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The 52-week high, momentum, and investor sentiment☆

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ABSTRACT

This paper examines the link between the profitability of the 52-week high momentum strategy and investor sentiment. We hypothesize that investors' investment decisions are subject to behavioral biases when the level of investor sentiment is high, resulting in higher profits for the 52-week high momentum following high-sentiment periods. Our empirical results confirm this prediction. In addition, we find that the significant profit of the 52-week high momentum following high-sentiment periods persists up to five years. Further investigations show that the strong persistence of the 52-week high winners (losers) is concentrated in stocks with higher (lower) earnings surprises, especially during periods following high sentiment. Overall, our results provide supportive evidence for the anchoring biases in explaining the 52-week high momentum, especially when the role of investor sentiment is taken into account.

1. Introduction

In the finance literature, understanding the nature of intermediate-term return continuations obtained by momentum strategies has been an important issue over the past two decades. Among potential explanations, behavioral theories have played an important role in explaining the momentum returns.[1] For example, Barberis, Shleifer, and Vishny (1998) and Hong and Stein (1999) show that investors' underreaction to information can generate momentum returns. Daniel, Hirshleifer, and Subrahmanyam (1998) propose a theoretical model that incorporates overconfidence and self-attribution biases to describe simultaneously the return patterns of intermediate-term momentum and long-term reversals.

Based on an alternative behavioral theory of the adjustment and anchoring biases (Kahneman, Slovic, & Tversky, 1982; Kahneman & Tversky, 1979), George and Hwang (2004) propose a new measure based on nearness to the 52-week high price to explain the profits from momentum investing. They rank individual stocks according to the ratio of their current price to the 52-week high price and show that stocks with the highest ratios outperform those with the lowest ratios over the subsequent 6 to 12 months. George and Hwang (2004) argue that the profitability of their 52-week high strategy arises because of the misreaction of investors on stocks that approach their 52-week high prices. Using the 52-week high as a reference point in evaluating the impact of news, when good (bad) news has pushed a stock's price near to (far from) its 52-week high, traders are reluctant to bid the price of

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[1] In addition to behavioral theories, researchers have also documented supportive evidence for the risk-based explanations on momentum profits. For example, Johnson (2002) proposes a theoretical model to show that momentum profits can reflect temporary increases in growth-related risk for winner-minus-loser portfolios. Liu and Zhang (2008) empirically demonstrate that winner stocks have temporarily higher loadings than loser stocks on the growth rate of industrial production and that more than half of momentum profits are explained by risk factors. Furthermore, there is also evidence indicating that momentum profits are related to firm characteristics that are associated with neither risk factors nor behavioral biases. Lee and Swaminathan (2000) find that past trading volume predicts both the magnitude and persistence of momentum returns. Avramov, Chordia, Jostova, and Philipov (2007), on the other hand, establish a robust link between momentum and credit rating.

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the stock higher (lower) even if the information warrants it. The information on the good (bad) news eventually prevails, and the price of the stock goes up (down), resulting in subsequent continuation.

The aim of this paper is to examine whether the profitability of the 52-week high strategy can in fact be attributed to investors' anchoring biases as suggested by George and Hwang (2004). We examine whether profits from the 52-week high momentum are concentrated in high-sentiment periods and, if so, whether this concentration is due to anchoring biases. To address this issue, we identify time periods with different states of investor sentiment based on recent findings in the literature. We hypothesize that investors' investment decisions are subject to anchoring biases especially when the level of investor sentiment is high, resulting in higher profit for the 52-week high strategy in high-sentiment periods. The profit of the 52-week high strategy following low-sentiment periods, on the other hand, is expected to be insignificant.

Our investigation is motivated by Stambaugh, Yu, and Yuan (2012) and Yu and Yuan (2011), who argue that behavioral biases arise because sentiment traders exert greater influence during high-sentiment periods.[2] However, our prediction on how investor sentiment affects the 52-week high profits is distinct from the argument of Stambaugh et al., who hypothesize that the presence of sentiment effects is prominent because of two important concepts in the literature. First, they consider investor sentiment as a market-wide effect that influences prices on many securities in the same direction. Second, according to Miller (1977), overpricing is more difficult to be arbitraged away than underpricing due to short-sale constraints. As a result, they predict that the profits of asset-pricing anomalies are concentrated in the underperformance of the short position following high sentiment. Because it is the anchoring bias that underpins the profitability of the 52-week high strategy, investors are more conservative when a stock's price is close to or away from its past 52-week high price, resulting in subsequent underreaction to the underpricing of 52-week high winners and the overpricing of 52-week high losers. If the anchoring bias is strengthened during periods of higher sentiment, we expect that investor sentiment has symmetrical effects on both long and short positions of the 52-week high strategy. That is, we hypothesize that the profit of the 52-week high strategy following high-sentiment periods is attributed to both outperformance of 52-week high winners and underperformance of 52-week high losers.

Following prior literature, we use the market-wide investor sentiment index constructed by Baker and Wurgler (2006) to measure the magnitude of behavioral biases. Using the cross-sectional regression approach proposed by George and Hwang (2004) that controls for other momentum effects, we show that over a six-month holding period, the 52-week high strategy generates a significant average monthly return of 1.396% following high-sentiment periods and an insignificant average monthly return of 0.056% following low-sentiment periods. Our results are robust when returns are adjusted by Fama and French's (1993) three-factor model, thus ruling out the possibility that the risk-based model influences our results. Furthermore, we find that the significant profit for the 52-week high strategy following high-sentiment periods persists up to five years. The 52-week high strategy following low-sentiment periods, however, does not exhibit any discernable continuation or reversal patterns in the subsequent five years.

Our empirical results suggest that sentiment enhances the effect of anchoring biases on both 52-week high winners and losers, as investors are more likely to be subject to the anchoring biases following high-sentiment periods in both cases. We demonstrate that following high-sentiment periods not only the past 52-week high losers generate significantly low returns but also the past 52-week high winners exhibit superior performance in the following year. Anchoring biases significantly affect 52-week high momentum of winners and losers, although the effect on losers is stronger in magnitude. Our study is related to Antoniou, Doukas, and Subrahmanyam (2013), who document that Jegadeesh and Titman's (1993) price momentum is related to investor sentiment. However, combining investors' cognitive dissonance with the slow-diffusion hypothesis of Hong and Stein (1999), Antoniou et al. show empirically that return continuation exists only when information is opposite to the direction of sentiment and that such phenomenon is more pronounced for past-return losers in optimistic sentiment periods because costly short selling on loser stocks impedes the arbitrage of cognitive dissonance in these states. Our evidence of significant effects of sentiment on both 52-week high winners and losers is in contrast to the findings of Antoniou et al.

Further, we do not find evidence of long-term reversal for the 52-week high strategy, which is consistent with George and Hwang (2004). When sentiment states are taken into account, we find long-term persistence for the 52-week high strategy up to five years after the portfolio formation following high-sentiment periods. If momentum returns are driven by the slow diffusion argument of Hong and Stein (1999), momentum returns should be followed by long-term reversals, particularly following high-sentiment periods, as documented in Antoniou et al. (2013). Our findings contradict the predictions of Hong and Stein and Antoniou et al. Thus the profitability of the 52-week high momentum is more likely due to anchoring biases rather than slow information diffusion.

To understand the nature of the significant profitability and persistence of the 52-week high strategy following high-sentiment states, we further examine whether the 52-week high serves as an explicit anchor for investors in evaluating earnings news about the firm. The investigation is motivated by George, Hwang, and Li (2013), who suggest that the momentum profits are induced because of investors' anchoring behavior on the 52-week high at earnings announcements. By incorporating the standardized unexpected earnings (SUE) to measure earnings surprises into our analysis, we show that the strong return continuation of the 52-week high strategy following high-sentiment periods is concentrated in the 52-week high winners with higher earnings surprises and the 52-week high losers with lower earnings surprises. In addition, the long-term persistence is induced by the continuously higher (lower) earnings surprises of the 52-week high winners (losers) in the subsequent second to fifth year after the construction of the 52-week high strategy.

Our results are robust in several aspects. First, motivated by the argument of Baker and Wurgler (2006, 2007) and Kumar (2009) that investors' behavioral biases are particularly stronger for small firms, we examine whether firm size influences our results. By dividing the sample into two groups based on market capitalizations, we show that the profitability of the 52-week high momentum is robust to firm size and that the 52-week high strategy based on small firms generates higher momentum returns following high-sentiment states. Second, we show that our results are robust to the consideration of the market states, which is motivated by Cooper, Gutierrez, and Hameed's (2004) argument that behavioral biases are accentuated after market gains, hence inducing higher momentum returns. We confirm that the 52-week high momentum is more significant after market gains. However, investor sentiment retains its incremental power in explaining the profits of the 52-week high even after accounting for market states. Third, arguing that the momentum profits are explained by time-varying expected returns that are related to business cycles, Chordia and Shivakumar (2002) empirically document that momentum returns are significantly positive during expansions and negative during recessions. We show that the relation between the profitability of the 52-week high momentum strategy and investor sentiment is robust in both

[2] Stambaugh et al. (2012) empirically test the relation between 11 asset-pricing anomalies and investor sentiment and find that each of the anomalies is stronger following high levels of investor sentiment. Yu and Yuan (2011) show that the correlation between the market's expected return and its volatility is positive during low-sentiment periods and almost flat during high-sentiment periods. They conclude that the market is less rational during high-sentiment periods due to higher participation by noise traders in such periods.

expansionary and recessionary periods. This finding partly suggests that our results are not captured by risk-based explanations. Finally, we show that our results are robust to different cutoff points of investor sentiment, thus ruling out potential data-mining biases.

This paper has several implications to the asset-pricing literature. First, although George and Hwang (2004) demonstrate the use of 52-week high prices as possible reference points in making investment decisions, we show that the presence of the anchoring bias is state dependent and can be captured by investor sentiment. The evidence suggests that investors can take market sentiment into consideration when adopting the 52-week high momentum to seek for possible profits. Second, Stambaugh et al. (2012) and Antoniou et al. (2013) both find that investor sentiment accounts for the risk premia of asset-pricing anomalies and that its effect is stronger for the short position (or the loser portfolio) due to short-sale impediments. As our finding shows that investor sentiment influences on both 52-week high winners and losers simultaneously, it suggests that in addition to short-sale constraints, anchoring bias can also result in impediments to arbitrage.

Finally, we find a strong persistence following high-sentiment periods for the 52-week high momentum up to five years after the portfolio formation. This result is related to findings of Lee and Swaminathan (2000), who show that the information contained in stocks' past trading volume can be useful in reconciling the intermediate-term continuation and long-term reversal effects. Our evidence suggests that a state variable such as investor sentiment may contain information that can be used to distinguish between continuation and reversal effects, a phenomenon that has not been documented in the prior literature.

The remainder of this paper is organized as follows. Section 2 describes the data and the construction of the 52-week high momentum. Section 3 discusses the impact of investor sentiment on the profitability and the long-term persistence of the 52-week high momentum. Section 4 further analyzes the role of the anchoring bias in the relation between the 52-week high momentum and investor sentiment. Section 5 provides several robustness tests, including the effects of firm size, market states and different definitions of sentiment states. Section 6 concludes this paper.

2. Data and construction of the 52-week high momentum

Our sample comprises all common stocks listed on the NYSE, the AMEX, and NASDAQ over the period from July 1965 to December 2010. We obtain prices and returns adjusted for stock splits and dividends using the price-adjustment factor for individual stocks from the Center for Research in Security Prices (CRSP) database. As in Bhootra (2011), we exclude stocks with prices below $5 at the end of the portfolio formation month to avoid the illiquidity and thin-traded problems.

As in George and Hwang (2004), we define the 52-week high of a stock as the highest closing price of the stock during the past 52-weeks. At the end of each month, we compute the proximity of current price to the 52-week high price as:

$$52WH = \frac{current\ price}{52 - week\ high\ price}. \quad (1)$$

The higher values of 52WH indicate that the current price of a stock is closer to its 52-week high price. The highest possible value of 52WH is 1, which occurs when the end-of-month price is the 52-week high price.

In addition to the 52WH measure, we also consider alternative strategies based on Jegadeesh and Titman's (1993) price momentum (denoted as JT) and Moskowitz and Grinblatt's (1999) industry momentum (denoted as MG) for comparisons. The JT measure is defined as the cumulative return of a stock over the past 12 months. The MG measure is defined as the cumulative value-weighted return over the past 12 months of the industry to which the stock belongs. As in Moskowitz and Grinblatt (1999), we allocate the stocks into 20 industries based on their two-digit SIC codes to calculate the returns for the industry portfolios.

