contributes to the literature as it links together the anchoring effect and momentum behavior, as well as the price momentum effect (i.e. H2). It is expected that deeper insights can then be obtained regarding the role of foreign ownership in investment decisions.

3.2. Estimation models

Regression models were used to test the above mentioned hypotheses. Following Bushee and Goodman (2007), the change in foreign ownership for stock i from $t-1$ to t is denoted as $\Delta Ownership_{i,t-1:t}$. With respect to Hypothesis 1, the changes in foreign ownership are regressed on past stock returns, prior ownership and other firm characteristics:

$$\Delta Ownership_{i,t-1:t} = \beta_0 + \beta_1 R_{i,t-1-k:t-1} + \beta_2 Ownership_{i,t-1} + \sum_{j=1}^{J} \gamma_j X_{ij,t-1} + \varepsilon_{i,t}, \quad (1)$$

where $R_{i,t-1\text{-}k:t-1}$ defines the return for stock i from $t-1-k$ to $t-1$ and $Ownership_{i,t-1}$ is the level of foreign ownership in stock i at time $t-1$ and $X_{ij,t-1}$ indicates other J control variables (i.e. the firm's

other characteristics).[2] It is noteworthy that past returns and lagged firm characteristics are used in order to ensure that this information was known to foreign institutional investors at $t-1$, prior to them deciding whether to buy this stock from $t-1$ to t. Additionally, this setting tries to prevent the potential endogeneity problem.

Hypothesis 1 can be tested by examining whether coefficient β_1 of Eq. (1) is significantly different from zero. More specifically, if β_1 is significantly positive, it implies that foreign institutional investors tend to adopt a momentum trading strategy. Next, a cross-product term was further introduced into Eq. (1) to allow for the existence of an anchoring effect:

$$\Delta Ownership_{i,t-1:t} = \beta_0 + \beta_1 R_{i,t-1-k:t-1} + \beta_2 Ownership_{i,t-1} + \beta_3 R_{i,t-1-k:t-1} \times Ownership_{i,t-1} + \sum_{j=1}^{J} \gamma_j X_{ij,t-1} + \varepsilon_{i,t}. \quad (2)$$

The cross-product term of Eq. (2) is used to analyze whether prior ownership can moderate foreign institutional investors' momentum behavior. Based on a partial differentiation of past returns, it is possible to derive the relationship between past returns and trading behavior, that is

$$\frac{\partial \Delta Ownership_{i,t-1:t}}{\partial R_{i,t-1-k:t-1}} = \beta_1 + \beta_3 Ownership_{i,t-1}. \quad (3)$$

Thus, regarding Hypotheses 1 and 2, it is expected that both coefficients β_1 and β_3 will be significantly positive.

Next, a second set of regressions was run to examine the profitability of the momentum strategy and its relationship with the anchoring effect. Rather than the change in foreign ownership, the regressions use future stock return as a dependent variable, i.e.

$$R_{i,t-1:t+s} = \theta_0 + \theta_1 R_{i,t-1-k:t-1} + \theta_2 Ownership_{i,t-1} + \sum_{j=1}^{J} \lambda_j X_{ij,t-1} + \nu_{i,t} \quad (4)$$

and

$$R_{i,t-1:t+s} = \theta_0 + \theta_1 R_{i,t-1-k:t-1} + \theta_2 Ownership_{i,t-1} + \theta_3 R_{i,t-1-k:t-1} \times Ownership_{i,t-1} + \sum_{j=1}^{J} \lambda_j X_{ij,t-1} + \nu_{i,t}. \quad (5)$$

where $R_{i,t-1:t+s}$ denotes the sequential return for stock i from $t-1$ to $t+s$, and s is equal to zero or one. When s equals zero (one), it means one-quarter (two-quarter) returns after time $t-1$. A positive θ_1 indicates that there exist persistent variations in the stock price and that a momentum trading strategy will generate positive profits. The coefficient θ_3 is used to capture the relationship between the profitability of the momentum strategy and the anchoring behavior of investors. A positive θ_3 implies that the profit of the momentum trading can be further enhanced by the anchoring behavior. Given that there is panel data, it is noted that all regression models herein are estimated by fixed-effect regressions, including year and quarter dummies.

3.3. Data

This paper investigated all the firms listed on the Taiwan Stock Exchange during the period 2003:Q1–2009:Q4, obtained from the Taiwan Economic Journal (TEJ) database. This database provides rich information on the firms' characteristics, including the financial ratios and stock prices used in this study. The main research variable – foreign ownership – was also obtained from the TEJ. Firms

[2] According to Jegadeesh and Titman (1993), k was allowed to take on the values of one, two, three and four, which correspond to cumulative one-quarter, two-quarter, three-quarter and four-quarter lagged returns, respectively. Furthermore, the possible effect of different prior-period return horizons on foreign investors' behavior can be observed by varying k.

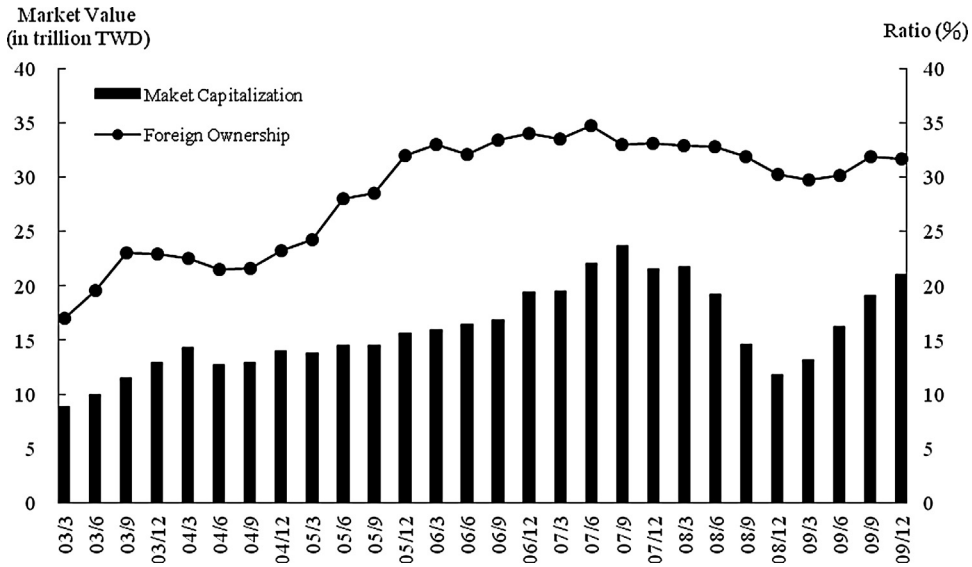

Fig. 1. Foreign ownership and market capitalization between 2003 and 2009.

listed less than one year ago and outliers from the study's dataset[3] were excluded. Thus, an unbalanced panel data was collected with a total of 19,296 firm-quarters.

