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INVESTOR ATTENTION, PSYCHOLOGICAL ANCHORS, AND THE STEALTH INDEX

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ABSTRACT

We categorize the stocks in the Taiwan share market by size, value, and growth, then form the portfolio index for each group according to the Taiwan Stock Exchange's weighted index method. Li and Yu's (2012) measurement method for investors' under- and overreactions, as well as Fama and French's (1993) three-factor analysis, are utilized to examine under- and overreactions regarding shares that cannot be observed by investors. The empirical results indicate that aside from the existence of under- and overreactions in the Taiwan Stock Exchange's weighted index, the indices formed according to stock size, value, and growth also contribute to price reactions. Li and Yu (2012) measure investors' reactions based on anchoring and limited attention. This study discovers that aside from a highly exposed market index, various stocks' non-observable weighted indexes also demonstrate the under- and overreaction phenomenon. This indicates that share prices would still be affected by both limited attention to other important information and the investor's anchoring.

JEL: G12, G14

KEYWORDS: Underreaction, Overreaction, Three-Factor Model

INTRODUCTION

The anomaly of share prices displaying both short-term momentum and long-term reversal has recently piqued scholars' research interest. The behavioral finance realm attempts to provide a different explanation for this phenomenon involving the short-term underreaction and long-term overreaction. Barberis, Shleifer, and Vishny (1998) attribute such phenomenon to investors' psychological anchors and representative biases. Daniel, Hirschleifer, and Subrahmanyam (1998) believe that the phenomenon is due to investors' overconfidence and self-attribution biases. Hong and Stein (1999) claim that the phenomenon can be explained by the limited rational and psychological interaction between news watchers and momentum traders.

The subject matter regarding "Attention" in the behavioral finance field primarily addresses describing the variation in investor psychology, which consequently changes investment behavior when no change occurs in the firm's internal and external environments. This produces abnormal fluctuations and transaction volumes. Li and Yu's (2012) proposed empirical evidence, based on anchoring and limited attention, believes that a 52-week high can be a proxy for investors' underreaction to news events, and a historical high may be a proxy for investors' overreaction to news events, hence forecasting the effect for overall market returns. Despite Li and Yu's (2012) utilization of the highly exposed Dow Jones Industrial Index as a basis for measurement, investors under limited fundamentals will still only react to shares that they hold, or are familiar with (Grullon, Kanatas, and Weston, 2004). However, many news events can spur investors' attention, such as revenue announcements, technical innovations, and new order acquisitions, among other major announcements. Investors' subsequent reactions would not be limited by a highly exposed market index. As the connotation of news events directly affects investors' behavior (Joe, Louis, and Robinson, 2009), we assume that Li and Yu's (2012) measurement would still be effective, despite its existence outside of the high exposure market index. We have consulted a market

index's compilation rules to utilize the composite index within the asset portfolio as a proxy for the shares that caught specific investors' attention due to their relevant information.

We then utilized this in our hypothesis testing. As Fama and French's (1993) three-factor model cannot fully explain the short-term returns in the momentum anomaly, financial scholars utilize the behavioral perspective in an attempt to explore the causes of book-to-market (overreaction) and momentum (underreaction) effects. Thus, we consider the aforementioned line of reasoning to utilize the asset portfolio index and follow Li and Yu's (2012) proposed measurement method, which notes under- and overreactions for 52-week high and historical high proxies, respectively. We will discuss both under- and overreaction scenarios according to the following grouping characteristics: large or small, and value or growth shares. For example, small sizes display the underreaction phenomena, but this is not the case with large sizes. Thus, we can be certain that such an anomaly is already captured by size effects; if overreaction exists in valued shares, but not in growth shares, then overreaction can be denoted by the book-to-market effect. The use of such a method can more precisely estimate whether other characteristics would affect the asset portfolio's returns in the momentum and reversal effect groups. We will then conduct a three-factor model analysis of the post-grouping for the under- or overreaction phenomenon. This study focuses on the Taiwanese share market, and the analysis indicates that the Taiwan Stock Exchange's weighted index exhibits both under- and overreaction phenomenon. Further, we group the shares as large, small, value, and growth shares according to the Taiwan Stock Exchange's weighted index rules. The discussion also extends to whether different groups' indices display under- or overreaction. The results demonstrate that the value share index does exhibit under- and overreaction phenomenon. Regarding growth shares index, underreaction only exists in one-month short-term holdings (with a less than 5% significance level) and overreaction appears in various other holding periods, with the exception of the three-month holding period. Regarding the size index, small sizes display apparent under- and overreaction phenomenon and, to a certain extent, display an expanding trend over time (12-month holdings decline); the overreaction phenomenon does not demonstrate a significant relationship with future returns in large sizes, regardless of whether the holding period is 1 to 12 months.

This result implies that the book-to-market and size factors can capture the under- and overreaction phenomenon. As the Taiwan share market displays an approximately 10-year cycle, we dissect this into three subsamples of 10 years each to test whether our hypothesis is robust. The results indicate that the α intercept is not significant in two subsamples, between 1995 and 2005; thus, the three-factor model explains the excess returns. This consequently justifies our inference, whereas Li and Yu's (2012) methodology stipulates that value and scale indices display under- and overreaction phenomenon despite the fact that these indicators are not apparent and not easily observable to investors. This finding indicates that investors would still focus on important information relevant to the shares they hold, and is effective on those shares. Such finding is the major contribution of this study. This study is organized as follows: the first section provide introduction; the second section presents a literature review on market under- and overreactions as well as the three-factor pricing model; the third section establishes the framework for limited attention and anchoring of investors, as well as a proxy measurement for investors' under- and overreaction and a three-factor analysis; the fourth section explains the empirical analysis' results; and the fifth section concludes.