Our analysis of the 52-week high momentum strategy follows the approach proposed by Jegadeesh and Titman (1993), which has been widely adopted in the literature (e.g., Chan, Jegadeesh, & Lakonishok, 1996; George & Hwang, 2004; Griffin, Ji, & Martin, 2002; Grundy & Martin, 2001; Gutierrez & Pirinsky, 2007; Jegadeesh & Titman, 2001; Rouwenhorst, 1998, 1999). In each month t, we rank individual stocks into 10 deciles according to their values of 52WH. Stocks with 52WH values ranked at the top 30% are assigned to the winner portfolio, and those with 52WH values ranked at the bottom 30% are assigned to the loser portfolio. These portfolios are equally weighted. As in Jegadeesh and Titman (1993, 2001), the 52-week high momentum strategy is to buy the winner portfolio and sell short the loser portfolio for the subsequent K months ($K = 3, 6, 9, 12$) with a month skipped between the formation period and holding period. In each month t, the return on the 52-week high momentum is calculated as the difference between the winner and loser portfolio returns, averaged across K separate positions, each formed in one of the K consecutive prior months from $t - K$ to $t - 1$. We test the average returns with t-statistics adjusted for autocorrelation and heteroskedasticity using Newey and West's (1987) standard errors.

Panel A of Table 1 reports raw returns and Fama–French adjusted returns on the 52-week high momentum strategy for the holding periods of one to four quarters. The Fama–French adjusted returns are obtained from the intercepts by regressing the raw returns on Fama and French's (1993) three-factor model. The 3-, 6-, 9-, and 12-month average monthly returns of the 52-week high momentum are 0.753%, 0.713%, 0.625%, and 0.505%, respectively, which are all statistically significant at the 1% level. The 52-week high momentum still retains its significance after adjusting for the Fama–French three-factor model across all holding horizons. To ensure that the results are not affected by the way that winners and losers are defined, we report the momentum returns using the 10% cutoffs for winners and losers in Panel B. The results show that the 52-week high momentum strategy obtains even higher returns when winners and losers are defined with relatively extreme 52WH values. Overall, consistent with George and Hwang (2004), we find supportive evidence for strong momentum based on the nearness of current price to the 52-week high price.

3. The 52-week high momentum and investor sentiment

3.1. Returns of the 52-week high momentum and sentiment states: portfolio analysis

Our focus is on whether the profitability of the 52-week high momentum is related to investor sentiment. To test this relation, it is important to identify the state of investor sentiment. We measure investor sentiment using the monthly market-based sentiment series constructed by Baker and Wurgler (2006; hereafter BW), which has been widely adopted in the recent literature (e.g., Berger & Turtle, 2012; Clement, Hales, & Xue, 2011; Hribar & McInnis, 2012; Livnat & Petrovits, 2009; McLean & Zhao, 2014; Mian & Sankaraguruswamy, 2012; Stambaugh et al., 2012; Yu & Yuan, 2011). Adopting the BW measure has two major advantages. First, Baker and Wurgler form their composite index by taking the first principal component of six measures of investor sentiment, which contains a wide range of sentiment information. Second, the BW sentiment index spans over 45 years, from July 1965 to December 2010, and hence provides a longer sample period for our analysis.

The BW sentiment index is downloaded from Jeffrey Wurgler's website.[3] To identify high and low investor sentiment periods, we

[3] See http://pages.stern.nyu.edu/~jwurgler/. We adopt the orthogonalized sentiment index with respect to a set of macroeconomic conditions.

Table 1
Profits of the 52-week high momentum strategy.

In each month t from July 1965 to December 2010, we rank individual stocks into 10 deciles according to their values on 52WH. Panel A (Panel B) reports the average returns for the winner and loser portfolios, which comprise stocks with their 52WH values ranked at the top and bottom 30% (10%) and the return differences between winners and losers. We calculate equally-weighted returns for these portfolios and hold the portfolios for the subsequent K months (K = 3, 6, 9, 12) with a month skipped between the formation and holding periods. In addition to the raw returns, we also report the results using Fama–French adjusted returns. Numbers in the parentheses are the t-statistics calculated using Newey and West's (1987) robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Portfolio	Raw returns				Fama–French adjusted returns			
	3 month	6 month	9 month	12 month	3 month	6 month	9 month	12 month
Panel A: 30% cutoff								
Winner	1.382***	1.367***	1.330***	1.277***	1.423***	1.415***	1.383***	1.335***
	(6.44)	(6.35)	(6.11)	(5.82)	(6.53)	(6.43)	(6.21)	(5.92)
Loser	0.629**	0.654**	0.705**	0.772**	0.766**	0.785**	0.827**	0.889***
	(1.99)	(2.06)	(2.21)	(2.41)	(2.29)	(2.33)	(2.45)	(2.63)
Winner–Loser	0.753***	0.713***	0.625***	0.505***	0.658***	0.630***	0.556***	0.445***
	(4.79)	(4.64)	(4.26)	(3.57)	(3.82)	(3.74)	(3.45)	(2.87)
Panel B: 10% cutoff								
Winner	1.440***	1.422***	1.376***	1.312***	1.477***	1.464***	1.425***	1.368***
	(6.61)	(6.49)	(6.21)	(5.87)	(6.74)	(6.62)	(6.35)	(6.02)
Loser	0.370	0.407	0.482	0.580	0.554	0.573	0.636*	0.727*
	(1.05)	(1.15)	(1.36)	(1.64)	(1.48)	(1.51)	(1.69)	(1.93)
Winner–loser	1.075***	1.020***	0.900***	0.738***	0.931***	0.898***	0.796***	0.648***
	(4.87)	(4.75)	(4.44)	(3.82)	(3.86)	(3.81)	(3.57)	(3.06)

follow the methodology proposed by Antoniou et al. (2013). First, we calculate a weighted-rolling average of the sentiment level for the three months prior to the end of the formation period, with a weight of 3 for the sentiment in the prior month, 2 for the sentiment in the month prior to that, and 1 for the sentiment three months prior to the current month. We then classify a formation period as high-sentiment if the three-month rolling average ending in month t is in the top 30% of the three-month rolling-average sentiment. Similarly, a formation period is classified as low-sentiment if the three-month rolling average ending in month t is in the bottom 30% of the three-month rolling-average sentiment.

Next, because the 52-week high momentum is formed from overlapping portfolios, in each holding month the strategy holds stocks from different formation periods, across which the level of sentiment may differ. We follow Antoniou et al. (2013) by defining a particular holding-period month as high-sentiment (low-sentiment) if all the formation periods (past 12 months) are classified as high-sentiment (low-sentiment), with the rest defined as mild-sentiment months.

To test whether the returns of the 52-week high momentum are significantly different from zero in each sentiment state, we perform the following time-series regression:

$$MOM_{K,t} = \alpha_1 HIGH_t + \alpha_2 MILD_t + \alpha_3 LOW_t + \varepsilon_{K,t}, \quad (2)$$

where $MOM_{K,t}$ is the return of the 52-week high momentum with the holding period of K months (K = 3, 6, 9, 12) in month t; $HIGH_t$ is the high-sentiment dummy, which equals 1 if month t belongs to high-sentiment periods; $MILD_t$ is the mild-sentiment dummy, which equals 1 if month t belongs to mild-sentiment periods; and LOW_t is the low-sentiment dummy, which equals 1 if month t belongs to low-sentiment periods. Furthermore, to test whether the average return of the 52-week high momentum in high-sentiment periods is significantly different from that in low-sentiment periods, we perform the following time-series regression:

$$MOM_{K,t} = \alpha_0 + \alpha_1 HIGH_t + \alpha_2 MILD_{tt} + \varepsilon_{K,t}. \quad (3)$$

The estimated value of α_1 represents the difference in average returns between high- and low-sentiment periods. We test the coefficients in Eqs. (2) and (3) with t-statistics adjusted for autocorrelation and heteroskedasticity using Newey and West's (1987) standard errors.

Panel A of Table 2 reports the regression results from Eqs. (2) and (3) for the returns of 52-week high momentum with 3-, 6-, 9-, and 12-month holding periods. The results show consistent evidence that the profit of the 52-week high momentum is sensitive to the BW measure of investor sentiment. Taking K = 3 for example, the average monthly momentum return is 1.389% (t-statistic = 3.37) in high-sentiment periods, decreases to 0.679% (t-statistic = 3.16) in mild-sentiment periods, and declines further to 0.279% (t-statistic = 0.86) in low-sentiment periods. The difference between high- and low-sentiment periods (i.e., α_1 in Eq. (3)) is 1.110% per month with a t-statistic of 2.12. The results are quantitatively and statistically similar when the holding period is extended to 6, 9, or 12 months. Taking a closer look at the winner portfolio across sentiment periods, we find that the returns are all significantly positive regardless of the level of sentiment, and we do not observe a particular monotonic pattern on the returns of the winner portfolio. The returns of the loser portfolio, however, display a monotonic increasing pattern from high- to low-sentiment periods. Because we do not control for the impact of the price and industry momentum strategies here, the return patterns of the portfolio analyses may contain other confounding effects. Later we show that after controlling for the effects of the price and industry momentum strategies the return of the 52-week high winners is positively related to the level of sentiment.

Although the results in Panel A of Table 2 suggest that investor sentiment has a significant impact on the profitability of the 52-week high momentum, we cannot rule out the possibility that the source of these patterns is driven by risk factors. To tackle this issue, we estimate the risk-adjusted momentum returns across different sentiment states in accordance with Cooper et al. (2004) and Antoniou et al. (2013). For each winner and loser portfolio with the holding period of K months, we regress the portfolio returns on Fama and French's (1993) factors to obtain the estimated factor loadings, which enable us to derive the risk-adjusted returns as follows:

$$r^{ADJ}_{p,K,t} = r_{p,K,t} - \beta_{p,K,RMRF} F_{RMRF,t} - \beta_{p,K,SMB} F_{SMB,t} - \beta_{p,K,HML} F_{HML,t}, \quad (4)$$

where $r_{p,K,t}$ is the return of (winner or loser) portfolio p with K-month holding-horizon in month t; $F_{RMRF,t}$, $F_{SMB,t}$, and $F_{HML,t}$ are the factor realizations of Fama and French's market, small-minus-big, and high-minus-low factors in month t, respectively; and $\beta_{RMRF,t}$, $\beta_{SMB,t}$, and $\beta_{HML,t}$ are the corresponding estimated factor loadings for portfolio p with K-month holding horizon. Once we obtain the adjusted return, we reestimate Eqs. (2) and (3) with $r^{ADJ}_{Winner,K,t}$, $r^{ADJ}_{Loser,K,t}$, and $r^{ADJ}_{Winner,K,t} - r^{ADJ}_{Loser,K,t}$ as the dependent variables, respectively. Panel B provides the results.

Table 2
Profits of the 52-week high momentum strategy following high- and low-sentiment periods.

In each month *t* from July 1965 to December 2010, we rank individual stocks into 10 deciles according to their values on 52WH. Panels A and B report the average raw and Fama–French adjusted returns, respectively, for the winner and loser portfolios, which comprise stocks with their 52WH values ranked at the top and bottom 30% and the return differences between winner and losers. We calculate equally weighted returns for these portfolios and hold the portfolios for the subsequent *K* months (*K* = 3, 6, 9, 12) with a month skipped between the formation and holding periods. We measure investor sentiment using the monthly market-based sentiment series constructed by Baker and Wurgler (2006). To identify whether the sentiment during a particular formation period is high or low, we calculate a weighted-rolling average of the sentiment level for the three months prior to the end of the formation period, with a weight of 3 for the sentiment in the prior month, 2 for the sentiment in the month prior to that, and 1 for the sentiment three months prior to the current month. We then classify a formation period as high-sentiment (low-sentiment) if the three-month rolling average ending in month *t* belongs in the top (bottom) 30% of the three-month rolling average sentiment time series. To test whether momentum profits in each sentiment state are equal to zero, we regress the time series of average monthly momentum profits on HIGH, MILD, and LOW sentiment dummies, with no intercept. To test whether the average return of the 52-week high momentum in high-sentiment periods is significantly different from that in low-sentiment periods, we regress the time series of average monthly momentum profits on HIGH and MILD sentiment dummies with a constant. Numbers in the parentheses are the *t*-statistics calculated using Newey and West's (1987) robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Sentiment	3-Month return			6-Month return			9-Month return			12-Month return		
State	Winner	Loser	Winner–loser	Winner	Loser	Winner–loser	Winner	Loser	Winner–loser	Winner	Loser	Winner–loser
Panel A: raw returns												
HIGH	1.569***	0.181	1.389***	1.559***	0.176	1.382***	1.501***	0.197	1.305***	1.445***	0.234	1.211***
	(2.83)	(0.21)	(3.37)	(2.82)	(0.21)	(3.36)	(2.74)	(0.23)	(3.13)	(2.64)	(0.28)	(2.92)
MILD	1.182***	0.502	0.679***	1.150***	0.525	0.625***	1.110***	0.594	0.516***	1.057***	0.677*	0.380**
	(4.24)	(1.22)	(3.16)	(4.13)	(1.27)	(3.06)	(3.94)	(1.45)	(2.74)	(3.73)	(1.65)	(2.15)
LOW	2.016***	1.738**	0.279	2.037***	1.765**	0.273	2.043***	1.800**	0.243	2.001***	1.862**	0.139
	(4.25)	(2.38)	(0.86)	(4.31)	(2.41)	(0.87)	(4.24)	(2.48)	(0.84)	(4.07)	(2.58)	(0.51)
HIGH–LOW			1.110**			1.109**			1.062**			1.072**
			(2.12)			(2.14)			(2.09)			(2.16)
Panel B: Fama–French adjusted returns												
HIGH	1.642***	0.377	1.264***	1.637***	0.365	1.272***	1.590***	0.372	1.218***	1.538***	0.408	1.130***
	(2.96)	(0.44)	(3.01)	(2.95)	(0.43)	(3.05)	(2.89)	(0.43)	(2.88)	(2.78)	(0.48)	(2.69)
MILD	1.206***	0.605	0.601***	1.181***	0.623	0.558***	1.145***	0.687	0.458**	1.096***	0.766*	0.330*
	(4.30)	(1.42)	(2.76)	(4.19)	(1.47)	(2.69)	(4.01)	(1.63)	(2.38)	(3.81)	(1.82)	(1.83)
LOW	2.086***	1.951***	0.134	2.112***	1.968***	0.143	2.123***	1.993***	0.130	2.087***	2.049***	0.038
	(4.34)	(2.60)	(0.40)	(4.41)	(2.62)	(0.44)	(4.36)	(2.67)	(0.43)	(4.19)	(2.77)	(0.13)
HIGH–LOW			1.130**			1.129**			1.088**			1.092**
			(2.10)			(2.13)			(2.09)			(2.15)