Previous literature has normally measured the foreign ownership of a firm by calculating the ratio of value of shares held by foreign investors to a firm's total capitalization.[4] Hence, foreign ownership of the whole market is measured by the ratio of total investment value to market capitalization. Fig. 1 depicts foreign ownership and market capitalization in the Taiwan stock market during the recent period. Foreign ownership shows a clearly upward trend, in line with the increase in market capitalization. It was only during the global financial crisis in late 2007 that foreign ownership and market capitalization declined significantly. Moreover, the proportion of foreign ownership gradually increased between 2003 (17.07%) and 2009 (31.66%), indicating that the Taiwan stock market has attracted an increasing number of foreign investors.

To select control variables, this paper followed extant literature, such as Dahlquist and Robertsson (2001), Lin and Shiu (2003) and Ferreira and Matos (2008), to choose several commonly-used firm characteristics. The definitions of these variables are as follows:

1. *Turnover*: defined as the ratio of total traded value of stocks over three months to market capitalization of the firm. This variable measures the liquidity of a firm in the stock market.
2. *Beta*: estimated by the market model with daily returns over the last three months. It measures the systemic risk of a firm.
3. *Size*: defined as market capitalization (in logarithm) of the firm at the quarter-end.
4. *Return on equity (ROE)*: computed by the ratio of net income to book value of equity at quarter-end.
5. *Debt ratio (Debt)*: measured as total liabilities divided by total assets at the quarter-end.
6. *Price-to-book ratio (P/B ratio)*: calculated as the ratio of stock price to book value. It should be noted that lower P/B ratios might mean the stock is undervalued; such firms are referred to as value firms.

[3] This paper excludes several observations if their characteristic variable values deviate excessively from the mean or if foreign investors never invested in those stocks during the relevant period. Accordingly, 72 observations were deleted (around 0.4% of the sample data) and this screening did not change the conclusions qualitatively.

[4] Foreign ownership of stock i at time t is illustrated as $C_{it}FS_{it}/C_{it}S_{it}$, where C_{it} is the closing price, and FS_{it} is shares held by foreign investors and S_{it} is total outstanding shares of stock i at time t.

Table 1
Descriptive statistics for dependent and independent variables This table reports mean, standard deviation, minimum and maximum of variables for the sample of listed firms in the Taiwan stock market. All variables are as defined in Section 3.3. The sample period is from 2003Q1 to 2009Q4. It is noted that *Size* is the log of market capitalization of a firm.

Variable	Mean	S.D.	Minimum	Maximum
Foreign ownership (%)	9.798	13.416	0.000	81.350
Return (%)	5.156	27.104	−83.374	388.711
Turnover (%)	55.165	59.445	0.002	584.463
Beta	0.867	0.484	−6.160	16.520
Size	8.561	1.541	2.833	14.443
ROE (%)	0.999	10.317	−411.610	131.420
Debt (%)	42.651	21.739	0.450	417.660
P/B ratio (%)	1.522	1.433	0.090	68.430
Dividend (%)	3.822	3.566	0.000	46.510

7. *Dividend yield (Dividend)*: defined as the value of all dividends as a percentage of the stock price of the firm.

Table 1 lists the descriptive statistics for all the variables used. The average foreign ownership is about 9.80% with a standard deviation of 13.42%, showing a clear variation in foreign investors' preferences. It is noted that the proportion of non-investment observations (i.e. foreign ownerships equal to zero) are around 3% of the sample data. Table 2 shows the correlation matrix of foreign ownership and firm characteristics. Both stock returns and return on equity (ROE) are positively correlated with foreign ownership, meaning that foreign institutional investors prefer firms with better market-based and accounting-based performances. Firm size has a high and positive relationship to foreign ownership. This is consistent with prior literature (e.g. Dahlquist & Robertsson, 2001; Lin & Shiu, 2003), that foreign institutional investors like to invest in larger firms.

Table 2 also presents a positive relationship between foreign ownership and price-to-book ratio, which indicates that foreign institutional investors prefer to invest in high value firms. Moreover, debt ratio is negatively associated with foreign ownership, which echoes the findings of Dahlquist and Robertsson (2001). However, the results for signs of the correlation between foreign ownership and turnover rate are the opposite to existing research reports. Additionally, the positive relationship between foreign ownership and dividend yield is contrary to the findings of Lin and Shiu (2003). However, these pair-wise correlations can only provide tentative measures of the relationships since a more complete result can only be shown by a multivariate analysis.

4. Empirical results

This empirical study consists of two parts: first, the changes in foreign investors' stock ownership were examined to see whether an anchoring effect exists and how it influences their trading behavior. Specifically, Hypotheses 1 and 2 were tested by examining the factors affecting the stock holdings of foreign institutions. The empirical results were further supplemented by dividing the sample periods into two sub-period samples, i.e. bull and bear markets. Furthermore, the consequences of the anchoring effect were examined to see how they affected the profitability of the momentum strategy. These are related to the testing of hypothesis H3.

4.1. Foreign investors' trading behavior and the anchoring effect

Table 3 lists the estimation results of foreign investors' trading behavior based on Eqs. (1) and (2). Past returns are measured in different ways according to the investment horizons when measuring past stock returns. Some literatures have emphasized that the momentum trading strategy may be different over different return horizons. This consideration has been incorporated by allowing the model in this study to include past returns over a wide spectrum, starting from 3 months to 12 months.