LITERATURE REVIEW

Current finance theories assume an efficient market, in which the market price would immediately react to variations in information. However, recent empirical studies have discovered many anomalies that cannot be explained by modern finance theories. Such empirical studies posit that these are caused by the assumption that the investors are completely rational, but it is apparent that this notion does not hold in an actual finance setting, as investors are both irrational and challenged in their knowledge and skills. Behavioral finance scholars have initially used the cognitive psychology perspective to propose a series of discussions regarding investor behavior to generate a more substantial explanation of market anomalies. It seems that the topic of investor attention is especially perceived as the single most important driver for

substantial variations in share prices. Kahneman (1973) claims that investor attention is actually a scarce source of cognition, which would cause the overreaction in a stock's fundamentals due to a specific event. Alternatively, limited attention, as proposed by Engelberg, Sasseville, and Williams (2012), is a situation in which the investor cannot completely process and understand a specific event. The effects of investors' under- and overreaction can explain profit forecasts' underreaction, as stated by Doyle, Lundholm, and Soliman (2003); as well as the price reaction of profit disclosure on Fridays, as noted by DellaVigna and Pollet (2009); plus the excess optimism to net operating earnings, as stated by Hirshleifer and Teoh (2003); and finally, abnormal share purchase levels near announcement dates, as posited by Barber and Odean (2008). The measurements in past literature of under- and overreactions primarily adopt a methodology that involves grouping by different investment strategies. Li and Yu (2012) divert from the conventional method and base their study on investor psychology, which includes anchoring and limited attention. These concepts suggest that indices nearing 52-week and historical highs are capable of acting as proxies for under- and overreaction, respectively.

Their research has proven that such a method is robust in forecasting abilities, and is unaffected by macroeconomic variables. A crucial assumption is that the Dow Jones Industrial Average index significantly affects investors' decisions due to its widespread nature; investors' limited attention occurs due to its high exposure. Such relationships result because, as Peng and Xiong (2006) note, the investor would process more market information than specific company information. Further, Griffin and Tversky (1992) state that investors' behavior only overreacts to prominent long-term records. Due to the low likelihood that the firm can maintain long-term growth, non-observable variables would therefore no longer be able to forecast the market index's historic highs. The proxy for overreaction, in other words, must depend on a high-exposure market index to be sustainable. However, much highly exposed information exists, and the market index is only one of these.

Engelberg, Sasseville, and Williams (2012) traced CNBC's "Mad Money" program to discover that after the host has recommended certain stocks, these shares subsequently experience higher price and trade volumes; Grullon, Kanatas, and Weston (2004) believe that, under the assumption that all conditions are equal, a firm's higher spending on advertising can lead to more investor attention toward the firm, hence receiving expanded investments; Cutler, Poterba, and Summers (1989) state that a relevant relationship exists between the media's report on a firm and its share price; DeLong et al. (1990) believe that media reports (on a firm) affect investor emotion, hence affecting the share price; Urrutia and Vu (1999) note that after information regarding a firm's profitability level becomes significant news, share prices' abnormal returns become apparent; Mian and Sankaraguruswamy (2012) prove that investors' emotions impact the sensitivity of share price reactions to company-specific news; and Joe, Louis, and Robinson (2009) find that the information content expressed by the media can directly affect investors' decisions. In summary, after the release of company-related news or information, the firm and its related industry would receive investor attention leading to variations in asset pricing.

The literature review not only explains the market index, but also highlights the fact that investors' decisions are also significantly affected by other information. Alternatively, investors are limited by time and ability, and cannot thoroughly investigate all stocks for investment. This leads to a constraint on the amount of information that must be analyzed, as further noted by Aboody, Lehavy, and Trueman (2010). Moreover, Merton (1987) highlighted the individual investor's tendency to hold a few stocks in a portfolio; the investor only purchases stocks that are familiar, and does not act impulsively in buying unfamiliar stocks. Barber and Odean (2008) also indicate that individual investors tend to be more prone to being affected by media reports, and consequently purchase the shares reported by the media. Grullon, Kanatas, and Weston (2004) state that due to their limited attention, investors often buy into familiar shares that caught their attention. The literature discussed here, other than that pertaining to the market index, allows this study to draw inferences regarding the other important information that stimulates investors' attention, as reflected in the share price in the investor's possession. If the shares held by the investor are perceived as an investment portfolio that follows the market indices' grouping method, we then assume such a portfolio index is equipped with the same effect as those that adopt the Dow Jones Index, as Li and Yu (2012) have posited.

Fama and French's (1993) three-factor pricing model greatly affects modern asset-pricing theories. This pricing model is a descendant of both the asset portfolio theory, as discussed by Markowitz (1959), Sharpe (1964), and Lintner (1965); and Black's (1972) CAPM theory, which explains asset returns from a risk perspective. Fama and French (1993) believe that portfolio returns can possibly relate to factors other than merely size, BM ratio, debt ratio, or PE ratio, among others. The authors posit that this is a result of risk tradeoff, in which the return is determined by the risk. This excludes the market factor, which leads to abnormal returns in the asset portfolio; this can also be explained by such risk factors as the "small minus big" (SMB) and "high minus low" (HML) factors, and as a summation of multiple influential factors. However, no model can completely rectify the existence of return momentum. Concurrently, expressing the Size and BM risk factors only as risk factors are strongly questioned. Daniel, Hirshleifer, and Subrahmanyam (1998) explain this through investor overconfidence and a self-attribution bias. Barberis, Shleifer, and Vishny (1998) believe that investors' limited ability causes an inadequate reaction from the short-term share price, and history will repeat itself, leading to overreaction. Hong and Stein (1999) alternatively perceive that investors' under- and overreaction is due to the velocity of spreading information. Previous studies have widely discussed the causes of BM and momentum effects. For example, Li and Yu (2012) utilized anchoring and limited attention in investor psychology to discover two important variables, namely, under- and overreaction. They also prove during this process that these two variables are not affected by macroeconomic fluctuations. Our study utilizes their method to group the three-factor model's key elements—namely, the Size and BM factors—before illustrating a portfolio index in various groups to explore the variation in momentum and reversal effects. Finally, we use a three-factor cross-sectional regression analysis to confirm whether our hypothesis regarding asset portfolio returns can provide extended explanatory ability.

