The Journal of Behavioral Finance & Economics Volume 5, Issues 1&2, 2015-2016, **69-97**

ISSN: 1551-9570

Recency Bias and Post-Earnings Announcement Drift[*]

Qingzhong Ma
California State University, Chico

David A. Whidbee
Washington State University

Wei Zhang
California State University, Chico

Abstract

In this paper we examine the role of the timing of 52-week high, or recency, in the post earnings announcement drift (PEAD) puzzle. We argue that, because investors are less likely to bid up (down) a stock price if a stock's 52-week high occurred in the recent (distant) past, these stocks tend to be underpriced (overpriced) and earn higher (lower) future returns. Consistent with this argument, PEAD profits are mainly driven by recency bias. An enhanced strategy based on both PEAD and recency accounts for 86% of total PEAD profits over the 1977 to 2013 period. The recency bias accounts for the entire PEAD profits of large stocks and of all stocks in the most recent 24 years. The effect of recency bias on PEAD exists even after controlling for price proximity to the 52-week high. Our evidence suggests that recency bias plays an important role in PEAD.

[*] Ma: College of Business, California State University, Chico, CA. Tel: 530 898 6182; email: qma@csuchico.edu. Whidbee: Carson College of Business, Washington State University, Pullman, WA. Tel: 509 335 3098; email: whidbee@wsu.edu. Zhang: College of Business, California State University, Chico, CA. Tel: 530 898 6544; email: wzhang15@csuchico.edu. We appreciate helpful comments from Dalen Chiang, Levon Goukasian, Christine Hsu, Emily Jian Huang, Richard Ponarul, Stephen Treanor, Jianfeng Yu, and seminar participants of FMA 2015 at Orlando, FL and California State University at Chico. All remaining errors are our own.

1. Introduction

We examine how price anchoring (based on the 52-week high) impacts investors' valuation perceptions by examining its role in the post earnings announcement drift (PEAD) puzzle. PEAD refers to the tendency for a stock's abnormal returns to 'drift' in the same direction of an earnings surprise for an extended period of time. This phenomenon was first documented by Ball and Brown (1968) and has been studied extensively. We propose an explanation based on recency bias. That is, we suggest that investors are less (more) likely to bid up a stock's price if its 52-week high price occurred in the recent (distant) past. Consequently, these stocks tend to be underpriced (overpriced) and earn higher (lower) returns in the future. We find that this recency bias is important in explaining the PEAD puzzle.

Based on a sample from 1977 to 2013 we report the following findings. First, consistent with the literature, we find that stocks with their 52-week high prices occurring in the recent past (high recency ratio) tend to earn higher returns over the subsequent three months than those with their 52-week high prices occurring in the distant past (low recency ratio).[1] We also confirm that during this time period the monthly PEAD profits over a three-month holding period are 0.72% on average. Second, when stocks are ranked independently by earnings surprise and recency ratios, the outperformance of stocks with high recency ratios over stocks with low recency ratios is more pronounced when earnings surprise is more extreme.

Third, we decompose the simple PEAD strategy into an enhanced strategy and a remaining strategy. The enhanced strategy buys stocks that have both an extreme positive earnings surprise and a high recency ratio and sells stocks with an extreme negative earnings surprise and low recency ratio; the remaining strategy buys stocks with an extreme positive earnings surprise but mid to low recency ratio and sells stocks with an extreme negative earnings surprise but mid to high recency ratio. We find that the enhanced strategy earns a monthly return of 1.52% but the remaining strategy earns a trivial 0.10%. Because the enhanced strategy takes into account investors' recency bias, the strategy decomposition indicates that the recency bias accounts for 86% of PEAD profits. Thus, our evidence suggests that the recency bias plays an important role in PEAD.

Fourth, we examine the role of the recency bias in PEAD in smaller and larger stocks, respectively. We find that recency bias plays an important role in both smaller and larger stocks. In particular, although PEAD in general is weaker among larger stocks, the recency bias plays a relatively larger role among larger stocks as it accounts for the entire PEAD profits. Among smaller stocks, the recency bias accounts for only 76% of PEAD profits. We also examine the role of the recency bias in PEAD in sub-periods and find that the recency bias plays an important role in all sub-periods. Further, while PEAD in general is weakening over time, the relative role of the recency bias in PEAD becomes stronger in the more recent periods. Specifically, in the early time period (1977 to 1989) the recency bias accounts for about 51% of PEAD profits, it accounts for 100% of PEAD profits in the later time period (from 1990 to 2013). The overall evidence suggests that investors' recency bias is widespread and persistent.

The main finding that investors' recency bias is important in PEAD survives a battery of robustness checks. The main finding holds with various methodologies of measuring future returns; it holds in Fama and MacBeth (1973) regressions with many other control variables; it holds for alternative ways of measuring earnings surprise; it also holds for alternative ways of two-

[1] Recency ratio is defined in equation (1) in section 3 and in the Appendix.

way portfolio formation; the impact of recency bias remains significant even after controlling for the price proximity ratio (the ratio of current stock price to the 52-week high).

Our paper is closely related to Bhootra and Hur (2013) who find that recency ratio has an incremental effect on George and Hwang's (2004) momentum strategy. Our paper is also closely related to contemporaneous work by George et al. (2014), who study the role of price proximity to its 52-week high on PEAD. Our paper highlights the role of recency bias in PEAD. We find that the recency ratio plays a significant role even after controlling for price proximity.

The paper contributes to the literature in two folds. First, the findings presented in this paper suggest that investors' behavioral bias, specifically the recency bias, plays an important role in PEAD. In this sense we add evidence to the large literature on PEAD that argues PEAD is attributable to investors' irrational behavior and that the market is not completely efficient. Second, we contribute to the growing literature on investors' anchoring bias with regard to the 52-week high price, especially on how the timing of the 52-week high affects investment.

The remaining of the paper is organized as follows. We discuss related literature and develop the hypothesis in Section 2. In Section 3 we describe the sample, data, and methodology. We present in section 4 the main results and conclude in Section 5.

2. Literature and Hypothesis

The paper is related to the literature examining the post-earnings announcement drift anomaly as well as recent literature examining whether a stock's 52-week high serves as an anchoring or reference point.

2.1. Post-earnings announcement drift

One of the major accounting-based market anomalies is known as the post-earnings announcement drift (PEAD) (see, e.g., Bernard and Thomas, 1989). PEAD refers to the tendency of firms with positive (negative) earnings surprises in a given quarter to experience an upward (downward) drift in stock price in subsequent quarters. This result exists in the U.S. and other countries (see, e.g., Gerard, 2012). Like many other anomalies, PEAD is stronger among smaller firms and it weakens in the more recent time periods (see, e.g., Richardson et al., 2010). The existence of a price drift following earnings announcements would appear to challenge the efficient market hypothesis, but there is little consensus in the literature.

Chief among the questions of interest to the literature is what drives PEAD. Researchers have proposed numerous possible hypotheses. One is investors' underreaction. That is, investors underreact to earnings news when using it to forecast future earnings. Recent evidence suggests that smaller and less sophisticated investors are likely responsible for the PEAD (Bartov et al., 2000; Battalio and Mendenhall, 2005; Shivakumar, 2006), although there is also evidence that PEAD is not explained by the trading activity of individual investors (Hirshleifer et al., 2008). Recent studies explore the role of overconfidence (Liang, 2003), investors limited attention (DellaVigna and Pollet, 2006), illusions of inflation (Chordia and Shivakumar, 2005), disposition effect (Frazzini, 2006), or distraction (Hirshleifer et al., 2011). Another line of research reveals that PEAD is stronger among firms with more market frictions, including transaction costs (Ng et al., 2008, and Chordia et al., 2009), arbitrage risk (Mendenhall, 2004), and short-sell constraints (Reed, 2007). Chen et al. (2014) examine the profits of revenue, earnings, and price momentum strategies to understand investor reactions while facing multiple sources of information.

In work that is contemporaneous to ours, George et al. (2014) examine the proximity of current stock price to the 52-week high in the context of PEAD and find that it plays an important role. Our paper focuses on the timing of the 52-week high. We find that the timing plays an important role in PEAD, above and beyond that by the price proximity.

2.2.The literature on 52-week high and its timing

A growing line of research in finance examines the role of stocks' 52-week high levels. The premise is that investors tend to use the 52-week high as an important reference, or anchoring point and make their decisions by adjusting away from this point. The evidence that supports this argument exists in numerous decision scenarios. It exists in employee stock option exercising decisions (Heath et al., 1999), return momentum (George and Hwang, 2004), investor trading volume (Huddart et al., 2009), merger offer price and completion probability (Baker et al., 2012), and evaluation of firms making acquisitions (Ma et al., 2016). Li and Yu (2012) find evidence of investor anchoring on the 52-week high of the Dow.

The adoption of the 52-week high price as a reference point has deep roots in the psychology literature, particularly the anchoring-and-adjustment mechanism. Tversky and Kahneman (1974) argue that, when making decisions under high uncertainty, subjects tend to use an easily available, but possibly irrelevant, reference point as a starting point and make adjustment in their estimation. Experiment evidence shows that subjects' adjustments are usually insufficient. Kaustia et al. (2008) report evidence of anchoring in estimates of long-term stock returns by college students and financial market professionals. Chang et al. (2013) examine the role of anchoring in the context of cross-listing.