Table 2
The correlation matrix for all variables This table reports pairwise correlation coefficients among all used variables. The variables include foreign ownership of a firm (*Foreign ownership*), stock returns (*Return*), stock turnover rate (*Turnover*), market model's beta coefficient (*Beta*), log firm size (*Size*), return on equity (*ROE*), debt ratio (*Debt*), price-to-book ratio (*P/B ratio*), and dividend yield (*Dividend*). The sample period is from 2003Q1 to 2009Q4.

Variables	Foreign ownership	Return	Turnover	Beta	Size	ROE	Debt	P/B ratio	Dividend
Foreign ownership	1.000								
Return	0.015*	1.000							
Turnover	−0.080***	0.298***	1.000						
Beta	0.069***	0.058***	0.298***	1.000					
Size	0.548***	0.085***	0.117***	0.261***	1.000				
ROE	0.114***	0.087***	0.086***	0.056***	0.246***	1.000			
Debt	−0.064***	−0.047***	−0.101***	−0.027***	−0.071***	−0.227***	1.000		
P/B ratio	0.275***	0.163***	0.165***	0.017	0.306***	−0.014	−0.043***	1.000	
Dividend	0.123***	−0.153***	−0.092***	−0.051***	0.208***	0.242***	−0.196***	0.057***	1.000

* Coefficients are significant at 10% level.
*** Coefficients are significant at 1% level.

Table 3

Estimation of foreign investors' trading behavior. This table reports estimates of fixed-effect regressions through regressing the change of foreign ownership on past stock returns, prior ownership and control variables. The dependent variable is the quarterly change of foreign ownership of a certain stock i and is denoted as $\Delta Ownership_{i,t-1:t}$. The main regressors include the past 3, 6, 9 and 12 months stock returns before $t-1$ ($Return_{i,t-1-k:t-1}$; $k = 1, 2, 3, 4$) and the cross-term, that is, prior ownership multiplied by past return ($Ownership_{i,t-1} \times Return_{i,t-1-k:t-1}$; $k = 1, 2, 3, 4$). All control variables are lagged for one quarter and include a log of firm size ($Size_{i,t-1}$), market model's beta coefficient ($Beta_{i,t-1}$), stock turnover rate ($Turnover_{i,t-1}$), return on equity ($ROE_{i,t-1}$), debt ratio ($Debt_{i,t-1}$), price-to-book ratio ($P/B\ ratio_{i,t-1}$) and dividend yield ($Dividend_{i,t-1}$). The sample period is from 2003Q1 to 2009Q4. The robust standard errors are reported in parentheses. It is noted that the coefficients of cross-terms are multiplied by 10^3 and the coefficients of intercept, year and quarter dummies are omitted for brevity.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
$Ownership_{i,t-1}$	−0.137*** (0.009)	−0.141*** (0.010)	−0.140*** (0.010)	−0.144*** (0.011)	−0.139*** (0.009)	−0.144*** (0.010)	−0.143*** (0.010)	−0.146*** (0.012)
$Return_{i,t-2:t-1}$	0.007*** (0.002)				0.003 (0.002)			
$Return_{i,t-3:t-1}$		0.008*** (0.003)				0.006* (0.004)		
$Return_{i,t-4:t-1}$			0.004*** (0.001)				0.003 (0.002)	
$Return_{i,t-5:t-1}$				0.002** (0.001)				0.002 (0.001)
$Ownership_{i,t-1} \times Return_{i,t-1-k:t-1}$					0.621*** (0.140)	0.276* (0.146)	0.163* (0.089)	0.098 (0.065)
Control variables								
$Size_{i,t-1}$	0.413*** (0.122)	0.331*** (0.097)	0.357*** (0.122)	0.422*** (0.127)	0.404*** (0.116)	0.331*** (0.094)	0.371*** (0.123)	0.432*** (0.128)
$Beta_{i,t-1}$	−0.021 (0.059)	−0.023 (0.071)	−0.029 (0.073)	−0.016 (0.074)	−0.031 (0.060)	−0.038 (0.075)	−0.040 (0.077)	−0.025 (0.076)
$Turnover_{i,t-1}$	−0.003*** (0.001)	−0.004*** (0.001)	−0.003*** (0.001)	−0.003*** (0.001)	−0.003*** (0.001)	−0.004*** (0.001)	−0.003*** (0.001)	−0.003*** (0.001)
$ROE_{i,t-1}$	−0.020 (0.019)	−0.020 (0.018)	−0.022 (0.020)	−0.023 (0.021)	−0.020 (0.020)	−0.021 (0.018)	−0.022 (0.020)	−0.023 (0.021)
$Debt_{i,t-1}$	−0.009** (0.004)	−0.009** (0.004)	−0.011*** (0.004)	−0.013*** (0.004)	−0.009** (0.004)	−0.009** (0.004)	−0.011*** (0.004)	−0.013*** (0.004)
$P/B\ ratio_{i,t-1}$	0.107* (0.063)	0.069 (0.049)	0.053 (0.046)	0.049 (0.043)	0.099* (0.059)	0.054 (0.042)	0.033 (0.037)	0.033 (0.037)
$Dividend_{i,t-1}$	−0.009 (0.010)	−0.002 (0.013)	−0.012 (0.011)	−0.019* (0.011)	−0.005 (0.010)	0.001 (0.013)	−0.010 (0.010)	−0.018 (0.011)
n	18,072	17,272	16,469	15,673	18,072	17,272	16,469	15,673
R^2	0.038	0.043	0.036	0.034	0.042	0.044	0.037	0.034

* Coefficients are significant at 10% level.

** Coefficients are significant at 5% level.

*** Coefficients are significant at 1% level.

Specifically, models 1, 2, 3 and 4 measure past returns by calculating the return over the past 1st, 2nd, 3rd and 4th quarters, respectively.[5]

All the results for models 1 to 4 are quite similar. Past returns present a significantly positive coefficient in these models, indicating that the better a stock's past performance, the more shares foreign investors will buy. For instance, the result in model 1 shows that foreign ownership in a stock will increase by 0.007% when the price is increased by 1% over the past quarter. This finding also reveals that foreign investors intend to invest in stocks with higher past returns, i.e., they adopt a momentum trading strategy. Thus, hypothesis 1 is confirmed, indicating that foreign investors are momentum traders in the Taiwan stock market.