DATA AND METHODOLOGY

This study's data is sourced from the *Taiwan Economic Journal*. The sample period spans June 1995 to May 2015, and the sample includes publicly traded shares from the Taiwan Stock Exchange, excluding delisted shares; we do not exclude financial shares and full-cash delivery stocks. We adopt weekly data for our empirical study, which differs from the monthly data used in previous research, as the abnormal anomaly of investors' under- and overreaction can end in a short span of time. Therefore, this study increases its data intensity to capture this specific phenomenon, to adhere to the true nature of investor behavior and avoid a result impacted by low data frequency. Li and Yu (2012) discovered two important variables for modern investors' under- and overreaction behavior from the New York Stock Exchange's data, based on the limited attention and anchoring concepts. The Dow Jones index, in nearing its 52-week high proxy for investor underreaction, is expressed as follows:

$$X_{52,t} = \frac{p_t}{p_{52,t}} \tag{1}$$

The Dow Jones index nearing its historic high proxy for investor overreaction is expressed as follows:

$$X_{max,t} = \frac{p_t}{p_{max,t}} \tag{2}$$

The former positively relates to future share market returns, and the latter negatively relates to future share market returns. Li and Yu (2012) also prove that these two proxies' explanatory ability would not be affected by macroeconomic variables. This finding provides a sound method to examine past debates on abnormal market phenomenon. Contrary to the traditional method, which involves a grouping analysis through factor dimensions, we can be more intuitive in comparing the differences in investors' under- and overreactions, as an apparent contrast in various assumptions of factors. A retrospective analysis can be conducted, and a specific cause can then be discovered. Li and Yu's (2012) methodology involves

conducting a monthly overlapping regression on the share trading data from the US market, and using international data to prove that such a method has sound explanatory power among G7 member nations. As the data used here is not listed in the G7 nations, we utilize the Taiwan Stock Exchange's weighted index as a proxy for the US market's Dow Jones index; thus, we can confirm its suitability in Taiwan's stock market. Further, the five explanatory variables are used to deduct the risk-free rate from the actual rate of return in the Taiwan Stock Exchange's weighted index, and forms $R_{pass,t}$ to represent past abnormal returns (1, 3, 6, and 12 months). The risk-free rate here is taken from the First Bank of Taiwan's one-year term deposit rate. Further, $X_{52,t}$ represents the extent of the Taiwan Stock Exchange's weighted index nearing its 52-week high, which acts as a proxy for investors' underreaction; $X_{max,t}$ represents the extent of the Taiwan Stock Exchange's weighted index nearing its historic high, which acts as a proxy for investor overreaction; D_t is the dummy variable, which assumes a value of 1 when the Taiwan Stock Exchange's weighted index is at a historic high, and 0 otherwise; I_t is also a dummy variable, which represents the stock price index's reaching a new high to imply investors' underreaction, and assumes a value of 1 when the 52-week high of the Taiwan Stock Exchange's weighted index equals the historic high, and 0 otherwise. The regression to examine under- and overreaction is as follows:

$$R_{future,t} = \alpha_0 + \beta_1 R_{pass,t} + \beta_2 X_{52,t} + \beta_3 X_{max,t} + \beta_4 D_t + \beta_5 I_t + \varepsilon_t \quad (3)$$

The dependent variable $R_{future,t}$ represents the future abnormal returns (1, 3, 6, and 12 months) and corresponds to $R_{pass,t}$. Table 1 presents the summary statistics for the correlated variables. Panel A indicates that the last month's abnormal return in the Taiwan Stock Exchange's weighted index R_t has an average value close to 0, the X_{52} average value nearing the 52-week high is 0.84, and the X_{max} historic high is only 0.57. This demonstrates that the Taiwan Stock Exchange's weighted index does not exhibit abnormal returns in the short-term (1 month), and the time nearness to a 52-week high is significantly longer than those close to the historic high, which parallels our expectations. Panel B illustrates a correlation coefficient between X_{52} and X_{max} of 0.56, which is higher than expected. However, these two variables' market return forecasting operates in contradictory directions; therefore, these two variables will incorporated into the forecast regression.