The recency bias is built upon psychological evidence. In a well cited study, Murdock (1962) finds that in an experiment in which subjects are presented a list of words whose orders are irrelevant, subjects tend to recall words at the end of the list. Subsequent work presents evidence of this recency bias in diverse settings, including performance appraisals (Mohrman et al., 1989), financial statements auditing (Tubbs et al., 1990), performance chasing behavior in mutual funds (Gruber, 1996), student course evaluations (Dickey and Pearson, 2005), and retail investors' repurchasing behavior (Nofsinger and Varma, 2013). In the context of stock price momentum, Bhootra and Hur (2013) document evidence that the recency ratio, the extent to which the 52-week high price occurred recently, contains incremental information beyond the proximity of current stock price to its 52-week high.

2.3.The hypothesis

In this paper we shed light on what drives PEAD by examining the role of investors' recency bias, which is implied in the forgoing discussions. That is, we suggest that when a stock has reached its 52-week high price recently (in the distant past), investors will be less (more) likely to bid up its price, a bias that leads to stock undervaluation (overvaluation) and thus higher (lower) future returns.

Specifically, we test the following two implications. First, recency bias plays an important role in PEAD. That is, conditional on an earnings surprise, stocks with their 52-week high occurring in the more recent past will tend to outperform those with their 52-week high price occurring in the more distant past. After accounting for the role of recency bias, the PEAD effect

becomes significantly weaker. Second, the effect of recency bias exists even after controlling for the price proximity to the 52-week high.

3. Sample, Data, and Methodology

3.1. Sample

Our sample is from CRSP and includes all common stocks (share codes 10 or 11) that are traded on the NYSE, AMEX, and NASDAQ from 1977 to 2013. As in Bhootra (2011), we exclude stocks with prices below $5 and stocks in the lowest NYSE market capitalization decile by the time of portfolio formation. We require that the stocks' market capitalization and book-to-market ratio are not missing.

3.2. Data

We use a stock's most recent quarterly earnings announcement period four-day (two days before to one day after the earnings announcement) abnormal return as a proxy for the earnings surprise (Kishore et al., 2008). The earnings announcement dates are from the quarterly Compustat data (from January 1977 to September 2013). In later analysis we also adopt an alternative measure of earnings surprise which is based on analyst consensus of earnings per share. The data for that measure is from the I/B/E/S.

The 52-week high price of a stock is the highest closing price of the stock during the past 52-weeks. Following George and Hwang (2004) and Bhootra and Hur (2013), the prices are adjusted for stock splits and dividends using the adjustment factor data in CRSP. Following Bhootra and Hur (2013), each stock in the sample is assigned a recency ratio (RR), which is defined in equation (1).

$$RR = 1 - \frac{Number\ of\ days\ since\ 52\ weeks\ high\ price}{364} \quad (1)$$

By definition, recency ratio is between 0 and 1. A stock with a recency ratio close to 1 means the stock's 52-week high price has occurred recently; a stock with a recency ratio close to 0 means the stock's 52-week high price has occurred a long time ago. These variables and all other variables used in the analysis are defined in the Appendix.

3.3. Methodology

We choose a monthly structure to formulate a trading strategy that takes advantage of the PEAD phenomenon in a timely manner. Every month the strategy takes into account the recent new earnings announcements and adjusts portfolios accordingly. The approach is similar to that of Jegadeesh and Titman (1993), George and Hwang (2004), and Bhootra and Hur (2013). When we sort firms into deciles based on their most recent earnings surprises, the recent actual earnings information might be announced in the current month, or one of the two months before the current month. The drift period is defined as the three months subsequent to the current month.

Specifically, for each month from January 1977 to September 2013 we form portfolios based on earnings surprise (or/and recency ratio) and hold the stocks in the portfolios for three months. For instance, stocks selected at the end of March 2004 will be held in April, May, and June of 2004; stocks selected in April 2004 will be held in May, June, and July of 2004; and stocks selected in May 2004 will be held in June, July, and August of 2004. Thus, in month June 2004,

the strategy holds three portfolios: one each selected in March, April, and May of 2004. For a month t in general, the strategy holds portfolios formed in months $t - j$ (j = 1, 2, and 3). This strategy results in a calendar-time portfolio from February 1977 to December 2013. For every month t in this period, we calculate the equal-weight mean of the three average (equal- or value-weight) returns of the portfolios formed in month $t - j$ (j = 1, 2, and 3). For portfolio analysis we use equal-weight portfolio returns only. For Fama and French (1993) regression alpha analysis we use both equal- and value-weight portfolio returns.

In our empirical work we first replicate the simple PEAD strategy. That is, one buys stocks with earnings surprise in the top decile (that is, Earnings Surprise High, or ESH=1) and sells stocks with earnings surprise in the bottom decile (that is, Earnings Surprise Low, or ESL=1).

$$\text{PEAD} = \begin{cases} \text{Buy stocks with ESH} = 1 \\ \text{Sell Stocks with ESL} = 1 \end{cases} \quad (2)$$

To explore the role of recency bias in PEAD, we independently rank stocks into terciles based on recency ratios. Thus, stocks with an extreme positive earnings surprise (ESH = 1) could have their recency ratio ranked in the top 1/3 (that is, Recency Ratio High, or RRH = 1), middle 1/3, or bottom 1/3 (that is, Recency Ratio Low, or RRL = 1); for the same reason, stocks with an extreme negative earnings surprise (ESL = 1) could have their recency ratio ranked in the top 1/3 (RRH=1), middle 1/3, or bottom 1/3 (RRL=1). We can thus decompose the PEAD strategy into an enhanced strategy and a remaining strategy, defined below.

$$\text{Enhanced} = \begin{cases} \text{Buy stocks with ESH} = 1 \text{ and RRH} = 1 \\ \text{Sell Stocks with ESL} = 1 \text{ and RRL} = 1 \end{cases} \quad (3)$$

$$\text{Remaining} = \begin{cases} \text{Buy stocks with ESH} = 1 \text{ and RRH} \neq 1 \\ \text{Sell Stocks with ESL} = 1 \text{ and RRL} \neq 1 \end{cases} \quad (4)$$

The decomposition of the trading strategy can be intuitively interpreted. First, the profit of trading on PEAD comes entirely from both the enhanced strategy and the remaining strategy. Second, PEAD and recency bias work together (or in the same direction) in the enhanced strategy, while in the remaining strategy recency bias works against PEAD. In particular, the term "enhanced" highlights the fact that in the enhanced strategy investors are buying stocks with good recent earnings and a stock price that hit a relatively recent 52-week high and selling stocks with bad recent earnings and a 52-week high that is a relatively distant memory. Thus, the performance from the enhanced strategy represents the PEAD profits that can be attributed to recency bias, and the performance from the remaining strategy represents the strength of PEAD when the recency bias effect works against it. The importance of recency bias in PEAD can thus be gauged by the relative performance of the two strategies.

4. Results

4.1. Univariate analysis

We first examine returns of portfolios formed individually on earnings surprise and recency ratios. Table I presents the average monthly returns over the three-month holding period of the deciles (Panel A) or terciles (Panel B) formed on earnings surprise and recency ratios. Consistent with the large literature on PEAD (e.g., Bernard and Thomas, 1989; Richardson et al., 2010), we find a strong PEAD effect over this sample period. The hedge portfolio (high earnings surprise minus low earnings portfolio) based on deciles earns a monthly abnormal return of 0.72% (t=8.16). Also consistent with Bhootra and Hur (2013), we find a strong recency effect. Based on deciles, the hedge portfolio earns a significant monthly return of 0.80% (t=4.24). Returns based on terciles

are also significant. Notably, the hedge portfolio returns on recency ratios in our Table I are very similar to that reported in Bhootra and Hur (2013, pp.3776).

Table I: Earnings surprises and recency ratio

In each month t from January 1977 to September 2013, stocks listed on NYSE, AMEX, and NASDAQ are sorted into 10 (Panel A) and three portfolios (Panel B) on earnings surprise and recency ratio (RR), respectively. Earnings surprise is defined as the cumulative abnormal returns during the four-day earnings announcement period (two days before to one day after the announcement); RR is defined as 1 – (current date – date of the 52-week high price)/364. We exclude stocks with price less than $5 or with market capitalization below the NYSE smallest decile market capitalization threshold at the end of the portfolio formation month t. Each portfolio is held for three months. The calendar-time portfolio returns for each month t from February 1977 to December 2013 are the average returns of the three portfolios formed in month t-j (j=1, 2, and 3). The table reports the average monthly portfolio returns and the return differences (t-statistics in brackets) of the extreme portfolios. The returns are in percentage.

Sort on	Earnings surprise	RR
Panel A: By 10 groups		
Lowest	0.79	0.67
2	1.11	0.94
3	1.19	1.02
4	1.20	1.20
5	1.23	1.33
6	1.28	1.32
7	1.30	1.42
8	1.34	1.47
9	1.36	1.49
Highest	1.51	1.46
High – Low	0.72	0.80
	[8.16]	[4.24]
Panel B: By 3 groups		
Low	1.05	0.91
2	1.25	1.32
High	1.39	1.47
High – Low	0.35	0.56
	[6.53]	[3.80]

4.2.Two-way sort on earnings surprise and recency ratio

We next study the role of recency ratio on the profits of the hedge portfolios based on earnings surprise. Specifically, we independently sort stocks into deciles based on earnings

surprise and terciles on recency ratios.[2] For stocks in each of the 30 portfolios we examine returns over the three-month holding period. Table II presents the results. Panel A of Table II shows the average returns of the 30 portfolios. For convenience we also list the returns based on earnings surprise only, in column "All." The last two columns of Panel A present the differences between portfolios of high (top 1/3) and low (bottom 1/3) recency ratios for each of the earnings surprise deciles and the t-statistics testing zero differences.