With respect to control variables, prior foreign ownership presents a negative association with changes in ownership, implying that foreign investors' trading is mean-reverting. Foreign investors prefer to increase their ownership in firms of a large size and with a low debt ratio. This evidence is consistent with previous findings, such as Dahlquist and Robertsson (2001), which considered that large firms provide rich information publicly and there is less information asymmetry. However, this study found that foreign investors reduce their ownership in a stock if the stock turnover rate is high. This seems incompatible with Dahlquist and Robertsson (2001). One possible explanation is that, in Taiwan, the Taiwan Stock Exchange (TSE) monitors the share turnover rate in the equity market. When the turnover rate of a stock is higher than some benchmark levels, the TSE puts that stock on a warning list. Moreover, the findings of this study are in line with related studies of the Taiwan stock market, e.g. Lin and Swanson (2003).

Models 5–8 (Table 3) add a cross-term (past returns multiply prior to ownership) into the regression model in order to examine Hypothesis 2. These results are consistent among models 5–8. For illustration, the findings were examined through model 5. Past returns are still positively associated with the change in foreign ownership, while the coefficient is insignificant. However, the coefficient of the cross-term is positively significant (0.0006), implying that the level of prior ownership can moderate the relationship between past returns and trading behavior. Specifically, with a fixed past return, a higher prior ownership of a certain stock encourages foreign investors' intentions to implement a momentum trading strategy. For example, assuming stocks A and B have the same firm characteristics and past returns, and the prior foreign ownership of stocks A and B is 20% and 5%, respectively. According to the results using Eq. (3), if the past return of stock B is increased by 1%, foreign investors would tend to increase their share holding by 0.006% in stock B. On the other hand, foreign investors will buy another 0.015% shares in stock A when the past return of stock A is increased by 1%.

The above example reveals that the overall effect of past returns on foreign investors trading behavior is influenced by the level of prior ownership. This finding is common to all models. Hence, it suggests that the foreign investors' momentum trading strategy is anchored by previous ownership. In other words, for foreign investors, the higher the prior ownership is, the more intensified the momentum strategy.

In order to provide a robust check, this paper further divided the whole sample into two subsamples: one sub-sample covers a bull market from 2004Q3 to 2007Q3 and the other is a bear market between 2007Q4 and 2008Q4 (see Fig. 1).[6] It is interesting to explore foreign investors' behavior and the anchoring effects under different market conditions. To further simplify the analyses in Tables 4–6,

[5] Some diagnostics were also checked for the models, including omitted variables test and fixed effect test. With respect to the omitted variables test, this paper adopts Ramsey's RESET procedure (Ramsey, 1969) to test this concern. All regressions (models 1–8) do not reject the null hypothesis that the model has no omitted variables. Therefore, it is suggested that the omitted variables problem is not serious for the models. Furthermore, a joint *F*-test was used to examine the heterogeneity across firms. Accordingly, all *F*-tests are significant for the models, implying that the fixed effect is existent. The test results are not reported here but available upon request from the authors.

[6] In financial literatures, there are various approaches that date the bull and bear markets (e.g., Fabozzi and Francis, 1977). This study followed Lunde and Timmermann's (2004) definition which defines that the stock market goes from a bull to a bear state if the stock price has declined a certain percentage since its previous local peak within that bull state. According to their definition, sequences of negative price movements in a stock price during a bull market would not be ruled out. This definition is also similar to the first definition of Fabozzi and Francis (1977) and Pagan and Sossounov (2003).

Table 4

Estimation results under bull and bear markets. This table reports estimates of fixed-effect regressions through regression of the prior ownership on past returns, prior foreign ownership and control variables in two sub-period samples. The dependent variable is the change of ownership ($\Delta Ownership_{i,t-1:t}$). The main regressors include returns of six months preceding $t-1$ ($Return_{i,t-3:t-1}$) and the cross-term, that is, prior ownership multiplies past returns ($Ownership_{i,t-1} \times Return_{i,t-3:t-1}$). All control variables are lagged one quarter and include log firm size ($Size_{i,t-1}$), market model's beta coefficient ($Beta_{i,t-1}$), stock turnover rate ($Turnover_{i,t-1}$), return on equity ($ROE_{i,t-1}$), debt ratio ($Debt_{i,t-1}$), price-to-book ratio ($P/B\ ratio_{i,t-1}$) and dividend yield ($Dividend_{i,t-1}$). The first sub-sample (bull market) covers the period from 2004Q3 to 2007Q3, while the second sub-sample (bear market) covers 2007Q4 to 2008Q4. The robust standard errors are reported in parentheses. It is noted that the coefficients of cross-terms are multiplied by 10^3 and coefficients of intercept, year and quarter dummies are omitted for brevity.

	Bull market		Bear market	
	(1)	(2)	(3)	(4)
$Ownership_{i,t-1}$	−0.212*** (0.018)	−0.213*** (0.015)	−0.624*** (0.074)	−0.641*** (0.075)
$Return_{i,t-3:t-1}$	0.011* (0.006)	0.010* (0.005)	0.006** (0.003)	−0.005** (0.002)
$Ownership_{i,t-1} \times Return_{i,t-3:t-1}$		0.136* (0.082)		0.897*** (0.188)
Control variables				
$Size_{i,t-1}$	0.878*** (0.186)	0.890*** (0.193)	−0.071 (0.556)	0.063 (0.529)
$Beta_{i,t-1}$	0.041 (0.080)	0.039 (0.079)	−0.475** (0.222)	−0.617*** (0.218)
$Turnover_{i,t-1}$	−0.006*** (0.002)	−0.006*** (0.002)	−0.008*** (0.002)	−0.005*** (0.002)
$ROE_{i,t-1}$	−0.037 (0.024)	−0.037 (0.024)	0.021* (0.012)	0.024** (0.011)
$Debt_{i,t-1}$	−0.015** (0.0067)	−0.015** (0.007)	−0.045*** (0.016)	−0.044*** (0.015)
$P/B\ ratio_{i,t-1}$	−0.087 (0.092)	−0.100 (0.093)	0.465*** (0.141)	0.433 (0.142)
$Dividend_{i,t-1}$	0.009 (0.022)	0.009 (0.022)	−0.062** (0.027)	−0.044 (0.027)
n	8617	8617	3315	3315
R^2	0.054	0.054	0.082	0.083

* Coefficients are significant at 10% level.