Table 1: Descriptive Statistics

Panel A： Summary Statistics

	R_t	X_{52}	X_{max}	D_t	I_t
Mean	0.00	0.84	0.57	0.02	0.13
Std.	0.09	0.16	0.17	0.15	0.34
Skewness	-0.24	-1.30	0.54	6.30	2.18
Kurtosis	7.22	4.52	3.09	40.70	5.75

Panel B：Correlation Matrix

	R_t	X_{52}	X_{max}	D_t	I_t
R_t	1.00				
X_{52}	0.34	1.00			
X_{max}	0.26	0.56	1.00		
D_t	0.31	0.15	0.41	1.00	
I_t	0.05	-0.22	0.44	0.40	1.00

Panel A presents the forecast variables' mean, standard deviation, skewness, and kurtosis. R_t represents the abnormal return of the past one month; X_{52} represents the extent of the Taiwan Stock Exchange's weighted index approaching a 52-week high; X_{max} represents the extent of the Taiwan Stock Exchange's weighted index approaching a historic high; D_t represents the Taiwan Stock Exchange's weighted index reaching a historic high; I_t represent the Taiwan Stock Exchange's weighted index reaching a new high. Panel B explains the same forecast variables through the correlation matrix. The sample period of the Taiwan Stock Exchange's weighted index occurs between June 1986 to May 2016.

We utilize the past 30 years of data from the Taiwan Stock Exchange's weighted index to test the model's applicability. Table 2 illustrates the results, and indicates that $X_{52,t}$, the proxy variable for investor underreaction, has a strong and positive explanatory ability for future abnormal returns (1, 3, 6, and 12

months) and increases through the period. This begins with 1 month, at 0.06, to 12 months, at 0.72, and positively relates to future returns, which fits the assumption that compensatory growth follows investor underreaction. Table 2 also reveals that the other variable $X_{max,t}$, a proxy for investor overreaction, has a significantly negative explanatory ability over various future periods of abnormal returns, from -0.09 at 1 month, declining to -1.13 at 12 months. The absolute value increases with the return forecast over time, which fits the assumption that compensatory decline follows investor overreaction. Although the correlation index of X_{52} and X_{max} is quite high (0.56), our forecast variance inflation factor is 2.9, or significantly less than the recommended value of 10 proposed by Kutner, Nachtsheim, and Neter (2004). This demonstrates that our empirical result is not affected by multicollinearity.

Further, only the abnormal return from the past 6 months $R_{pass,t}$ can explain the negative relationship of future abnormal returns, as no other group has such explanatory ability. Only the one-month holding from the historic high in the Taiwan Stock Exchange's weighted index exhibits a positive relationship with future abnormal returns, while other groups do not indicate this significance. Finally, the I_t variable, which implies investor underreaction, displays a significant, positive relationship with future abnormal returns in all groups; therefore, in the process of reaching a new high, compensatory growth is apparent due to investors' underreactions. Generally, Table 2 displays the significant under- and overreaction anomaly in the Taiwan Stock Exchange's weighted index. As the examination method mirrors Li and Yu's (2012) offered assumption, not the only G7 nation can be explained by this method when it is applied to the Taiwan share market such would still offer sound explanatory ability.

Table 2: Monthly Overlapping Regression – Taiwan Stock Exchange's Weighted Index

Horizon	R_t	X_{52}	X_{max}	D_t	I_t	R^2
1 Month	0.07	0.06***	-0.09***	0.07*	0.03*	0.03
	(1.61)	(3.91)	(-3.81)	(1.84)	(1.91)	
3 Months	0.06	0.19***	-0.31***	-0.06	0.16***	0.04
	(1.25)	(6.76)	(-6.80)	(-1.07)	(5.00)	
6 Months	-0.07**	0.46***	-0.73***	-0.01	0.32***	0.10
	(-2.53)	(12.85)	(-12.69)	(-0.10)	(7.66)	
12 Months	-0.04	0.72***	-1.13***	0.15	0.45***	0.12
	(-1.35)	(15.70)	(-15.33)	(0.95)	(10.37)	

This table adopts a monthly overlapping regression, expressed as follows: $R_{future,t} = \alpha_0 + \beta_1 R_{pass,t} + \beta_2 X_{52,t} + \beta_3 X_{max,t} + \beta_4 D_t + \beta_5 I_t + \varepsilon_t$ *where* $R_{future,t}$ *represents future (1, 3, 6, and 12-month) abnormal returns;* $R_{pass,t}$ *represents the past (1, 3, 6, and 12-month) abnormal returns and corresponding future abnormal returns;* $X_{52,t}$ *represents the extent of the Taiwan Stock Exchange's weighted index approaching the 52-week high;* $X_{max,t}$ *represents the extent of the Taiwan Stock Exchange's weighted index approaching a historic high;* D_t *represents the Taiwan Stock Exchange's weighted index reaching a historic high; and* I_t *represents the Taiwan Stock Exchange's weighted index reaching a new high. The risk-free rate, used to calculate the abnormal rate of return, is the one-year fixed-term deposit offered by the First Bank of Taiwan. The sample period for the Taiwan Stock Exchange's weighted index data spans June 1986 to May 2016, and sampling occurs on a monthly basis, with the Newey-West control used to contain heteroscedasticity and autocorrelation. The t-values are presented in brackets. *, **, and *** represent 10%, 5%, and 1% levels of significance, respectively*

Section 170 of Taiwan's Corporations Law states that an annual shareholders' meeting is to be held within six months after the end of the financial year, and relevant financial reports should accompany this meeting, which explains why most publicly traded firms publish their financial reports before the end of June every year. Therefore, in compliance with Fama and French's (1993) methodology, which utilizes the annual change-in-weight method to define SMB and HML. Grouping by size is conducted by an observation of the firm's market value one trading day before each first trading day in June from 1995 to 2015. Stocks are categorized as "big" or "small," or B (50%) and S (50%). Similarly, the book-to-market value is calculated using the first trading day in June compared to the net value of the first quarterly report with the market value at the end of May. After excluding firms with negative net value, the sample is reorganized from big to small, and further categorized into "high" (30%), "medium" (40%), and "low" (30%). Two of each are then cross-grouped into six combinations, namely "SL," "SM," "SH," "BL," "BM," and "BH," and the returns for each of the six are then calculated, from June of the current year to May of the following year. The size premium is represented by (SMB = [(SL + SM + SH) – (BL + BM + BH)] / 3), and the book-to-market premium is represented by (HML = [(SH + BH) – (SL + BL)] / 2).