Panel A of Table II shows that the recency ratio makes a significant difference in all the earnings surprise deciles. The differences are particularly large in the extreme deciles. For instance, among stocks with the most negative earnings surprise, those with a high recency ratio (top 1/3) earn an average monthly return of 1.20% while those with a low recency ratio (bottom 1/3) earn 0.49%, leading to a high – low difference of 0.71% (t=3.71); among stocks with the most positive earnings surprise, stocks with a high recency ratio (top 1/3) earn an average monthly return of 2.01% while those with a low recency ratio (bottom 1/3) earn 0.89%, leading to a high – low difference of 1.12% (t=6.19). In the middle earnings surprise deciles, stocks with high recency ratios also significantly outperform those with low recency ratios, albeit by a relatively smaller magnitude. The data in Panel A of Table II are thus consistent with our hypothesis that investors are afflicted with the recency bias. This recency bias exists even after controlling for the earnings surprises. Further, the recency bias appears strongest when the earnings surprise is extreme.

We now measure the impact of the recency bias on PEAD. That is, we are interested in how much of the PEAD returns can be attributed to investors' recency bias. To do so, as discussed in the previous section, we propose an enhanced investment strategy based on both earnings surprise and recency ratios, and compare profits from this strategy against profits from an alternative PEAD-based strategy. Specifically, the enhanced strategy buys stocks with the most positive earnings surprises (top decile) and high recency ratios (top 1/3) and sell stocks with the most negative earnings surprises (bottom decile) and low recency ratios (bottom 1/3). Accordingly, we calculate the profits in the simple PEAD portfolio excluding those in the enhanced strategy. That is, the remaining portfolio buys stocks with the most positive earnings surprises (top decile) and low or mid recency ratios (bottom 2/3) and sell stocks with the most negative earnings surprises (bottom decile) and mid to high recency ratios (top 2/3). We call these two strategies the enhanced and remaining strategies, respectively.

Panel B of Table II presents the profits from the enhanced and remaining strategies. For ease of comparison, the simple PEAD strategy profit is also listed, which is 0.72%. The data in Panel A of Table II suggests that the enhanced strategy generates an average monthly return of 2.01% from the long leg and 0.49% from the short leg, leading to a hedge profit of 1.52% (t=7.62). By contrast, the remaining strategy earns a return of 0.10% (t=0.97). The difference between these two strategies is large. The profit from the enhanced strategy represents more than double that of the simple PEAD strategy, while that from the remaining strategy is trivial.

To measure the impact of the recency bias on PEAD, we propose a simple measure, called percent by RR (recency ratio), as defined in equation (5).[3]

$$Percent\ by\ RR = 1 - \frac{Profits\ from\ the\ remaining\ strategy}{Profits\ from\ the\ PEAD\ strategy} \quad (5)$$

[2] Robustness check shows that main results hold for quintiles on earnings surprise and quintiles on recency ratio.

[3] For ease of interpretation we limit this measure to be between 0 and 100%. When the profits from the remaining strategy are negative, the percent by RR would exceed 100%. In such cases, we truncate the measure to 100%; when the profits from the remaining strategy exceed those from the PEAD strategy, the percent by RR would be negative. In such cases, we truncate the measure to 0%.

Based on data presented in Panel B of Table II, the Percent by RR as defined in equation (2) is 86% (=1 – 0.10/0.72). That is, about 86% of the PEAD profits can be attributed to investors' recency bias.

Table II: Base two-way sort result

In each month t from January 1977 to September 2013, stocks listed on NYSE, AMEX, and NASDAQ are sorted independently into 10 portfolios on earnings surprise and three portfolios on recency ratio (RR). We hold the portfolios for three months. The calendar-time portfolio returns for month t from February 1977 to December 2013 are the average returns of the three portfolios formed in month t-j (j=1, 2, and 3). Panel A reports the average monthly portfolio returns for the 30 (10 x 3) portfolios, as well as the return differences and associated t-statistics (in brackets) between the high RR (top 1/3) and low RR (bottom 1/3) portfolios for each of the 10 earnings surprise deciles. Panel B presents the profits (t-statistics in brackets) from the simple PEAD strategy (PEAD), the enhanced strategy (Enhanced), and the remaining strategy (Remaining), as well as the percentage of PEAD profits attributable to the recency bias, defined as 1 – (Remaining /PEAD), trimmed between 0 and 100%. The returns are in percentage. Earnings surprise and RR are defined in the Appendix.

Panel A: Returns from a two-way sort on earnings surprises and recency ratio

Earnings surprise	All	Low RR	Mid RR	High RR	High – Low	T
Most negative	0.79	0.49	1.00	1.20	0.71	[3.71]
2	1.11	0.91	1.26	1.24	0.33	[2.03]
3	1.19	0.99	1.28	1.34	0.35	[2.21]
4	1.20	0.93	1.37	1.28	0.35	[2.39]
5	1.23	1.00	1.34	1.34	0.34	[2.30]
6	1.28	1.07	1.34	1.40	0.33	[2.23]
7	1.30	1.04	1.35	1.45	0.41	[2.90]
8	1.34	1.04	1.39	1.51	0.47	[3.31]
9	1.36	0.95	1.49	1.56	0.61	[4.20]
Most positive	1.51	0.89	1.46	2.01	1.12	[6.19]

Panel B: Profits of strategies

Strategies	PEAD	Enhanced	Remaining	Percent by RR
Profits	0.72	1.52	0.10	86%
	[8.16]	[7.62]	[0.97]	

4.3.Does risk explain the results?

So far we interpret our findings from the lens of investors' recency bias. It is important, however, to examine whether our finding is due to the differential risks of the stocks involved. Specifically, for the 30 portfolios formed on earnings surprise deciles and recency ratio terciles, we regress the calendar-time average monthly portfolio returns on the Fama and French (1993) three factors. Table III presents the alphas of the equal- (Panel A) and value-weight (Panel B)

portfolios, respectively. For convenience, Table III also lists alphas for the earnings surprise deciles.

Shown in Panel A-1 of Table III, the PEAD hedge portfolio earns an equal-weight monthly alpha of 0.76% (t=8.68), similar to the profit number reported in Table I. Consistent with the results in Table II, within each decile, the recency ratio makes a significant difference, and the difference is largest in the most extreme earnings surprise deciles. For instance, the equal-weight monthly alpha for the high – low difference is 0.86% (t=4.02) among stocks with the most negative earnings surprise and 1.25% (t=6.70) among stocks with the most positive earnings surprise.

Shown in Panel A-2 of Table III, the enhanced strategy earns an equal-weight monthly alpha of 1.67% (t=8.02) while the remaining strategy earns 0.06% (t=0.54). This pattern is similar to that shown in Table II. It is clear that the PEAD profits mostly come from the enhanced strategy. Following the definition in equation (5), the percent by RR is 92%. That is, after accounting for the Fama and French (1993) three factors, 92% of the PEAD profit can be attributed to investors' recency bias.

Panels B-1 and B-2 of Table III present the value-weight results. Consistent with prior findings that the PEAD effect is stronger among smaller stocks, the value-weight PEAD profits are relatively smaller. The PEAD profits on a value-weight basis are 0.40% (t=2.78), as compared to the equal-weight alpha of 0.76% (t=8.68). The role of the recency bias, however, exhibits a general pattern similar to that shown in Panels A-1 and A-2. In Panel B-1, the recency ratio plays a role in all earnings surprise deciles, especially in the extreme deciles. As a result, the enhanced strategy earns a value-weight alpha of 1.23% (t=5.01) and the remaining strategy earns -0.15% (t=-0.97). Because the remaining strategy profit is negative, we truncate the percent by RR measure at 100%. That is, in this case we interpret the results as showing that the recency bias accounts for 100% of the PEAD profits. The results in Table III suggest that the recency bias does not appear to be explained by risk.[4]

Table III: Fama-French regression alphas

In each month t from January 1977 to September 2013, stocks listed on NYSE, AMEX, and NASDAQ are sorted independently into 10 portfolios on earnings surprise and three portfolios on recency ratio (RR). Earnings surprise and RR are defined in the Appendix. We hold each of the 30 portfolios for three months. For month t from February 1977 to December 2013, the calendar-time portfolio return is the average return of the three portfolios formed on month t-j (j=1, 2, and 3). The monthly portfolio returns are regressed on Fama-French (1993) three factors. The equal-weight (value-weight) alphas are reported in Panel A-1 (B-1). Also reported are the alphas of the ten earnings surprise deciles, as well as the alphas of the return difference between the high (top 1/3) and low (bottom 1/3) RR portfolios for each of the earnings surprise deciles. T-statistics are reported in parenthesis. Panels A-2 and B-2 report the alphas of the hedge portfolios based on the simple PEAD strategy (PEAD), the enhanced strategy (Enhanced), and the remaining strategy (Remaining), and the percentage attributable to the recency bias, defined as 1 – (Remaining / PEAD), trimmed between 0 and 100%. The returns are in percentage.

[4] In unreported analysis, we also add the momentum factor (Carhart, 1997), the liquidity factors by Pastor and Stambaugh (2003) and Sadka (2006). We find very similar results, which suggest that the recency bias is not explained by rational risks.