** Coefficients are significant at 5% level.

*** Coefficients are significant at 1% level.

Table 5
The profitability of the momentum strategy This table reports estimates of fixed-effect regressions by regressing the sequential stock returns on past returns, prior foreign ownership and control variables. The dependent variables are quarterly returns of a certain stock i from t-1 to t ($Return_{i,t-1:t}$) and quarterly returns of a certain stock i from $t-1$ to $t+1$ ($Return_{i,t-1:t+1}$), respectively. The main regressors include past six months stock returns before $t-1$ ($Return_{i,t-3:t-1}$) and the cross-term, that is, prior ownership multiplied by past return ($Ownership_{i,t-1} \times Return_{i,t-3:t-1}$) according to the Fair–Shiller test. All control variables are lagged one quarter and include log firm size ($Size_{i,t-1}$), market model's beta coefficient ($Beta_{i,t-1}$), stock turnover rate ($Turnover_{i,t-1}$), return on equity ($ROE_{i,t-1}$), debt ratio ($Debt_{i,t-1}$), price-to-book ratio ($P/B\ ratio_{i,t-1}$) and dividend yield ($Dividend_{i,t-1}$). The sample period is from 2003Q1 to 2009Q4. The robust standard errors are reported in parentheses. It is noted that the coefficients of cross-terms are multiplied by 10^3 and the coefficients of intercept, year and quarter dummies are omitted for brevity.

Dep. Var.	$Return_{i,t-1:t}$		$Return_{i,t-1:t+1}$	
	(1)	(2)	(3)	(4)
$Ownership_{i,t-1}$	0.019 (0.037)	0.020 (0.036)	0.181** (0.076)	0.181** (0.076)
$Return_{i,t-3:t-1}$	0.078*** (0.007)	0.078*** (0.008)	0.119*** (0.012)	0.119*** (0.013)
$Ownership_{i,t-1} \times Return_{i,t-3:t-1}$		−0.104 (0.414)		−0.040 (0.723)
Control variables				
$Size_{i,t-1}$	−17.698*** (0.787)	−17.698*** (0.786)	−38.147*** (1.756)	−38.149*** (1.753)
$Beta_{i,t-1}$	−0.894 (0.648)	−0.888 (0.646)	3.859*** (1.445)	3.861*** (1.451)
$Turnover_{i,t-1}$	−0.056*** (0.006)	−0.056*** (0.006)	−0.047*** (0.010)	−0.047*** (0.010)
$ROE_{i,t-1}$	0.335*** (0.057)	0.335*** (0.057)	0.456*** (0.072)	0.456*** (0.073)
$Debt_{i,t-1}$	−0.144*** (0.029)	−0.144*** (0.029)	−0.242*** (0.061)	−0.243*** (0.061)
$P/B\ ratio_{i,t-1}$	−0.421 (0.364)	−0.416 (0.362)	−3.253*** (0.695)	−3.249*** (0.696)
$Dividend_{i,t-1}$	0.077 (0.084)	0.076 (0.083)	0.891*** (0.167)	0.891*** (0.167)
N	17,272	17,272	16,516	16,516
R^2	0.055	0.055	0.083	0.083

** Coefficients are significant at 5% level.
*** Coefficients are significant at 1% level.

Table 6
The profitability of the momentum strategy using delayed stock returns. This table reports estimates of fixed-effect regressions by regression of the sequential stock return on past return, prior foreign ownership and control variables. The dependent variables are the delayed return of a certain stock *i* from *t* to *t* + 1 ($Return_{i,t:t+1}$) and the delayed return of a certain stock *i* from *t* to *t* + 2 ($Return_{i,t:t+2}$). The main regressors include the past six months stock returns before *t* − 1 ($Return_{i,t-3:t-1}$) and the cross-term, that is, prior ownership multiplied by past return ($Ownership_{i,t-1} \times Return_{i,t-3:t-1}$) according to the Fair-Shiller test. All control variables are lagged one quarter and include log firm size ($Size_{i,t-1}$), market model's beta coefficient ($Beta_{i,t-1}$), stock turnover rate ($Turnover_{i,t-1}$), return on equity ($ROE_{i,t-1}$), debt ratio ($Debt_{i,t-1}$), price-to-book ratio ($P/B\ ratio_{i,t-1}$) and dividend yield ($Dividend_{i,t-1}$). The sample covers the period from 2003Q1 to 2009Q4. The robust standard errors are reported in parentheses. It is noted that the coefficients of cross-terms are multiplied by 10^3 and the coefficients of intercept, year and quarter dummies are omitted for brevity.

Dep. Var.	$Return_{i,t:t+1}$		$Return_{i,t:t+2}$	
	(1)	(2)	(3)	(4)
$Ownership_{i,t-1}$	0.169*** (0.034)	0.176*** (0.034)	0.331*** (0.070)	0.335*** (0.073)
$Return_{i,t-3:t-1}$	0.033*** (0.007)	0.040*** (0.008)	0.042*** (0.011)	0.047*** (0.013)
$Ownership_{i,t-1} \times Return_{i,t-3:t-1}$		−0.951** (0.441)		−0.675 (0.879)
Control variables				
$Size_{i,t-1}$	−20.755*** (0.892)	−20.802*** (0.883)	−42.978*** (1.711)	−43.024*** (1.707)
$Beta_{i,t-1}$	5.126*** (0.653)	5.173*** (0.664)	10.797*** (1.091)	10.830*** (1.027)
$Turnover_{i,t-1}$	0.016*** (0.005)	0.015*** (0.006)	0.018** (0.009)	0.017* (0.009)
$ROE_{i,t-1}$	0.123** (0.048)	0.126** (0.049)	0.198*** (0.065)	0.201*** (0.065)
$Debt_{i,t-1}$	−0.099*** (0.028)	−0.101*** (0.028)	−0.164*** (0.060)	−0.166*** (0.060)
$P/B\ ratio_{i,t-1}$	−1.688*** (0.450)	−1.587*** (0.446)	−2.791*** (0.753)	−2.703*** (0.766)
$Dividend_{i,t-1}$	0.912*** (0.086)	0.904*** (0.087)	1.855*** (0.174)	1.849*** (0.175)
n	16,516	16,516	15,756	15,756
R^2	0.052	0.052	0.055	0.055