Compared with the numbers reported in Panel A of Table 2, the results controlling for risk as reported in Panel B remain unchanged. The profits for the 52-week high momentum are significantly positive in high-sentiment periods and insignificant in low-sentiment periods across the four sets of holding horizons. The overall results confirm our conjecture that the 52-week high momentum exhibits more pronounced return continuations during high-sentiment periods. The fact that the 52-week high momentum profit is significant only in high-sentiment periods but not in low-sentiment periods indicates that investor sentiment plays an important role in explaining the source of the 52-week high momentum and that it is likely driven by the magnified effect of anchoring biases during such periods. We provide further evidence to support this hypothesis in Section 4.

3.2. Results from the George–Hwang style cross-sectional regressions

In addition to the portfolio analysis, we also perform the Fama and MacBeth (1973) style cross-sectional regression developed by George and Hwang (2004) to examine the relation between profits on the 52-week high momentum and investor sentiment. A major advantage of this approach is that by hedging out the impact of other strategies and other control variables, we can isolate the confounding effects due to microstructure problems such as the bid–ask bounce and the interactions of different momentum strategies. As a result, we can facilitate the estimation of the net premium related to each momentum strategy. In the cross-sectional regressions, we simultaneously consider the 52WH, JT, and MG measures, expressed as follows (for $j = 2$ to $j = 7$ or $j = 2$ to $j = 13$):

$$r_{i,t} = b_{0jt} + b_{1jt} r_{i,t-1} + b_{2jt} SIZE_{i,t-1} + b_{3jt} JTH_{i,t-j} + b_{4jt} JTL_{i,t-j} + b_{5jt} MGH_{i,t-j} + b_{6jt} MGL_{i,t-j} + b_{7jt} 52WHH_{i,t-j} + b_{8jt} 52WHL_{i,t-j} + \varepsilon_{i,t}, \quad (5)$$

where $r_{i,\,t}$ is the return of stock i in month t; $SIZE_{i,\,t-1}$ is the natural logarithm of stock i's market capitalization at the end of previous month; $JTH_{i,\,t-j}$ ($JTL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's JT measure is in the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $MGH_{i,\,t-j}$ ($MGL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's MG measure is in the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $52WHH_{i,\,t-j}$ ($52WHL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's 52WH measure is in the top (bottom) 30% at the end of month $t - j$, and zero otherwise. We skip one month because of the short-term return reversals documented in the literature (Jegadeesh, 1990; Lo & MacKinlay, 1990). In addition, we include $r_{i,\,t-1}$ and $SIZE_{i,\,t-1}$ to control for the bid–ask bounce and small-firm effects.

In each month t, we estimate 6 (or 12) cross-sectional regressions for $j = 2$ to $j = 7$ (or $j = 2$ to $j = 13$) and average the corresponding coefficient estimates. For example, the return of pure 52WH winner (loser) portfolio with the six-month holding period in month t is calculated as $\overline{b}_{7t} = \frac{1}{6}\sum_{j=2}^{7} b_{7jt}$ ($\overline{b}_{8t} = \frac{1}{6}\sum_{j=2}^{7} b_{8jt}$). The difference between $\overline{b}_{7t}$ and $\overline{b}_{8t}$ is thus the net return of the 52-week high momentum controlling for the JT and MG momentum measures and other confounding effects. We report the time-series averages of the corresponding coefficients as the raw returns of the winner and loser portfolios in the subsequent tables. We also obtain the intercepts from a time-series regression of monthly returns of the portfolio on the contemporaneous Fama–French three factors to adjust for risks.

Table 3
The profitability of the momentum strategies: Cross-sectional regressions

In each month t from July 1965 to December 2010, we perform the following 6 or 12 cross-sectional regressions (for $j = 2$ to $j = 7$ or $j = 2$ to $j = 13$):

$$r_{i,t} = b_{0jt} + b_{1jt} r_{i,t-1} + b_{2jt} SIZE_{i,t-1} + b_{3jt} JTH_{i,t-j} + b_{4jt} JTL_{i,t-j} + b_{5jt} MGH_{i,t-j} + b_{6jt} MGL_{i,t-j} + b_{7jt} 52WHH_{i,t-j} + b_{8jt} 52WHL_{i,t-j} + \varepsilon_{i,t},$$

where $r_{i,t}$ is the return of stock i in month t; $SIZE_{i,t-1}$ is the natural logarithm of stock i's market capitalization at the end of previous month; and $JTH_{i,t-j}$ ($JTL_{i,t-j}$) is a dummy variable that equals 1 if stock i's JT measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $MGH_{i,t-j}$ ($MGL_{i,t-j}$) is a dummy variable that equals 1 if stock i's MG measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $52WHH_{i,t-j}$ ($52WHL_{i,t-j}$) is a dummy variable that equals 1 if stock i's 52WH measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise. In each month t, we estimate 6 (or 12) cross-sectional regressions for $j = 2$ to $j = 7$ (or $j = 2$ to $j = 13$) and average the corresponding coefficient estimates. To obtain risk-adjusted returns, we perform time-series regressions of these averages (one for each average) on the contemporaneous Fama–French factor realizations to hedge out the factor exposure. Numbers in the parentheses are the t-statistics calculated using Newey and West's (1987) robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Variable	Raw return (2,7)		Raw return (2,13)		FF–adj. return (2,7)		FF–adj. return (2,13)	
	Jan. Inc.	Jan. Exc.	Jan. Inc.	Jan. Exc.	Jan. Inc.	Jan. Exc.	Jan. Inc.	Jan. Exc.
Intercept	2.219***	1.421***	2.155***	1.336***	1.403***	0.914***	1.329***	0.817***
	(6.06)	(4.07)	(5.84)	(3.78)	(7.77)	(5.52)	(7.27)	(4.93)
$r_{i,t-1}$	−0.056***	−0.046***	−0.057***	−0.047***	−0.052***	−0.045***	−0.053***	−0.046***
	(−13.68)	(−12.56)	(−13.81)	(−12.72)	(−14.49)	(−14.11)	(−14.53)	(−14.18)
SIZE	−0.203***	−0.086**	−0.190***	−0.070*	−0.170***	−0.083***	−0.155***	−0.066**
	(−5.08)	(−2.32)	(−4.74)	(−1.88)	(−5.63)	(−3.07)	(−5.10)	(−2.43)
JTH	0.026	0.018	−0.092	−0.105	0.016	0.019	−0.103**	−0.106**
	(0.27)	(0.18)	(−1.03)	(−1.06)	(0.27)	(0.33)	(−2.04)	(−2.16)
JTL	−0.175**	−0.327***	−0.107	−0.248***	−0.260***	−0.394***	−0.194***	−0.312***
	(−2.06)	(−3.86)	(−1.43)	(−3.33)	(−3.85)	(−6.04)	(−3.41)	(−5.68)
MGH	0.317***	0.293***	0.159**	0.143*	0.320***	0.297***	0.172***	0.159**
	(3.72)	(3.27)	(1.99)	(1.66)	(4.95)	(4.44)	(2.86)	(2.58)
MGL	−0.239***	−0.228***	−0.162**	−0.151**	−0.237***	−0.225***	−0.172***	−0.152**
	(−3.08)	(−2.87)	(−2.24)	(−2.10)	(−3.74)	(−3.47)	(−2.98)	(−2.58)
52*WHH*	0.158***	0.207***	0.148***	0.192***	0.265***	0.279***	0.253***	0.263***
	(2.84)	(3.69)	(3.04)	(3.83)	(8.00)	(8.33)	(9.39)	(9.51)
52*WHL*	−0.355***	−0.540***	−0.232**	−0.409***	−0.455***	−0.594***	−0.331***	−0.464***
	(−3.42)	(−4.92)	(−2.38)	(−4.15)	(−6.37)	(−8.96)	(−5.26)	(−7.92)
JTH–JTL	0.201	0.345***	0.014	0.143	0.277***	0.413***	0.091	0.206***
	(1.58)	(2.65)	(0.13)	(1.26)	(2.66)	(4.12)	(1.10)	(2.59)
MGH–MGL	0.556***	0.521***	0.321***	0.294**	0.557***	0.522***	0.344***	0.311***
	(4.41)	(4.05)	(2.68)	(2.39)	(5.72)	(5.25)	(3.83)	(3.41)
52*WHH*–52*WHL*	0.513***	0.747***	0.380***	0.602***	0.720***	0.874***	0.584***	0.727***
	(3.49)	(4.86)	(2.83)	(4.39)	(8.07)	(10.34)	(7.74)	(10.11)

Once we have the time series of the average coefficients from the George–Hwang style regressions, we regress these coefficients on high-, mild-, and low-sentiment dummies as described in Section 3.1 to isolate the return patterns of these winner and loser portfolios in different sentiment states. Specifically, to examine the effect of sentiment states on the pure return of the 52-week high momentum, we perform the following regressions:

$$\bar{b}_{7t} - \bar{b}_{8t} = \alpha_1 HIGH_t + \alpha_2 MILD_t + \alpha_3 LOW_t + \varepsilon_t, \quad (6)$$

and

$$\bar{b}_{7t} - \bar{b}_{8t} = \alpha_0 + \alpha_1 HIGH_t + \alpha_2 MILD_{tt} + \varepsilon_t. \quad (7)$$

Similarly, we test the coefficients from above equations using Newey and West's (1987) standard errors to adjust for autocorrelation and heteroskedasticity.

In Table 3, we report the regression results of Eq. (5) to compare the relative profitability of the 52WH, JT, and MG strategies. The top panel reports the regression results, and the bottom panel displays the "pure" profits for the three momentum strategies. Consistent with George and Hwang (2004), the 52-week high strategy dominates the other strategies in magnitude and statistical significance, especially when January months are excluded. When January is excluded, the 52-week high momentum strategy yields an average return of 0.747% (0.602%) per month when the strategy is held for 6 (12) months, which is much higher than 0.345% (0.143%) for the 6 (12) month JT strategy and 0.521% (0.294%) for the 6 (12) month MG strategy. Moreover, the dominance is even stronger when returns are adjusted by the Fama–-French three-factor model.

To test further the robustness of our previous finding of the sentiment effect by controlling for other momentum effects, we regress the coefficients from Eq. (5) on high-, mild-, and low-sentiment dummies. Table 4 reports the results.[4] As in Table 3, the overall results with the 12-month holding period are quite similar to those with the 6-month holding period. The average monthly returns on the 52-week high strategy ($\bar{b}_{7t} - \bar{b}_{8t}$) with the six-month holding period are 1.396%, 0.361% and 0.056% following high-, mild-, and low-sentiment periods, respectively. The difference in returns of the 52-week high strategy between high- and low-sentiment periods is 1.340% per month with a t-statistic of 3.20, indicating that the effect of investor sentiment on the profitability of the 52-week high strategy is robust with the inclusion of other momentum effects. Compared with the numbers reported in Table 3, profit of the 52-week high strategy following high-sentiment periods is more than double the average 52-week high profit across all periods (1.396% vs. 0.513%), suggesting the economic significance of

[4] To conserve space, we omit the coefficients that are related to the size and lag returns, which are available upon request. In addition, the results for the Fama–French three-factor model adjusted returns as the dependent variable are similar and available upon request.

Table 4
Cross-sectional regressions conditional on different sentiment states.