The market risk premium is represented by (RMF = Rm – Rf), where Rm is the return from the Taiwan Stock Exchange's weighted index; and Rf is the risk-free rate for the First Bank of Taiwan's one-year term deposit. The asset portfolio's abnormal return is represented by (RPF = Rp – Rf), where Rp is the weighted return of six combinations, namely SL, SM, SH, BL, BM, and BH; the intercept α (Jensen's alpha) is the indicator for abnormal returns. If α is significant, the asset portfolio bears abnormal returns that cannot be explained by the three-factor model. Taiwan's stock market has a large number of small shares, and great disparity in its larger stocks, as the value of the top 20 largest stocks exceeds 50% of the entire market. Concerning this specific characteristic of Taiwan's share market, value weights cannot be used to capture the effects of small stocks. We use avoid any distortion of our results by adopting the equal-weight method to calculate the weighting, and specifically DeBondt and Thaler's (1985) calculation method for the accumulative abnormal returns for the 1-, 3-, 6-, and 12-month holding periods. The defining three-factor model, based on the above description, is as follows:

$$RPF_t = \alpha + \beta_1 RMF_t + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t \quad (4)$$

It is noteworthy that Li and Yu's (2012) reference index (Equation 3) would no longer stand after grouping the samples; hence, we must reconstruct the asset portfolio index. Another grouping method is noted below that considers the Taiwan Stock Exchange's rule (Equation 5), and the groups' weighted stock price index is shown in the following expression:

$$INDEX = \sum_{t=1}^{n} P_t Q_t \; / \; BV \times 100 \quad (5)$$

The INDEX is given by the market value of total shares issued (PtQt) divided by the base value (BV), then multiplied by 100. The base value is the market value of the total shares issued from the first transaction day; the adjustment point for the base value occurs at the first transaction in June. The adjustment is conducted by multiplying the previous base value by the compared value of the total market value prior to the change.

EMPIRICAL RESULTS

This research provides an empirical study of the prices of publicly traded firms listed on the Taiwan Stock Exchange, with a data set spanning 1995 to 2015. The first part of the empirical examination involves the behavioral perspective, comparing the under- and overreaction anomalies under a book-to-market ratio grouping, with the differences in reaction between value stocks and growth stocks. The firm size grouping allows us to examine the differences in price reactions between large and small stocks; the study further extends to explore an explanation for the difference in the groupings by book-to-market ratio and firm size. The second part of this examination begins with the traditional perspective, and compares not only value and growth stocks, but also large and small stocks, using Fama and French's (1993) three-factor method to explain the difference in abnormal returns. This is followed by an examination of our results' robustness.

Under- and Overreaction Phenomenon

This section analyzes groupings by the book-to-market ratio and firm size. Table 3 illustrates the overlapping regression result of grouping by the book-to-market ratio. The result of the value stock analysis in Panel A indicates that both variables X_{52} and X_{max} have the capability to forecast future abnormal returns, and such a capability expands with the increase in the holding period. This result

demonstrates that Taiwan's stock market exhibits apparent under- and overreaction. The extent of underreaction increases from 0.11 at 1 month to 1.15 at 12 months; the extent of overreaction increases from -0.11 at 1 month to -1.14 at 12 months. The explanatory capability improves with an increase in the holding period, from 0.04 at 1 month to 0.31 at 12 months. The analysis result for normal stocks in Panel B approximates that in Panel A, but the related reaction is reduced for future abnormal returns. Alternatively, the results in Panel C reveal that only the 6-month period is not significant for X_{52}, as the 1-, 3-, and 12-month holdings indicate significant relationships. The 1-, 6-, and 12-month holding periods all demonstrated significant relationships for X_{max}, while the 3-month period did not. The results in Panel C also indicate that all the groups except for the 6-month holding period exhibit underreactions, while all groups except for the 3-month holding period display the overreaction phenomenon.

The short-term share price momentum displayed in Table 3 is the same as Rosenberg, Reid, and Lanstein's (1985), in which firms with high book-to-market ratio have higher average returns. This also corresponds with Fama and French's (1998) notion that value stocks have higher future returns, and further explains that firms with higher book-to-market ratios (value stocks) are more capable of generating abnormal rates of return than those with low book-to-market ratios. A significant relationship is demonstrated between the variable X_{52} and value stocks toward future abnormal returns for the 6-month holding period, whereas growth stocks do not indicate such a phenomenon. The three-factor model's book-to-market effect confirms that the HML factor includes the underreaction phenomenon. Similarly, the variable X_{max} also confirms that the HML factor exhibits an overreaction phenomenon for the 3-month holding period. Overall, Table 3 reveals that value stocks have both under- and overreaction phenomenon. However, growth stocks' under- and overreactions are not as consistent.