* Coefficients are significant at 10% level.
** Coefficients are significant at 5% level.
*** Coefficients are significant at 1% level.

a test was used to determine the value of the return horizon. According to a Fair–Shiller test (Fair & Shiller, 1990), the setting of $k = 2$ is preferred to other selected values.[7]

Table 4 presents the estimation of the two sub-samples. With respect to the second and third columns (bull market sub-sample), the results show that foreign investors are inclined to be momentum traders and their momentum behavior is anchored by prior ownership. Thus, it completely echoes the conclusions mentioned above. The last two columns list the estimation results under a bear market. These are somewhat different from the above-mentioned result. In other words, it was found that foreign investors tend to adopt a contrarian strategy for stocks with low ownership whilst adopting a momentum strategy for stocks with high ownership in a bear market. More specifically, the last column shows that foreign investors may implement a contrarian trading strategy. However, the cross-term is positively significant, implying that foreign investors turn to a momentum trading strategy if prior ownership is higher than 6%. Once again, this result is consistent with previous conclusions that prior ownership can moderate the relationship between past stock returns and future returns.

It was found that the degree of anchoring effect is much higher in a bear market than in a bull market. The detailed explanation of this phenomenon is left for future research. Recalling the assumption that investors are willing to buy more shares of a stock because they expect a better return in the future, the result shows that foreign investors tend to be momentum traders, while the intensity of their momentum trading behavior is anchored by prior foreign ownership. Hence, it is interesting to see whether a momentum strategy is profitable in the Taiwan stock market. Moreover, this study is also interested in examining whether prior foreign ownership can improve the returns for the momentum strategy. The corresponding analysis is presented in the next subsection.

4.2. Profitability of foreign investors' momentum behavior

Table 5 lists the results obtained by estimating Eqs. (4) and (5). We regress future returns on past returns through a fixed-effect model. The second and third columns of Table 5 present how past returns can predict stock returns from $t-1$ to t. In other words, how does the stock price move in subsequent quarter(s), given the specific data of past returns and firm characteristics? The second column shows that the past six months' returns are positively and significantly associated with the following quarter's returns, indicating there is a momentum effect in the Taiwan stock market. This also implies that, on average, foreign investors' momentum behavior is profitable. Furthermore, the third column represents that the coefficient of the cross-term is negative but insignificant, meaning that prior foreign ownership does not moderate the relationship between past and future returns.

The last two columns of Table 5 show how past returns can predict returns for the two subsequent quarters. In general, the results are consistent with those mentioned above, i.e. the momentum effect in Taiwan may persist for more than six months. However, the cross-terms are similarly negative but insignificant in the last column. Hence, it suggests that prior foreign ownership can cause an anchoring bias in foreign investors' momentum behavior, but this anchoring effect cannot create positive future returns. It is obvious that, according to this result, Hypothesis 3 is supported and the negative sign of the cross-terms are consistent with the expectations of this study. In addition, it is suggested that the anchoring effect is embedded in the market participants. This conclusion is in agreement with Campbell and Sharpe (2009) who found an anchoring bias in consensus forecasts. However, this bias cannot influence market prices.

The above-mentioned results imply that price movements are predictable by their past returns and that foreign ownership through the anchoring effect cannot influence market prices. Hence, it seems to contravene the efficient market hypothesis (EMH). The EMH, basically, assumes that all investors are rational, or at least investors' irrational behavior occurs randomly (Shleifer, 2000). However, this

[7] The coefficients of $Return_{i,t-3:t-1}$ and $Ownership_{i,t-1} \times Return_{i,t-3:t-1}$ (i.e. $k = 2$) are only reported in Tables 4–6. In fact, whatever k is chosen, the conclusion does not change systemically. For details, please refer to Appendix.

study shows that foreign institutional investors are behavioral and irrational because their cognitive bias (anchoring bias) is significant and occurs non-randomly. Thus, the Taiwan stock market seems incompatible with the EMH.

The results also show that, generally, small size firms with low P/B ratios and low turnover rate yield higher expected returns. The size, value and illiquidity premia are well-documented in existing literature. In addition, firms with a high return on equity and low debt ratio have higher than expected returns, implying that the return on equity and debt ratio can forecast a firm's future performance. Dividend yields positively correlate to future returns and this is consistent with Fama and French (1988). However, the relationship between beta and sequential return is mixed; beta can positively affect expected returns over a longer ex post horizon.

It could be argued that the dependent variables in Tables 3 and 5 are endogenous, which means positive stock returns may result from the increase of foreign ownership during the period $t-1$ to t (Badrinath & Wahal, 2002). Therefore, the study has adopted delayed returns as the dependent variable (Jegadeesh & Titman, 2001). Eqs. (4) and (5) were then re-run and the estimation results are presented in Table 6.

The second and third columns of Table 6 show how past returns can predict stock returns from t to $t+1$. As shown in the second column, the signs of past returns ($\text{Return}_{t-3:t-1}$) are significantly positive, indicating the momentum effect is valid, even when delayed future return is used. However, the third column illustrates that the momentum profitability decreases if prior foreign ownership of a stock is high. This finding strongly implies that the anchoring bias in foreign investors' momentum behavior damages their momentum trading performance. For example, if prior ownership is more than 43%, the expectation of momentum profitability becomes negative. However, foreign investors expect higher prior ownership to strengthen the benefits of their momentum strategies (see previous subsection). Therefore, it is suggested that the anchoring bias in foreign investors' momentum behavior is unprofitable. Similar findings can be found in the last two columns of Table 6.

In summary, the results support our hypotheses, revealing that foreign investors tend to adopt a momentum trading behavior and can indeed earn profit by this behavior. In addition, the findings support that foreign investors' momentum trading behavior is anchored by their prior ownership of a stock, but this anchoring effect cannot provide a profit in the Taiwan stock market. A direct implication of this result is that foreign investors should only focus on the past performance of a certain stock and ignore how much they have previously owned in order to implement a momentum strategy.