Panel A: Equal-weight results

Panel A-1: The alphas of the portfolios

		Recency ratio			
Earnings surprises	All	Low	Mid	High	High - Low
Most negative	-0.60	-0.96	-0.39	-0.10	0.86
	(-7.04)	(-6.53)	(-3.92)	(-0.87)	(4.02)
2	-0.20	-0.46	-0.05	-0.00	0.46
	(-2.90)	(-3.53)	(-0.62)	(-0.05)	(2.58)
3	-0.07	-0.34	0.02	0.15	0.49
	(-1.28)	(-3.08)	(0.34)	(1.80)	(3.08)
4	-0.02	-0.36	0.15	0.14	0.50
	(-0.35)	(-3.28)	(2.04)	(1.70)	(3.09)
5	0.03	-0.28	0.13	0.21	0.48
	(0.65)	(-2.61)	(1.83)	(2.53)	(3.07)
6	0.08	-0.21	0.12	0.28	0.48
	(1.59)	(-1.86)	(1.69)	(3.69)	(3.04)
7	0.07	-0.25	0.11	0.30	0.55
	(1.44)	(-2.34)	(1.42)	(3.81)	(3.54)
8	0.09	-0.27	0.15	0.32	0.60
	(1.97)	(-2.59)	(2.04)	(4.44)	(4.04)
9	0.08	-0.39	0.18	0.33	0.72
	(1.66)	(-3.56)	(2.14)	(4.09)	(4.46)
Most positive	0.16	-0.53	0.09	0.72	1.25
	(2.55)	(-4.01)	(0.93)	(7.24)	(6.70)

Panel A-2: Profits of strategies

PEAD	Enhanced	Remaining	% by recency
0.76	1.67	0.06	92%
(8.68)	(8.02)	(0.54)	

Panel B: Value-weight results

Panel B-1: The alphas of the portfolios

		Recency ratio			
Earnings surprises	All	Low	Mid	High	High - Low
Most negative	-0.35	-0.72	-0.11	-0.23	0.50
	(-3.16)	(-4.04)	(-0.95)	(-1.65)	(2.02)
2	0.03	-0.29	0.14	-0.02	0.26
	(0.38)	(-2.14)	(1.42)	(-0.22)	(1.44)
3	0.06	-0.18	0.06	0.22	0.40
	(0.92)	(-1.39)	(0.67)	(1.85)	(1.93)

4	0.01	-0.15	0.09	0.07	0.22
	(0.09)	(-1.10)	(0.89)	(0.72)	(1.14)
5	0.04	-0.09	0.11	0.10	0.19
	(0.71)	(-0.68)	(1.36)	(1.06)	(1.00)
6	0.11	-0.16	0.15	0.26	0.42
	(1.88)	(-1.19)	(1.58)	(2.70)	(2.21)
7	0.00	-0.28	0.07	0.17	0.46
	(0.02)	(-2.39)	(0.76)	(1.96)	(2.67)
8	-0.03	-0.28	-0.01	0.11	0.39
	(-0.46)	(-2.16)	(-0.11)	(1.35)	(2.25)
9	-0.05	-0.40	-0.03	0.08	0.49
	(-0.66)	(-2.62)	(-0.30)	(0.69)	(2.14)
Most positive	0.05	-0.58	-0.07	0.51	1.08
	(0.48)	(-3.45)	(-0.50)	(3.83)	(4.78)

Panel B-2: Profits of strategies

PEAD	Enhanced	Remaining	% by recency
0.40	1.23	-0.15	100%
(2.78)	(5.01)	(-0.97)	

4.4.The role of firm size

As discussed in section 2, a stronger PEAD effect is associated with less sophisticated investors and firms with more market frictions, issues that are closely related to firm size. In this section we examine whether the recency bias plays a larger role among smaller firms. A priori the argument could go either way. On one hand, given that more individual investors are likely to trade smaller stocks and individual investors are more prone to behavioral biases, such as the recency bias, we would expect that the recency bias has a stronger impact on the PEAD puzzle among smaller firms. On the other hand, however, even though institutional investors are more likely to hold and trade larger firms, the actual individuals who determine the valuation and trading decisions in larger firms are also human beings and are equally prone to the recency bias. Furthermore, because the information environment is better for larger firms, other factors that contribute to the PEAD puzzle might play a relatively weaker role among larger firms than smaller firms. Thus, it is essentially an empirical question whether the recency bias plays a relatively more or less important role among larger firms.

To examine these possibilities, we conduct an independent three-way sort of stocks on earnings surprise (deciles), recency ratio (terciles), and market capitalization (two groups by NYSE median). We call stocks with market capitalization below (above) the NYSE median as small (large) firms. For the subsamples of small and large firms, we then perform the two-way sort analysis and examine the portfolios' future returns over the subsequent three-month holding period. The process is exactly the same as in Table II. The results are shown in Table IV.

We first confirm that indeed PEAD is stronger among smaller firms than larger firms. The average monthly return following the PEAD investment strategy is 0.92% (t=9.48) for smaller firms but only 0.29% (t=2.69) for larger firms. However, the recency bias plays an important role in both smaller and larger firms. Specifically, the enhanced investment strategy that takes into account the recency bias in PEAD earns an average return of 1.82% (t=8.69) among smaller firms,

accounting for 76% of the PEAD profits; the enhanced strategy earns an average return of 0.88% (t=3.83) among larger firms, leaving the remaining stocks in the PEAD strategy earning a -0.13% (t=-0.90). Thus, the recency bias accounts for 100% of the PEAD profits among the larger firms.

Table IV: Recency bias and firm size

In each month t from January 1977 to September 2013, stocks listed on NYSE, AMEX, and NASDAQ are ranked independently into 10 portfolios on earnings surprise, three portfolios on recency ratio (RR), and two portfolios on market capitalization (by NYSE median). For each of the 60 portfolios, we examine their returns over the subsequent three-month holding period. Calendar-time portfolio returns for month t from February 1977 to December 2013 are the average returns of the three portfolios formed in month t-j (j=1, 2, and 3). Panel A reports the average monthly portfolio returns for small stocks and large stocks, respectively. Panel B presents the profits (t-statistics in brackets) from the simple PEAD strategy (PEAD), the enhanced strategy (Enhanced), and the remaining strategy), as well as the percentage of PEAD profits attributable to the recency bias, defined as 1 – (Remaining /PEAD), trimmed between 0 and 100%. The returns are in percentage.

Panel A: Recency, firm size, and returns

	Small stocks				Large stocks			
Earnings surprises	All small	Low RR	Mid RR	High RR	All Large	Low RR	Mid RR	High RR
Most negative	0.74	0.42	0.98	1.26	0.96	0.71	1.06	1.21
2	1.12	0.89	1.27	1.39	1.11	0.93	1.23	1.07
3	1.22	1.02	1.30	1.44	1.19	1.01	1.27	1.24
4	1.19	0.90	1.40	1.34	1.23	1.03	1.36	1.19
5	1.29	1.02	1.48	1.41	1.18	1.00	1.19	1.27
6	1.35	1.16	1.36	1.55	1.21	0.97	1.32	1.23
7	1.42	1.13	1.42	1.70	1.16	0.95	1.27	1.19
8	1.47	1.14	1.49	1.76	1.19	0.95	1.33	1.22
9	1.53	1.10	1.72	1.75	1.16	0.76	1.21	1.30
Most positive	1.66	1.01	1.56	2.25	1.25	0.72	1.29	1.59

Panel B: Profits of strategies

Strategies	PEAD	Enhanced	Remain	% by RR	PEAD	Enhanced	Remain	% by RR
Profit	0.92 [9.48]	1.82 [8.69]	0.23 [2.03]	76%	0.29 [2.69]	0.88 [3.83]	-0.13 [-0.90]	100%

4.5.The disappearing PEAD

The PEAD puzzle has been weakening over time (see, e.g., Richardson et al., 2010). It is interesting to see whether the disappearing of the PEAD puzzle coincides with a weakening role of the recency bias over time. Whether the role of recency bias weakens over time or not, however, is unclear ex ante. On one hand, the learning and self-correcting of behavioral biases (including recency bias) by investors could lead to a weaker recency bias effect in PEAD. On the other hand,

the greater availability of the 52-week high information over time might make the recency bias effect even stronger.

To examine the role of recency bias in PEAD over time, we divide our sample into three subsamples, corresponding to three time periods (1977 to 1989, 1990 to 1999, and 2000 to 2013). Table V presents the results for the three subsamples.

Indeed the PEAD puzzle weakens in the more recent time period. In the 1977-1989 and 1990-1999 periods, the PEAD profits are 0.98% (t=9.01) and 1.07% (t=7.15), respectively. In the recent period (2000-2013) the PEAD profits are only 0.27% (t=1.58).

In the 1977-1989 period the enhanced strategy (buying firms with extreme positive earnings surprise and high recency ratio) earns an average return of 1.62% (t=8.53), leaving the remaining strategy earning 0.48% (t=3.16). Thus the recency bias accounts for 51% of the PEAD profits. In the 1990-1999 period, the enhanced strategy earns an average return of 2.49% (t=6.87) and the remaining strategy earns -0.03% (t=-0.14). The recency bias accounts for 100% of the PEAD profits. In the 2000-2013 period, though the PEAD profits are not significant, the enhanced strategy continues to earn a significant return of 0.82% (t=1.95), and the remaining strategy generates -0.19% (t=-0.96). Thus, the recency bias accounts for 100% of PEAD in this period.