Table 3: Monthly Overlapping Regression – Grouping by Book-to-Market Ratio

	Horizon	1 Month	3 Months	6 Months	12 Months
Panel A: Value Stocks					
	X_{52}	0.11***	0.35***	0.63***	1.15***
		(3.44)	(6.26)	(9.49)	(15.30)
	X_{max}	-0.11***	-0.35***	-0.6***	-1.14***
		(-3.16)	(-5.51)	(-7.93)	(-12.93)
	R^2	0.04	0.09	0.21	0.31
Panel B: Normal Stocks					
	X_{52}	0.05***	0.16***	0.36***	0.61***
		(2.61)	(4.38)	(8.98)	(12.54)
	X_{max}	-0.05**	-0.17***	-0.37***	-0.63***
		(-2.31)	(-3.88)	(-7.39)	(-10.11)
	R^2	0.02	0.04	0.12	0.20
Panel C: Growth Stocks					
	X_{52}	0.05***	0.07*	-0.08	-0.09*
		(2.69)	(1.65)	(-1.5)	(-1.65)
	X_{max}	-0.05**	-0.04	0.21***	0.32***
		(-2.18)	(-0.73)	(3.28)	(4.67)
	R^2	0.02	0.05	0.18	0.34

This table displays the result of the monthly overlapping regression, as follows: $R_{future,t} = \alpha_0 + \beta_1 R_{pass,t} + \beta_2 X_{52,t} + \beta_3 X_{max,t} + \beta_4 D_t + \beta_5 I_t + \varepsilon_t$ *where* $R_{future,t}$ *represents the future abnormal returns (at 1, 3, 6, and 12 months);* $R_{pass,t}$ *represents the past abnormal returns (1, 3, 6, and 12 months) and the corresponding future abnormal returns;* $X_{52,t}$ *represents the extent of the Taiwan Stock Exchange's weighted index reaching its 52-week high;* $X_{max,t}$ *represents the extent of the Taiwan Stock Exchange's weighted index reaching its historical high;* D_t *represents the Taiwan Stock Exchange's weighted index reaching its historical high;* I_t *represents the Taiwan Stock Exchange's weighted index reaching a new high. The risk-free rate for the calculation of abnormal returns is that of the First Bank of Taiwan's one-year term deposit rate. The sample period of the Taiwan Stock Exchange's weighted index spans June 1995 to May 2015, and sampling is conducted monthly. A Newey-West t-statistic is adopted to control for heteroskedasticity and autocorrelation, with the t-values noted in brackets. *, **, and *** represent the 10%, 5%, and 1% levels of significance, respectively.*

Table 4 notes the overlapping period regression result for the grouping by firm size. The analysis for small stocks in Panel A reveals that X_{52} and X_{max}, which respectively proxy for under- and overreaction, are extremely capable of forecasting future abnormal returns. The value of X_{52}increases from 0.18 at 1 month, 0.73 at 6 months, and to 0.53 at 12 months, where it approximates the 3-month level. This indicates that small stocks in Taiwan's stock market demonstrate significant under- and overreaction anomalies, and the extent of underreaction increases in the withholding period while

demonstrating an expansionary trend. Alternatively, a similar situation appears in the overreaction, with an expansion from -0.2 at 1 month to -0.69 at 6 months, ultimately reaching -0.34 at 12 months. Panel A in Table 4 indicates that the extent of small stocks' under- and overreactions both peak at six months, then decline thereafter. The model's explanatory capability increases with the withholding period, with 0.08 at 1 month to 0.22 at 12 months. An analysis of large stocks, in Table 4, Panel B indicates that the underreaction anomaly is only apparent under the 1- and 12-month holding periods, relative to the future abnormal returns of 0.04 and 0.18. No significant relationship exists in the 3- and 6-month holding periods. Overreaction anomalies show no significant relationship in large stocks, regardless of the holding period. The model's explanatory capability approximates that of small stocks, in which withholding periods are expanded, from 0.04 at 1 month to 0.40 at 12 months.

Table 4 notes that large stocks' under- and overreactions are less significant than those of small stocks. This short-term momentum result is similar to Banz's (1981) finding, in which small firms provide higher returns than large firms. Further, a future abnormal return is positively associated with X_{52}, a proxy for underreaction; and negatively associated with X_{max}, a proxy for overreaction. This finding also parallels the assumptions outlined in Li and Yu's (2012) method. We can compare the performance of X_{52} in small and large stocks to observe that these stocks appear to exhibit both significant and non-significant relative associations for the 3- and 6-month holding periods, and by defining size effects, we can confirm that the SMB factor covers the underreaction anomaly; following the same method, the utilization of X_{max} also confirms the 1- to 12-month holding period groups, with the SMB factor covering the overreaction anomaly. Generally, Table 4 indicates that small stocks exhibit consistent under- and overreactions, whereas such an anomaly is mostly not significant for large stocks.

Table 4: Monthly Overlapping Regression – Grouping by Firm Size

	Horizon	1 Month	3 Months	6 Months	12 Months
Panel A: Small Stocks					
	X_{52}	0.18***	0.54***	0.73***	0.53***
		(5.82)	(8.71)	(7.88)	(5.36)
	X_{max}	-0.20***	-0.58***	-0.69***	-0.34***
		(-5.53)	(-7.83)	(-6.19)	(-2.73)
	R^2	0.08	0.10	0.17	0.22
Panel B: Large Stocks					
	X_{52}	0.04**	0.05	0.04	0.18***
		(2.00)	(1.20)	(0.73)	(3.18)
	X_{max}	-0.04	-0.01	0.08	-0.01
		(-1.44)	(-0.15)	(1.31)	(-0.13)
	R^2	0.04	0.11	0.26	0.40

*Taiwan Stock Exchange's weighted index reaching its historical high; and I_t represents the Taiwan Stock Exchange's weighted index reaching a new high. The risk-free rate for the calculation of abnormal returns is that of the First Bank of Taiwan's one-year term deposit rate. The sample period of the Taiwan Stock Exchange's weighted index spans June 1995 to May 2015, with sampling conducted monthly. A Newey-West t-statistic is adopted to control for heteroskedasticity and autocorrelation, with t-values noted within brackets. *, **, and *** represent 10%, 5%, and 1% levels of significance, respectively.*

We combine the results of Tables 3 and 4 to confirm that various holding period groups capture both under- and overreactions, and especially in Table 3, Panel C, in which growth stocks with 6- and 12-month holding periods indicate the X_{52} variable changes from positive to negative. Further, the X_{max} variable changes from an expected negative value to a positive value. Therefore, we presume that it is likely that an interference factor exists in the holding period groups of 6 months and longer, but the discussion of such a topic shall be left for future research.