Moreover, from the perspectives of market regulators and policy makers, the empirical results of this study would be valuable for them. First, Lee, Lin, & Liu (1999) investigated the dynamic patterns of foreign institutional investors and individual investors in Taiwan. They found that individual investors (especially small individuals) may follow foreign institutional investors. Hence, with respect to the results of this study, it is suggested that market regulators should disclose the information about foreign ownerships more detail in order to avoid individual investors misjudge the information. Second, although the anchoring effect cannot create additional profits, the anchor points, the previous foreign ownership of shares, present significantly positive effects on future price movements. It implies that foreign institutional investors would be positive feedback traders, especially for those stocks with high foreign ownership in a bear market. Therefore, market regulators should monitor the changes of foreign owned shares to stabilize price fluctuations induced by extremely positive feedback trading.

5. Conclusions

The anchoring effect is a cognitive bias whereby participants make their decisions by starting from an easily available reference value (anchor), even though this value is irrelevant. This paper provides the first empirical study on the anchoring effect in financial markets by analyzing the trading behavior of foreign institutional investors in the Taiwan stock market. The study documents its existence and its implication on the profitability of the prevailing momentum strategy.

Table A1
Fair–Shiller test for model comparison. This table reports estimates of OLS for the Fair–Shiller test. The Fair–Shiller test is a kind of encompassing test that can tell predictions from which model contain more independent information. The test is based on the following regression model: $Y_t - Y_{t-1} = \alpha + \beta(\hat{Y}_{mt} - Y_{t-1}) + \gamma(\hat{Y}_{nt} - Y_{t-1}) + v_t$, where $\hat{Y}_{mt}$ and $\hat{Y}_{nt}$ denote the predictions of Y_t made from Models m and n, respectively, at time $t-1$. If $\beta = 0$ and $\gamma > 0$, Model m contains no information but Model n contains some information relevant to predicting Y_t. Models 1–8 are the same as Table 3. The sample period is from 2003Q1 to 2009Q4. Newey and West (1987) t-statistics are reported in parentheses.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
(1)	0.015 (0.06)	0.987*** (3.68)						
(2)	0.160 (1.32)		0.859*** (7.56)					
(3)	0.186 (1.49)			0.845*** (8.02)				
(4)		0.497* (1.84)	0.524** (2.36)					
(5)		0.464** (2.08)		0.587*** (3.58)				
(6)			0.359** (2.03)	0.663*** (4.23)				
(7)					0.276 (1.49)	0.759*** (3.68)		
(8)					0.343 (3.35)***		0.697*** (6.71)	
(9)					0.366*** (3.58)			0.694*** (6.84)
(10)						0.515** (2.29)	0.507*** (2.71)	
(11)						0.504*** (2.83)		0.549*** (4.08)
(12)							0.447*** (2.65)	0.580*** (3.48)

* Coefficients are significant at 10% level.
** Coefficients are significant at 5% level.
*** Coefficients are significant at 1% level.

Prior foreign ownership is found to be important in determining the future course of any changes and it can be interpreted as an anchor for the investment decisions of foreign institution investors. Prior foreign ownership also affects the relationship between past stock returns and foreign investors' trading behavior. This study confirms that foreign investors tend to be momentum traders, i.e., they buy past winners and sell past losers. Interestingly, momentum trading is intensified when prior foreign ownership is high.

This paper also examined whether momentum behavior and anchoring effects are profitable in the Taiwanese market. It was found that the momentum profit is significantly positive but the anchoring effect may be counterproductive in generating profit. A negligible, if not negative, increase in trading profit occurred as a result of the anchoring effect. This study echoes the findings of Boehmer and Kelley (2009) and Campbell and Sharpe (2009) and confirms that the anchoring effect is embedded in market participants. Whether the anchoring effect extends to other types of investors and other markets are open questions yet to be explored. How the market condition affects the momentum strategy, and how it interacts with the anchoring effect, are also interesting questions for future research.

Appendix.

A Fair–Shiller test (Fair & Shiller, 1990) was applied (an encompassing test) to select an appropriate model (an appropriate k) that can sketch better the foreign investors' trading behavior. This procedure is also used to simplify the analysis with only one prior-period horizon (k). Table A1 lists comparisons of pairs of data through the Fair–Shiller test. Table A1 shows that model 1 is dominated by models 2, 3 and 4. For example, in the second row of Table A1, the coefficients of models 1 and 2 are 0.015 and 0.987, respectively, indicating that model 2 greatly dominates model 1. Model 4 seems to be the best model, implying that the use of a cumulative one year return can better predict foreign investors' momentum behavior. With respect to the last four models, model 8, using the preceding one year's return, still dominated the other three models. However, the coefficients of past return and cross-term were insignificant in model 8 (see Table 3). Therefore, the setting of model 6 (past six months return, $k = 2$) was used to investigate the research questions.

References

Andreassen, P. B. (1988). Explaining the price–volume relationship: The difference between price changes and changing prices. *Organization Behavior and Human Decision Processes*, *41*, 371–389.

Badrinath, S. G., & Wahal, S. (2002). Momentum trading by institutions. *Journal of Finance*, *57*, 2449–2478.

Barber, B. M., Lee, Y.-T., Liu, Y.-J., & Odean, T. (2009). Just how much do individual investors lose by trading? *Review of Financial Studies*, *22*, 609–632.

Białkowski, J., & Otten, R. (2011). Emerging market mutual fund performance: Evidence for Poland. *North American Journal of Economics and Finance*, *22*, 118–130.

Boehmer, E., & Kelley, E. K. (2009). Institutional investors and the informational efficiency of prices. *Review of Financial Studies*, *22*, 3563–3594.

Bushee, B. J., & Goodman, T. H. (2007). Which institutional investors trade based on private information about earnings and returns? *Journal of Accounting Research*, *45*, 289–321.

Campbell, S. D., & Sharpe, S. A. (2009). Anchoring bias in consensus forecasts and its effect on market prices. *Journal of Financial and Quantitative Analysis*, *44*, 369–390.