The results in Table V confirm that the PEAD puzzle is disappearing. The impact of recency bias on PEAD, however, remains. Overall, in the more recent 24 years (1990-2013), the recency bias accounts for the entirety of the PEAD profits.

Table V: Samples of sub-periods

In each month t from January 1977 to September 2013, stocks listed on NYSE, AMEX, and NASDAQ are ranked independently into 10 portfolios on earnings surprise and three portfolios on recency ratio (RR). For each of the 30 portfolios, we examine their returns over the subsequent three-month holding period. Calendar-time portfolio returns for month t from February 1977 to December 2013 are the average returns of the three portfolios formed in month t-j (j=1, 2, and 3). We divide up the calendar-time portfolio series into three sub-periods (February 1977 to December 1989, January 1990 to December 1999, and January 2000 to December 2013). For each of the sub-periods, we examine the portfolios returns and profits of various strategies. Panel A reports the average monthly portfolio returns. Panel B presents the profits (t-statistics in brackets) from the simple PEAD strategy (PEAD), the enhanced strategy (Enhanced), andthe remaining strategy), as well as the percentage of PEAD profits attributable to the recency bias, defined as 1 – (Remaining /PEAD), trimmed between 0 and 100%. The returns are in percentage.

Panel A: Recency and returns over three sub-periods

	197702 to 198912				199001 to 199912				200001 to 201312			
Earnings surprises	All	Low RR	Mid RR	High RR	All	Low RR	Mid RR	High RR	All	Low RR	Mid RR	High RR
Most negative	0.89	0.59	1.15	1.13	0.98	0.47	1.15	1.84	0.68	0.50	0.84	1.01
2	1.29	1.03	1.47	1.45	1.29	0.93	1.46	1.57	0.89	0.83	0.97	0.95
3	1.40	1.22	1.50	1.54	1.31	0.84	1.49	1.69	0.96	0.93	0.95	1.04
4	1.44	1.27	1.59	1.45	1.26	0.78	1.49	1.49	0.98	0.74	1.11	1.10
5	1.50	1.18	1.67	1.59	1.31	0.89	1.47	1.58	0.99	0.96	0.97	1.02
6	1.60	1.43	1.66	1.66	1.30	0.83	1.47	1.57	1.04	0.93	0.97	1.19
7	1.55	1.30	1.66	1.65	1.41	1.06	1.44	1.73	1.05	0.84	1.05	1.19
8	1.65	1.33	1.82	1.77	1.52	1.05	1.54	1.88	1.00	0.84	0.94	1.14
9	1.64	1.10	1.96	1.78	1.59	0.94	1.55	2.10	1.05	0.85	1.08	1.10
Most positive	1.87	1.26	1.98	2.22	2.06	0.92	1.87	2.96	0.95	0.63	0.78	1.32

Panel B: Profits of strategies

Strategies	PEAD	Enhanced	Remain	% by RR	PEAD	Enhanced	Remain	% by RR	PEAD	Enhanced	Remain	% by RR
Profit	0.98	1.62	0.48	51%	1.07	2.49	-0.03	100%	0.27	0.82	-0.19	100%
	[9.01]	[8.53]	[3.16]		[7.15]	[6.87]	[-0.14]		[1.58]	[1.95]	[-0.96]	

4.6.Fama and MacBeth (1973) regressions

In this section we examine the role of the recency ratio in PEAD in the Fama and MacBeth (1973) cross-sectional regression setting. Specifically, for each monthly cross-section, we estimate the following three (j=1, 2, and 3) regressions, as in equation (6) shown below, of the month t return on a set of control variables (past month return, natural logarithm of market capitalization, natural logarithm of the book-to-market ratio, and the one-year past return), a dummy variable for the top 1/3 recency ratio (RRH), a dummy variable for the bottom 1/3 recency ratio (RRL), and a set of interaction terms (ESH*RRH, ESH*RRL, ESL*RRH, and ESL*RRL). Here ESH and ESL are dummy variables for the top and bottom earnings surprise deciles, respectively. For each month, we first take the average of the regression coefficients from the three (j=1, 2, and 3) regressions to form a time-series of the regression coefficients. The time-series averages of the regression coefficients are presented in the first column (Raw) of Table VI. To eliminate any impact of the risk factors, we also regress each of the coefficient time series on the contemporaneous Fama and French (1993) risk factors and present their alphas in the second column of Table VI (Risk-adj.).

$$
\begin{aligned}
R_{i,t} = {} & b_{0jt} \\
& + b_{1jt}R_{i,t-1} + b_{2jt}\ln(MC)_{i,t-1} + b_{3jt}\ln(BM)_{i,t-1} + b_{4jt}\mathrm{R}_{i,t-1\sim t-12} \\
& + b_{5jt}\mathrm{ESH}_{i,t-j} + b_{6jt}\mathrm{ESL}_{i,t-j} \\
& + b_{7jt}\mathrm{RRH}_{i,t-j} + b_{8jt}\mathrm{RRL}_{i,t-j} \\
& + b_{9jt}\mathrm{ESH}_{i,t-j} * \mathrm{RRH}_{i,t-j} + b_{10jt}\mathrm{ESH}_{i,t-j} * \mathrm{RRL}_{i,t-j} \\
& + b_{11jt}\mathrm{ESL}_{i,t-j} * \mathrm{RRH}_{i,t-j} + b_{12jt}\mathrm{ESL}_{i,t-j} * \mathrm{RRL}_{i,t-j} \\
& + \mathrm{e}_{i,t-j} \qquad (6)
\end{aligned}
$$

Where j=1, 2, and 3 and t is from February 1977 to December 2013.

In this regression setting, the coefficient difference $b_7 - b_8$ tests whether the recency ratio makes a difference in the earnings surprise deciles other than the two extreme deciles; the coefficient difference $b_9 - b_{10}$ tests whether the recency ratio makes a difference in the most positive earnings surprise decile; the coefficient difference $b_{11} - b_{12}$ tests whether the recency ratio makes a difference in the most negative earnings surprise decile. These tests are presented in Panel B of Table VI.

In Panel A of Table VI, the RRH coefficients are not significant, and the RRL coefficients are negative and significant. Thus, when the earnings surprise is not extreme (in the top or bottom deciles), stocks in the top 1/3 of the recency ratio do not earn higher or lower returns than those in the middle 1/3 of the recency ratio, but stocks in the bottom 1/3 of the recency ratio do earn lower returns than those in the middle 1/3 of the recency ratio. The difference between b_7 and b_8, as presented in row (13) of Panel B, is positive, and significant for the risk-adjusted case.

The interaction term ESH*RRH carries significant positive coefficients, and the coefficients on ESH*RRL are not significant. Thus, when the earnings surprise is extremely positive (in the top decile), stocks with a recency ratio in the top 1/3 are underpriced and earn higher returns than those in the middle 1/3. On the other hand, stocks with a recency ratio in the bottom 1/3 do not earn statistically different returns than those in the middle 1/3. As a result, the difference between b_9 and b_{10}, which measures the impact of recency ratios on stocks with extreme positive earnings surprise, is positive and significant in both raw and risk-adjusted cases.

Shown in rows (11) and (12) of Panel A, the coefficients of ESL*RRH and ESL*RRL are not significant but the differences between the two are significant, albeit with a smaller magnitude,

shown in row (15) of Panel B. Thus, when the earnings surprise is extremely negative (in the bottom decile), stocks with a recency ratio in the bottom 1/3 earn significantly higher returns than those in the bottom 1/3.

The coefficients on the control variables are largely as expected. The past month's return has significant negative coefficients while past year return has significant positive coefficients. The coefficients on size are largely negative and those on B/M are positive, although their statistical significance is relatively weak.

Overall, the results presented in Table VI are consistent with those in the portfolio analysis and further support the hypothesis that recency bias plays an important role in explain PEAD.

Table VI: Fama and MacBeth Regressions

In each month t from January 1977 to September 2013, stocks listed on NYSE, AMEX, and NASDAQ are ranked independently into 10 portfolios on earnings surprise and three portfolios on recency ratio (RR). For month t from February 1977 to December 2013, we run cross-sectional regressions, as specified in equation (6), of monthly return on past month return, market capitalization, book-to-market ratio, past year return, and a set of portfolio rank variables and their interactions, including ESH, ESL, RRH, RRL, ESH*RRH, ESH*RRL, ESL*RRH, and ESL*RRH, measured in time t-j (j=1, 2, and 3). We then take the average of the three (j=1, 2, and 3) coefficients to form a time-series of regression coefficients for month t from February 1977 to December 2013. Column "Raw" of Panel A reports the time-series average of the coefficients with t-statistics in parentheses, which are based on time-series standard errors. The time-series of the average coefficients (from three regressions) are also regressed on the Fama-French (1993) three factors. Column "Risk adj." of Panel A reports the alphas for each of the coefficients. Panel B reports test statistics of the coefficients, indicated by their row indices.