The Three-Factor Model's Explanatory Capability

As the explanatory result is obtained after grouping, it is necessary to be prudent with the research by

conducting tests prior to the grouping process. An observation of Tables 3 and 4 regarding the reaction of holding periods prior to grouping reveals that value stocks exhibit high levels of significance for the 3-month holding period group in Table 3, when comparisons are made between the coefficients of variables X_{52} and X_{max}. However, growth stocks indicate marginal and no significance for these coefficients, respectively; the 3-month group in Table 4 reveals significant coefficients of variables X_{52} and X_{max} with small stocks, but not with large stocks. Therefore, the 3-month holding period group can, in theory, completely capture the under- and overreaction anomalies through the calculations made on the HML and SMB factors.

The regression analysis of the three-factor model results is quite meaningful. If the intercept α still has the explanatory capability for the asset portfolio's future returns, then this reveals that other characteristics still exist that the model cannot capture, aside from the momentum and reversal factors. If the intercept α does not have the explanatory capability for the asset portfolio's future returns, then the three-factor model does completely explain future returns. We test the 3-month holding period group, meanwhile extending our test to subsamples from various periods. As there appears to be a 10-year cycle in Taiwan's share market, we segment the data into three subsamples, with each sample including a 10-year period. The subsamples cover the 1997 Asian financial crisis, the 2000 technology bubble, the 2007 subprime crisis, and the 2008 global financial crisis. We can use the frequency and length of the subsamples' systemic risk to determine whether our findings are robust; Table 5 illustrates these results.

Table 5: Three-Factor Model Regression Analysis

	RMF	SMB	HML	α	R-squared
Sample A: 06/1995–05/2015					
	1.1004***	0.8963***	0.2059***	0.0020*	0.9395
	(122.2059)	(35.8085)	(19.5420)	(1.6840)	
Sample B: 06/1995–05/2005					
	1.0710***	1.0630***	0.1934***	-0.0028	0.9442
	(88.6076)	(31.5415)	(16.1242)	(-1.6010)	
Sample C: 06/2000–05/2010					
	1.1036***	0.8831***	0.2172***	0.0007	0.8885
	(61.5883)	(16.8372)	(11.9012)	(1.2747)	
Sample D: 06/2005–05/2015					
	1.1408***	0.6206***	0.2104***	0.0084***	0.9460
	(91.5360)	(18.3760)	(8.0475)	(5.6846)	

*The three-factor model in this table is expressed as follows: $RPF = \alpha + \beta_1 RMF + \beta_2 SMB + \beta_3 HML + \varepsilon i$ where RPF represents the asset portfolio's abnormal returns; RMF represents the market risk premium; SMB represents the size premium; and HML represents the book-to-market premium. The risk-free rate used to calculate abnormal returns is sourced from the First Bank of Taiwan's one-year term deposit rate. The sample period spans June 1995 to May 2015. The asset portfolio's holding period is 3 months. The grouping standard is determined by whether the firm issues cash dividends. The t-values are noted within brackets. *, **, and *** represent 10%, 5%, and 1% levels of significance, respectively.*

Table 5 indicate that all three factors, RMF, SMB, and HML, are significant; therefore, these factors can properly explain abnormal returns. As we have confirmed that overreaction can be captured by the HML factor, and underreaction can be captured by SMB and HML, the three factors should theoretically be able to completely explain abnormal returns. Therefore, the intercept α is critically significant. We discover that the subsample's intercept α in Table 5, Panel A, is not meaningful. The intercept α of the subsample in Panel D displays high significance, indicating that the intercept α of Panel A exhibits marginal significance due to the effect of the 2005 to 2015 subsample.

An interesting phenomenon is apparent in Taiwan's stock market, in that a major change has occurred in the investment structure in the past 20 years ("Securities Trading Value Percentage by Type of Investors" is presented in the Appendix). There is a decline in the overall composition of individual investors, from 45.84% in 1995 to 26.62% as of 2015. In a period of relatively higher-level individual investors, the

three-factor model's explanation as outlined in Table 5, Panel B proves our inference. In a period with a relatively low level of individual investors, other characteristics still cannot be captured by the three-factor model. These results fit our assumption from Section 2, in which important information other than the market index would invite individual investors' attention, consequently contributing to the prices of shares in their possession. Meanwhile, we also proved that the asset portfolio index has the same effect as the Dow Jones index, as noted by Li and Yu (2012).

CONCLUSION

This study discusses the under- and overreaction phenomenon from the behavioral finance perspective. The measures adopted in past literature are primarily based on comparisons of different investment strategies. Li and Yu (2012) contrast traditional methods by proving that the market index, approaching 52-week and historic highs, can respectively proxy for under- and overreaction based on the anchoring mentality and investors' limited attention. Such a method has an adequate forecast capability, and is not affected by macroeconomic variables; however, the proxy variables should be attached to a highly exposed market index for it to endure. As a vast amount of information exists, we believe that investors are still attracted to information other than that of the market index, and ultimately react based on the prices of the stocks that they possess. If various shares are perceived as a category portfolio, with an index formed according to the market index, we anticipate that such an index would also exhibit under- and overreaction phenomenon.