Cen, L., Hilary, G., & Wei, J. K. C. (2013). The role of anchoring bias in the equity market: Evidence from analysts' earnings forecasts and stock returns. *Journal of Financial and Quantitative Analysis*, *48*, 47–76.

Chordia, T., & Shivakumar, L. (2002). Momentum, business cycle, and time-varying expected returns. *Journal of Finance*, *57*, 985–1019.

Dahlquist, M., & Robertsson, G. (2001). Direct foreign ownership, institutional investors and firm characteristics. *Journal of Financial Economics*, *59*, 431–440.

De Bondt, W. F. M. (1993). Betting on trends: Intuitive forecasts of financial risk and return. *International Journal of Forecasting*, *9*, 355–371.

Fabozzi, F. J., & Francis, J. C. (1977). Stability tests for alphas and betas over bull and bear market conditions. *Journal of Finance*, *32*, 1093–1099.

Fair, R. C., & Shiller, R. J. (1990). Comparing information in forecasts from econometric models. *American Economic Review*, *80*, 375–389.

Fama, E. F., & French, K. R. (1988). Dividend yields and expected stock returns. *Journal of Financial Economics*, *22*, 3–25.

Ferreira, M. A., & Matos, P. (2008). The colors of investors' money: The role of institutional investors around the world. *Journal of Financial Economics*, *88*, 499–533.

Fisher, K. L., & Statman, M. (2000). Cognitive biases in market forecasts. *Journal of Portfolio Management*, *27*, 72–81.
George, T. J., & Hwang, C.-Y. (2004). The 52-week high and momentum investing. *Journal of Finance*, *59*, 2145–2176.
Gervais, S., & Odean, T. (2001). Learning to be overconfident. *Review of Financial Studies*, *14*, 1–27.
Griffin, J. M., Harris, J. H., & Topaloglu, S. (2003). The dynamics of institutional and individual trading. *Journal of Finance*, *58*, 2285–2320.
Griffin, J. M., Nardari, F., & Stulz, R. M. (2007). Do investors trade more when stocks have performed well? Evidence from 46 countries. *Review of Financial Studies*, *20*, 905–951.
Grinblatt, M., & Keloharju, M. (2001). What makes investors trade? *Journal of Finance*, *51*, 589–616.
Grinblatt, M., Titman, S., & Wermers, R. (1995). Momentum investment strategies, portfolio performance, and herding: A study of mutual fund behavior. *American Economic Review*, *85*, 1088–1105.
Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for market efficiency. *Journal of Finance*, *48*, 65–91.
Jegadeesh, N., & Titman, S. (2001). Profitability of momentum strategies: An evaluation of alternative explanations. *Journal of Finance*, *56*, 699–720.
Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, *47*, 263–291.
Kalev, P. S., Nguyen, A. H., & Oh, N. Y. (2008). Foreign versus local investors: Who knows more? Who makes more? *Journal of Banking and Finance*, *32*, 2376–2389.
Kang, J.-K., & Stulz, R. M. (1997). Why is there a home bias? An analysis of foreign portfolio equity ownership in Japan. *Journal of Financial Economics*, *46*, 3–28.
Kaustia, M., Alho, E., & Puttonen, V. (2008). How much does expertise reduce behavioral biases? The case of anchoring effects in stock return estimates. *Financial Management*, *37*, 391–412.
Lee, Y.-T., Lin, J.-C., & Liu, Y.-J. (1999). Trading patterns of big versus small players in an emerging market: An empirical analysis. *Journal of Banking and Finance*, *23*, 701–725.
Lin, C. H., & Shiu, C.-Y. (2003). Foreign ownership in the Taiwan stock market – An empirical analysis. *Journal of Multinational Financial Management*, *13*, 19–41.
Lin, A. Y., & Swanson, P. E. (2003). The behavior and performance of foreign investors in emerging equity markets: Evidence from Taiwan. *International Review of Finance*, *4*, 189–210.
Liu, L. X., & Zhang, L. (2008). Momentum profits, factor pricing, and macroeconomic risk. *Review of Financial Studies*, *21*, 2417–2448.
Lunde, A., & Timmermann, A. (2004). Duration dependence in stock prices: An analysis of bull and bear markets. *Journal of Business and Economic Statistics*, *22*, 253–273.
Maymin, P. (2012). Music and the market: Song and stock volatility. *North American Journal of Economics and Finance*, *23*, 70–85.
Mussweiler, T., & Schneller, K. (2003). What goes up must come down – How charts influence decisions to buy and sell stocks. *Journal of Behavioral Finance*, *4*, 121–130.
Newey, W. K., & West, K. D. (1987). Hypothesis testing with efficient method of moments estimation. *International Economic Review*, *28*, 777–787.
Ng, L., & Wu, F. (2007). The trading behavior of institutions and individuals in Chinese equity markets. *Journal of Banking and Finance*, *31*, 2695–2710.
O'Connell, P. G. J., & Teo, M. (2009). Institutional investors, past performance, and dynamic loss aversion. *Journal of Financial and Quantitative Analysis*, *44*, 155–188.
Pagan, A. R., & Sossounov, K. A. (2003). A simple framework for analysing bull and bear markets. *Journal of Applied Econometrics*, *18*, 23–46.
Park, S.-C. (2010). The moving average ratio and momentum. *Financial Review*, *45*, 415–447.
Ramsey, J. B. (1969). Tests for specification errors in classical linear least-squares regression analysis. *Journal of the Royal Statistical Society, Series B*, *31*, 350–371.
Sagi, J. S., & Seasholes, M. S. (2007). Firm-specific attributes and the cross-section of momentum. *Journal of Financial Economics*, *84*, 389–434.
Shleifer, A. (2000). *Inefficient Market*. Oxford: Oxford University Press.
Svedsater, H., Karlsson, N., & Garling, T. (2009). Momentum trading, disposition effects and prediction of future share prices: An experimental study of multiple reference points in responses to short- and long-run return trends. *Applied Financial Economics*, *19*, 595–610.
Törngren, G., & Montgomery, H. (2004). Worse than chance? Performance and confidence among professionals and laypeople in the stock market. *Journal of Behavioral Finance*, *5*, 148–153.
Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, *185*, 1124–1131.

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