Variables	Raw	Risk-adj.
Panel A: Regression		
(0) Intercept	1.70	0.53
	(4.18)	(3.66)
(1) Rj,t-1	-3.42	-2.86
	(-7.72)	(-6.65)
(2) Sizej,t-1	-0.06	-0.01
	(-1.62)	(-0.43)
(3) B/Mj,t-1	0.14	0.05
	(1.83)	(1.68)
(4) Past year return	0.49	0.61
	(3.01)	(4.87)
(5) ESH	0.10	0.02
	(0.98)	(0.30)
(6) ESL	-0.33	-0.42
	(-3.66)	(-5.97)
(7) RRH	-0.06	-0.01
	(-0.82)	(-0.09)
(8) RRL	-0.21	-0.26

	(-3.04)	(-3.94)
(9) ESH*RRH	0.38	0.33
	(4.63)	(3.87)
(10) ESH*RRL	-0.12	-0.15
	(-1.30)	(-1.47)
(11) ESL*RRH	0.11	0.12
	(1.19)	(1.28)
(12) ESL*RRL	-0.11	-0.12
	(-1.34)	(-1.43)
Panel B: Test RR		
(13)=(7) - (8)	0.15	0.26
	(1.59)	(2.75)
(14)=(9) - (10)	0.50	0.48
	(5.50)	(4.68)
(15)=(11) - (12)	0.22	0.24
	(2.16)	(2.21)

4.7. Robustness

We address three aspects of robustness. First we adopt alternative measures of earnings surprise. Second, we form 5 by 5, instead of 10 by 3, portfolios. Third, we study the impact of recency ratios on PEAD after controlling for the nearness ratio. The results are discussed in turn.

4.7.1. Alternative measure of earnings surprise

In our main analysis we use earnings announcement period abnormal returns to measure earnings surprise. Other measures have been used in the literature as well. One of the more popular measures is earnings surprise based on analyst consensus (e.g., Doyle et al., 2006; Livnat and Mendenhall 2006). We repeat our analysis in Table II using earnings surprise based on analyst consensus. The results are presented in Table VII.

Panel A of Table VII shows that the recency ratio makes a difference in all earnings surprise deciles, with most differences being statistically significant. The high – low differences are also larger when earnings surprise is extreme. The PEAD profits are 0.71% (t=5.43). The enhanced strategy earns an average monthly profit of 1.26% (t=5.08) and the remaining strategy earns an insignificant return of 0.08% (t=0.61). As a result, the recency bias accounts for 89% of the PEAD profits.

Table VII: Earnings surprise based on analyst consensus

In each month t from January 1977 to September 2013, stocks listed on NYSE, AMEX, and NASDAQ are sorted independently into 10 portfolios on earnings surprise and three portfolios on recency ratio (RR). Earnings surprise is defined as the difference between the actual earnings per share and the most recent analyst consensus earnings per share. RR is defined in the Appendix. We hold the portfolios for three months. The calendar-time portfolio returns for month t from February 1977 to December 2013 are the average returns of the three portfolios formed in month t-j (j=1, 2, and 3). Panel A reports the average monthly portfolio returns for the 30 (10 x 3)

portfolios, as well as the return differences and associated t-statistics (in brackets) between the high RR (top 1/3) and low RR (bottom 1/3) portfolios for each of the 10 earnings surprise deciles. Panel B presents the profits (t-statistics in brackets) from the simple PEAD strategy (PEAD), the enhanced strategy (Enhanced), and the remaining strategy (Remaining), as well as the percentage of PEAD profits attributable to the recency bias, defined as 1 – (Remaining /PEAD), trimmed between 0 and 100%. The returns are in percentage.

Panel A: Two-way sorts on earnings surprises and recency ratio

Earnings surprises	All	Low RR	Mid RR	High RR	High – Low	T
Most negative	0.85	0.65	1.08	1.42	0.77	[2.94]
2	1.08	0.81	1.27	1.27	0.47	[2.27]
3	1.03	0.75	1.08	1.26	0.45	[2.29]
4	0.93	0.81	0.99	0.99	0.16	[0.92]
5	1.01	0.91	1.15	0.97	0.09	[0.50]
6	1.12	0.80	1.23	1.22	0.41	[1.94]
7	1.33	0.97	1.41	1.47	0.50	[2.67]
8	1.26	0.98	1.31	1.45	0.45	[2.46]
9	1.36	0.97	1.43	1.47	0.55	[2.93]
Most positive	1.55	1.05	1.56	1.91	0.86	[4.36]

Panel B: Profits of strategies

Strategies	PEAD	Enhanced	Remaining	Percent by RR
Profits	0.71	1.26	0.08	89%
	[5.43]	[5.08]	[0.61]	

4.7.2. Alternative portfolio formation

In our main analysis we independently form deciles on earnings surprise and terciles on recency ratios, resulting in a total of 30 portfolios. We check robustness by forming a five by five independent two-way sort on earnings surprise and quintiles on recency ratio, resulting in a total of 25 portfolios. With 25 portfolios, we conduct the same two-way sort as in Table II.

Results are presented in Table VIII. For convenience, in Panel A of Table VIII we lump all the middle groups of recency ratio together. That is, "Low RR" and "High RR" in Panel A means the recency ratio is in the bottom and top 1/5, respectively, and "Mid RR" includes stocks with recency ratios in the middle three quintiles.

From Panel A, the "High – Low" numbers and their associated t-statistics suggest a strong impact of the recency ratio in each of the earnings surprise quintiles. Based on quintiles, the PEAD profits are on average 0.49% (t=7.20). The enhanced strategy earns an average monthly return of 1.22% (t=5.96%), the remaining strategy earns 0.21% (t=3.17%), and the recency bias accounts for 57% of the PEAD profits. These results are largely consistent with the main finding that the recency bias plays an important role in explaining PEAD.

Table VIII: Quintile portfolio formation

In each month t from January 1977 to September 2013, stocks listed on NYSE, AMEX, and NASDAQ are sorted independently into five portfolios on earnings surprise and five portfolios on recency ratio (RR). We then lump the middle three RR quintiles together. Thus "High RR" and "Low RR" refer to the top and bottom quintiles, respectively, and the "Mid RR" group refers to the middle three quintiles combined. We hold the portfolios for three months. The calendar-time portfolio returns for month t from February 1977 to December 2013 are the average returns of the three portfolios formed in month t-j (j=1, 2, and 3). Panel A reports the average monthly portfolio returns for the 15 (5 x 3) portfolios, as well as the return differences and associated t-statistics (in brackets) between the high RR (top 1/5) and low RR (bottom 1/5) portfolios for each of the five earnings surprise deciles. Panel B presents the profits (t-statistics in brackets) from the simple PEAD strategy (PEAD), the enhanced strategy (Enhanced), and the remaining strategy (Remaining), as well as the percentage of PEAD profits attributable to the recency bias, defined as 1 – (Remaining /PEAD), trimmed between 0 and 100%. The returns are in percentage. Earnings surprise and RR are defined in the Appendix.

Panel A: Two-way sorts on earnings surprises and recency ratio

Earnings surprises	All	Low RR	Mid RR	High RR	High – Low	T
Most negative	0.95	0.57	1.07	1.25	0.68	[3.12]
2	1.20	0.84	1.29	1.27	0.43	[2.38]
3	1.26	0.92	1.34	1.31	0.39	[2.21]
4	1.32	0.97	1.36	1.45	0.48	[3.10]
Most positive	1.44	0.82	1.46	1.80	0.97	[5.43]

Panel B: Profits of strategies

Strategies	PEAD	Enhanced	Remaining	Percent by RR
Profits	0.49	1.22	0.21	57%
	[7.20]	[5.96]	[3.17]	

4.7.3. Controlling for nearness ratio

In contemporaneous work, George et al. (2014) examine the role of nearness ratio (price proximity) in PEAD and find that the nearness ratio is an important factor explaining PEAD. Following their work, we define nearness ratio as the ratio of current stock price to the 52-week high. Because nearness ratio and recency ratio are highly correlated (Bhootra and Hur, 2013), and the nearness ratio uses more recent price information, it is expected that the effect of the recency ratio becomes weaker after controlling for the nearness ratio.

In this section we examine the impact of the recency ratio on PEAD after controlling for the nearness ratio. We use Fama and MacBeth (1973) regressions. The results are presented in Table IX. For convenience we first duplicate the two regressions in Table VI in the first two columns of Table IX (Model 1). We then replace the recency ratio with the nearness ratio and estimate the two regressions in Table VI. Doing so, we define two dummy variables, NRH and NRL. NRH is equal to one if the nearness ratio is in the top 1/3 and NRL is one if the nearness ratio is in the bottom 1/3. The regression model is shown in equation (7).

$$R_{i,t} = b_{0jt}$$

$$
\begin{aligned}
&+b_{1jt}R_{i,t-1} + b_{2jt}\ln(MC)_{i,t-1} + b_{3jt}\ln(BM)_{i,t-1} + b_{4jt}\mathrm{R}_{i,t-1\sim t-12}\\
&+b_{5jt}\mathrm{ESH}_{i,t-j} + b_{6jt}\mathrm{ESL}_{i,t-j}\\
&+b_{7ajt}\mathrm{NRH}_{i,t-j} + b_{8ajt}\mathrm{NRL}_{i,t-j}\\
&+b_{9ajt}\mathrm{ESH}_{i,t-j} * \mathrm{NRH}_{i,t-j} + b_{10ajt}\mathrm{ESH}_{i,t-j} * \mathrm{NRL}_{i,t-j}\\
&+b_{11ajt}\mathrm{ESL}_{i,t-j} * \mathrm{NRH}_{i,t-j} + b_{12ajt}\mathrm{ESL}_{i,t-j} * \mathrm{NRL}_{i,t-j}\\
&+\mathrm{e}_{i,t-j} \qquad (7)
\end{aligned}
$$

Where j=1, 2, and 3 and t is from February 1977 to December 2013.