In each month t from July 1965 to December 2010, we perform the following 6 or 12 cross-sectional regressions (for $j = 2$ to $j = 7$ or $j = 2$ to $j = 13$):

$$r_{i,t} = b_{0jt} + b_{1jt} r_{i,t-1} + b_{2jt} SIZE_{i,t-1} + b_{3jt} JTH_{i,t-j} + b_{4jt} JTL_{i,t-j} + b_{5jt} MGH_{i,t-j} + b_{6jt} MGL_{i,t-j} + b_{7jt} 52WHH_{i,t-j} + b_{8jt} 52WHL_{i,t-j} + \varepsilon_{i,t},$$

where $r_{i,t}$ is the return of stock i in month t; $SIZE_{i,t-1}$ is the natural logarithm of stock i's market capitalization at the end of previous month; $JTH_{i,t-j}$ ($JTL_{i,t-j}$) is a dummy variable that equals 1 if stock i's JT measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $MGH_{i,t-j}$ ($MGL_{i,t-j}$) is a dummy variable that equals 1 if stock i's MG measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; and $52WHH_{i,t-j}$ ($52WHL_{i,t-j}$) is a dummy variable that equals 1 if stock i's 52WH measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise. In each month t, we estimate 6 (or 12) cross-sectional regressions for $j = 2$ to $j = 7$ (or $j = 2$ to $j = 13$) and average the corresponding coefficient estimates. Once we have the time series of the average coefficients from the George–Hwang style regressions, we regress these coefficients on HIGH, MILD, and LOW sentiment dummies with no intercept to test whether momentum profits in each sentiment state are equal to zero. To test whether the average returns of the momentum strategies in high-sentiment periods are significantly different from that in low-sentiment periods, we regress the time series of average monthly momentum profits on HIGH and MILD sentiment dummies with a constant. Numbers in the parentheses are the t-statistics calculated using Newey and West's (1987) robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Variable	Raw return (2,7)				Raw return (2,13)			
	HIGH	MILD	LOW	HIGH-LOW	HIGH	MILD	LOW	HIGH–LOW
JTH	−0.384**	0.160	0.048	−0.433*	−0.538***	0.025	0.001	−0.540**
	(−2.00)	(1.14)	(0.28)	(−1.67)	(−2.79)	(0.20)	(0.01)	(−2.15)
JTL	−0.426***	−0.117	−0.004	−0.422**	−0.322**	−0.030	−0.033	−0.289*
	(−2.74)	(−0.93)	(−0.03)	(−2.08)	(−2.43)	(−0.27)	(−0.32)	(−1.74)
MGH	0.088	0.403***	0.301**	−0.213	0.026	0.219*	0.088	−0.062
	(0.67)	(3.20)	(2.07)	(−1.09)	(0.26)	(1.79)	(0.75)	(−0.40)
MGL	−0.524**	−0.268***	0.130	−0.653***	−0.351*	−0.194**	0.131	−0.482**
	(−2.28)	(−2.66)	(1.60)	(−2.69)	(−1.69)	(−2.02)	(1.62)	(−2.16)
52*WHH*	0.436***	0.146**	−0.086	0.522***	0.347***	0.145**	−0.056	0.403***
	(3.42)	(2.01)	(−0.78)	(3.10)	(2.87)	(2.30)	(−0.59)	(2.63)
52*WHL*	−0.960***	−0.215	−0.142	−0.818***	−0.837***	−0.084	−0.024	−0.812***
	(−4.36)	(−1.50)	(−0.77)	(−2.85)	(−4.17)	(−0.63)	(−0.13)	(−2.97)
JTH–JTL	0.042	0.276	0.052	−0.010	−0.216	0.055	0.034	−0.250
	(0.20)	(1.47)	(0.22)	(−0.03)	(−1.11)	(0.35)	(0.17)	(−0.90)
MGH–MGL	0.611**	0.671***	0.171	0.440	0.377	0.413**	−0.043	0.421
	(2.29)	(3.70)	(0.96)	(1.37)	(1.60)	(2.35)	(−0.26)	(1.46)
52*WHH*–52*WHL*	1.396***	0.361*	0.056	1.340***	1.184***	0.229	−0.032	1.215***
	(4.36)	(1.82)	(0.21)	(3.20)	(3.98)	(1.29)	(−0.12)	(3.05)

the 52-week high momentum following high-sentiment periods. In addition, no significant differences exist in the returns between high- and low-sentiment periods for Jegadeesh and Titman's (1993) price momentum and Moskowitz and Grinblatt's (1999) industry momentum strategies. Unlike Antoniou et al. (2013), we do not find a significant momentum return for the JT strategy following high-sentiment periods, indicating that the profitability of the JT strategy is subsumed by that of the 52-week high strategy. Overall, the results indicate that the 52-week high strategy plays a dominant role in momentum investing following high-sentiment periods. Again, these findings imply that the anchoring bias proposed by George and Hwang (2004), which leads to underreaction and generates the 52-week high momentum, is more pronounced when investor sentiment is high.

Taking a closer look at the returns of each winner and loser variable, we find different return patterns for the 52-week high winners and the JT/MG winners across sentiment periods. Based on Hong and Stein's (1999) theory, Antoniou et al. (2013) propose that information opposite to the direction of sentiment diffuses slowly and causes momentum. Specifically, their evidence shows that return continuation exists in past-return winners (losers) following pessimistic (optimistic) periods. Our results on the returns of *JTH* and *MGH* confirm the prediction of Antoniou et al. in that both *JTH* and *MGH* decrease as sentiment gets higher. However, we document a positive relation between the return on 52*WHH* and investor sentiment, which is inconsistent with the finding in Table 2. Taking the six-month holding period for example, the coefficients on 52*WHH* are 0.436%, 0.146% and −0.086% following high-, mild-, and low-sentiment periods, respectively. A major difference between Tables 2 and 4 is that the 52-week high winner returns reported in Table 2 may contain the confounding effects of JT and MG winners. After controlling the JT and MG effects, our results from Table 4 suggest that the 'pure' 52-week high winners generate higher returns following high-sentiment periods than following low-sentiment periods, which further confirms the effect of anchoring biases on the 52-week high strategy.

The most pronounced persistence comes from 52*WHL* following high-sentiment periods, which amounts to −0.960% (−0.837%) per month for $K = 6$ ($K = 12$), about twice the absolute magnitude as 52*WHH*. The result indicates that investors are reluctant to sell stocks when the price of the stock is far from its 52-week high price, resulting in significantly negative returns over the subsequent 6 or 12 months, especially when the sentiment is high. The stronger effect on losers than on winners is not surprising because short selling loser stocks is costly, as argued by D'Avolio (2002) and Antoniou et al. (2013). Our evidence suggests that the anchoring bias conditional on high-sentiment periods is an important source of the 52-week momentum returns.

3.3. Long-term persistence of the 52-week high strategy conditional on sentiment states

We find that investor sentiment has a significant impact on the 52-week high momentum; thus, it is interesting to examine further the return behavior of the 52-week high strategies in the long term following different states of investor sentiment. George and Hwang (2004) empirically show no evidence of long-term reversals for the 52-week high strategy. They conclude that short-term momentum and long-term reversals are separate phenomena, which contradict the underreaction theory of Barberis et al. (1998) and Hong and Stein (1999) and the overreaction theory of Daniel et al. (1998). In their result, short-term

Table 5
The persistence of momentum profits.

In each month t from July 1965 to December 2010, we perform the following 12 cross-sectional regressions (for $j = 14$ to $j = 25$ to $j = 50$ to $j = 61$):

$$r_{i,t} = b_{0jt} + b_{1jt} r_{i,t-1} + b_{2jt} SIZE_{i,t-1} + b_{3jt} JTH_{i,t-j} + b_{4jt} JTL_{i,t-j} + b_{5jt} MGH_{i,t-j} + b_{6jt} MGL_{i,t-j} + b_{7jt} 52WHH_{i,t-j} + b_{8jt} 52WHL_{i,t-j} + \varepsilon_{i,t},$$

where $r_{i,t}$ is the return of stock i in month t; $SIZE_{i,t-1}$ is the natural logarithm of stock i's market capitalization at the end of previous month; $JTH_{i,t-j}$ ($JTL_{i,t-j}$) is a dummy variable that equals 1 if stock i's JT measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $MGH_{i,t-j}$ ($MGL_{i,t-j}$) is a dummy variable that equals 1 if stock i's MG measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; and $52WHH_{i,t-j}$ ($52WHL_{i,t-j}$) is a dummy variable that equals 1 if stock i's 52WH measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise. In each month t, we estimate 12 cross-sectional regressions for $j = 14$ to $j = 25$ to $j = 50$ to $j = 61$ and average the corresponding coefficient estimates. Numbers in the parentheses are the t-statistics calculated using Newey and West's (1987) robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Variable	Raw return (14,25)		Raw return (26,37)		Raw return (38,49)		Raw return (50,61)	
	Jan. Inc.	Jan. Exc.	Jan. Inc.	Jan. Exc.	Jan. Inc.	Jan. Exc.	Jan. Inc.	Jan. Exc.
JTH	−0.234***	−0.255***	−0.158**	−0.194**	−0.088	−0.137	−0.122	−0.187**
	(−3.07)	(−3.06)	(−2.06)	(−2.43)	(−1.09)	(−1.64)	(−1.61)	(−2.33)
JTL	0.050	−0.071	0.013	−0.055	−0.028	−0.061	0.024	0.016
	(0.85)	(−1.34)	(0.24)	(−1.03)	(−0.61)	(−1.22)	(0.72)	(0.43)
MGH	−0.133*	−0.149*	−0.005	−0.024	0.053	0.031	0.027	0.024
	(−1.96)	(−1.94)	(−0.08)	(−0.34)	(0.91)	(0.51)	(0.35)	(0.32)
MGL	−0.028	−0.059	−0.102*	−0.114*	−0.022	−0.013	0.037	0.026
	(−0.36)	(−0.77)	(−1.76)	(−1.81)	(−0.37)	(−0.22)	(0.72)	(0.54)
52*WHH*	0.038	0.073*	0.000	0.046	0.015	0.040	−0.019	−0.001
	(0.92)	(1.76)	(0.00)	(1.05)	(0.38)	(0.97)	(−0.49)	(−0.03)
52*WHL*	0.020	−0.127	0.043	−0.072	−0.042	−0.120	−0.101	−0.161**
	(0.21)	(−1.35)	(0.51)	(−0.84)	(−0.56)	(−1.54)	(−1.51)	(−2.32)
JTH–JTL	−0.283***	−0.184**	−0.171**	−0.138*	−0.060	−0.076	−0.146**	−0.203***
	(−3.44)	(−2.23)	(−2.27)	(−1.79)	(−0.81)	(−1.00)	(−2.08)	(−2.82)
MGH–MGL	−0.105	−0.090	0.096	0.090	0.076	0.044	−0.009	−0.002
	(−1.03)	(−0.80)	(1.03)	(0.90)	(0.90)	(0.51)	(−0.10)	(−0.02)
52*WHH*–52*WHL*	0.017	0.200	−0.043	0.118	0.057	0.160	0.082	0.160
	(0.14)	(1.61)	(−0.36)	(0.98)	(0.55)	(1.46)	(0.84)	(1.57)

continuation is best characterized as an anchoring bias without overcorrection that results in long-term reversals. In Table 5, we first report the estimation results from Eq. (5) for $j = 14, \ldots, 25$ to $j = 50, \ldots, 61$, that is, for the holding period of the second to the fifth year. Consistent with George and Hwang (2004), our result suggests significant reversals for the JT strategy starting from the second year but insignificant returns for the MG and 52-week high strategies. The average monthly returns on the differences between *JTH* and *JTL* are significantly negative in the second, third, and fifth years, whereas those on *MGH–MGL* and 52*WHH*–52*WHL* are all insignificant across different holding periods. The evidence shows that the possibility of overreaction underlies the long-run return reversals for the JT strategy (see Barberis et al., 1998; Daniel et al., 1998; Hong & Stein, 1999), but not the MG and 52-week high strategies. Overall, our results are consistent with George and Hwang (2004), who do not find long-term reversals for the 52-week high strategy.

We next perform time-series regressions for the coefficients obtained from Eq. (5) with $j = 14, \ldots, 25$ to $j = 50, \ldots, 61$ on high-, mild-, and low-sentiment dummies as defined in Section 3.1. Table 6 provides the regression results. Several interesting results emerge. First, consistent with Antoniou et al. (2013), the JT strategy exhibits significant reversals only when sentiment is high. The coefficients on *JTH–JTL* following high-sentiment states are −0.535% (t-statistic = −2.29), −0.544% (t-statistic = −2.13), −0.332% (t-statistic = −2.06), and −0.433% (t-statistic = −2.93) for the holding period of the second, third, fourth, and fifth year, respectively. The returns on *JTH–JTL* following low-sentiment states are mostly insignificant, with the only exception of the marginal significance for the fourth year, which is −0.227% per month with a t-statistic of −1.81.