This research utilizes as its subject the publicly traded stocks listed on the Taiwan Stock Exchange, and the empirical result indicates that aside from under- and overreactions, changes in investor composition in this stock market lead to the changes in these phenomena. A measurement (by the portfolio index) of investors' reaction in the representative category portfolio and group, by both the book-to-market and size factors, captures this under- and overreaction phenomenon. An examination using the three-factor model reveals that other characteristics still exist in periods with low levels of personal investors that cannot be captured by the three-factor method. However, the three-factor model has a complete explanatory capability for abnormal returns during periods more highly composed of individual investors. The results fit our inference, in which investors would still focus their attention on other important information aside from a highly exposed market index, and subsequently react. This proves that the category asset portfolio index has the same effect as the Dow Jones index, as adopted by Li and Yu (2012).

This study extends an application of the methodology to measure investor reaction, as posited by Li and Yu (2012). Although this does not include the highly exposed information readily available to investors, one can still utilize the asset portfolio-grouping method to measure and observe investors' under- and overreactions. This stealth index greatly improves the methodology's practicality, further enhancing the breadth of the subject under investigation, and no longer limiting it to market indices. As this study utilizes a three-factor model to test its robustness, an analysis is conducted regarding the asset groups categorized by firm size, value stocks, and growth stocks, but does not further analyze other firm characteristics. Moreover, the growth stocks within the 6-month holding period group display signs in the opposite direction, as anticipated; we logically suspect that the existence of an unknown interfering factor or the holding period's length causes investors' different reactions. Therefore, we recommend that subsequent research also conducts further groupings based on other firm characteristics, aside from the asset portfolio's holding period, as well as a more detailed examination of the sub-grouping, by considering the behavioral perspective to investigate the causes of under- and overreactions. The method adopted by this research has newly illuminated the debate between the rationalist and three-factor momentum effects in the behaviorist perspective, in terms of the use of HML and SMB factors to capture under- and overreaction phenomena. This clarifies the debate by reexamining the arguments proposed in past literature.

The development of the Taiwanese stock market lags behind those in developed nations; hence, the financial dataset's span is restricted to a 20-year period. Therefore, certain observed values are sacrificed due to incomplete firm data. We recommend that future studies adopt data from more advanced markets

as the subject of research for a more robust examination. More importantly, the investors in more advanced markets are psychologically more mature. The aforementioned conditions would then be more advantageous for a longer period of study, and international data would allow our research to be more complete. Finally, it is not possible to obtain detailed data on the transaction parties' categories due to data limitations. The depth of this research has exhibited minor inadequacies, as only the transaction parties' primary category can be obtained. If future research allows for the gathering of such detailed data, we recommend that further examination be conducted regarding specific investor types to develop more objective results.

APPENDIX

Appendix A: Securities Trading Value Percentage by Type of Investors

Unit: %

Year	Domestic Individual		Domestic Juridical Person		Foreign Individual		Foreign Juridical Person	
	Purchase	*Sale*	*Purchase*	*Sale*	*Purchase*	*Sale*	*Purchase*	*Sale*
1990	48.36	48.30	1.63	1.68	0.00	0.01	0.00	0.01
1991	48.56	48.35	1.41	1.62	0.00	0.00	0.04	0.01
1992	48.08	48.02	1.80	1.84	0.00	0.01	0.13	0.12
1993	46.95	47.18	2.70	2.67	0.00	0.01	0.36	0.13
1994	46.75	46.75	2.89	2.92	0.00	0.01	0.36	0.32
1995	45.84	46.08	3.37	3.32	0.00	0.01	0.78	0.59
1996	44.60	44.65	4.28	4.34	0.00	0.01	1.12	1.00
1997	45.43	45.29	3.77	3.78	0.00	0.01	0.79	0.92
1998	44.92	44.81	4.27	4.36	0.00	0.01	0.81	0.81
1999	44.05	44.17	4.53	4.83	0.00	0.01	1.41	0.99
2000	42.83	43.27	5.28	4.99	0.00	0.01	1.89	1.73
2001	42.02	42.39	4.72	4.97	0.00	0.01	3.26	2.63
2002	41.20	41.10	4.95	5.10	0.52	0.45	3.34	3.34
2003	38.62	39.22	5.39	6.12	0.74	0.50	5.25	4.16
2004	37.82	38.12	5.63	5.93	0.92	0.71	5.62	5.25
2005	34.02	34.82	6.10	7.19	1.36	1.05	8.52	6.94
2006	34.87	35.69	5.36	5.68	1.21	1.04	8.57	7.58
2007	33.51	33.75	6.57	6.44	1.07	1.04	8.85	8.77
2008	31.10	30.56	7.18	6.79	1.05	1.21	10.67	11.45
2009	35.67	36.38	5.75	5.84	0.02	0.02	8.56	7.76
2010	33.83	34.12	6.69	6.89	0.02	0.02	9.46	8.97
2011	31.48	31.26	7.87	7.58	0.02	0.02	10.63	11.15
2012	30.72	31.32	7.80	7.55	0.01	0.04	11.47	11.10
2013	29.24	29.92	8.12	8.05	0.01	0.02	12.63	12.01
2014	29.02	29.77	8.69	8.72	0.01	0.02	12.27	11.49
2015	26.62	26.65	9.14	9.21	0.01	0.01	14.23	14.13
2016	28.41	27.20	8.26	8.33	0.01	0.01	13.32	14.46

Source: The Taiwan Securities Exchange

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