The results are presented in the following two columns (under Model 2). These two regressions are to examine the impact of the nearness ratio in PEAD. From Model 2, it is clear that nearness ratio has an important impact on PEAD, with a pattern similar to that in Model 1. In Panel B of Table IX, rows (14a) and (15a) are as strong as in rows (14) and (15). The statistical significance of row (13a) is slightly weaker than in row (13). That is, when the earnings surprise is not extreme, the recency ratio appears to have a slightly stronger impact on stock returns.

In Model (3), we allow both recency ratio and nearness ratio to enter the regressions. The regression model is shown in equation (8).

$$
\begin{aligned}
R_{i,t} = {} & b_{0jt}\\
&+b_{1jt}R_{i,t-1} + b_{2jt}\ln(MC)_{i,t-1} + b_{3jt}\ln(BM)_{i,t-1} + b_{4jt}\mathrm{R}_{i,t-1\sim t-12}\\
&+b_{5jt}\mathrm{ESH}_{i,t-j} + b_{6jt}\mathrm{ESL}_{i,t-j}\\
&+b_{7jt}\mathrm{RRH}_{i,t-j} + b_{8jt}\mathrm{RRL}_{i,t-j}\\
&+b_{9jt}\mathrm{ESH}_{i,t-j} * \mathrm{RRH}_{i,t-j} + b_{10jt}\mathrm{ESH}_{i,t-j} * \mathrm{RRL}_{i,t-j}\\
&+b_{11jt}\mathrm{ESL}_{i,t-j} * \mathrm{RRH}_{i,t-j} + b_{12jt}\mathrm{ESL}_{i,t-j} * \mathrm{RRL}_{i,t-j}\\
&+b_{7ajt}\mathrm{NRH}_{i,t-j} + b_{8ajt}\mathrm{NRL}_{i,t-j}\\
&+b_{9ajt}\mathrm{ESH}_{i,t-j} * \mathrm{NRH}_{i,t-j} + b_{10ajt}\mathrm{ESH}_{i,t-j} * \mathrm{NRL}_{i,t-j}\\
&+b_{11ajt}\mathrm{ESL}_{i,t-j} * \mathrm{NRH}_{i,t-j} + b_{12ajt}\mathrm{ESL}_{i,t-j} * \mathrm{NRL}_{i,t-j}\\
&+\mathrm{e}_{i,t-j} \qquad (8)
\end{aligned}
$$

Where j=1, 2, and 3 and t is from February 1977 to December 2013.

We find that RRH and NRH remain largely insignificant, as in the two earlier models. RRL remains negative and significant, while the coefficient on NRL becomes smaller and statistically weaker. The evidence is consistent with evidence from Models 1 and 2 that the recency ratio has a slightly stronger, and more resilient, impact on stock returns when the earnings surprise is not extreme. The coefficients of ESH*RRH remain positive for both raw and risk-adj. cases and statistically significant for the raw case. The coefficient differences $b_7 - b_8$ and $b_9 - b_{10}$ (rows 13 and 14) in Panel B remain positive and significant. The magnitude of $b_9 - b_{10}$ becomes smaller, suggesting a weaker impact of the recency bias after controlling for nearness ratio. Furthermore, in this model, the coefficient differences $b_{11} - b_{12}$ (row 15) are not statistically significant. On the other hand, the coefficient differences b_{9a} - b_{10a} and $b_{11a} - b_{12a}$ (rows 14a and 15a) remain positive and significant.

Overall, we find that the impact of recency bias in explaining PEAD remains even after controlling for the nearness ratio. Admittedly, controlling for the nearness ratio to some extent weakens the impact of the recency bias in PEAD, especially in cases involving extreme negative earnings surprise.

Table IX: Impact of recency ratio after controlling for nearness ratio

In each month t from January 1977 to September 2013, stocks listed on NYSE, AMEX, and NASDAQ are ranked independently into 10 portfolios on earnings surprise, three portfolios on recency ratio (RR), and three portfolios on nearness ratio. For month t from February 1977 to December 2013, we run cross-sectional regressions, as specified in equation (6), of monthly return on a set of control variables (past month return, market capitalization, book-to-market ratio, past year return), and a set of portfolio rank variables and their interactions, including ESH, ESL, RRH, RRL, ESH*RRH, ESH*RRL, ESL*RRH, and ESL*RRH, measured in time t-j (j=1, 2, and 3). We then take the average of the three (j=1, 2, and 3) coefficients to form a time-series of regression coefficients for month t from February 1977 to December 2013. Column "Raw" of Model 1 in Panel A reports the time-series average of the coefficients with t-statistics in parentheses, which are based on time-series standard errors. The time-series of the average coefficients (from three regressions) are also regressed on the Fama-French (1993) three factors. Column "Risk adj." of Model 1 in Panel A reports the alphas for each of the coefficients. Panel B reports the test statistics of the coefficients, indicated by their row indices. In Model 2, we replace RRH and RRL in Model 1 with NRH and NRL, respectively. In Model 3, we combine the independent variables in both Models 1 and 2. All variables are defined in the Appendix.

Table IX (Continued)

Panel A: Regression

	Model 1		Model 2		Model 3	
Variables	Raw	Risk-adj.	Raw	Risk-adj.	Raw	Risk-adj.
(0) Intercept	1.70	0.53	1.61	0.46	1.72	0.57
	(4.18)	(3.66)	(4.05)	(3.23)	(4.34)	(3.92)
(1) Rj,t-1	-3.42	-2.86	-3.54	-3.02	-3.51	-2.98
	(-7.72)	(-6.65)	(-8.31)	(-7.25)	(-8.26)	(-7.24)
(2) Sizej,t-1	-0.06	-0.01	-0.05	-0.01	-0.06	-0.01
	(-1.62)	(-0.43)	(-1.44)	(-0.31)	(-1.57)	(-0.58)
(3) B/Mj,t-1	0.14	0.05	0.13	0.03	0.13	0.03
	(1.83)	(1.68)	(1.79)	(1.14)	(1.78)	(1.08)
(4) Past year return	0.49	0.61	0.61	0.65	0.55	0.59
	(3.01)	(4.87)	(4.17)	(5.61)	(3.86)	(5.28)
(5) ESH	0.10	0.02	0.22	0.12	0.17	0.09
	(0.98)	(0.30)	(2.25)	(1.67)	(1.64)	(1.08)
(6) ESL	-0.33	-0.42	-0.25	-0.28	-0.23	-0.26
	(-3.66)	(-5.97)	(-3.05)	(-4.30)	(-2.64)	(-3.42)
(7) RRH	-0.06	-0.01			-0.03	-0.03
	(-0.82)	(-0.09)			(-0.57)	(-0.45)
(8) RRL	-0.21	-0.26			-0.19	-0.22
	(-3.04)	(-3.94)			(-3.22)	(-3.70)
(9) ESH*RRH	0.38	0.33			0.17	0.15
	(4.63)	(3.87)			(1.98)	(1.64)
(10) ESH*RRL	-0.12	-0.15			-0.03	-0.07
	(-1.30)	(-1.47)			(-0.28)	(-0.72)
(11) ESL*RRH	0.11	0.12			-0.08	-0.07
	(1.19)	(1.28)			(-0.88)	(-0.71)
(12) ESL*RRL	-0.11	-0.12			-0.06	-0.09
	(-1.34)	(-1.43)			(-0.67)	(-1.05)
(7a) NRH			-0.08	0.03	-0.10	0.00
			(-1.41)	(0.56)	(-1.90)	(0.05)
(8a) NRL			-0.06	-0.19	-0.01	-0.14
			(-0.58)	(-2.47)	(-0.12)	(-1.99)
(9a) ESH*NRH			0.30	0.30	0.22	0.22
			(4.13)	(4.04)	(2.90)	(2.90)
(10a) ESH*NRL			-0.34	-0.30	-0.29	-0.25
			(-3.72)	(-3.20)	(-3.22)	(-2.63)
(11a) ESL*NRH			0.14	0.10	0.20	0.16
			(1.34)	(1.01)	(1.94)	(1.58)
(12a) ESL*NRL			-0.21	-0.23	-0.20	-0.21
			(-2.78)	(-3.07)	(-2.52)	(-2.61)

Panel B: Test RR

	Model 1		Model 2		Model 3	
Variables	Raw	Risk-adj.	Raw	Risk-adj.	Raw	Risk-adj.
(13)=(7) - (8)	0.15	0.26			0.16	0.19
	(1.59)	(2.75)			(1.93)	(2.46)
(14)=(9) - (10)	0.50	0.48			0.20	0.22
	(5.50)	(4.68)			(2.11)	(2.12)
(15)=(11) - (12)	0.22	0.24			-0.03	0.02
	(2.16)	(2.21)			(-0.25)	(0.20)
(13a)=(7a) - (8a)			-0.03	0.22	-0.09	0.14
			(-0.19)	(1.93)	(-0.68)	(1.47)
(14a)=(9a) - (10a)			0.64	0.60	0.52	0.47
			(6.97)	(5.91)	(5.24)	(4.59)
(15a)=(11a) - (12a)			0.35	0.33	0.40	0.37
			(2.99)	(3.00)	(3.20)	(2.97)

5. Concluding Remarks

In this paper we examine the role of the timing of a stock's price reaching its 52-week high, or recency, in the post earnings announcement drift (PEAD) puzzle. We argue that, because investors are less likely to bid up (down) a stock price if the stock's 52-week high occurred in the recent (distant) past, these stocks will tend to be underpriced (overpriced) and earn higher (lower) future returns. We report these findings. First, PEAD profits are mainly driven by recency bias. An enhanced strategy based on both PEAD and recency accounts for 86% of total PEAD profits. Second, the recency bias accounts for the entire PEAD profits of large stocks and of all stocks in the recent 24 years. The effect of recency bias on PEAD exists even after controlling for price proximity to the 52-week high. Our evidence suggests that recency bias plays an important role in explaining PEAD.