Second, our evidence reveals that the significantly positive returns on 52*WHH*–52*WHL* following high-sentiment states persist up to five years. The coefficients on 52*WHH*–52*WHL* following high-sentiment periods for the second to the fifth year are 0.891% (t-statistic = 3.83), 0.655% (t-statistic = 3.24), 0.603% (t-statistic = 2.99), and 0.774% (t-statistic = 3.78), respectively. The long-term returns on 52*WHH*–52*WHL* following low-sentiment periods, on the other hand, are all negative but insignificant. Finally, after high-sentiment periods, the reversal of the JT strategy mainly comes from the underperformance of the winner portfolios, while the outperformance of winner portfolios and the underperformance of the loser portfolios both contribute to the long-run return persistence of the 52-week high strategy. The phenomenon is observable from the significantly negative coefficients on *JTH* and 52*WHL*, as well as the significantly positive coefficients on 52*WHH* following high-sentiment periods.

Interestingly, we show a strong pattern of return persistence for the 52-week high strategy following high-sentiment periods. Our results show that the sources of the 52-week high momentum and the JT/MG strategies are likely to be different, which results in different short- and long-term return patterns conditional on investor sentiment. We next turn to the issue of the possible source of the strong and persistent momentum profits behind the 52-week high strategy following high-sentiment periods. We hypothesize that the adjustment and anchoring biases as argued by George and Hwang (2004) are an important driving force because behavior biases are likely to be stronger during high-sentiment periods. It is possible that market participants may be subject to anchoring bias when estimating a firm's profitability (Cen, Hilary, & Wei, 2013). We provide empirical evidence in the next section to support this hypothesis.

4. Tests of the anchoring effect: the role of analysts' earnings forecasts

To understand the nature of the strong profitability and persistence of the 52-week high strategy following high-sentiment states, we

Table 6
The persistence of momentum profits conditional on different sentiment states.

In each month t from July 1965 to December 2010, we perform the following 12 cross-sectional regressions (for $j = 14$ to $j = 25$ to $j = 50$ to $j = 61$):

$$r_{i,\,t} = b_{0jt} + b_{1jt}r_{i,\,t-1} + b_{2jt}SIZE_{i,\,t-1} + b_{3jt}JTH_{i,\,t-j} + b_{4jt}JTL_{i,\,t-j} + b_{5jt}MGH_{i,\,t-j} + b_{6jt}MGL_{i,\,t-j} + b_{7jt}52WHH_{i,\,t-j} + b_{8jt}52WHL_{i,\,t-j} + \varepsilon_{i,\,t},$$

where $r_{i,\,t}$ is the return of stock i in month t; $SIZE_{i,\,t-1}$ is the natural logarithm of stock i's market capitalization at the end of previous month; $JTH_{i,\,t-j}$ ($JTL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's JT measure is ranked at the top (bottom) 30% at the end of month $t-j$, and zero otherwise; $MGH_{i,\,t-j}$ ($MGL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's MG measure is ranked at the top (bottom) 30% at the end of month $t-j$, and zero otherwise; and $52WHH_{i,\,t-j}$ ($52WHL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's 52WH measure is ranked at the top (bottom) 30% at the end of month $t-j$, and zero otherwise. In each month t, we estimate 12 cross-sectional regressions for $j = 14$ to $j = 25$ to $j = 50$ to $j = 61$ and average the corresponding coefficient estimates. Once we have the time series of the average coefficients from the George–Hwang style regressions, we regress these coefficients on HIGH, MILD, and LOW sentiment dummies with no intercept to test whether momentum profits in each sentiment state are equal to zero. To test whether the average returns of the momentum strategies in high-sentiment periods are significantly different from that in low-sentiment periods, we regress the time series of average monthly momentum profits on HIGH and MILD sentiment dummies with a constant. Numbers in the parentheses are the t-statistics calculated using Newey and West's (1987) robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Raw return (14,25)			Raw return (26,37)			Raw return (38,49)			Raw return (50,61)		
	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW
JTH	−0.669***	−0.040	−0.629**	−0.712***	−0.042	−0.671***	−0.502***	−0.151	−0.351*	−0.511***	−0.038	−0.474**
	(−3.03)	(−0.30)	(−2.44)	(−3.36)	(−0.33)	(−2.72)	(−3.37)	(−1.17)	(−1.78)	(−3.61)	(−0.23)	(−2.21)
JTL	−0.134	0.090	−0.224	−0.168*	0.100	−0.269**	−0.170*	0.075	−0.245**	−0.078	0.157**	−0.235**
	(−1.43)	(0.81)	(−1.54)	(−1.82)	(1.25)	(−2.20)	(−1.87)	(1.09)	(−2.15)	(−1.15)	(2.57)	(−2.57)
MGH	−0.251	0.004	−0.255	−0.328*	−0.032	−0.296	0.006	−0.024	0.030	−0.053	−0.103	0.049
	(−1.10)	(0.04)	(−1.03)	(−1.67)	(−0.35)	(−1.36)	(0.04)	(−0.24)	(0.17)	(−0.35)	(−0.85)	(0.25)
MGL	0.033	−0.045	0.078	−0.176	−0.041	−0.135	−0.140	0.042	−0.182	0.002	0.056	−0.054
	(0.29)	(−0.47)	(0.52)	(−1.24)	(−0.49)	(−0.82)	(−0.90)	(0.39)	(−0.96)	(0.03)	(0.61)	(−0.44)
52*WHH*	0.295***	−0.122	0.417***	0.206***	−0.082	0.288**	0.169**	0.037	0.132	0.247***	−0.155	0.401***
	(2.89)	(−1.33)	(3.03)	(2.65)	(−0.85)	(2.32)	(2.19)	(0.49)	(1.23)	(2.84)	(−1.43)	(2.90)
52*WHL*	−0.596***	0.179	−0.775***	−0.449***	0.225	−0.673***	−0.434***	0.057	−0.491**	−0.528***	0.004	−0.532***
	(−3.91)	(1.04)	(−3.38)	(−3.11)	(1.25)	(−2.92)	(−3.04)	(0.36)	(−2.31)	(−3.95)	(0.03)	(−2.68)
JTH–JTL	−0.535**	−0.130	−0.405	−0.544**	−0.142	−0.402	−0.332**	−0.227*	−0.106	−0.433***	−0.194	−0.239
	(−2.29)	(−0.74)	(−1.38)	(−2.13)	(−1.22)	(−1.43)	(−2.06)	(−1.81)	(−0.52)	(−2.93)	(−1.19)	(−1.09)
MGH–MGL	−0.284	0.049	−0.333	−0.152	0.009	−0.161	0.146	−0.066	0.212	−0.056	−0.159	0.103
	(−1.13)	(0.33)	(−1.14)	(−0.57)	(0.06)	(−0.53)	(0.67)	(−0.46)	(0.81)	(−0.32)	(−0.88)	(0.41)
52*WHH*–52*WHL*	0.891***	−0.301	1.192***	0.655***	−0.307	0.961***	0.603***	−0.020	0.623**	0.774***	−0.159	0.934***
	(3.83)	(−1.25)	(3.57)	(3.24)	(−1.24)	(3.00)	(2.99)	(−0.10)	(2.19)	(3.78)	(−0.69)	(3.02)

further examine whether the 52-week high serves as an explicit anchor for investors in evaluating earnings news about the firm. The idea of incorporating earnings surprises as a measure of the anchoring bias is motivated by Cen et al.'s (2013) argument that market participants such as analysts and investors may be subject to a particular anchor when estimating the future profitability of a firm. They hypothesize that if the level of a firm's forecast earnings per share (EPS) is higher (lower) than its industry peers, analysts are reluctant to make earnings forecasts that further deviate from the current industry norm. As a result, stocks that are forecasted to have higher levels of EPS should significantly outperform their industry peers that are forecasted to have lower levels of EPS when stocks' true earnings are finally revealed, resulting in subsequent return predictability. George et al. (2013), on the other hand, show that investors tend to underreact to positive (negative) news of a firm when its current price is near (far from) its 52-week high price, which further induces the post earnings announcement drift in the subsequent six months. Their empirical results suggest that the momentum profits are induced by investors' anchoring behavior on the 52-week high at earnings announcements.

To examine whether the profitability and persistence of the 52-week high strategy following high-sentiment periods are related to the anchoring bias, we incorporate SUE into our analysis. We hypothesize that the strong return continuation of the 52-week high strategy following high-sentiment periods is concentrated in the 52-week high winners with higher earnings surprises and the 52-week high losers with lower earnings surprises. In addition, the long-term persistence is induced because the 52-week high winners (losers) continuously reveal higher (lower) earnings surprises in the subsequent second to fifth year after the construction of the 52-week high strategy.

To consider the effects of the 52-week high and earnings announcements simultaneously, we sort individual stocks independently by 52WH and by SUE in each month t. As in Chan et al. (1996) and Chordia and Shivakumar (2006), we calculate SUE as $(e_q - e_{q-4})/\sigma_q$, where e_q is the most recently announced earnings, e_{q-4} is the earnings in the same quarter of the previous year, and σ_q is the standard deviation of $e_q - e_{q-4}$ over the prior eight quarters. In each month t, we perform the following 12 cross-sectional regressions (for $j = 2$ to $j = 13$, $j = 14$ to j = 25, $j = 26$ to $j = 37$, $j = 38$ to $j = 49$ and $j = 50$ to $j = 61$):

$$\begin{aligned} r_{i,t} = {} & b_{0jt} + b_{1jt}r_{i,t-1} + b_{2jt}SIZE_{i,t-1} + b_{3jt}JTH_{i,t-j} + b_{4jt}JTL_{i,t-j} \\ & + b_{5jt}MGH_{i,t-j} + b_{6jt}MGL_{i,t-j} + b_{7jt}52WHH_{i,t-j} + b_{8jt}52WHL_{i,t-j} \\ & + b_{9jt}52WHH_{i,t-j} \times SUEH_{i,y-1} + b_{10jt}52WHL_{i,t-j} \times SUEL_{i,y-1} + \varepsilon_{i,t}, \end{aligned} \tag{8}$$

where $SUEH_{i,\,y-1}$ ($SUEL_{i,\,y-1}$) is a dummy variable that equals 1 if stock i's SUE measure is ranked at the top (bottom) 30% at the end of the previous year, and zero otherwise. For example, for the holding period of $j = 14$ to $j = 25$, a stock is ranked according to its SUE calculated at the end of the first year, and so on. The coefficient on the interaction between 52*WHH* and *SUEH* (b_{9jt}) captures the incremental effects of the 52-week high winners conditional on higher earnings surprises, while the coefficient on the interaction between 52*WHL* and *SUEL* (b_{10jt}) captures the incremental effects of the 52-week high losers conditional on lower earnings surprises. We then perform the time-series regressions of Eqs. (6) and (7) by using the coefficients obtained from Eq. (8) as the dependent variables. Table 7 gives the regression results.[5]

We first focus on the results based on the holding period of the first year, that is, for $j = 2$ to $j = 13$. The coefficient on $52WHH \times SUEH$ is 0.557% (with a t-statistic of 5.87) following periods of high-sentiment states and 0.485% (with a t-statistic of 4.56) following periods of low-

[5] To conserve space, we only report the coefficients that are related to the 52-week high variables. The coefficients on other variables are available upon request.

Table 7
The interaction effect between the 52-week high and standardized unexpected earnings conditional on different sentiment states.

In each month t from July 1965 to December 2010, we perform the following 12 cross-sectional regressions (for $j = 2$ to $j = 13$ to $j = 50$ to $j = 61$):

$$r_{i,t} = b_{0jt} + b_{1jt} r_{i,t-1} + b_{2jt} SIZE_{i,t-1} + b_{3jt} JTH_{i,t-j} + b_{4jt} JTL_{i,t-j} + b_{5jt} MGH_{i,t-j} + b_{6jt} MGL_{i,t-j} + b_{7jt} 52WHH_{i,t-j} + b_{8jt} 52WHL_{i,t-j} + b_{9jt} 52WHH_{i,t-j} \times SUEH_{i,y-1} + b_{10jt} 52WHL_{i,t-j} \times SUEL_{i,y-1} + \varepsilon_{i,t},$$

where $r_{i,t}$ is the return of stock i in month t; $SIZE_{i,t-1}$ is the natural logarithm of stock i's market capitalization at the end of previous month; $JTH_{i,t-j}$ ($JTL_{i,t-j}$) is a dummy variable that equals 1 if stock i's JT measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $MGH_{i,t-j}$ ($MGL_{i,t-j}$) is a dummy variable that equals 1 if stock i's MG measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $52WHH_{i,t-j}$ ($52WHL_{i,t-j}$) is a dummy variable that equals 1 if stock i's 52WH measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; and $SUEH_{i,y-1}$ ($SUEL_{i,y-1}$) is a dummy variable that equals 1 if stock i's standardized unexpected earnings (SUE) measure is ranked at the top (bottom) 30% at the end of the previous year, and zero otherwise. In each month t, we estimate 12 cross-sectional regressions for $j = 14$ to $j = 25$ to $j = 50$ to $j = 61$, and average the corresponding coefficient estimates. Once we have the time series of the average coefficients from the George–Hwang style regressions, we regress these coefficients on HIGH, MILD, and LOW sentiment dummies with no intercept to test whether momentum profits in each sentiment state are equal to zero. To test whether the average returns of the momentum strategies in high-sentiment periods are significantly different from that in low-sentiment periods, we regress the time series of average monthly momentum profits on HIGH and MILD sentiment dummies with a constant. Numbers in the parentheses are the t-statistics calculated using Newey and West's (1987) robust standard errors. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** denotes significance at the 1% level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Raw return (2,13)			Raw return (14,25)			Raw return (26,37)			Raw return (38,49)			Raw return (50,61)		
	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH –LOW	HIGH	LOW	HIGH –LOW	HIGH	LOW	HIGH –LOW
$52WHH$	0.207*	−0.166	0.373**	0.155*	−0.209**	0.363***	0.091	−0.159	0.250**	0.051	−0.050	0.101	0.139*	−0.227**	0.366***
	(1.83)	(−1.51)	(2.36)	(1.67)	(−2.09)	(2.67)	(1.20)	(−1.64)	(2.03)	(0.67)	(−0.64)	(0.92)	(1.72)	(−2.02)	(2.65)
$52WHL$	−0.166	0.311	−0.478	−0.079	0.351*	−0.430*	0.071	0.323*	−0.251	0.043	0.224	−0.181	−0.088	0.277	−0.365
	(−0.88)	(1.27)	(−1.54)	(−0.58)	(1.69)	(−1.74)	(0.50)	(1.65)	(−1.04)	(0.29)	(1.20)	(−0.75)	(−0.62)	(1.58)	(−1.62)
$52WHH \times SUEH$	0.557***	0.485***	0.072	0.687***	0.474***	0.213*	0.585***	0.397***	0.188	0.629***	0.491***	0.138	0.577***	0.379***	0.198
	(5.87)	(4.56)	(0.50)	(7.03)	(5.67)	(1.66)	(6.97)	(4.03)	(1.45)	(6.49)	(4.12)	(0.90)	(5.87)	(4.12)	(1.47)
$52WHL \times SUEL$	−1.038***	−0.546***	−0.493**	−0.963***	−0.370*	−0.593***	−0.932***	−0.263	−0.668***	−0.852***	−0.385**	−0.467**	−0.778***	−0.534***	−0.243
	(−7.95)	(−2.91)	(−2.16)	(−9.30)	(−1.94)	(−2.74)	(−8.77)	(−1.49)	(−3.24)	(−7.09)	(−2.52)	(−2.40)	(−5.73)	(−5.06)	(−1.41)
$52WHH–52WHL$	0.374	−0.477	0.850*	0.233	−0.560*	0.793**	0.020	−0.481*	0.501	0.008	−0.274	0.282	0.228	−0.504*	0.731**
	(1.33)	(−1.41)	(1.93)	(1.14)	(−1.94)	(2.24)	(0.10)	(−1.79)	(1.51)	(0.04)	(−1.15)	(0.89)	(1.11)	(−1.89)	(2.17)
$52WHH \times SUEH - 52WHL \times SUEL$	1.596***	1.031***	0.565*	1.650***	0.844***	0.806***	1.516***	0.660***	0.856***	1.480***	0.875***	0.605**	1.355***	0.914***	0.441*
	(8.79)	(4.07)	(1.81)	(10.15)	(3.70)	(2.88)	(9.80)	(2.70)	(2.96)	(8.16)	(4.74)	(2.34)	(6.90)	(5.76)	(1.75)

sentiment states. The coefficient on 52*WHL* × *SUEL*, however, is −1.038% (with a *t*-statistic of −7.95) following periods of high sentiment and −0.546% (with a *t*-statistic of −2.91) following periods of low sentiment. As a result, the difference between 52*WHH* × *SUEH* and 52*WHL* × *SUEL* is 1.596% following high-sentiment periods, which is significantly higher than the return of 1.031% following low-sentiment periods. Moreover, the coefficients on 52*WHH*, 52*WHL*, and 52*WHH–52WHL* following high-sentiment periods all become insignificant when the interaction effect of SUE is taken into account. The results suggest that the profitability of the 52-week high strategy mainly comes from the 52-week high winners with the highest earnings surprises and the 52-week high losers with the lowest earnings surprises, confirming our conjecture that profitability is induced by the anchoring bias.

These findings also hold for the holding period of the second to the fifth year. The coefficients on 52*WHH* × *SUEH* (52*WHL* × *SUEL*) are all significantly positive (negative) following high-sentiment periods, resulting in significantly positive differences between 52*WHH* × *SUEH* and 52*WHL* × *SUEL* from the second to the fifth year. The 52-week high strategy without extreme earnings surprises, however, does not exhibit return continuation in the long run. The findings imply that when a stock's price is near (far from) its 52-week high price and positive (negative) earnings news about the stock constantly comes out in the future, investors will persistently underreact to the news due to the anchoring bias, particularly when investor sentiment is high. Overall, consistent with George and Hwang (2004) and George et al. (2013), our findings suggest that the anchoring bias is important in explaining the 52-week high momentum and causes its effect to last up to five years following high-sentiment periods.

5. Robustness checks

5.1. Does firm size matter?

To enhance the robustness of our results, we first examine whether our results are robust to firm size. This investigation is important because Nagel (2005) shows that the return predictability is stronger for small firms, which are held mostly by individual investors. Furthermore, Baker and Wurgler (2006, 2007) and Kumar (2009) both demonstrate that investors' behavioral biases are particularly strong for small firms, suggesting the possibility that the relation between investor sentiment and stock returns is stronger for small firms. To test the impact of firm size on our results, we partition our sample into two size groups. We use the median of the market equity based on all NYSE stocks as the size breakpoints at the end of the formation period and divide all NYSE, AMEX, and NASDAQ stocks into two size groups based on the size breakpoints. Within each of the two size groups, we identify winners and losers for the 52WH, JT, and MG measures as in Section 3.2 and perform the cross-sectional regressions of Eq. (5) for each size group. We then perform the time-series regressions of Eqs. (6) and (7) separately for the two size groups. Table 8 reports the estimation results for the holding period of the first to the fifth year.[6]

The results in Table 8 indicate that the 52-week high strategy generates significant momentum returns up to five years following high-sentiment periods for both the small-firm (Panel A) and large-firm (Panel B) groups. Although both size groups display significant momentum returns, the small-firm 52-week high strategy generates higher momentum profits following high-sentiment periods. Specifically, the coefficients on 52*WHH*–52*WHL* for the holding period of the first to the fifth year following high-sentiment states are 1.283%, 0.951%, 0.812%, 0.643% and 0.840% per month for the small-firm group and 0.957%, 0.771%, 0.341%, 0.447% and 0.473% per month for the large-firm group. The coefficients on 52*WHH*–52*WHL* following low-sentiment states, however, are all insignificant across the holding period of the first to the fifth year regardless of the firm size. To summarize, we find that the profitability of the 52-week high momentum is robust to firm size and that the 52-week high strategy based on small firms generates higher momentum returns following high-sentiment states. The findings confirm our conjecture that sentiment significantly affects the 52-week high momentum returns.

5.2. Do market states matter?

Cooper et al. (2004) suggest that investor biases are more accentuated after market gains and further show that the JT momentum strategy is profitable only following positive market returns. By taking market states into consideration, Antoniou et al. (2013) show that the positive relation between momentum profits and investor sentiment concentrates in up markets and report insignificant momentum profits in down markets regardless of the state of sentiment. To address whether the state of the market influences our results, we repeat our analyses and include market states as another conditioning variable. To do so, we first follow Cooper et al. to classify each formation period into UP or DOWN market states that are independent of investor sentiment.

At the beginning of each month *t*, we calculate the buy-and-hold return on the CRSP value-weighted index over the past 36 months prior to the holding period of the momentum strategies. If this return is positive (negative), we classify the market state of month *t* as UP (DOWN). Before examining whether the profits of the 52-week high strategy conditional on investor sentiment display different patterns during different market states, we first observe whether the market return, as a continuous variable, has an impact on the profitability of the 52-week high strategy. Specifically, we perform time-series regressions for the 52-week high profits on investor sentiment and past 36-month market returns as follows:

$$MOM_{K,t} = b_0 + b_1 SENTIMENT_t + b_2 MARKET_t + b_3 MARKET_t^2 + \varepsilon_{K,t}, \quad (9)$$

where $MOM_{K,\,t}$ is the return of the 52-week high momentum with the holding period of *K* months (*K* = 3, 6, 9, 12) in month *t*, as defined in Section 3.1; $SENTIMENT_t$ is the three-month rolling-average sentiment ending in month $t-1$; $MARKET_t$ is the lagged market return of the value-weighted index during the 36-month period prior to the beginning of the strategies' holding period; and $MARKET_t^2$ is the square of the market return. $MARKET_t^2$ is included to capture the nonlinear relation between momentum profits and market returns, as documented by Cooper et al. (2004). Panel A of Table 9 shows the regression results.

The significantly positive coefficients on $SENTIMENT_t$ across 3- to 12-month holding periods are consistent with our previous findings that the 52-week high momentum generates higher returns following high-sentiment periods. We also observe significantly positive coefficients on $MARKET_t$, suggesting that both investor sentiment and market returns impact the profitability of the 52-week high momentum. In addition, the negative coefficients on $MARKET_t^2$ confirm Cooper et al.'s (2004) argument that a nonlinear relation exists between momentum profits and market returns. To demonstrate further that our results are not due to the specific window used to calculate market returns, we repeat the analysis using 24-month (Panel B) and 12-month (Panel C) CRSP value-weighted index returns to proxy for past market performances; our results are robust to different definitions of market returns.

We next examine whether the 52-week high momentum displays different patterns across investor sentiment conditional on market states. Specifically, we derive the momentum profits from the George–Hwang cross-sectional regressions as in Eq. (5) every month

[6] To conserve space, we only report the results of the 52-week high strategy starting from Table 8. The returns on the JT and MG strategies are available upon request.

Table 8
Cross-sectional regressions conditional on different sentiment states and firm size.

In each month t from July 1965 to December 2010, we perform the following 12 cross-sectional regressions (for $j = 2$ to $j = 13$ to $j = 50$ to $j = 61$):

$$r_{i,t} = b_{0jt} + b_{1jt}r_{i,t-1} + b_{2jt}SIZE_{i,t-1} + b_{3jt}JTH_{i,t-j} + b_{4jt}JTL_{i,t-j} + b_{5jt}MGH_{i,t-j} + b_{6jt}MGL_{i,t-j} + b_{7jt}52WHH_{i,t-j} + b_{8jt}52WHL_{i,t-j} + \varepsilon_{i,t},$$

where $r_{i,t}$ is the return of stock i in month t; $SIZE_{i,t-1}$ is the natural logarithm of stock i's market capitalization at the end of previous month; $JTH_{i,t-j}$ ($JTL_{i,t-j}$) is a dummy variable that equals 1 if stock i's JT measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $MGH_{i,t-j}$ ($MGL_{i,t-j}$) is a dummy variable that equals 1 if stock i's MG measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; and $52WHH_{i,t-j}$ ($52WHL_{i,t-j}$) is a dummy variable that equals 1 if stock i's 52WH measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise. In each month t, we estimate 12 cross-sectional regressions for $j = 2$ to $j = 13$ to $j = 50$ to $j = 61$, and average the corresponding coefficient estimates. Once we have the time series of the average coefficients from the George–Hwang style regressions, we regress these coefficients on HIGH, MILD, and LOW sentiment dummies with no intercept to test whether momentum profits in each sentiment state are equal to zero. To test whether the average returns of the momentum strategies in high-sentiment periods are significantly different from that in low-sentiment periods, we regress the time series of average monthly momentum profits on HIGH and MILD sentiment dummies with a constant. Panel A gives momentum profits implemented using firms with their market capitalizations greater than the median market capitalization of all NYSE stocks, and Panel B gives momentum profits implemented using firms with their market capitalizations lower than the median market capitalization of all NYSE stocks. Numbers in the parentheses are the t-statistics calculated using Newey and West's (1987) robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Raw return (2,13)			Raw return (14,25)			Raw return (26,37)			Raw return (38,49)			Raw return (50,61)		
	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW
Panel A: small firms															
$52WHH$	0.377***	−0.088	0.466***	0.314***	−0.185*	0.499***	0.259***	−0.035	0.293**	0.153*	0.048	0.105	0.238**	−0.147	0.385**
	(2.86)	(−0.81)	(2.73)	(2.82)	(−1.86)	(3.34)	(3.00)	(−0.32)	(2.10)	(1.66)	(0.54)	(0.82)	(2.58)	(−1.16)	(2.46)
$52WHL$	−0.906***	−0.065	−0.841***	−0.636***	0.185	−0.821***	−0.554***	0.229	−0.783***	−0.490***	0.109	−0.599**	−0.602***	0.061	−0.663***
	(−4.29)	(−0.30)	(−2.80)	(−4.06)	(0.95)	(−3.28)	(−3.48)	(1.15)	(−3.07)	(−3.04)	(0.64)	(−2.55)	(−3.78)	(0.37)	(−2.90)
$52WHH - 52WHL$	1.283***	−0.024	1.307***	0.951***	−0.370	1.321***	0.812***	−0.264	1.076***	0.643***	−0.061	0.704**	0.840***	−0.207	1.048***
	(4.00)	(−0.08)	(2.94)	(3.86)	(−1.37)	(3.62)	(3.63)	(−0.94)	(3.01)	(2.70)	(−0.27)	(2.13)	(3.55)	(−0.77)	(2.91)
Panel B: large firms															
$52WHH$	0.255**	0.048	0.207	0.261**	−0.048	0.309**	0.171**	−0.069	0.240*	0.123*	0.064	0.059	0.224***	−0.149	0.373***
	(2.07)	(0.60)	(1.41)	(2.53)	(−0.61)	(2.38)	(2.05)	(−0.72)	(1.89)	(1.69)	(0.98)	(0.60)	(2.59)	(−1.43)	(2.75)
$52WHL$	−0.702***	−0.127	−0.575**	−0.510**	−0.071	−0.439*	−0.170	0.065	−0.236	−0.324**	−0.123	−0.201	−0.249**	−0.016	−0.233
	(−3.18)	(−1.05)	(−2.28)	(−2.55)	(−0.60)	(−1.89)	(−1.20)	(0.51)	(−1.23)	(−2.55)	(−0.85)	(−1.04)	(−2.08)	(−0.11)	(−1.29)
$52WHH - 52WHL$	0.957***	0.175	0.782**	0.771***	0.023	0.748**	0.341*	−0.134	0.476*	0.447***	0.187	0.261	0.473***	−0.134	0.606**
	(3.04)	(0.94)	(2.13)	(2.72)	(0.13)	(2.22)	(1.71)	(−0.68)	(1.69)	(2.88)	(1.04)	(1.10)	(2.68)	(−0.61)	(2.16)

Table 9
Regressions of momentum profits on investor sentiment and market returns.