REFERENCES

Baker, M., Pan, X., and J. Wurgler, 2012, "The effect of reference point prices on mergers and acquisitions", *Journal of Financial Economics* 106, 49–71.

Ball, R., and P. Brown, 1968, "An Empirical Evaluation of Accounting Income Numbers", *Journal of Accounting Research* 6, 159-178.

Bartov, E., Radhakrishnan, S., and I. Krinksy, 2000, "Investor sophistication and patterns in stock returns after earnings announcements", *The Accounting Review* 75, 43–63.

Battalio, R., and R. Mendenhall, 2005, "Earnings expectations, investor trade size, and anomalous returns around earnings announcements", *Journal of Financial Economics* 77, 289–319.

Bernard, V., and J. Thomas, 1989, "Post-earnings-announcement drift: delayed price response or risk premium?" *Journal of Accounting Research* 27, 1–48.

Bhootra, A., 2011, "Are momentum profits driven by the cross-sectional dispersion in expected stock returns?" *Journal of Financial Markets* 14, 494–513.

Bhootra, A., and J. Hur, 2013, "The timing of 52-week high price and momentum", *Journal of Banking and Finance* 37, 3773-3782.

Carhart, M., 1997, "On persistence in mutual fund performance", *Journal of Finance* 52, 57–82.

Chang, E., Luo, Y., and J. Ren, 2013, "Cross-listing and pricing efficiency: The informational and anchoring role played by the reference price", *Journal of Banking and Finance* 37, 4449-4464.

Chen, H., Chen, S., Hsin, C., and C. Lee, 2014, "Does revenue momentum drive or ride earnings or price momentum?" *Journal of Banking and Finance* 38, 166-185.

Chordia, T., Goyal, A., Sadka, G., Sadka, R., and L. Sivakumar, 2009, "Liquidity and the Post-Earnings-Announcement Drift", *Financial Analysts Journal*, vol. 65, no. 4 (July-August): 18-32.

Chordia, T., and L. Shivakumar, 2005, "Inflation illusion and post-earnings-announcement drift", *Journal of Accounting Research* 43, 521–556.

DellaVigna, S., and J. Pollet, 2006, "Investor inattention and Friday earnings announcements", *Journal of Finance* 64, 709-749.

Dickey, D., and C. Pearson, 2005, "Recency effect in college student course evaluations", *Practical Assessment, Research, and Evaluation* 10, 1–10.

Doyle, J., Lundholm, R., and M. Soliman, 2006, "The extreme future stock returns following

I/B/E/S earnings surprises", *Journal of Accounting Research* 44, 849-887.

Fama, E.F., and J. MacBeth, 1973, "Risk, return, and equilibrium: empirical tests", *Journal of Political Economy* 81, 607–636.

Fama, E., and K. French, 1993, "Common risk factors in the returns on stocks and bonds", *Journal of Financial Economics* 33, 3–56.

Frazzini, A., 2006, "The disposition effect and underreaction to news", *Journal of Finance* 61, 2017-2046.

George, T., and C. Hwang, 2004, "The 52-week high and momentum investing", *Journal of Finance* 59, 2145–2176.

George, T.J., Hwang, C., and Y. Li, 2014, "Anchoring, the 52-Week High and Post Earnings Announcement Drift", (April 2014). Available at SSRN: http://ssrn.com/abstract=2391455.

Gerard, X. 2012, "Information Uncertainty and the Post-Earnings Announcement Drift in Europe", *Financial Analysts Journal* 68, 51-69.

Gruber, M.J., 1996, "Another puzzle: the growth in actively managed mutual funds", *Journal of Finance* 51, 783–810.

Heath, C., Huddart, S., and M. Lang, 1999, "Psychological factors and stock option exercise", *Quarterly Journal of Economics* 114, 601–627.

Hirshleifer, D., Lim, S., and S.H. Teoh, 2011, "Limited investor attention and stock market misreactions to accounting information", *Review of Asset Pricing Studies* 1, 35-73.

Hirshleifer, D., Myers, J., Myers, L., and S.H. Teoh, 2008, "Do individual investors drive post-earnings announcement drift? Direct Evidence from Personal Trades", *The Accounting Review* 83, 1521-1550.

Huddart, S., Lang, M., and M. Yetman, 2009, "Volume and price patterns around a stock's 52-week highs and lows: Theory and evidence", *Management Science* 55, 16–31.

Jegadeesh, N., and S. Titman, 1993, "Returns to buying winners and selling losers: Implications for stock market efficiency", *Journal of Finance* 48, 65–91.

Kahneman, D., and A. Tversky, 1979, "Prospect theory: An analysis of decision under risk" *Econometrica* 47:2, 263–292.

Kaustia, M., Alho, E., and V. Puttonen, 2008, "How much does expertise reduce behavioral biases? The case of anchoring effects in stock return estimates", *Financial Management* 37, 391–411.

Kishore, R., Brandt, M., Santa-Clara, P., and M. Venkatachalam, 2008, "Earnings announcements are full of surprises", Working paper, Duke University and UCLA.

Li, J., and J. Yu, 2012, "Investor attention, psychological anchors, and stock return predictability", *Journal of Financial Economics* 104, 401–419.

Liang, L., 2003, "Post-earnings-announcement-drift and market participants' information processing biases", *Review of Accounting Studies*, 321–345.

Livnat, J., and R. Mendenhall, 2006, "Comparing the post-earnings announcement drift for surprises calculated from analyst and time series forecasts", *Journal of Accounting Research* 44, 177-205.

Ma, Q., Whidbee, D.A., and W. Zhang, 2016, "Anchoring and acquisitions", Working paper. Available at SSRN: http://ssrn.com/abstract=2716329.

Mendenhall, R., 2004, "Arbitrage risk and post-earnings-announcement drift", *Journal of Business* 77, 875–894.

Mohrman Jr., A.M., Resnick-West, S.M., and E.E. Lawler III, 1989, *Designing Performance Appraisal Systems: Aligning Appraisals and Organizational Realities*. Jossey-Bass Publishers, San Francisco.

Murdock Jr., B.B., 1962, "The serial position effect of free recall", *Journal of Experimental Psychology* 64, 482–488.

Ng, J., Rusticus, T., and R. Verdi, 2008, "Implications of transaction costs for the post-earnings-announcement drift", *Journal of Accounting Research* 46, 661–696.

Nofsinger, J., and A. Varma, 2013, "Availability, recency, and sophistication in the repurchasing behavior of retail investors", *Journal of Banking and Finance* 37, 2572-2585.

Pastor, L., and R. Stambaugh, 2003, "Liquidity risk and expected stock returns", *Journal of Political Economy* 111, 642-685.

Reed, A., 2007, "Costly short-selling and stock price adjustments to earnings announcements", Working Paper, University of North Carolina.

Richardson, S., Tuna, I., and P. Wysocki, 2010, "Accounting anomalies and fundamental analysis: A review of recent research advances", *Journal of Accounting and Economics* 50, 410-454.

Sadka, R., 2006, "Momentum and post-earnings announcement drift anomalies: The role of liquidity risk", *Journal of Financial Economics* 80, 309-349.

Shivakumar, L., 2006, "Accruals, cash flows and the post-earnings-announcement drift", *Journal of Business Finance and Accounting* 33, 1–25.

Tubbs, R.M., Messier Jr., W.F., and R.W. Knechel, 1990, "Recency effects in auditor's belief-revision process", *The Accounting Review* 65, 452–460.

Tversky, A., and D. Kahneman, 1974, "Judgement under uncertainty: heuristics and biases" *Science* 185, 1124–1131.

Appendix A: Variable definitions

$B/M_{j,t-1}$ is the natural logarithm of the book-to-market ratio as of past month end.

Earnings surprise (ES): The abnormal returns during the [-2, +1] window surrounding the earnings announcement date (day 0), adjusted by CRSP equal-weight market return.

ESH = 1 if the stock is ranked in the top decile based on earnings surprise, and 0 otherwise.

ESL = 1 if the stock is ranked in the bottom decile based on earnings surprise, and 0 otherwise.

NR: Nearness ratio = current stock price / the 52-week high price.

NRH = 1 if the stock is ranked in the top 1/3 based on nearness ratio, and 0 otherwise.

NRL = 1 if the stock is ranked in the bottom 1/3 based on nearness ratio, and 0 otherwise.

Past year return: is the buy-and-hold return over the past 12 months.

$R_{j,t-1}$ is the past month return.

RR: Recency ratio = 1 – (current date – date of the 52-week high price) /364.

RRH = 1 if the stock is ranked in the top 1/3 based on recency ratio, and 0 otherwise.

RRL = 1 if the stock is ranked in the bottom 1/3 based on recency ratio, and 0 otherwise.

$Size_{j,t-1}$ is the natural logarithm of market capitalization measured at prior month end.