In each month t from July 1965 to December 2010, we rank individual stocks into 10 deciles according to their values on 52WH. Stocks with their 52WH values ranked at the top (bottom) 30% are classified as winners (losers). We calculate equally-weighted returns for winner and loser portfolios, as well as the return differences between winners and losers, and hold the portfolios for the subsequent K months (K = 3, 6, 9, 12) with a month skipped between the formation and holding periods. We then perform the following regressions:

$$MOM_{K,\,t} = b_0 + b_1 SENTIMENT_t + b_2 MARKET_t + b_3 MARKET_t^2 + \varepsilon_{K,\,t},$$

where $MOM_{K,\,t}$ is the return of the 52-week high momentum with the holding period of K months (K = 3, 6, 9, 12) in month t; $SENTIMENT_t$ is the three-month rolling-average sentiment ending in month $t-1$; $MARKET_t$ is the lagged market return of the value-weighted index prior to the beginning of the strategies' holding period; and $MARKET_t^2$ is the square of the market return. In Panels A, B, and C, the market return is calculated as the buy-and-hold return on the CRSP value-weighted index over past 36, 24, and 12 months prior to the holding period of the momentum strategies, respectively. Numbers in the parentheses are the t-statistics calculated using Newey and West's (1987) robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	K = 3	K = 6	K = 9	K = 12
Panel A: 36-month market return				
Intercept	0.205	0.172	0.123	0.054
	(0.60)	(0.51)	(0.37)	(0.17)
SENTIMENT	0.359**	0.343**	0.292*	0.279*
	(2.14)	(2.09)	(1.83)	(1.82)
MARKET	0.031**	0.030**	0.028**	0.026*
	(2.13)	(2.06)	(2.00)	(1.96)
$MARKET^2$	−0.023*	−0.022	−0.021	−0.020
	(−1.69)	(−1.62)	(−1.60)	(−1.64)
Panel B: 24-month market return				
Intercept	0.355	0.313	0.261	0.177
	(1.38)	(1.23)	(1.03)	(0.72)
SENTIMENT	0.411***	0.392**	0.338**	0.320**
	(2.64)	(2.58)	(2.29)	(2.24)
MARKET	0.038**	0.037**	0.035**	0.033**
	(2.23)	(2.21)	(2.14)	(2.08)
$MARKET^2$	−0.039	−0.037	−0.036	−0.035
	(−1.53)	(−1.49)	(−1.52)	(−1.53)
Panel C: 12-month market return				
Intercept	0.644***	0.605***	0.532**	0.423**
	(2.90)	(2.81)	(2.54)	(2.08)
SENTIMENT	0.568***	0.548***	0.482***	0.452***
	(3.65)	(3.60)	(3.29)	(3.20)
MARKET	0.055***	0.053***	0.049***	0.045***
	(3.30)	(3.13)	(2.97)	(2.80)
$MARKET^2$	−0.113**	−0.109**	−0.102**	−0.093**
	(−2.41)	(−2.30)	(−2.25)	(−2.16)

and perform the following time-series regressions:

$$\begin{aligned}\bar{b}_{7t} - \bar{b}_{8t} = {} & \alpha_1 HIGH_t \times UP_t + \alpha_2 MILD_t \times UP_t + \alpha_3 LOW_t \times UP_t \\ & + \alpha_4 HIGH_t \times DOWN_t + \alpha_5 MILD_t \times DOWN_t \\ & + \alpha_6 LOW_t \times DOWN_t + \varepsilon_t,\end{aligned} \tag{10}$$

and

$$\begin{aligned}\bar{b}_{7t} - \bar{b}_{8t} = {} & \alpha_0 UP_t + \alpha_1 HIGH_t \times UP_t + \alpha_2 MILD_t \times UP_t + \alpha_3 DOWN_t \\ & + \alpha_4 HIGH_t \times DOWN_t + \alpha_5 MILD_t \times DOWN_t + \varepsilon_t,\end{aligned} \tag{11}$$

where UP_t and $DOWN_t$ are the dummies for UP and DOWN market states, respectively, calculated using past 36-month market returns as previously described. α_1 and α_4 in Eq. (11) represent the differences in the 52-week high momentum returns between high- and low-sentiment periods during UP and DOWN markets, respectively. Table 10 presents the estimation results from Eqs. (10) and (11) across different market states.[7]

Panel A of Table 10 shows that the profits of the 52-week high momentum in UP markets vary with investor sentiment. Specifically, the coefficients on 52*WHH*–52*WHL* for the holding period of the first to the fifth year following high-sentiment states are highly significant at 1.213%, 0.809%, 0.666%, 0.648% and 0.812% per month, respectively. The coefficients on 52*WHH*–52*WHL* following low-sentiment states, however, are all insignificant across the five-year holding horizons. Panel B shows that the 52-week high strategy in DOWN markets in general produces insignificant momentum profits, regardless of the state of investor sentiment. Although the coefficients on 52*WHH*–52*WHL* are higher following high-sentiment periods than following low-sentiments, they are all insignificant due to the very small numbers of observations in each sentiment group, as pointed out by Antoniou et al. (2013). Hence, the interpretation of the results in DOWN markets is meaningless. Overall, we show that the 52-week high momentum profits are significantly higher and more persistent when investor sentiment is high, especially in UP markets.

5.3. The effects of business cycles

Based on the rational risk-based perspective, Chordia and Shivakumar (2002) examine whether the common macroeconomic variables that are related to the business cycles can explain the momentum profits. They show that the returns of the price momentum are significantly positive during expansions and insignificantly negative during recessions. To examine the impact of business cycles on our results, we follow Chordia and Shivakumar and classify each holding month into expansionary and recessionary periods based on the definition of National Bureau of Economic Research.[8] We then replace UP_t and $DOWN_t$ in Eqs. (10) and (11) with EXP_t and REC_t, respectively, where EXP_t is defined as the dummy for expansionary periods and REC_t is defined as the dummy for recessionary periods. Table 11 reports the estimation results conditional on sentiment states and business cycle dummies.

Panel A of Table 11 shows that the coefficients on 52*WHH*–52*WHL* in the high-sentiment group during expansions are remarkably high at 1.276%, 0.983%, 0.694%, 0.762%, and 0.922% per month for the holding period of the first to the fifth year, respectively. The strong profitability is attributed to the pronounced continuation of both 52-week high winner and loser portfolios. The coefficients on 52*WHH*–52*WHL* in the low-sentiment group during expansions, however, are all insignificant across the five-year holding horizons. Panel B provides the results during recessions and reveals similar but slightly weaker patterns as in Panel A. The significantly positive coefficients on 52*WHH*–52*WHL* in the high-sentiment group during recessions persist for three years following the portfolio formation and become insignificant for the fourth and the fifth years. The lack of significance is likely because of the shorter durations of recessionary periods, as pointed out by Chordia and Shivakumar (2002). Overall, the results from Table 11 confirm our previous findings that the 52-week high strategy generates significant momentum returns following high-sentiment states, regardless of the economic environment. The evidence is inconsistent with the rationality-based theory of macroeconomic conditions in explaining our results.

[7] In Table 10, the market returns are calculated based on a holding period of past 36 months. The results with market states classified using past 12- and 24-month market returns are similar and are available upon request.

[8] The business cycle reference dates and the definition of expansions and recessions are obtained from the website of National Bureau of Economic Research. See http://www.nber.org/cycles/cyclesmain.html.

Table 10

Cross-sectional regressions conditional on different sentiment states and market states.

In each month t from July 1965 to December 2010, we perform the following 12 cross-sectional regressions (for $j = 2$ to $j = 13$ to $j = 50$ to $j = 61$):

$r_{i,\,t} = b_{0jt} + b_{1jt}r_{i,\,t-1} + b_{2jt}SIZE_{i,\,t-1} + b_{3jt}JTH_{i,\,t-j} + b_{4jt}JTL_{i,\,t-j} + b_{5jt}MGH_{i,\,t-j} + b_{6jt}MGL_{i,\,t-j} + b_{7jt}52WHH_{i,\,t-j} + b_{8jt}52WHL_{i,\,t-j} + \varepsilon_{i,\,t}$,

where $r_{i,\,t}$ is the return of stock i in month t; $SIZE_{i,\,t-1}$ is the natural logarithm of stock i's market capitalization at the end of previous month; $JTH_{i,\,t-j}$ ($JTL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's JT measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $MGH_{i,\,t-j}$ ($MGL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's MG measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; and $52WHH_{i,\,t-j}$ ($52WHL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's 52WH measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise. In each month t, we estimate twelve cross-sectional regressions for $j = 2$ to $j = 13$ to $j = 50$ to $j = 61$ and average the corresponding coefficient estimates. Once we have the time series of the average coefficients from the George–Hwang style regressions, we regress these coefficients on HIGH, MILD, and LOW sentiment dummies with no intercept to test whether momentum profits in each sentiment state are equal to zero. To test whether the average returns of the momentum strategies in high-sentiment periods are significantly different from that in low-sentiment periods, we regress the time series of average monthly momentum profits on HIGH and MILD sentiment dummies with a constant. Panel A gives momentum profits implemented in up markets, and Panel B gives momentum profits implemented in down markets. Numbers in the parentheses are the t-statistics calculated using Newey and West's (1987) robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Raw return (2,13)			Raw return (14,25)			Raw return (26,37)			Raw return (38,49)			Raw return (50,61)		
	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW
Panel A: up markets															
52*WHH*	0.368***	−0.024	0.392***	0.250***	−0.076	0.326***	0.218**	−0.034	0.252*	0.188**	0.005	0.183	0.239***	−0.179*	0.418***
	(3.24)	(−0.30)	(2.83)	(2.62)	(−1.02)	(2.69)	(2.40)	(−0.33)	(1.83)	(2.15)	(0.06)	(1.48)	(2.60)	(−1.83)	(3.11)
52*WHL*	−0.845***	−0.118	−0.727***	−0.558***	0.107	−0.666***	−0.448***	0.187	−0.634**	−0.461***	0.083	−0.544**	−0.573***	−0.010	−0.564***
	(−4.02)	(−0.72)	(−2.73)	(−3.58)	(0.62)	(−2.86)	(−2.74)	(0.98)	(−2.52)	(−2.94)	(0.47)	(−2.29)	(−4.46)	(−0.06)	(−2.83)
52*WHH* − 52*WHL*	1.213***	0.094	1.119***	0.809***	−0.183	0.992***	0.666***	−0.221	0.887**	0.648***	−0.078	0.727**	0.812***	−0.169	0.982***
	(4.05)	(0.43)	(3.02)	(3.62)	(−0.86)	(3.21)	(2.84)	(−0.84)	(2.51)	(2.88)	(−0.34)	(2.27)	(3.95)	(−0.76)	(3.24)
Panel B: down markets															
52*WHH*	0.229	−0.189	0.419	0.543	−0.315	0.858*	0.139	−0.281	0.419*	0.067	0.149	−0.083	0.289	−0.077	0.366
	(0.45)	(−0.54)	(0.67)	(1.47)	(−0.91)	(1.70)	(1.27)	(−1.34)	(1.77)	(0.31)	(0.95)	(−0.31)	(1.01)	(−0.23)	(0.84)
52*WHL*	−0.790	0.371	−1.161	−0.807	0.481	−1.288*	−0.454	0.382	−0.835	−0.285	−0.036	−0.249	−0.274	0.050	−0.324
	(−1.08)	(0.60)	(−1.21)	(−1.52)	(0.95)	(−1.75)	(−1.24)	(0.79)	(−1.38)	(−0.63)	(−0.11)	(−0.44)	(−0.51)	(0.15)	(−0.51)
52*WHH* − 52*WHL*	1.019	−0.561	1.580	1.350	−0.796	2.146*	0.592	−0.663	1.255*	0.352	0.185	0.166	0.562	−0.127	0.689
	(0.85)	(−0.60)	(1.04)	(1.56)	(−0.96)	(1.79)	(1.35)	(−1.09)	(1.67)	(0.55)	(0.48)	(0.22)	(0.71)	(−0.20)	(0.68)

Table 11

Cross-sectional regressions conditional on different sentiment states and business cycles.

In each month t from July 1965 to December 2010, we perform the following 12 cross-sectional regressions (for $j = 2$ to $j = 13$ to $j = 50$ to $j = 61$):

$r_{i,\,t} = b_{0jt} + b_{1jt} r_{i,\,t-1} + b_{2jt} SIZE_{i,\,t-1} + b_{3jt} JTH_{i,\,t-j} + b_{4jt} JTL_{i,\,t-j} + b_{5jt} MGH_{i,\,t-j} + b_{6jt} MGL_{i,\,t-j} + b_{7jt} 52WHH_{i,\,t-j} + b_{8jt} 52WHL_{i,\,t-j} + \varepsilon_{i,\,t}$,

where $r_{i,\,t}$ is the return of stock i in month t; $SIZE_{i,\,t-1}$ is the natural logarithm of stock i's market capitalization at the end of previous month; $JTH_{i,\,t-j}$ ($JTL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's JT measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $MGH_{i,\,t-j}$ ($MGL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's MG measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; and $52WHH_{i,\,t-j}$ ($52WHL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's 52WH measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise. In each month t, we estimate 12 cross-sectional regressions for $j = 2$ to $j = 13$ to $j = 50$ to $j = 61$ and average the corresponding coefficient estimates. Once we have the time series of the average coefficients from the George–Hwang style regressions, we regress these coefficients on HIGH, MILD, and LOW sentiment dummies with no intercept to test whether momentum profits in each sentiment state are equal to zero. To test whether the average returns of the momentum strategies in high-sentiment periods are significantly different from that in low-sentiment periods, we regress the time series of average monthly momentum profits on HIGH and MILD sentiment dummies with a constant. Panel A gives momentum profits during expansions, and Panel B gives momentum profits during recessions, as defined by the National Bureau of Economic Research. Numbers in the parentheses are the t-statistics calculated using Newey and West's (1987) robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Raw return (2,13)			Raw return (14,25)			Raw return (26,37)			Raw return (38,49)			Raw return (50,61)		
	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW
Panel A: expansionary periods															
52*WHH*	0.436***	−0.056	0.492***	0.390***	−0.088	0.477***	0.230**	−0.058	0.288**	0.253***	−0.005	0.258**	0.266**	−0.177*	0.443***
	(3.17)	(−0.66)	(3.05)	(2.98)	(−1.11)	(3.12)	(2.31)	(−0.56)	(2.01)	(3.09)	(−0.06)	(2.28)	(2.35)	(−1.76)	(2.93)
52*WHL*	−0.839***	−0.084	−0.756**	−0.593***	0.119	−0.713***	−0.464**	0.199	−0.663***	−0.508***	0.066	−0.575**	−0.656***	−0.033	−0.623***
	(−3.36)	(−0.47)	(−2.46)	(−3.00)	(0.70)	(−2.73)	(−2.58)	(1.10)	(−2.60)	(−2.95)	(0.40)	(−2.39)	(−4.17)	(−0.22)	(−2.85)
52*WHH* − 52*WHL*	1.276***	0.028	1.248***	0.983***	−0.207	1.190***	0.694***	−0.258	0.951***	0.762***	−0.071	0.833***	0.922***	−0.144	1.066***
	(3.55)	(0.11)	(2.87)	(3.28)	(−0.93)	(3.19)	(2.74)	(−1.00)	(2.63)	(3.35)	(−0.33)	(2.67)	(3.66)	(−0.63)	(3.14)
Panel B: recessionary periods															
52*WHH*	0.169	−0.059	0.228	0.106	−0.510	0.615	0.159	−0.352*	0.511**	0.001	0.445	−0.444	0.207	0.040	0.167
	(0.74)	(−0.09)	(0.34)	(0.74)	(−0.96)	(1.12)	(1.26)	(−1.76)	(2.16)	(0.01)	(1.98)	(−1.57)	(1.51)	(0.10)	(0.40)
52*WHL*	−0.831**	0.651	−1.482	−0.602***	0.858	−1.460*	−0.418*	0.506	−0.924	−0.285	−0.033	−0.252	−0.271	0.339	−0.610
	(−2.33)	(0.67)	(−1.43)	(−2.85)	(1.13)	(−1.85)	(−1.83)	(0.63)	(−1.10)	(−1.12)	(−0.08)	(−0.54)	(−1.09)	(0.77)	(−1.20)
52*WHH* − 52*WHL*	1.000*	−0.710	1.709	0.708**	−1.367	2.075	0.577*	−0.858	1.435*	0.286	0.479*	−0.192	0.478	−0.299	0.777
	(1.83)	(−0.45)	(1.02)	(2.14)	(−1.07)	(1.57)	(1.75)	(−1.11)	(1.70)	(0.70)	(1.86)	(−0.40)	(1.34)	(−0.36)	(0.87)

Table 12

Cross-sectional regressions conditional on different sentiment states: Alternative definitions of sentiment states.

n each month t from July 1965 to December 2010, we perform the following 12 cross-sectional regressions (for $j = 2$ to $j = 13$ to $j = 50$ to $j = 61$):

$r_{i,\,t} = b_{0jt} + b_{1jt}r_{i,\,t-1} + b_{2jt}SIZE_{i,\,t-1} + b_{3jt}JTH_{i,\,t-j} + b_{4jt}JTL_{i,\,t-j} + b_{5jt}MGH_{i,\,t-j} + b_{6jt}MGL_{i,\,t-j} + b_{7jt}52WHH_{i,\,t-j} + b_{8jt}52WHL_{i,\,t-j} + \varepsilon_{i,\,t}$,

where $r_{i,\,t}$ is the return of stock i in month t; $SIZE_{i,\,t-1}$ is the natural logarithm of stock i's market capitalization at the end of previous month; $JTH_{i,\,t-j}$ ($JTL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's JT measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; $MGH_{i,\,t-j}$ ($MGL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's MG measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise; and $52WHH_{i,\,t-j}$ ($52WHL_{i,\,t-j}$) is a dummy variable that equals 1 if stock i's 52WH measure is ranked at the top (bottom) 30% at the end of month $t - j$, and zero otherwise. In each month t, we estimate twelve cross-sectional regressions for $j = 2$ to $j = 13$ to $j = 50$ to $j = 61$ and average the corresponding coefficient estimates. Once we have the time series of the average coefficients from the George–Hwang style regressions, we regress these coefficients on HIGH, MILD, and LOW sentiment dummies with no intercept to test whether momentum profits in each sentiment state are equal to zero. To test whether the average returns of the momentum strategies in high-sentiment periods are significantly different from that in low-sentiment periods, we regress the time series of average monthly momentum profits on HIGH and MILD sentiment dummies with a constant. In Panel A, the sentiment periods are determined using top and bottom 20% as cutoffs, and in Panel B the sentiment periods are determined using top and bottom 40% as cutoffs. Numbers in the parentheses are the t-statistics calculated using Newey and West's (1987) robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Raw return (2,13)			Raw return (14,25)			Raw return (26,37)			Raw return (38,49)			Raw return (50,61)		
	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW	HIGH	LOW	HIGH–LOW
Panel A: 20%–20% sentiment states															
52*WHH*	0.249*	−0.185*	0.434**	0.203*	−0.190	0.393**	0.143*	−0.181*	0.324**	0.078	−0.090	0.168	0.159*	−0.250*	0.409**
	(1.81)	(−1.74)	(2.50)	(1.88)	(−1.59)	(2.43)	(1.77)	(−1.77)	(2.49)	(0.84)	(−1.10)	(1.36)	(1.89)	(−1.77)	(2.49)
52*WHL*	−0.660***	0.144	−0.804**	−0.518***	0.279	−0.797***	−0.354**	0.330	−0.685**	−0.345**	0.091	−0.436	−0.405**	−0.006	−0.400
	(−2.99)	(0.61)	(−2.49)	(−3.06)	(1.27)	(−2.88)	(−2.05)	(1.51)	(−2.46)	(−1.97)	(0.44)	(−1.61)	(−2.55)	(−0.03)	(−1.63)
52*WHH* − 52*WHL*	0.909***	−0.329	1.238***	0.721***	−0.469	1.190***	0.498**	−0.511*	1.009***	0.423*	−0.182	0.605*	0.564**	−0.244	0.809**
	(2.75)	(−1.01)	(2.67)	(2.75)	(−1.51)	(2.93)	(2.07)	(−1.72)	(2.63)	(1.73)	(−0.71)	(1.71)	(2.49)	(−0.80)	(2.12)
Panel B: 40%–40% sentiment states															
52*WHH*	0.335***	−0.025	0.360***	0.200**	−0.092	0.291**	0.120*	−0.062	0.182	0.117*	0.032	0.086	0.138**	−0.154	0.292**
	(3.51)	(−0.26)	(2.63)	(2.43)	(−1.10)	(2.49)	(1.79)	(−0.67)	(1.59)	(1.70)	(0.38)	(0.80)	(2.02)	(−1.61)	(2.48)
52*WHL*	−0.736***	−0.061	−0.675***	−0.497***	0.099	−0.596***	−0.359***	0.156	−0.515***	−0.325***	−0.020	−0.305*	−0.415***	−0.047	−0.368**
	(−4.42)	(−0.35)	(−2.78)	(−3.63)	(0.63)	(−2.86)	(−3.00)	(1.00)	(−2.62)	(−2.84)	(−0.14)	(−1.68)	(−3.80)	(−0.38)	(−2.22)
52*WHH* − 52*WHL*	1.071***	0.036	1.035***	0.696***	−0.191	0.887***	0.479***	−0.218	0.697**	0.443***	0.052	0.391	0.553***	−0.107	0.659***
	(4.41)	(0.14)	(2.96)	(3.53)	(−0.87)	(3.01)	(2.84)	(−0.99)	(2.52)	(2.71)	(0.28)	(1.57)	(3.45)	(−0.56)	(2.64)

5.4. Alternative definitions of sentiment states

So far our analyses are based on sentiment states defined using the top and bottom 30% cutoffs of the previous three-month rolling-average sentiment. To ensure that our results are not sensitive to the definition of sentiment states, we also consider 20% and 40% cutoff points and repeat the George–Hwang regression. Table 12 reports the results conditional on investor sentiment. Consistent with the results in Tables 4 and 6, short-term and long-term returns on 52*WHH* (52*WHL*) are significantly positive (negative) following high-sentiment periods, regardless of the use of finer (20% in Panel A) or wider (40% in Panel B) cutoffs to identify sentiment states. Consistent with our previous findings, the return differences on 52*WHH* and 52*WHL* following low-sentiment periods are mostly insignificantly different from zero across all holding horizons, with either the 20% or the 40% cutoffs. These return patterns result in reliably high profits for the 52-week high strategy following high-sentiment states and insignificant returns following low-sentiment states. Thus, our main findings are robust with respect to different definitions of sentiment states.

6. Conclusion

George and Hwang (2004) propose an investing strategy based on the nearness to the past 52-week high and show that the 52-week high strategy dominates Jegadeesh and Titman's (1993) price momentum and Moskowitz and Grinblatt's (1999) industrial momentum strategies in generating momentum profits. They attribute the profitability of the 52-week high strategy to the adjustment and anchoring biases. We examine whether behavioral bias underpins the predictability of the 52-week high measure by incorporating the effect of investor sentiment. We hypothesize that investors' investment decisions are subject to anchoring biases especially when the level of investor sentiment is high, resulting in higher profit for the 52-week high strategy. We confirm this hypothesis by showing that the significantly positive momentum returns of the 52-week high strategy are concentrated in periods following high sentiment.

We further document that the significant profit of the 52-week high strategy following high-sentiment periods persists up to five years after portfolio formation. This finding is surprising and has not been documented in prior literature. By incorporating earnings surprises to proxy for the anchoring bias, we also show that the strong profitability and persistence of the 52-week high strategy following high-sentiment periods mainly come from the 52-week high winners with higher earnings surprises and the 52-week high losers with lower earnings surprises. Our finding is consistent with George et al.'s (2013) argument that anchoring on the 52-week high is responsible for the market's underreaction to extreme earnings news.

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